



## Interdialytic weight gain and pre-dialysis mean arterial pressure on patients with chronic hemodialysis

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### ABSTRACT

Patients with chronic kidney disease on hemodialysis (CKD-HD) frequently experience an increase in fluid volume, which is largely shown by interdialytic weight gain (IDWG). An increase in IDWG may cause the mean arterial pressure (MAP) during dialysis to increase. Chronic renal disease patients, it might worsen their condition and implies a change in intravascular. Patients must control their fluid intake, nevertheless, there are still a lot of patients who struggle with this. The aim of this study was to investigate the relationship between IDWG and pre-dialysis MAP in patients with chronic kidney disease. A descriptive correlation method with a cross-sectional approach was used in this study. The instruments were observation sheets to note the weight dan blood pressure, weight scales, and a sphygmomanometer. The purposive sampling method was used to select the respondents in this study. The respondents were 52 CKD-HD patients over the age of 18 who exercise at least twice a week and are not in intensive care. The data was collected at a hemodialysis unit. Statistical analysis used Pearson's product-moment correlation. The results showed that most of the respondents had IDWG in the adequate category (78.8%) and pre-dialysis MAP in the optimal category (23.1%),  $p=0.003$  ( $<0.05$ ) and  $r=0,41$ . This study concluded that there was a relationship with moderate strength between IDWG and pre-dialysis MAP in patients with chronic kidney disease. Nurses are urged to strengthen monitoring of IDWG and pre-dialysis MAP, as well as monitoring of dietary compliance and patient fluid intake limitations, to identify potential issues in patients with chronic renal disease

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### INTRODUCTION

Hemodialysis (HD) is a therapy that can help improve the ability of chronic kidney disease patients to survive, although HD is not to restore overall kidney function (Widianti et al., 2017). Patients with chronic kidney disease are prone to a number of problems that can occur during HD. One problem that often arises is excess fluid volume between two HD times manifested by weight gain or Interdialytic Weight Gain (IDWG) (Sulistini et al., 2014).

IDWG is very important to pay attention to, because it is an indicator of the adequacy of HD therapy and as a marker of fluid intake during interdialysis, as well as compliance with fluid management (Wahyuni et al., 2019). IDWG is set by the Kidney Disease Improving Global Outcomes (KDIGO) no more than 5% of dry body weight, to prevent

complications during HD (NFK-KDIGO), 2000). Data from a study (Nerbass et al., 2011) in Brazil showed patients who had IDWG  $\leq 5\%$  as many as 211 people, while patients with an increase in IDWG  $> 5\%$  as many as 67 people or about 24% of the total 278 HD patients in the study. The  $>5\%$  increase in IDWG in this study was considered to have a high value and had resulted in an increase in predialysis blood pressure.

An increase in IDWG indicates an expansion of extracellular volume that can lead to an increase in predialysis blood pressure and an increase in predialysis MAP (López-Gómez et al., 2005; Nerbass et al., 2011). Research by (López-Gómez et al., 2005) through a prospective study for 5 years in Spain has shown an association between IDWG and MAP predialysis in patients with chronic kidney disease, where increased IDWG is associated with higher MAP predialysis. Another study by

(Wang et al., 2009) also found that a higher increase in IDWG occurred in patients with higher predialysis MAP (>90 mmHg).

MAP represents the average arterial blood pressure of one heart cycle and is regulated stably to maintain perfusion of vital organs, such as the brain, heart, lungs, liver, and kidneys (Sherwood, 2012). MAP monitoring can be an indicator to determine changes in intravascular status in HD patients, as well as a decrease in disease conditions (Bradshaw & Health, 2012). MAP measurement is also useful for detecting the risk of death in HD patients (Wang et al., 2009).

Based on the description above, researchers are interested in the results of research from (López-Gómez et al., 2005b) which showed that increased IDWG is associated with higher predialysis MAP, so conducting a recent study in Indonesia related to the relationship of IDWG with predialysis MAP in chronic kidney disease patients using a different research design, namely descriptive correlation with cross sectional approach or observation was carried out only once during the study, and did not research related to the survival of these patients. This study aimed to analyze the relationship of IDWG with predialysis MAP in chronic kidney disease patients.

## METHODS

This study uses a descriptive research design with a correlation approach cross-sectional. The study was conducted at the Hemodialysis Unit of Tugurejo Hospital, Semarang on 04-09 July 2022. The sample of this study met the inclusion criteria in the form of outpatients who undergo HD at least 2x a week, age  $\geq 18$  years, experience interdialytic weight gain, have awareness *compos mentis*, and can be weighed standing. The research sample was 52 respondents who were taken using the technique of total sampling. Research instruments in the form of observation sheets, as well as weight scales and sphygmomanometer from RSUD Tugurejo Semarang which has been routinely calibrated once every 1 year. The research data were analyzed univariately (descriptively) and bivariate using the correlation test Pearson product moment. This research has passed the ethical test at the ethics committee of Tugurejo Hospital Semarang Number 057/KEPK.EC/VI/2022.

## RESULTS AND DISCUSSION

**Table 1. Frequency Distribution of Respondents by Age (n=52)**

Variable	Mean	Min-Max	SD
Age	50,85	22-76	12,95

Table 1 shows the ages of the respondents in this study were in the range of 22-76 years. The average (*mean*) age of the respondents in this study was 50.85 years and a standard deviation of 12.95

Table 2 shows that the majority of respondents were male (51.9%), high school education level (30.8%), and had hypertension comorbidities (63.5%). All respondents received vitamins and minerals (100%), and most of the respondents used antihypertensive drugs (63.5%). All respondents did not smoke (100%). Most of the respondents had HD  $\geq 12$  months (61.5%), and did not experience hypervolemia (76.9%

**Table 2 Frequency Distribution of Respondents Based on Respondent Characteristics (n=52)**

No.	Characteristics of Respondents	Frequency	Percentage (%)
<b>Gender</b>			
1.	Man	27	51,9
	Woman	25	48,1
<b>Education Level</b>			
2.	Did not finish elementary school	5	9,6
	SD	15	28,8
	SMP	10	19,2
	SMA	16	30,8
	Higher education	6	11,5
<b>Comorbidities</b>			
<b>Hypertension</b>			
3.	Tidak ada	19	36,5
	Ada	33	63,5
<b>Diabetes Mellitus</b>			
3.	Tidak ada	35	67,3
	Ada	17	32,7
<b>Heart Disease</b>			
3.	Tidak ada	49	94,2
	Ada	3	5,8
<b>Use of Drugs</b>			
<b>Antihypertensive</b>			
4.	Tidak ada	19	36,5
	Ada	33	63,5
<b>Diuretic</b>			
4.	Tidak ada	33	63,5
	Ada	19	36,5
<b>Antianemia</b>			
4.	Tidak ada	40	76,9
	Ada	12	23,1
<b>Analgesic</b>			
4.	Tidak ada	28	53,8
	Ada	24	46,2
<b>Vitamins and Minerals</b>			
4.	Tidak ada	0	0
	Ada	52	100
<b>Antidiabetic</b>			
4.	Tidak ada	38	73,1
	Ada	14	26,9
<b>Antiangina</b>			
4.	Tidak ada	49	94,2
	Ada	3	5,8
<b>Smoke</b>			
5.	No smoking	52	100
	Smoke	0	0
<b>Long Time in HD</b>			
6.	< 12 months	20	38,5
	$\geq 12$ months	32	61,5
<b>Hypervolemia</b>			
7.	Tidak hipervolemia	40	76,9
	Hipervolemia	12	23,1
<b>Sum</b>		<b>52</b>	<b>100</b>

**Table 3. Frequency Distribution of Respondents based on IDWG (n=52)**

IDWG	Frequency	Percentage (%)
Adequate	41	78,8
Increased	11	21,2
<b>Amount</b>	<b>52</b>	<b>100</b>

The results in Table 3 show that most of the respondents have IDWG in the adequate category (78.8%).

**Table 4. Frequency Distribution of Respondents Based on MAP Predialysis (n=52)**

Predialysis MAP Blood Pressure	Frequency	Percentage (%)
Optimal	12	23,1
Normal	7	13,5
Normal height	7	13,5
Grade 1 hypertension	11	21,2
Grade 2 hypertension	10	19,2
Grade 3 hypertension	5	9,6
<b>Total</b>	<b>52</b>	<b>100</b>

Table 4 shows that most respondents have predialysis MAP in the optimal category (23.1%). Respondents had at least MAP predialysis in the category of grade 3 hypertension (9.6%).

**Table 5. Relationship between IDWG and MAP Predialysis (n=52)**

Variable	MAP Predialysis		
	N	p-value	Correlation Coefficient (r)
<b>IDWG</b>	52	0,003	0,41

Table 5 shows the value of  $p = 0.003$  ( $p < 0.05$ ), so it can be concluded that there is a relationship between IDWG and predialysis MAP. The strength of the relationship is moderate ( $r = 0.41$ ) and the nature of the relationship is positive. This shows that if IDWG increases, predialysis MAP will also increase.

### Interdialytic Weight Gain (IDWG) for Chronic Kidney Disease Patients

The majority of patients in this study had IDWG in the adequate category ( $\leq 5\%$ ). The results of this study are supported by previous studies by (Nerbass et al., 2011) and (Rizani et al., 2019) which showed the same results. Patients with adequate IDWG can be caused by patient compliance in diet management and fluid intake restriction (Isroin, 2016). Factors such as the use of diuretic drugs and the length of time of undergoing HD  $\geq 12$  months in patients can also affect blood pressure. Loop diuretics, one of which is furosemide can reduce excess fluid volume which is the main trigger factor for increasing IDWG (Sholihah & Ardy, 2020). Patients with HD  $\geq 12$  months have reached the stage of longterm adaption (advanced adaptation), so that patients begin to be able to adapt to changes in health conditions due to their disease and also do interdialysis weight management (Baykan & Yargic, 2012).

Based on the results of this study, patients with IDWG were still found in the increased category ( $>5\%$ ). An increase in IDWG of  $>5\%$  needs to be watched out for because of the risk of complications, such as intradialysis hypertension/hypotension, shortness of breath, nausea and vomiting, ascites, left heart failure, congestive heart failure, or even death (Khairidina et al., 2020). The increased IDWG in this study may be due to non-adherence of patients in diet

management and restriction of fluid intake, hypervolemia and frequency of HD 2 times a week. Hypervolemia in HD patients can result from non-compliance with maintaining fluid intake during interdialysis, which increases extracellular fluid volume (Isroin, 2016). Less frequent HD frequencies may lead to a risk of fluid volume overload and worse electrolyte imbalance due to longer interdialysis intervals (Obi et al., 2015). Another condition that causes an increase in IDWG can occur is the use of diuretics that are not in accordance with the recommended dose (Oh & Han, 2015).

### Mean Arterial Pressure (MAP) Predialysis Chronic Kidney Disease Patients

This study showed the most MAP predialysis category ( $<93.33$  mmHg). The optimal category of predialysis MAP indicates that the pressure to circulate blood throughout the body in adequate conditions or intravascular status is adequate (Bradshaw & Health, 2012b; Kundu et al., 2017; Sherwood, 2012). The optimal predialysis MAP value can also be influenced by the use of drugs consumed by respondents, such as antihypertensive drugs, diuretics, and vitamins and minerals. Antihypertensive drugs and diuretics cause vasodilation of renal afferent arterioles and result in better MAP values (Digne-Malcolm et al., 2016). Antiangina in the form of isosorbide dinitrate has an effect on blood pressure because it is metabolized into nitric oxide (NO), which can cause vascular smooth muscle relaxation and vasodilation (Mavrakanas et al., 2022). High intake of vitamins and minerals, in the form of folic acid and vitamin B12 has a beneficial effect on endothelial function and affects blood pressure or MAP values (Tamai et al., 2011). Vitamins and minerals in the form of calcium carbonate have natriuretic effects that play a role in the regulation of extracellular fluid volume and blood pressure (Alfiana et al., 2014).

This study also found patients with predialysis MAP in grade 1 hypertension (105.68-119.00 mmHg) and grade 2 hypertension (119.01-132.33 mmHg) were not much different in number with the optimal category. This condition can be affected by an increase in IDWG. An increase in IDWG indicates an excess of extracellular volume that can cause blood pressure to rise and result in an increase in predialysis MAP (López-Gómez et al., 2005; Nerbass et al., 2011). The increase in predialysis MAP can also be influenced by hypertension and diabetes mellitus comorbidities owned by respondents, the use of analgesic and antianemia drugs, as well as female sex factors and aged  $>45$  years. Hypertension can cause kidney damage which will aggravate the disease condition and can lead to complications (Kadir, 2016). Diabetes causes the ability of the kidneys to filter blood to be reduced as well as stiffness of blood vessels, resulting in high blood pressure (Van Buren & Toto, 2011). Analgesic drugs in the form of acetaminophen can inhibit the production of nitric oxide (NO), which causes increased blood vessel tone and hypertension (Curhan et al., 2002). The effect of vasoconstrictors on antianemia drugs in the form of erythropoietin can increase vascular resistance and result in hypertension (Brar et al., 2021). Hypertension has a greater risk of occurring in women aged  $>45$  years or after entering menopause due to a progressive decrease in LFG and renal blood flow (RBF) values (Ka et al., 2014).

## Relationship of IDWG with MAP Predialysis in Chronic Kidney Disease Patients

The results of bivariate analysis in this study found a relationship between IDWG and predialysis MAP in chronic kidney disease patients at the Hemodialysis Unit of Tugurejo Hospital Semarang. The association between IDWG and predialysis MAP is positive, meaning that an increase in IDWG in chronic kidney disease patients is in line with an increase in predialysis MAP. This research is supported by previous research by (Chen et al., 2003; López-Gómez et al., 2005a; Wang et al., 2009) who showed similar results.

Decreased LFG in patients with chronic kidney disease makes the kidneys experience a decrease in the ability to excrete sodium and fluid, resulting in excess extracellular volume and increased peripheral perfusion, thereby stimulating vasoconstriction which will increase peripheral vascular resistance, as a result of which predialysis blood pressure increases (Inrig et al., 2007; Ku et al., 2019). An increase in predialysis blood pressure can cause an increase in predialysis MAP. In addition to decreased kidney function, MAP predialysis can also be associated with IDWG. According to research by (López-Gómez et al., 2005), an increase in IDWG indicates an accumulation of excessive extracellular fluid volume which results in an increase in predialysis blood pressure and causes an increase in predialysis MAP.

However, some studies show conflicting results which show no correlation between IDWG and predialysis blood pressure (Sulistini et al., 2014; Testa & Plou, 2001). This condition illustrates that the incidence of hypertension in HD patients has a complex pathophysiology, so that other factors such as activation of the angiotensin renin system, increased vasopressin, endothelin, catecholamines, and decreased nitric oxide affect blood pressure levels and patient MAP (Testa & Plou, 2001).

The results of this study showed a relationship between IDWG and MAP predialysis with a moderate level of relationship. These results support previous studies that have also shown moderate relationship strength ( $r < 0.5$ ). Therefore, changes in the size of predialysis MAP values not only occur as a result of IDWG, but there are other factors that can also influence, such as age, sex, comorbidities of hypertension and diabetes mellitus, as well as the use of drugs consumed by respondents.

## CONCLUSIONS AND SUGGESTIONS

Based on the results of the study, it can be concluded that most patients with chronic kidney disease have IDWG in the adequate category and most predialysis MAP in the optimal category, and there is a relationship between IDWG and MAP blood pressure. predialysis in patients with chronic kidney disease in the Hemodialysis Unit with moderate correlation. Nurses are advised to increase predialysis IDWG and MAP monitoring in patients with chronic kidney disease in anticipation of complications that may occur, as well as monitoring adherence to diet and limiting patient fluid intake.

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included in this section, the author is responsible for the written consent of every person who communicates personally or recognized by the individual in the text.

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