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Excessive interdialytic weight gain and associated factors

Aumento de peso interdiálisis excesivo y sus factores asociados

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ABSTRACT

Excessive interdialytic weight gain (IDWG) may be associated with numerous factors that are discussed little in the literature. The aim of the present study was to evaluate factors associated with excessive IDWG in patients on hemodialysis. A cross-sectional study was conducted with 197 adults on hemodialysis at a satellite clinic in the city of Jaboatão dos Guararapes, Brazil. We calculated %IDWG by the mean difference among 12 hemodialysis sessions, with >4.5% considered excessive. The conceptual model considered socioeconomic, demographic, clinical, anthropometric and laboratorial variables. Excessive IDWG was found in 28.4% of the sample. In the final adjusted Poisson regression model, three variables remained independently associated with excessive IDWG: age between 20 and 59 years (adjusted prevalence ratio [PAdjusted]= 1.87, 95% CI: 1.21-2.88), household income between one and two times the minimum monthly salary (PAdjusted=2.14, 95% CI: 1.36-3.44) and <nine years of schooling (PAdjusted= 1.78 95% CI: 1.15-2.76). The results revealed associations between excessive IDWG and some factors. The most strongly associated factor was low income, followed by non-elderly adult age and low level of schooling.

Key words: Assessment nutritional; Associated factors; Dialysis; Weight gain.

RESUMEN

El aumento de peso interdiálisis (APID) excesivo puede asociarse a numerosos factores, pero todavía es poco discutido en la literatura. El objetivo fue evaluar los factores asociados al APID excesivo de pacientes en hemodiálisis (HD). Estudio transversal, que incluyó a 197 pacientes adultos en HD, y fue realizado en una clínica satélite ubicada en Jaboatão dos Guararapes/PE. Para el análisis del % APID, se calculó el promedio de la diferencia de peso de 12 sesiones de hemodiálisis, considerándose excesivo el valor >4,5%. El modelo conceptual consideró variables socioeconómicas, demográficas, clínicas, antropométricas y de labora-

torio. El APID excesivo estuvo presente en el 28,4% de la muestra y, tras el ajuste para el modelo final obtenido por la regresión de Poisson, tres variables permanecieron independientemente asociadas al APID excesivo: edad entre 20 y 59 años (razón de prevalencia ajustada – RPajustada= 1,87 IC95% 1,21-2,88), renta familiar entre 1 y 2 sueldos mínimos (RPajustada= 2,14 IC95% 1,36-3,44) y nivel educacional <9 años de estudio (RPajustada= 1,78 IC95% 1,15-2,76). Los resultados mostraron una asociación entre APID excesivo con algunos factores, siendo la renta familiar baja la más fuertemente asociada, seguida por la edad adulta no-anciana y el bajo nivel educacional.

Palabras clave: Aumento de peso; Diálisis; Evaluación nutricional; Factores asociados.

INTRODUCTION

Diminished kidney function leads to a significant reduction in urinary volume and an inability to maintain adequate homeostasis of the body, resulting in water retention. The amount of fluid acquired between dialysis sessions is denominated interdialytic weight gain (IDWG)¹. Excessive IDWG seems to have clinical implications, such as changes in interdialytic blood pressure^{2,3}, and is an independent predictor of myocardial infarction⁴ as well as other serious cardiac and cerebrovascular events⁵. Moreover, recent studies report an association between excessive fluid retention and an increased risk of hospitalization⁶, mortality due to cardiovascular causes⁴, and all-cause mortality⁶.

Some demographic, anthropometric, and clinical variables seem to be associated with IDWG^{7,8}. Patients with longer treatment⁷, males, with higher body weight and body mass index (BMI) may have higher IDWG⁸. However, the data reported in the literature are inconsistent. Therefore, the aim of the present study was to identify factors associated with excessive IDWG so that adequate nutritional management can be instituted.

METHODS

A case-series study was conducted involving adult patients with chronic kidney disease undergoing dialysis at a satellite clinic located in the city of Jaboatão dos Guararapes, which is part of the metropolitan region of Recife, Brazil.

The sample was composed of male and female adults and older patients who received conventional dialysis three times per week in January 2016 and had been undergoing dialysis for at least three months. A convenience sample was used of patients who agreed to adhere to the study.

Patients in the active phase of systemic lupus erythematosus, those with neoplasms, acquired immunodeficiency syndrome, liver disease, or refractory heart failure and individuals who had an unstable clinical condition at the onset of the study were excluded.

Data were collected from electronic charts and IDWG was calculated as the mean of the difference between the starting and ending weight of 12 dialysis sessions: %IDWG=(pre-dialysis weight – post-dialysis weight) ÷ dry weight x 100⁹. The patients were distributed into two groups based on %IDWG: Group 1 – excessive IDWG (>4.5%); Group 2 – without excessive IDWG (≤4.5%).

The body mass index (BMI= dry weight/height²) was used to evaluate nutritional status based on the classification proposed by the World Health Organization¹⁰. Anemia was recorded when serum hemoglobin was <13.5 g/dL for men and <12 g/dL women¹¹. Regarding laboratory data, the values correspond to the first dialysis session of the study month. The following K/

DOQI reference values were considered normal for patients with CKD undergoing dialysis¹²: albumin ≥3.8 g/dL, creatinine >10 mg/dL, total cholesterol <200 mg/dL, triglycerides <150 mg/dL, and pre-dialysis urea 150 to 200 mg/dL.

The data were entered into the Epi-Info program, version 6.04 (CDC/WHO, Atlanta, GA, USA) twice, followed by the use of the Validate module to check for possible typographical errors. Statistical analysis was performed with the aid of SPSS, version 13.0 (SPSS Inc., Chicago, IL, USA). Crude and adjusted prevalence ratios (PR) of the characteristics associated with IDWG and respective 95% confidence intervals (CI) were calculated. Multivariate Poisson regression analysis was performed using STATA 7.0 (Stata, TX, USA). All variables with a p-value <0.20 in bivariate analysis were incorporated into the multivariate model using the stepwise forward procedure. A p-value <0.05 was adopted for acceptance of the associations investigated in the final model.

This study received approval from the Human Research Ethics Committee of the Federal University of Pernambuco (certificate number: 82017417.5.0000.5208).

RESULTS

At the onset of the study, 280 patients had been on dialysis for more than three months, 83 of whom were excluded for having congestive heart failure (39.7%), an infectious condition (34.9%), cancer (14.4%), liver disease (9.6%), or clinical instability (1.2%). Thus, 197 individuals were eligible and evaluated.

Mean age was 55.6 ± 14.7 years. Men accounted for 60.9% of the sample and older adults accounted for 44.2%. The sample was predominantly composed of individuals with brown skin (47.2%), a family income between one and two times the Brazilian monthly minimum wage (75.9%), and a low level of schooling (53.8% with less than nine years of study). Patients on dialysis for three to 12 months accounted for 50.9% of the sample. A total of 28.4% of the sample exhibited excessive IDWG, 52.3% were classified in the ideal range according to BMI, 70.1% had serum albumin ≥ 3.8 g/dL, and 63.4% had serum creatinine >10 mg/dL (Table 1).

Table 2 displays the associations between the demographic/socioeconomic variables and excessive IDWG in the bivariate analysis. Individuals with age between 20 and 59 years (PR= 2.37; CI_{95%}: 1.39 to 4.05), <nine years of schooling (PR= 2.31; CI_{95%}: 1.28 to 4.17), and low family income (PR= 2.65; CI_{95%}: 1.21 to 5.78) had a greater likelihood of exhibiting excessive IDWG.

Table 3 displays clinical characteristics. Patients with less time on dialysis (three to 59 months) were more likely to exhibit excessive IDWG (PR= 1.82; CI_{95%}: 1.05 to 3.15).

Table 4 displays the associations with anthropometric and laboratory variables. Patients with serum creatinine >10 mg/dL

had a greater likelihood of exhibiting excessive IDWG (PR= 1.73 CI_{95%}: 1.02 to 2.94).

Table 1. Excessive interdialytic weight gain (IDWG) and nutritional characterization of patients on dialysis at satellite clinic, Jaboatão dos Guararapes, PE, Brazil, 2016 (n= 197).

Variable	n	%
Excessive IDWG (>4.5%)		
Yes	56	28.4
No	141	71.6
Nutritional status based on BMI		
Underweight	18	9.1
Ideal range	103	52.3
Overweight	54	27.4
Obesity	22	11.2
Hypoalbuminemia		
Yes	59	29.9
No	138	70.1
Serum creatinine		
≤10 mg/dL	71	36.6
>10 mg/dL	123	63.4

BMI – Body mass index.

Table 2. Prevalence ratio of excessive IDWG according to demographic and socioeconomic characteristics of patients on dialysis at a satellite clinic, Jaboatão dos Guararapes, PE, Brazil, 2016 (n= 197).

Variables	Total		Excessive IDWG		PR	CI95%	p-value
	n	%	n	%			
Sex							0.3978*
Male	120	60.9	31	25.8	0.80	0.51-1.24	
Female	77	39.1	25	32.5	1.00		
Age (years)							0.0011*
20 to 59	110	55.8	42	38.2	2.37	1.39-4.05	
≥60	87	44.2	14	16.1	1.00		
Ethnicity							0.2369**
White	47	23.9	11	23.4	0.64	0.34-1.18	
Brown	93	47.2	24	25.8	1.43	0.88-2.32	
Black	57	28.9	21	36.8	1.00		
Schooling							0.0043*
<9 years	126	70.4	45	35.7	2.31	1.28-4.17	
≥9 years	71	39.6	11	15.5	1.00		
Marital status							0.1687*
Married/stable union	105	53.3	25	23.8	1.00		
Other	92	46.7	31	33.7	1.42	0.91-2.21	
Family income							0.0096*
1 to 2 x BMMW	148	75.9	50	33.8	2.65	1.21-5.78	
≥3 x BMMW	47	24.1	6	12.8	1.00		

IDWG – interdialytic weight gain; BMMW – Brazilian monthly minimum wage; ** linear trend chi-square test; * Pearson's chi-square test; PR prevalence ratio; CI – confidence interval.

Table 5 displays the results of the Poisson regression analysis. After adjustments to the final model, three variables remained independently associated with excessive IDWG:

low family income ($PR_{\text{adjusted}} = 2.14$; CI95%: 1.36 to 3.44), age 20 to 59 years ($PR_{\text{adjusted}} = 1.87$; CI95%: 1.21 to 2.88), and low schooling ($PR_{\text{adjusted}} = 1.78$; CI95%: 1.15 to 2.76).

Table 3. Prevalence ratio of excessive IDWG according to clinical characteristics of patients on dialysis at a satellite clinic, Jaboatão dos Guararapes, PE, Brazil, 2016 (n= 197).

Excessive IDWG Variables	Total		Yes		PR	CI95%	p-value
	n	%	n	%			
Time on dialysis (months)							
3 to 59	127	64.5	43	33.8	1.82	1.05-3.15	0.0347*
≥ 60	70	35.5	13	18.5	1.00		
Hypertension							
Yes	127	64.5	39	30.7	1.26	0.78-2.06	0.4286*
No	70	35.5	17	24.3	1.00		
Diabetes mellitus							
Yes	67	34	20	29.9	1.08	0.68-1.71	0.8796*
No	130	66	36	27.7	1.00		
Vascular access							
AVF	175	88.8	50	28.6	1.05	0.51-2.16	0.9017*
Other	22	11.2	6	27.3	1.00		

IDWG - interdialytic weight gain; AVF – arteriovenous fistula; *Pearson's chi-square test; PR prevalence ratio; CI – confidence interval.

Table 4. Prevalence ratio of excessive IDWG according to anthropometric and laboratory characteristics of patients on dialysis at a satellite clinic, Jaboatão dos Guararapes, PE, Brazil, 2016 (n= 197).

Variables	Total		Excessive IDWG Yes		PR	CI95%	p-value n
	n	%	n	%			
Excess weight							0.0977*
No	121	61.4	40	33.1	1.57	0.95-2.60	
Yes	76	38.6	16	21.1	1.00		
Hypoalbuminemia						0.2592*	
Yes	59	29.9	13	22.0	0.71	0.41-1.21	0.4362*
No	138	70.1	43	31.2	1.00		
Anemia							
Yes	171	87.2	51	29.8	0.67	0.30-1.52	0.0486*
No	25	12.8	5	20.0	1.00		
Serum creatinine (mg/dL)							
≤10	71	36.6	14	19.7	1.00	1.02-2.94	0.9143*
>10	123	63.4	42	34.1	1.73		
Pre-dialysis urea (mg/dL)							
<150	85	43.1	24	28.2	1.00	0.65-1.58	0.9382*
≥150	112	56.9	32	28.6	1.01		
Total cholesterol (mg/dL)							
≤200	167	87.9	48	28.7	1.00	0.55-2.05	0.3401*
>200	23	12.1	7	30.4	1.06		
Triglycerides (mg/dL)							
≤150	102	53.7	33	32.4	1.00	0.49-1.22	
>150	88	46.3	22	25.0	0.77		

IDWG - interdialytic weight gain; *Pearson's chi-square test; PR prevalence ratio; CI – confidence interval.

Table 5. Crude and adjusted prevalence ratios of characteristics independently associated with excessive IDWG in patients on dialysis at a satellite clinic, Jaboatão dos Guararapes, PE, Brazil, 2016 (n= 197).

Variables	PR _{crude}	CI _{95%}	PR _{adjusted}	CI _{95%}	p-value
Age 20-59 years	2.37	1.39-4.05	1.87	1.21-2.88	0.009
Income 1 to 2 x	2.65	1.21-5.78	2.14	1.36-3.44	0.000
BMMW					
<9 nine years of schooling	2.31	1.28-4.17	1.78	1.15-2.76	0.006

BMMW – Brazilian monthly minimum wage; Poisson regression model adjusted for interdialytic weight gain, CI – confidence interval, PR – prevalence ratio, p= chi-square test.

DISCUSSION

There is no consensus on the recommended values for IDWG. European guidelines¹³ recommend up to 4.5% of “dry” weight (weight without edema), whereas American guidelines (K/DOQI, 2000)¹² defines 5% as the limit. Higher weight gain does not seem to be safe for individuals on dialysis^{14,15,16}.

In the present study, 28.4% of the sample exhibited excessive IDWG, which is similar to the finding described in a cross-sectional study conducted by Nerbass et al.³ in which 24% of patients on dialysis gained excessive weight between sessions. Excessive fluid retention in this population seems to be associated with an increase in morbidity and mortality², especially due to cardiovascular causes^{4,14}.

Several factors seem to be involved in the occurrence excessive IDWG, such as age. In the present study, younger adults (20 to 59 years) were more likely to have this condition, which is in agreement with data described in previous studies^{3,8,9,17}. Ferraz et al.⁸ found that individuals in this age range exhibited greater weight gain (>3.4 kg) compared to older individuals. These findings can be explained by the fact that diverse physiological and pathological changes occur with advancing age. Such changes include reduced sensitivity for the senses of taste and smell, tooth loss, intestinal hypomotility with delayed gastric emptying, as well as diminished cognitive and functional capacities, all of which exert a direct effect on food intake and, consequently, nutritional status of older adults¹⁸. Moreover, older adults may have a deficient mechanisms involving the sensation of thirst, which results in a diminished perception of the organism regarding the need for an increase in liquid ingestion¹⁹.

Some researchers consider a lack of patient adherence to treatment to be a public health problem, which has been denominated the “invisible epidemic”²⁰. In high-income countries, only 50% of patients with chronic diseases adhere to treatment and the magnitude and impact of this problem are believed to be even higher in low- and middle-income countries²¹.

Factors such as the understanding of dietary recommendations, language, socioeconomic status, educational level, and cultural differences can exert an influence on food and water intake in patients on dialysis²². In the present study, individuals with less than nine years of schooling and those with a low income (one to two times the Brazilian monthly minimum wage) had a greater likelihood of exhibiting excessive IDWG, possibly due to the fact that low schooling may diminish one’s understanding with regards to dietary restrictions.

The association between socioeconomic factors, such as income and schooling, and adherence to treatment has been widely reported, especially in individuals with chronic diseases^{23,24,25}. Findings in the literature show that individuals with higher levels of schooling adhere better to treatment for chronic diseases²⁵ as well as the control of potassium, phosphorus, and IDWG²².

Most of the patients in the present study had BMI as well as serum albumin and creatinine levels within the ideal range, indicating good nutritional status. However, no associations were found between excessive IDWG and anthropometric or laboratory variables. In contrast, previous studies report such associations, but with divergent results.

Patients with a higher IDWG may have greater protein-energy intake and, therefore, better nutritional status. However, studies have shown that excessive fluid retention is negatively associated with nutritional status (evaluated based on the BMI)^{14,26,27} and serum albumin²⁶, suggesting that malnourished individuals may have a greater preference for liquids or pasty foods³.

Non-adherence to fluid restriction, due to thirst and xerostomia is a major healthcare challenge for individuals with chronic diseases, such as patients on dialysis^{28,29,30}. Educating patients with regards to dietary restrictions has the potential to affect eating behavior^{12,28,29}, with the limited intake of salt and foods rich in sodium to facilitate the control of thirst, thereby favoring lower fluid intake and IDWG⁸. The educational approach should be easy to understand,

as individuals with a lower level of education have greater IDWG, and should involve both family³¹ and professional support to ensure the success of treatment.

The present study had limitations that should be considered, such as the lack of data on residual diuresis, dietary salt intake, the measurement of the intake of liquids, urinary sodium (natriuria/24h) and dialysis quality (Kt/V). Furthermore, weight measured by different professionals and in different shifts can lead to errors. Further research is needed to determine the factors associated with IDWG.

CONCLUSION

In the present study, excessive IDWG was associated with age, schooling, and family income. Easy-to-understand nutritional education for patients on dialysis, addressing dietary restrictions related to salt intake and the consumption of sodium-rich foods to facilitate the control of thirst, seems to be a strategy to ensure adequate interdialytic weight gain.

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