
Original article

Impact of Interdialytic Weight Gain (IDWG) on Nutritional Parameters, Cardiovascular Risk Factors and Quality of Life in Hemodialysis Patients

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Abstract

Introduction. The amount of interdialytic weight gain (IDWG) considering body weight is of great importance in hemodialysis patients. In general practice, patients are asked to get standard weight between two hemodialysis sessions. However, it should be individualized considering patient's weight. We aimed to determine the association between the IDWG and the nutritional parameters, cardiovascular risk factors, and quality of life.

Methods. Thirty-two patients receiving hemodialysis at least for one year were enrolled into the study. Patients were monitored for 12 consecutive hemodialysis sessions; and the arithmetic mean of IDWG was calculated. IDWG% was calculated in accordance with patients' dry weight. Data of patients with IDWG<3% (Group I) and IDWG≥3 (Group II) were compared. Sociodemographic variables, laboratory, anthropometric measurements, blood pressure, left ventricular mass index, Subjective Global Assessment Scale and SF-36 Quality of Life Scale were applied to evaluate the patients.

Results. 59.4% (n=19) and 40.6% (n=13) of patients were included in Group I and Group II, respectively. In Group II, albumin (p=0.02), potassium (p=0.02), phosphorus (p=0.04), nPCR (p=0.03), physical function (p=0.04), role limitations caused by physical problems (p=0.04), general health (p=0.03), physical quality of life (p=0.04) scores were significantly higher. A significant correlation was detected between IDWG and physical and mental quality of life, total score SF-36, albumin, total protein and the potassium values.

Conclusions. Patients with an IDWG ≥ 3% have better nutritional parameters and quality of life scales. The limiting of IDWG to 1-2 kg, ingoring patient weight may give rise to malnutrition and a reduced quality of life.

Key words: hemodialysis, interdialytic weight gain, nutritional parameters, SF-36, triceps skinfold thickness

Introduction

The weight gain occurring in hemodialysis patients during the interval between the two hemodialysis sessions is called "interdialytic weight gain" (IDWG). Interdialytic weight gain is used as a measure to limit the weight gain between the two consequent dialysis sessions; however the values identified for this measure have been restricted to an absolute value of 1-2 kg [1,2]. Interdialytic weight gain usually tends to be relatively constant for each patient [1-3] and is affected by the dialytic factors (hypernatremia, the NaCl solution infusion during the hemodialysis), residual renal function, nutritional habits, hyperglycemia, environmental factors, the level of self-care and compliance with treatment [2-4]. Interdialytic weight gain may vary individually, while in the majority of the patients the IDGW is less than 5% of the body weight and is usually in the range of 2 and 3.5 kg [5].

In general, IDGW is thought to result from salt and water intake between the two dialysis sessions [2,3,6]. Liquid and salt are commonly consumed with carbohydrates, fats and proteins, suggesting that high IDGWs could be associated with a better nutritional state [2].

Despite the recent advances in hemodialysis, the mortality in dialysis patients is still very high, when compared to the normal population [1,7-9]. Malnutrition is one of the most significant risk factor for mortality in dialysis patients with no other concomitant systemic disease [1,7-11]. Malnutrition is defined as a state of nutrition, where inadequate, excessive or imbalanced intake of protein, energy and other nutrients cause measurable side effects on the tissues, whole body functions and the

clinical outcomes [10]. Malnutrition may lead to suppression of the immune system, increased susceptibility to the infections, reduced wound healing, reduced functional capacity, anemia, erythropoietin resistance, and vascular access complications [1,7,11].

Malnutrition is multifactorial in chronic renal disease. Loss of protein, increased protein catabolism, endocrine causes and inadequate intake may be summarized as the etiologic factors [1,7-11]. In dialysis patients, strict diet, dysgeusia, nausea-vomiting, inadequate dialysis, psychological and socio-economical causes contribute to malnutrition [1,8-10].

The end-stage renal disease (ESRD) itself is also associated with many unfavorable factors such as hypertension, dyslipidemia and inflammation, which are also established as risk factors for cardiovascular diseases [12].

Using the percentage of the weight gain instead of a fixed number, is more correct to be in accordance between the body weight and weight gain. The weight gain per body weight takes into account patient's measures. For example, a 3 kg weight gain is excessive for a patient weighing 50 kg (6%) but it is normal for a patient weighing 50 kg (3% increase) [1].

The amount of IDWG considering body weight is of great importance in hemodialysis patients. Thereof, the IDGW should be individualized as IDWG%: weight gain per body weight. In this descriptive and correlative and cross-sectional study, we aimed to analyze the possible correlation between IDGW% and sociodemographic variables, disease variables, nutritional state variables, cardiovascular risk factors and the quality of life in hemodialysis patients.

Material and methods

This study was conducted at the Adnan Menderes University Medical Faculty Hospital Hemodialysis Unit between February 2013 and April 2013.

Ethical Considerations

This study was performed in accordance with the principles of the Helsinki Declaration. The study was submitted to the local ethics committee of clinical research and was granted approval with decision number B.30.2.ADU.0.20.05.00/050.04-220, dated 31.08.2012.

The objectives, methods, targets and the potential hazards of the study were explained to all individuals. The participants were informed and gave their informed consent before participating in the study.

The study population

Chronic hemodialysis patients for at least one year, aged 18- 75 years, without overt hypervolemia, active infection or malignancy were considered to be eligible

for the study. Forty patients were evaluated for eligibility and 32 patients fulfilled the criteria.

Study Group

The IDWG were recorded during 12 consecutive hemodialysis sessions. The IDWG (the current pre-dialysis weight minus the preceding post-dialytic weight) was measured in each hemodialysis session and the mean IDWG of 12 consecutive hemodialysis sessions was used for statistical analysis. The IDWG% was expressed as a proportion of the current dry weight [3,14]. Patients were grouped into 2 groups based on the percent IDWG considering the dry weight: Group I and Group II were composed of patients with IDWG less than 3% of dry weight and IDWG equal or greater than 3% of dry weight, respectively.

Data Collection Tools

Patients' height, mid-arm circumference, and triceps skinfold thickness and pre-dialysis and post-dialysis weight were measured. A skin caliper was used for measuring triceps skinfold thickness. Mid-arm muscle circumference, arm muscle area were calculated by the Heymsfield formula [13]. Mid-arm fat area was calculated as $[(\text{mid-arm circumference} - \text{triceps skinfold thickness}) / 2] - [(\pi \times \text{triceps skinfold thickness}^2) / 4]$, and body mass index (BMI) was calculated using the weight (kg)/height (m²) formula.

Blood pressure was measured throughout the 12 sessions, recorded and the arithmetic means were calculated. The "General data form" intended for the hemodialysis patients, and the "Session data form", "Subjective Global Assessment (SGA) Scale", "The Medical Outcomes Study Short Form 36-Item Health Survey (SF-36)" intended for the dialysis session, were used as data collection tools.

The SGA consisted of 5 components, including weight change, dietary intake, GI symptoms, functional capacity, subcutaneous fat and signs of muscle wasting. Each component was scored as A (normal), B (mild to moderate malnutrition) or C (severe malnutrition). Based on the data from all forms, the physician grouped the patients into 3 in accordance with the total SGA score as well-nourished (A), mildly-moderately malnourished (B) and severely malnourished (C) [15]. The SF-36 is designed as 2 main-topic scales that include 36 expressions and assess 8 health dimensions. The main topics are the quality of life and the global quality of life. The 8 dimensions are the Physical function (PF), Role limitations caused by physical problems, Pain, General health, Vitality/energy, Social function, Mental health/emotional well-being and Role limitations caused by emotional problems/mental health. Each dimension was scored as 0-100, with a higher score indicating better quality of life [16]. The SF-36 and the SGA forms completed

by the investigator used the personal expressions and the patient file records through face-to-face interviews.

Biochemical Analysis

During the initial session of the study, a 12-hour fasting blood sampling was performed before the hemodialysis for measuring urea, creatinine, sodium, potassium, calcium, phosphorus, total protein, albumin, lipid panel and hemoglobin. At the end of the hemodialysis session, post-dialysis serum urea, serum creatinine and potassium measurements were obtained. Urea reduction rate (URR) was calculated as follows: [(pre dialysis urea-post dialysis urea) x 100] / (pre dialysis urea). Single pool Kt/V was calculated, using the Daugridas formula, and the normalized protein catabolic rate (nPCR) calculated via kinetic urea model [17].

Echocardiographic Evaluation

An experienced cardiologist conducted the echocardiographic investigations at the Cardiology department of our Faculty. Measuring the parameters by the Devereux formula, the left ventricular mass was divided by the body surface area to calculate the left ventricular mass index (LVMI) [18]. A left ventricular mass index >131 gr/m² and >100 gr/m² was accepted to indicate the presence of left ventricular hypertrophy (LVH) for males and females, respectively [19]. The patients were divided into 2 groups as those with and without LVH.

Statistical Data Analysis

Statistical assessments were performed using the Statistical Package for Social Sciences for Windows, version 17 [SPSS Inc; Chicago, IL, USA]. The descriptive statistics was expressed in number (n, %) and the mean \pm standard deviation.

The quantitative variables were expressed as mean \pm standard deviation (SD), and the qualitative variables as percentage (%) or proportion. The compliance of the variables with the normal distribution was assessed by the Kolmogorov-Smirnov test. For comparison of the variables between the groups, the Student's t-test and the Mann-Whitney U test were used respectively in case of normal and abnormal distribution. As for the qualitative variables, the chi-square test was used, or the Fisher's exact test if the expected values were below 5 in the cross tables. The correlations between the variables were investigated using the Pearson's correlation test. A value of $p < 0.05$ was considered significant.

Results

Thirty-two patients were included in the study. The mean age was 64.3 ± 8.3 years. 40.6% were males (13), 93.8% were married, 62.5% were primary school graduates, 96.9% lived with the family, 50% were retired, 31.3% were housewives and 87.5% had a moderate income.

Table 1. Sociodemographic features of the groups

Sociodemographic features	Group I (n=19) (IDWG < 3%)	Group II (n=13) (IDWG \geq 3%)	P
Age (mean \pm sd)	64.1 \pm 7.8	64.6 \pm 9.3	0.954
Gender (n,%)			
Male	12(37.5%)	7(21.9%)	0.598
Female	7(21.9%)	6(18.8%)	
Marital status (n,%)			
Single	1(3.1%)	0(0%)	0.482
Married	17(53.1%)	13(40.6%)	
Divorced/Widow	1(3.1%)	0(0%)	
Education (n,%)			
Literate	1(3.1%)	1(3.1%)	0.162
Primary school	13(40.6%)	7(21.9%)	
Middle school	3(9.4%)	0(0%)	
High school and higher	2(6.2%)	5(15.6%)	
Profession (n,%)			
Housewife	6(18.8%)	4(12.5%)	0.670
Retired	10(31.2%)	6(18.8%)	
Self-employed	2(6.2%)	2(6.2%)	
Civil servants	0(0%)	1(3.1%)	
Laborer	1(3.1%)	0(0%)	
Live with (n,%)			
Alone	1(3.1%)	0(0%)	0.401
With family	18(56.2%)	13(40.6%)	
Income level (n,%)			
Low-income	3(9.4%)	1(3.1%)	0.458
Moderate	16(50.0%)	12(37.5%)	

With respect to the primary disease, 37.5% of them had hypertensive nephropathy and 25% had diabetic nephropathy. The mean dialysis duration was 24 months.

In addition to ESRD, 34.4% of the patients had concomitant hypertension, 25% had diabetes and 12.5% had cardiac diseases.

Table 2. Laboratory and cardiovascular features of the groups

Parameter	Group I (n=19) (IDWG < 3%)	Group II (n=13) (IDKA ≥ 3%)	P
BUN (mg/dL)	53.3±14.3	56.4±7.6	0.156
Creatinine (mg/dL)	6.7±1.8	7.8±2.1	0.140
Total protein (gr/dL)	6.9±0.4	7±0.5	0.758
Albumin (gr/dL)	3.4±0.4	3.7±0.2	0.026*
CRP (ng/dL)	10.6±10.6	8.1±7.1	0.759
Phosphorus (mg/dL)	4.1±1.3	4.7±0.9	0.040*
Potassium (mg/dL)	4.5±0.7	4.9±0.5	0.025*
Total cholesterol (mg/dL)	193.6±82.5	193±52.8	1
Triglycerides (mg/dL)	180.2±143.6	180.6±96.8	0.242
Hemoglobin (g/dL)	11.4±1.5	11.2±1.6	0.734
Fe (mg/dL)	61.7±26	68.9±20	0.234
Transferrin saturation (%)	28.5±10	32.2±12	0.274
Ferritin (ng/dL)	524±527	386±274	0.454
HCO ₃ (mEq/L)	20.5±2.0	21.6±1.8	0.124
Kt/V	1.7±0.3	1.75±0.2	0.847
URR (%)	77.7±6.9	77.4±4.1	0.478
nPCR (gr/kg/day)	0.9±0.2	1.1±0.1	0.032*
Systolic BP (mmHg)	120.3±18.6	115.2±14.2	0.398
Diastolic BP (mmHg)	70.3±8.5	68.3±6.4	0.551
MAP (mmHg)	90.8±13.1	94.6±13.2	0.425
Ejection fraction (%)	58.1±6.2	56.0±10.7	0.654
LVMI (gr/m ²)	115.9±52.4	105.4±29.2	0.939
Cardiothoracic ratio (%)	47.1±4.1	49.4±4.4	0.123

Abbreviations: BUN - Blood urea nitrogen, CRP- C-reactive protein, URR - Urea reduction rate; nPCR - normalized protein catabolic rate; BP - Blood pressure; MAP - Mean arterial pressure; LVMI - Left ventricle mass index

The hemodialysis patients were grouped into 2 based on their IDWG: 19 patients (54.9%) were in Group I (IDWG less than 3% body weight) and 13 patients (40.6%) were in Group II (IDWG equal or greater than 3% body weight). There were no differences between the two groups with respect to sociodemographic features (Table 1).

Group I had significantly lower values of albumin (p=0.02), potassium (p=0.02), phosphorus (p=0.04) and nPCR (p=0.03) in comparison to Group II. There was no difference in mean age, Kt/V, URR, serum iron, transferrin saturation, and ferritin levels between the groups (Table 2). The BMI and mid-arm circumference values were 24.2±4.4, 25.3±3.9 kg/m², and 26.7±3.3, 27.5±3.2 cm in Group I

and Group II, respectively. As for the anthropometric parameters, BMI, mid-arm circumference, triceps skinfold thickness, arm muscle area, midarm muscle circumference, mid-arm fat area did not differ between the groups (Figure 1).

Ejection fraction, systolic and diastolic blood pressure were similar between the groups. LVMI was 115.9±52.4 gr/m² and 105.4±29.2 gr/m² in Group I and II, respectively; no significant difference was detected (p=0.939) (Table 2). Left ventricular hypertrophy was present at a rate of 68.4% (13/19) in group I and 69.2% (9/13) in Group II.

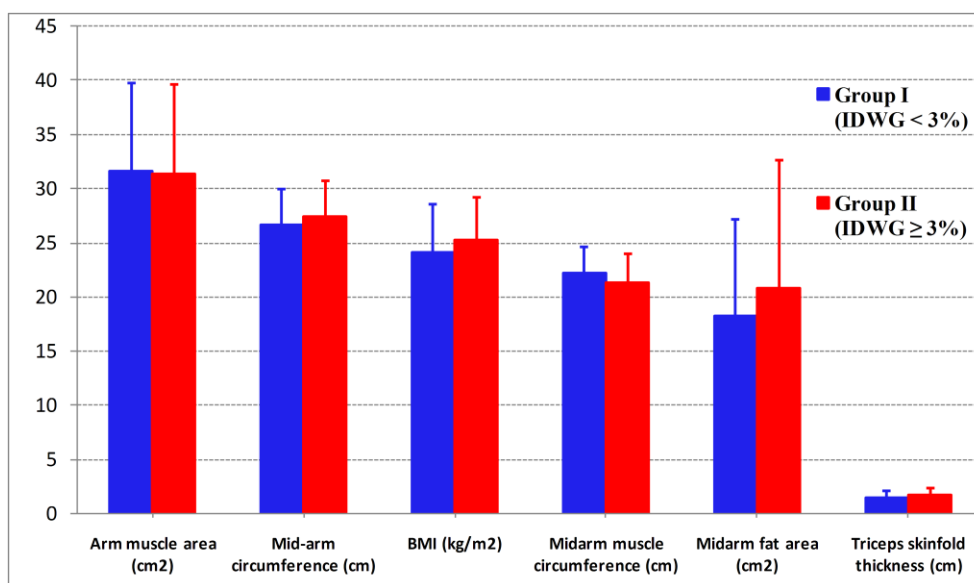


Fig. 1. Anthropometric parameters of the two groups (BMI - Body mass index, no difference found between two groups, $p>0.05$)

The rate of well-nourished patients (A) was 68.4% in Group I (13/9) and 69.2% (9/13) in Group II; there was no difference between the two groups with respect to

SGA. There were no severely malnourished (C) patients in either group.

Table 3. SF-36 scores of the groups

Health dimensions	Grup I (IDWG < 3%, n=19)	Grup II (IDWG ≥ 3%, n=13)	P
Physical function	51.5±32.1	74.7±23.2	0.043*
Role limitations physical (RP)	34.2±40.1	66.1±35.0	0.040*
Pain	59.2±27.2	64.6±23.3	0.801
General health	50.6±25.4	69.3±30.5	0.034*
Vitality/Energy	59.7±23.0	68.0±24.2	0.240
Social function	63.4±24.3	65.9±31.8	0.643
Mental health (MH)	44.1±38.7	63.9±28.1	0.150
Role limitations emotional (RE)	63.4±15.9	70.0±23.2	0.233
Physical component summary	48.1±25.3	69.0±24.3	0.046*
Mental component summary	55.9±20.5	68.3±23.6	0.107
Total score of SF-36	52.1±21.6	63.3±29.5	0.173

Abbreviations: RP - Role limitations caused by physical problems; MH - Mental health/emotional well-being; RE - Role limitations caused by emotional problems/mental health

The SF-36 overall score in Group I and Group II was 52.1±21.6 and 63.3±29.5, respectively ($p=0.173$). Compared to Group I, Group II had a significantly higher Physical function (PF) ($p=0.04$), Role limitations caused by physical problems ($p=0.04$), General health ($p=0.03$) scores among the quality of life sub-dimensions, and a significantly higher physical quality of life ($p=0.04$)

from the main topic (Table 3). In correlation analysis, IDWG was positively correlated with total protein, albumin and potassium (Figure 2). In addition, IDWG was positively correlated with the main topics of quality of life (physical and mental quality of life). The IDWG was not correlated with the anthropometric measurements, and cardiovascular findings (Table 4).

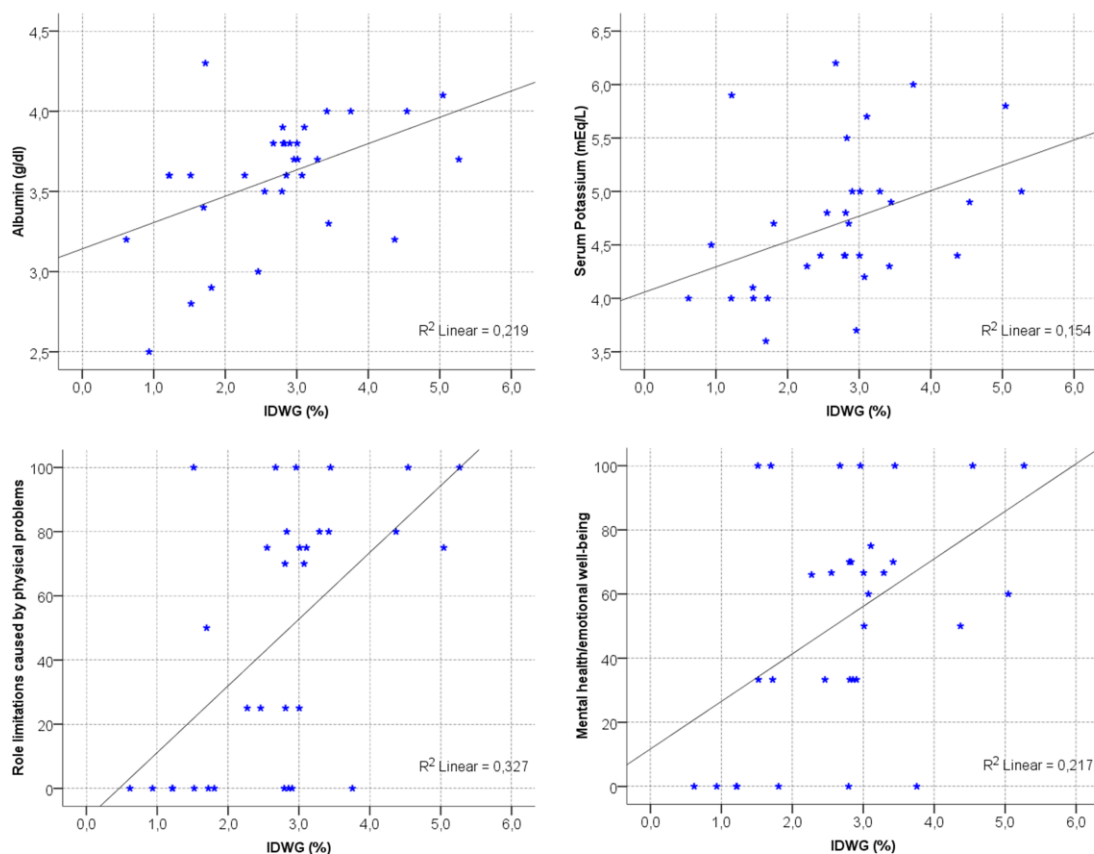


Fig. 2. Intradialytic weight gain (IDWG) correlation between the variables

Table 4. Interdialytic weight gain correlation with laboratory, anthropometric, cardiovascular parameters and SF-36 scores

Parameter	R	P	Parameter	R	P
Age (year)	0.195	0.284	Cardiothoracic ratio (%)	0.205	0.262
BUN (mg/dL)	0.09	0.625	Triceps skinfold thickness (cm)	-0.097	0.599
Creatinine (mg/dL)	0.304	0.091	Mid-arm muscle circumference (cm)	-0.065	0.722
Total protein (gr/dL)	0.351	0.049*	Arm muscle area (cm ²)	0.020	0.913
Albumin (g/dL)	0.468	0.007*	Mid-arm fat area (cm ²)	-0.131	0.476
Phosphorus (mg/dL)	0.325	0.069	Mid-arm circumference (cm)	-0.069	0.706
Potassium (mg/dL)	0.393	0.026*	Physical function	0.433	0.013*
Kt/V	-0.013	0.943	Role limitations physical (RP)	0.572	0.001*
URR	-0.126	0.494	Pain	0.146	0.425
nPCR (gr/kg/day)	0.300	0.095	General health	0.365	0.040*
Total cholesterol (mg/dL)	-0.008	0.966	Vitality/Energy	0.277	0.125
HCO ₃ (mEq/L)	-0.280	0.120	Social function	-0.139	0.447
BMI(kg/m ²)	0.091	0.621	Emotional	0.466	0.007*
LVMI (gr/m ²)	-0.009	0.960	Mental health (MH)	0.275	0.128
Ejection fraction (%)	-0.185	0.310	Physical component summary	0.436	0.013*
Systolic BP (mmHg)	-0.011	0.983	Mental component summary	0.357	0.045*
Diastolic BP (mmHg)	0.083	0.652	Total score of SF-36	0.358	0.044*

Abbreviations: BUN - Blood urea nitrogen; URR - Urea reduction rate; nPCR - Normalized protein catabolic rate; BMI - Body mass index; LVMI - Left ventricle mass index; BP - Blood pressure; RP - Role limitations caused by physical problems; MH - Mental health/emotional well-being

Discussion

Interdialytic weight gain is regarded as an indicator for treatment compliance for a long time [2,3]. The effect of IDGW is unclear in the dialysis patients. No consensus was achieved on the fact that a higher IDWG was beneficial for the dialysis patients [3,5,9,20,21]. Various

trials have reported on the association between the nutritional parameters and the IDWG [2,3,6,9,14,21]. A study reported better five-year actuarial survival with high IDWG [3]. However, in a retrospective study, 255 patients who had recently started hemodialysis, a high IDWG was reported not to be an indicator of nutrition; and in contrast, a high IDWG was indicated to

increase mortality by resulting in LVH, hypertension and intradialytic hypotension [20].

The mean IDWG was 2.7 ± 1.1 in our study and IDWG values presented similarity with the other studies [3-5,9]. As previous studies have defined IDWG a cutoff value of 3% showed that less than 3% have poor prognosis and poor nutrition [3,9]. Therefore, in our study this 3% value was used as a cutoff value for identifying the groups. Interdialytic weight gain is directly in line with the body weight; this explains the higher absolute IDGW (expressed in kg) in males [5] Lopez *et al.* [3] detected that IGWG was higher in males than in females. Patients below 65 years of age were reported to have a higher appetite; in addition, younger patients were observed to have a quite high level of sodium and fluid loading and thus their IDWG were higher [1,3-5,14,21]. Even if this is true for the overall population, it may also result from a low comorbidity associated with young age [3].

Various methods are applied to detect malnutrition. These primarily include the anthropometric measurements, assessment of serum albumin level, SGA and nPCR [10]. Particularly, serum albumin level is a valuable parameter in hemodialysis patients; a low serum albumin level (<3.5 gr/dl) is known to be a significant indicator of malnutrition and thus mortality [7]. Mortality and morbidity is high in hemodialysis patients with a low serum urea and albumin level [8]. Many studies have reported a high albumin level in patients with a high IDWG; on the other hand a retrospective study in 283 patients detected a negative correlation between IDWG and albumin [3,4,6,9,21]. While albumin is used as an indicator in assessment of nutrition, there is a considerable extent of suspicion on its sensitivity. Albumin is a negative acute phase reactant; under conditions of inflammation, sepsis or stress, serum albumin level generally does not respond to nutritional support or responds slightly [8,10]. In our study, the level of CRP, an inflammation indicator, was similar between the two groups. Albumin levels were detected to be significantly high in the high IDWG group. We attributed it to good nutritional status.

Likewise, nPCR, measured via kinetic urea model, is an index of protein intake [3]. It is also a practically ideal nutrition parameter since it is mildly affected by inflammation [8,10,17]. Patients with a high IDWG were shown to have a higher nPCR [3,4,6,9,21]. Phosphorus level is an indicator of protein intake; potassium level is likewise related to nutritional state. We found significantly high levels of nPCR, phosphorus and potassium levels in the high IDWG group. These findings supported the fact that patients were well-nourished. There are relevant studies with findings that are in line with ours [3,4,9]. There are a large number of studies reporting a positive correlation between IDWG and the nutritional indicators of pre-dialysis BUN, creatinine and pre-albumin levels [3,9,21].

Kt/V indicates the sufficiency of dialysis. Severely high levels may result from a reduced urea distribution volume, due to a latent malnutrition presence. Kt/V values >1.7 were reported to potentially indicate malnutrition [22,23]. While a negative correlation was detected between IDWG and Kt/V, there are also studies reporting a positive correlation [3,4,6,21]. In our study, the groups did not differ in Kt/V and URR values and the values were above the target value; and thus additional factors such as dialysis insufficiency, which could impair the analysis of IDWG and nutrition correlation, were excluded.

Dialysis patients with a higher IDWG were detected to have lower serum HCO_3 values compared to those with a low IDGW. This was attributed to the high acid production in concomitance with higher protein intake and dilution was indicated to potentially contribute to this reduction [2,3,24]. In contrast, we detected no relationship between HCO_3 and IDWG.

Subjective global assessment is a simple method used to demonstrate the state of nutrition in ESRD patients, which involves parameters such as medical history, state of nutrition, and acute stress. The subjective global assessment was reported to be closely associated with morbidity and mortality [8,11,15]. Modified SGA score was shown to be negatively correlated with triceps skinfold thickness, mid-arm muscle circumference, pre-albumin, ferritin, transferrin and the total iron binding capacity in hemodialysis patients [15,25]. The IDWG% values were detected to be high in hemodialysis patients with malnutrition as defined by SGA [26]. In our study, we did not find a correlation between SGA and IDGW.

Anthropometric measurements are convenient, fast and safe to administer [8,11]. The body mass index is an important indicator of the state of nutrition [3]. Different from the general population, dialysis patients are reported to have a reduction in mortality as the BMI increases; this has been potentially attributed to better nutrition [11]. Another study revealed a mortality in the form of *j* curve in similarity to the general society and the mortality was the lowest in those with a BMI of $25-27.5$ kg/m^2 [27]. A strong correlation was detected between BMI and IDWG% [9]. In patients IDWG less than 3% were found significantly lower BMI. Considering that the changes in BMI occur slowly in each patient, one could assume IDWG has a large effect on the state of nutrition in hemodialysis patients. There was no difference between the two groups in anthropometric measurements in our study and there was no correlation with IDWG. Similarly, in a previous study, there was a negative correlation between IDWG and mid-arm circumference and no association found with IDWG and arm muscle area. It was indicated that the findings could be misleading in ESRD patients due to the inadequacy of the sensitivity of the anthropometric measurements and the variable tissue hydration or myopathy [4]. We agree with this opinion.

The risk of cardiovascular events has increased 5 to 30-fold in dialysis patients relative to the overall population [28,29]. The target blood pressure values in the absence of cardiovascular risk, recommended for renal patients are as follows: systolic <130 mmHg, diastolic <80 mmHg. We detected systolic and diastolic blood pressure values as 120.3±18.6, 115.2±14.2, 70.3±8.5, 68.3±6.4 mmHg in group I and II, respectively; the values were within the target range. Blood pressure did not significantly differ between the two groups. There are trials showing no relationship between blood pressure and IDWG, and interdialytic blood pressure in normotensive or hypertensive patients does not correlate with the rise in IDWG [2,28,30]. There are also studies indicating that blood pressure was positively correlated with IDWG [3,21,31]. Cardiovascular and overall mortality was observed to be high in those with an IDGW > 5.7 [1]. Each 1% increase in IDGW was detected to increase the blood pressure by 1 mmHg; however, patients with IDGW less than 3% were observed to have a higher mortality after 5 years [31]. A prospective, observational study reported that the 5-year survival increased with the IDWG increase and the two-year mortality rate was higher in patients with a lower IDGW [3,9]. The investigators concluded that the favorable effects of IDGW on nutrition outweighed the unfavorable effects of blood pressure. They also underlined the fact that patients needed to maintain dietary salt restriction for blood pressure management [3].

In dialysis patients, LVH is the first condition occurring with a potential to lead to other complications over time including ischemic cardiac disease and cardiac failure. Anemia, hypertension, secondary hyperparathyroidism, volume overload, AV fistula, uremia and malnutrition are among the factors that contribute to the development of LVH. Repetitive volume overload may lead to early mortality by contributing to LVH and left ventricular dilatation [10,12].

There was no significant difference between the groups with respect to LVH. In a different study, LVH was observed to be significantly high in patients with an IDWG >5%; IDWG was reported to potentially cause LVH via non-blood pressure-mediated mechanisms [32]. We used the 3% value; therefore, the results were considered to lack similarity with 5% of findings. Our study showed no correlation between LVMI and IDWG; this finding is consistent with those from the previous study [32]. There are no quality of life comparisons with IDWG in the literature. However, association between state of nutrition and quality of life showed that patients with a better nutritional state had a better physical condition [33-35]. In diabetic patients, an adequate maintenance of life is defined as fulfillment of all individual requirements, satisfaction with life, adequate social behaviors, enough recreational time spared, sufficient emotional and physical state, and maintenance of interindividual relations. The quality of life is lower in ESRD with

regard to the normal population due to the dialysis procedure, nutrition, and other risk factors such as the presence of concomitant diseases [33].

In our high-IDWG group (group II), physical function, role limitations caused by physical problems, general health and physical quality of life, included in the quality of life scale were detected to be higher. Physical and mental quality of life items of the quality of life scale, and overall SF-36 score were significantly correlated with IDWG. Our findings suggest a potential correlation between the increase in quality of life and the IDWG.

Conclusions

Based on our results, we can conclude that an IDWG less than 3% of the body weight could result in undesirable nutritional effects and secondary malnutrition and reduced quality of life. Therefore, awareness of the fact that IDWG% is a good indicator of nutrition should be established, and caution exercised to avoid the potential negative effects of nutrition. 3-5% IDWG seems to be most suitable weight gain due to mortality and nutrition.

Conflict of interest statement. None declared.

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