Jurnal Aisyah: Jurnal Ilmu Kesehatan

Volume 10, Issue 2, 09 2025, p. 592-603

ISSN 2502-4825 (print), ISSN 2502-9495 (online)

IMPACT OF DIFFERENT INTRADIALYTIC EATING TIMES ON HEMODYNAMIC STABILITY AND HEMODIALYSIS ADEQUACY

Authors:

Tutut Setiowati[1], Fahrun Nur Rosyid*[2], Beti Kristinawati[3]

[1]Master of Nursing Program,Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

[2,3]Department of Medical Surgical Nursing, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

**Corresponding Email:* fnr100@ums.ac.id

About the Author

1. 1st Author : Tutut Setiowati, S.Kep., Ners.
   Affiliation : Master of Nursing Program, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta
   Mailing address : Jl. Sengon, Ds. Wonoasri, Kecamatan Ngadirojo, Kabupaten Pacitan, Jawa Timur-Indonesia, Zip Code 63572
   Email of author : j218240009@student.ums.ac.id
   Orcid ID : 0000-0002-9534-2796
   Google Scholar URL : https://scholar.google.com/citations?user=gs15jg0AAAAJ&hl=en&oi=ao
   Phone number : 083898572297

2. 2nd Author : Dr. Fahrun Nur Rosyid, S.Kep., Ns., M. Kes
   Affiliation : Department of Medical Surgical Nursing, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta
   Mailing address : Jl. A. Yani, Mendungan, Pabelan, Kec. Kartasura, Kabupaten Sukoharjo, Central Java, Indonesia, Zip Code 57162.
   Email of author : fnr100@ums.ac.id
   Orcid ID : 0000-0001-8300-8996
   Google Scholar URL : https://scholar.google.com/citations?user=6EddpiEAAAAJ&hl=en&oi=ao
   Phone number : 08123183523

3. 3th Author : Beti Kristinawati, S.Kep., M.Kep., Ns. p. Kep. M.B.
   Affiliation : Department of Medical Surgical Nursing, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta
   Mailing address : Perumahan Tegal Yoso Indah No. B 11 Klaten
   Email of author : bk115@ums.ac.id
   Orcid ID : 0000-0002-8283-8346
   Google Scholar URL : https://scholar.google.com/citations?user=NLj8kskAAAAJ&hl=en&oi=ao
   Phone number : 082137266023

ABSTRACT

Intradialytic eating (IE) remains controversial due to the absence of standardised clinical guidelines. While it can potentially improve patients' nutritional status, its effects on hemodynamic stability and dialysis adequacy remain inconclusive. This study aimed to evaluate the impact of IE timing on hemodynamic and dialysis adequacy. A quasi-experimental design with a control group was employed, involving 32 hemodialysis patients assigned to either an intervention or control group. The intervention group received a standardised meal consisting of 100 ml of milk and two egg whites (<200 kcal; approximately 15 grams of protein) at varying times during five dialysis sessions. Observed parameters included systolic and diastolic blood pressure, pulse rate, MAP, and Kt/V. Measurements were recorded every 30 minutes throughout each session. Data were analysed using independent t-test and Repeated Measures ANOVA with Bonferroni correction. No statistically significant differences between the intervention and control groups across all parameters ($p > 0.05$). However, within the intervention group, repeated measures ANOVA revealed changes in systolic blood pressure ($F = 4.270$, $p = 0.004$), MAP ($F = 3.129$, $p = 0.021$), and Kt/V ($F = 2.869$, $p = 0.031$). Post-hoc Bonferroni tests identified significant differences in systolic blood pressure ($p = 0.010$ and $p = 0.045$) and MAP ($p = 0.041$). IE had a significant impact on hemodynamics during the first and second hours of dialysis ($p < 0.05$). These findings suggest that late-session intradialytic eating may be a safe nutritional approach with minimal hemodynamic risk and better preservation of dialysis adequacy.

Keywords: Dialysis Adequacy; Hemodialysis Patients; Hemodynamic Stability, Intradialytic Eating; Meal Timing

ABSTRAK

Intradialytic eating (IE) masih menjadi kontroversial tanpa pedoman klinis yang baku. Meski berpotensi meningkatkan status nutrisi, dampaknya terhadap stabilitas hemodinamik dan adekuasi dialisis masih diperdebatkan. Penelitian ini bertujuan mengevaluasi pengaruh perbedaan waktu intradialytic eating terhadap stabilitas hemodinamik dan kecukupan dialysis. Penelitian ini merupakan quasi experiment with control group yang melibatkan 32 pasien hemodialisis, dibagi menjadi kelompok intervensi dan kontrol. Kelompok intervensi mengonsumsi makanan berupa 100 ml susu dan dua putih telur (<200 kkal; ±15 gram protein) pada waktu berbeda selama lima sesi hemodialisis. Parameter yang diamati meliputi tekanan darah sistolik, diastolik, frekuensi nadi, MAP, dan Kt/V. Observasi dilakukan setiap 30 menit. Analisis data menggunakan independent t-test dan Repeated Measures ANOVA dengan Bonferroni correction. Tidak terdapat perbedaan bermakna antara kelompok intervensi dan kontrol pada seluruh parameter ($p > 0,05$). Namun, analisis RM Anova dalam kelompok intervensi menunjukkan perubahan signifikan pada tekanan darah sistolik ($F = 4.270$, $p = 0.004$), MAP ($F = 3.129$, $p = 0.021$), dan Kt/V ($F = 2.869$, $p = 0.031$). Uji Bonferroni menunjukkan perbedaan bermakna pada tekanan darah sistolik ($p = 0,010$; $p = 0,045$) dan MAP ($p = 0,041$). IE secara signifikan memengaruhi parameter hemodinamik pada interveni 1 jam dan 2 jam setelah inisiasi hemodialisis ($p < 0,05$). Temuan ini menunjukkan bahwa makan intradialitik pada fase akhir sesi hemodialisis dapat menjadi pendekatan nutrisi yang aman, dengan risiko hemodinamik minimal dan kemampuan yang lebih baik dalam mempertahankan adequasi dialisis.

Kata kunci: Adekuasi Dialisis; Pasien Hemodialisis; Stabilitas Hemodinamik; *Intradialytic Eating*; Waktu Pemberian Makanan

INTRODUCTION

Chronic kidney disease (CKD) is an increasingly prevalent global health problem worldwide (Filipska et al., 2021; Lestari & Hudiyawati, 2022; Lianti et al., 2024). Hemodialysis (HD) is the most common form of renal replacement therapy, accounting for approximately 69% of all renal therapies and 89% of all dialysis treatments (Bello et al., 2022;Preka & Shroff, 2023). Hemodialysis patients frequently encounter nutritional challenges that negatively impact their quality of life (Kistler et al., 2018; Ariyanto et al., 2024). At the same time, they are susceptible to hemodynamic instability, particularly intradialytic hypotension, which can hinder adequate tissue perfusion and dialysis adequacy (Gullapudi et al., 2018; Kooman & Van Der Sande, 2019; Mufidah et al., 2019; Ayunarwanti et al., 2020). The practice of intradialytic eating, or consuming food during HD sessions, is commonly adopted to support nutritional intake (Kistler et al., 2018;Elkeraie et al., 2023; Gharib et al., 2023). However, its effects on hemodynamic stability and dialysis adequacy remain controversial (Borzou et al., 2016; Rhee et al., 2017; Fotiadou et al., 2020; Premlatha et al., 2020;

Fotiadou et al., 2022; Elkeraie et al., 2023). The optimal timing of intradialytic food intake has not yet been clearly defined in clinical practice (Agarwal & Georgianos, 2018).

Although many HD centers, including those in Indonesia, allow intradialytic eating, its implementation remains controversial. Registry data indicate suboptimal dialysis adequacy (81% of patients had Kt/V <1.8) and a high incidence of intradialytic hypotension (53.7%) (Indonesian Renal Registry 2018). While IE may improve nutritional status and reduce protein-energy wasting, it can also redistribute splanchnic blood flow, leading to postprandial hypotension and impaired ultrafiltration efficiency (Borzou et al., 2016; Rhee et al., 2017; Fotiadou et al., 2020; Fotiadou et al., 2022; Agarwal & Georgianos, 2018).

Intradialytic eating, which contributes to hemodynamic stability and dialysis adequacy, is influenced by several factors (Goyal et al., 2023). Changes in Relative Blood Volume (RBV) after food intake tend to be more pronounced when meals are consumed in a seated position. RBV reduction usually peaks 16 minutes after eating and returns to baseline within 30 minutes. A decrease in Mean Arterial Pressure (MAP) may occur within 30 minutes following a meal (Agarwal & Georgianos, 2018). A study by Borzou et al. (2016) further demonstrated that reductions in both systolic and diastolic blood pressure may persist for up to one to one and a half hours after eating.

At the hospital where this study was conducted, the majority of patients undergoing hemodialysis engage in intradialytic eating during sessions lasting 4–5 hours (Data Rekam Medis RS UNS, 2024). Although intradialytic eating is common, no clear guidelines exist on optimal meal timing to ensure hemodynamic stability and dialysis adequacy (Agarwal & Georgianos, 2018). This absence of standardized clinical recommendations represents a critical research gap, leaving clinicians uncertain about whether early or late intradialytic eating is safer and more effective. Therefore, this study evaluates the effects of different intradialytic eating times on hemodynamic parameters and dialysis adequacy is urgently needed. The findings from this study are expected to serve as a foundation for developing practical recommendations for dialysis technicians and nurses in managing meal timing during HD sessions, to minimise clinical risks and optimise therapeutic outcomes.

METHOD

Participant

This quantitative study adopted a quasi-experimental design with a control group and was conducted at a single hemodialysis centre, Hospital X. A total of 32 patients undergoing regular hemodialysis twice weekly were recruited and evenly assigned to either the intervention group (n = 16) or the control group (n = 16). The sample size was calculated using G*Power 3.1.9.4 with a medium effect size (Cohen's f = 0.25), $\alpha = 0.05$, power = 0.95, two groups, five repeated measurements, assumed correlation among repeated measures of 0.5, and non-sphericity correction $\varepsilon = 1.0$. Participants were selected using purposive sampling based on the inclusion criteria. Inclusion criteria were as follows: aged 18–65 years, had undergone hemodialysis for at least eight months, were fully conscious (compos mentis), cooperative, and had a habitual practice of eating during dialysis sessions. Patients who were hospitalised during the study period were excluded.

Intervention

The study was conducted over five consecutive hemodialysis sessions for each participant. The intervention and control groups were assigned to different dialysis days to minimise contamination (intervention: Monday and Thursday; control: Tuesday and Friday). The first session served as a baseline (pre-test) measurement, during which no meal timing regulation was applied, to obtain initial hemodynamic and dietary behaviour data. In the subsequent four sessions, the intervention group received a standardised intradialytic meal consisting of 100 mL of high-protein milk and two boiled

egg whites (total energy <200 kcal; approximately 15 g protein). The timing of intake varied across sessions: in the first session, the meal was administered 1 hour after dialysis initiation; in the second, at the second hour; in the third, at the third hour; and in the final session, at the fourth hour. Meanwhile, the control group did not receive any specific meal provision or scheduled eating instructions from the researchers. Patients in this group were allowed to eat according to their habitual practices during dialysis sessions, but continued to receive standard nutritional counselling from a registered dietitian, under clinical protocols.

Measures

Data collected in this study included sociodemographic characteristics (age, sex, education level, occupation, duration of hemodialysis, and comorbidities), along with clinical parameters such as systolic and diastolic blood pressure, heart rate, mean arterial pressure (MAP), and Kt/V as an indicator of dialysis adequacy. Additional data were obtained from medical records and patient interviews regarding eating habits during dialysis sessions. Clinical parameters were measured every 30 minutes throughout each five-hour dialysis session, resulting in a total of 11 observation points per session for each participant. All measurements were recorded using monitoring devices integrated into the dialysis machine.

Data analysis

Data were analyzed using SPSS version 23. Descriptive statistics (means, standard deviations, and percentages) were calculated for demographic and baseline characteristics. Independent t-tests were used to compare the effects of the intervention on hemodynamic parameters and dialysis adequacy between the intervention and control groups for normally distributed data. Repeated Measures Analysis of Variance (RM ANOVA) examined changes across sessions and assessed the effects of the intervention over time. Bonferroni post hoc tests were performed to identify time points with significant pairwise differences.

Ethical Considerations

The study protocol was reviewed and approved by the Health Research Ethics Committee of UNS Hospital (Approval No: 026/UN27.46/TA.04.19/KEP/EC/2025). All participants received information regarding the study objectives, procedures, potential risks, and benefits, and provided written informed consent before participation. Participants were informed of their right to withdraw at any time without consequences.

RESULTS

Characteristics of Respondents

A total of 32 participants were enrolled in this study, with an equal distribution between the intervention and control groups (16 participants in each). The majority of participants were male (59.4%), with a higher proportion observed in the control group (68.8%) compared to the intervention group (50%). The age range represented a diverse adult to elderly population, with the 55–65 years age group comprising the largest proportion (46.9%). The duration of hemodialysis therapy varied across participants: 46.9% had been undergoing treatment for 1–3 years, 37.5% for more than 3 years, and 15.6% for less than 1 year.

Comorbidity was highly prevalent in this population (81.2%), with hypertension being the most common condition frequently coexisting with diabetes mellitus or a history of cerebrovascular accident. All participants reported the habit of eating during hemodialysis sessions, including both snacks and full meals, with varying consumption patterns. Specifically, 46.9% consumed a combination of snacks and main meals, 21.9% consumed only main meals, and 31.3% consumed snacks only. The majority of participants (84.4%) consumed food while in a supine position, by

standard hemodialysis practice, while the remaining 15.6% chose to eat while sitting upright. Regarding fluid intake during dialysis, 87.6% of participants reported consuming moderate to large volumes of fluids, with 43.8% consuming more than 200 mL. These findings highlight the variability in dietary and fluid intake behaviours during dialysis sessions, which may have implications for hemodynamic stability throughout the procedure (Table 1).

Table 1. Demographic and Clinical Characteristics of Participants

Characteristics	Intervention		Control		Total		p-value
	(n=16)	%	(n=16)	%	(N=32)	%	
Gender							
Man	8	50	11	68,8	19	59,4	0,280[a]
Woman	8	50	5	31,2	13	40,6	
Age							
18-44	5	31,3	5	31,3	10	31,3	
45-54	5	31,3	2	12,5	7	21,9	0,381[b]
55-65	6	37,5	9	56,3	15	46,9	
Duration of Hemodialysis							
8 month-1 year	3	18,8	2	12.5	5	15.6	
>1-3 years	9	56,3	6	37.5	15	46.9	0,339[b]
>3 years	4	25,0	9	50.0	12	37.5	
Comorbidities							
Yes	14	87,5	12	75,0	26	81,2	0,654[c]
None	2	12,5	4	25,0	6	18,8	
Type of food							
Snack	4	25.0	6	37.5	10	31.3	
Large meal	3	18.8	4	25.0	7	21.9	0,563[b]
Snack + large meal	9	56.3	6	37.5	15	46.9	
Fluid Intake							
Mild (≤100 ml)	2	12.5	2	12.5	4	12.5	0,751[b]
Moderate (101-200 ml)	8	50.0	6	37.5	14	43.8	
Severe (>200 ml)	6	37.5	8	50.0	14	43.8	

[a]Person Chi-Square test [b]Likelihood Ratio [c]Fisher's Exact Test [d]Monte Carlo

Effect of Differences in Intradialytic Eating Time on Hemodynamic Parameters

An independent t-test was conducted to compare the mean values of all hemodynamic and dialysis adequacy parameters between the intervention and control groups. The results showed no statistically significant differences between groups ($p > 0.05$). These findings indicated that the timing of intradialytic meal administration did not result in significant differences in hemodynamic stability or dialysis adequacy between the two groups (Table 2).

Table 2. Effects of Differences in Intradialytic Eating Time

Parameter	Intervention Groups (Mean ± SD)	Control Groups (Mean ± SD)	t-value	p-value[a]
Sistol	146.40±24.97	154.36±27.61	-1.913	0.058
Diastol	78.31±12.72	77.33±10.04	0.545	0.587
MAP	101.04±15.86	102.98±14.83	-0.798	0.426
Nadi	75.49±11.16	78.73±10.67	-1.875	0.063

[a]Independent T-test; MAP: Mean Arterial Pressure; HR : Heart Rate

Analysis of repeated measurements over the five hemodialysis sessions (Table 3) in the intervention group revealed significant changes in systolic blood pressure ($F = 4.270$; $p = 0.004$) and mean arterial pressure (MAP) ($F = 3.129$; $p = 0.021$), with a fluctuating pattern observed across the sessions. In contrast, the control group showed no statistically significant changes in any hemodynamic

parameters (p > 0.05), indicating stability throughout the intervention period. These findings suggested a dynamic response in hemodynamic values and dialysis adequacy with the timing of intradialytic feeding.

Bonferroni post-hoc analysis revealed no significant difference in systolic blood pressure between the pre-intervention baseline and session 4 (mean difference = –2.625; p = 1.000), indicating that systolic pressure at session 4 had returned to near-baseline levels. However, systolic blood pressure in session 4 was significantly higher compared to sessions 1 and 2 (session 1 vs. 4: mean difference = –11.375; p = 0.010; session 2 vs. 4: mean difference = –12.188; p = 0.045). In contrast, no significant difference was found between the baseline (pre) and sessions 1 (p = 0.624) or 2 (p = 0.462), suggesting a trend of decreased systolic pressure during the early sessions (1 and 2), followed by a return toward baseline by session 4. These findings imply that the initial intervention sessions (particularly sessions 1 and 2) may pose a greater risk of blood pressure reduction compared to the later sessions. Regarding mean arterial pressure (MAP), a significant difference was observed between session 2 and session 4 (mean difference = –6.563; p = 0.041), with MAP being lower in session 2. However, no significant differences were detected between baseline and session 2 (p = 0.828) or baseline and session 4 (p = 1.000). This suggested a temporary decline in MAP during the early phase of the intervention, which then tended to return to baseline by the fourth session (Table 4).

Table 3. Hemodynamic Stability Based on Differences in Intradialytic Eating Time

Parameter	**Group**	**RM ANOVA**	
		F	p-value[a]
Systolic	Intervention	4.270	0.004
	Control	1.135	0.341
Diastolic	Intervention	1.790	0.143
	Control	0.682	0.051
MAP	Intervention	3.129	0.021
	Control	2.029	0.119
HR	Intervention	0.477	0.712
	Control	0.441	0.779

[a]Repeated Measures ANOVA; MAP: Mean Arterial Pressure; HR : Heart Rate

Table 4. Pairwise comparison

Parameter	**Session**	**Mean difference**	**Std. error**	**p-value[a]**
Systolic	Pre-intervention vs intervention 1	8.750	4.346	0.624
	Pre-intervention vs intervention 2	9.563	4.401	0.462
	Pre-intervention vs intervention 4	-2.625	5.055	1.000
	Intervention 1 vs Intervention 4	-11.375	2.782	0.010
	Intervention 2 vs Intervention 4	-12.188	3.653	0.045
MAP	Pre-intervention vs intervention 2	5.063	2.724	0.828
	Pre-intervention vs intervention 4	-1.500	2.677	1.000
	Intervention 2 vs Intervention 4	-6.563	1.939	0.041

[a]Bonferroni post hoc test

Hemodynamic Trends over Time in the Intervention Group

The intradialytic eating (IE) intervention in the experimental group significantly affected hemodynamic parameters, particularly during the first (systolic p = 0.001; diastolic p = 0.006; MAP p = 0.001; pulse p = 0.002) and second dialysis sessions (systolic p = 0.001; diastolic p = 0.003; MAP p = 0.001; pulse p = 0.046) (Tables 5 and 6, Supplementary File). These significant fluctuations in systolic and diastolic blood pressure, MAP, and heart rate suggested transient hemodynamic instability and a possible occurrence of intradialytic hypotension, likely as a physiological response to nutrient intake during dialysis.

In contrast, no statistically significant changes in blood pressure were observed in the third and fourth sessions (Tables 7 and 8, Supplementary File), indicating a more stable hemodynamic profile. However, a notable increase in heart rate was recorded during the third session ($p = 0.014$), and a near-significant increase was observed in the fourth session ($p = 0.061$), which may reflect the activation of compensatory cardiovascular mechanisms in response to repeated intradialytic feeding.

These findings suggest that while early exposure to intradialytic nutrition may temporarily disrupt hemodynamic stability, adaptive physiological responses may develop over time, potentially attenuating these effects in subsequent sessions. Continued monitoring is essential to identify patients at risk of adverse hemodynamic events and to optimise the timing and composition of intradialytic meals.

Effect of Differences in Intradialytic Eating Time on Hemodialysis Adequacy

Repeated-measures ANOVA analysis of Kt/V values revealed a statistically significant change during the intradialytic eating sessions ($F = 2.869$, $p = 0.031$). In the intervention group, the mean Kt/V decreased from 1.74 ± 0.27 at baseline to 1.63 ± 0.23 during the first session, followed by mild fluctuations, ultimately increasing to 1.68 ± 0.29 by the fourth session. These findings suggest that intradialytic nutritional intake had an observable effect on dialysis adequacy variability.

The initial decline might have reflected an adaptive physiological response to the intervention, potentially due to altered hemodynamics or gastrointestinal perfusion redistribution during nutrient absorption. The subsequent increase toward the final session indicated a trend toward stabilisation, implying that repeated exposure to intradialytic feeding might have allowed the patient's system to adjust without compromising dialysis effectiveness.

In contrast, the control group showed no significant changes in dialysis adequacy parameters throughout the sessions ($p > 0.05$) (Table 8), supporting the interpretation that the observed Kt/V variability was likely attributable to the nutritional intervention rather than external or procedural factors.

Table 9. Hemodialysis Adequacy Based on Differences in Intradialytic Eating Time (N = 32)

Parameter	Group	Pre-test	Intradialytic Eating Session				RM Anova	
			1	2	3	4	F	P -value[a]
K.t/V	Intervention	1.74±0.27	1.63±0.23	1.60±0.25	1.65±0.28	1.68±0.29	2.869	0.031
	Control	1.5±0.39	1.73±0.41	1.63±0.41	1.64±0.36	1.67±0.42	1.747	0.187

[a]Repeated Measures ANOVA

DISSCUSSION

The practice of allowing food intake during hemodialysis sessions remains a subject of considerable debate among healthcare professionals. Advocates of this practice emphasize its potential benefits, including improved nutritional status and enhanced patient satisfaction. However, concerns have been raised regarding the possible increase in hemodynamic instability and a reduction in dialysis adequacy.

Previous studies reported inconsistent effects of intradialytic eating on hemodynamic stability. For example, Fotiadou et al., (2020) found that food consumption during dialysis reduced blood pressure and increased symptomatic intradialytic hypotension, indicating potential risks for dialysis adequacy. Similarly, Fotiadou et al., (2022) showed that intradialytic food intake increased blood pressure variability and reduced dialysis adequacy, reinforcing concerns about patient safety.

A single-centre quasi-experimental study conducted by (Goyal et al., 2023) demonstrated that consuming food during dialysis sessions significantly increased the risk of intradialytic hypotension (IDH), although it did not produce a meaningful effect on dialysis adequacy. Notably, the quantity of food intake was not correlated with the occurrence of IDH. This finding suggests that the timing of food consumption and the patient's physiological status may play a more prominent role in influencing IDH risk than the amount of food consumed.

There were no established guidelines regarding meal timing during hemodialysis sessions in the study unit before this investigation. In this study, we implemented scheduled control of intradialytic meal timing and standardised nutritional intake. Our findings indicate that this structured approach did not produce statistically significant intergroup differences in hemodynamic parameters or dialysis adequacy. However, within the intervention group, we observed a notable dynamic physiological response over the five dialysis sessions, as reflected by significant fluctuations in systolic blood pressure, mean arterial pressure (MAP), and Kt/V values.

A key finding of this study is that the timing of intradialytic meal intake produced differential effects on hemodynamics. Early meals (hours 1–2) induced transient hypotension and compensatory heart rate increases, whereas late meals (hours 3–4) were associated with more stable blood pressure, suggesting that meal timing is a critical factor in managing intradialytic hemodynamic fluctuations. Short-term increases in blood pressure (BP) variability induced by early intradialytic food intake may have important prognostic implications. Our results indicate that systolic blood pressure initially declined during sessions 1 and 2, followed by a gradual increase approaching baseline levels by session 4. Despite these fluctuations, there was no statistically significant difference between pre-intervention and final session measurements, suggesting that blood pressure tends to return to baseline over the course of the intervention. Similarly, mean arterial pressure (MAP) values showed episodic changes, with a tendency to revert to baseline levels, supporting the notion that intradialytic hemodynamic fluctuations were transient rather than cumulative. These findings highlight that meal timing, rather than the act of eating per se, is the primary determinant of hemodynamic variability during dialysis, emphasizing the need for a time-sensitive approach when providing nutritional support..

Previous observational studies have indicated that greater intradialytic BP variability is associated with an elevated risk of cardiovascular events and mortality among hemodialysis patients (Liao et al., 2019; Zhang et al., 2022). his risk becomes more pronounced in the presence of symptomatic intradialytic hypotension—a common and serious complication of the dialysis procedure—which has been linked to increased cardiovascular morbidity and mortality (Kuipers et al., 2019;Sidiq, 2021; Fortuna et al., 2023). This concern is further underscored by the present study's findings, which identified hypertension as the most prevalent comorbidity among participants. From a physiological standpoint, hypertension may exacerbate hemodynamic instability and increase susceptibility to blood pressure fluctuations during dialysis, particularly in the context of intradialytic eating.

The transient reductions in blood pressure following early intradialytic meals may be explained by splanchnic vasodilation and visceral blood pooling, which redistribute circulating volume and transiently lower systemic blood pressure. This mechanism is consistent with previous reports.(Borzou et al., 2016; Agarwal & Georgianos, 2018; Fotiadou et al., 2020; Jelicic, 2021; Fotiadou et al., 2022; Goyal et al., 2023). In the later phases of the hemodialysis session, total body fluid volume is typically reduced due to ultrafiltration. This physiological fluid shift may enable compensatory mechanisms to stabilise blood pressure, thus partially mitigating earlier hypotensive effects.

Several previous interventional studies have reported that food intake during hemodialysis may significantly reduce dialysis adequacy (Fotiadou et al., 2020; Fotiadou et al., 2022;Fotiadou et al.,

2023). In the study, a decline in dialysis adequacy was observed primarily during the earlier intradialytic eating sessions, whereas the average Kt/V tended to increase in the later sessions.

This study also highlights the potential influence of blood flow rate (BFR) management on both hemodynamics and dialysis adequacy. Throughout the sessions, BFR was maintained at a high level from the beginning until near the end of treatment to optimize the clearance of solutes and fluid removal. This approach aligns with the findings of Wayunah et al. (2023), who reported a positive correlation between higher BFR and improved dialysis adequacy. Toward the end of the session, a gradual reduction in BFR was implemented to alleviate cardiovascular strain, even though ultrafiltration rates were maintained—this was feasible due to the decreased residual fluid volume (Preka & Shroff, 2023). This strategy may help maintain hemodynamic stability by minimising intravascular volume depletion.

Previous studies have highlighted age, sex, comorbidities, and eating position as potential determinants of hemodynamic instability and dialysis adequacy (Chazot et al., 2021; Saefulloh et al., 2023; Rosyid et al., 2025; Wang et al., 2025). In the present study, these variables showed no significant intergroup differences. These findings suggest that dietary intake during dialysis may have contributed to the hemodynamic fluctuations observed.

LIMITATION OF THE STUDY

This study has several limitations that may affect the interpretation of the findings. The relatively small sample size (n = 32) limits the generalizability of the results to broader hemodialysis populations. The quasi-experimental design without full randomisation may introduce selection bias and compromise internal validity. Additionally, several potential confounding factors—such as hydration status, anxiety levels, daily dietary patterns, and the use of antihypertensive medications—were not fully controlled, which may have influenced the observed hemodynamic outcomes. Future research is recommended to involve larger sample sizes and adopt fully randomised experimental designs to enhance internal validity and reduce bias. It is also important to incorporate strategies to control for relevant confounding variables. Moreover, a longitudinal approach is warranted to explore the long-term effects of intradialytic eating on hemodynamic stability and dialysis adequacy

CONCLUSIONS AND SUGGESTIONS

Based on the findings of this study, no statistically significant differences were observed between the intervention and control groups in overall hemodynamic parameters or dialysis adequacy. However, within the intervention group, significant changes were identified in systolic blood pressure, mean arterial pressure (MAP), and Kt/V values following food intake, particularly during the first and second hours post-intervention.

These results suggest that intradialytic eating may offer nutritional benefits for hemodialysis patients without substantially compromising overall hemodynamic stability. Moreover, the timing of food administration appears to play a critical role. Consumption during the later phases of the dialysis session was associated with more stable clinical responses, indicating that late-session feeding may represent a safer and more effective approach for managing the nutritional needs of hemodialysis patients. Late-session intradialytic eating may be recommended as a safer nutritional strategy, pending larger confirmatory trials.

Acknowledgment

We extend our deepest appreciation to all the patients who participated in this study, as well as to UNS Hospital and the entire dialysis staff for their invaluable support and assistance throughout the research process.

ETHICAL CONSIDERATIONS

Funding Statement.

This study was conducted independently without financial support or assistance from any organisation.

Conflict of Interest Statement

The authors declare that they have no conflict of interest related to this study.

REFERENCES

Agarwal, R., & Georgianos, P. (2018). Feeding during dialysis—risks and uncertainties. *Nephrology Dialysis Transplantation*, *33*(6), 917. https://doi.org/10.1093/NDT/GFX195

Ariyanto, F., Pratiwi, A., & Hudiyawati, D. (2024). Psychosocial Therapy Model to Reduce Anxiety Levels in Hemodialysis Patients. *MEDISAINS: Jurnal Ilmiah Ilmu-Ilmu Kesehatan*, *22*(3), 132–136. https://doi.org/10.30595/MEDISAINS.V22I3.23788

Ayunarwanti, R., & Maliya, A. (2020). Self-Efficacy on Intradialysis Hypertension in Kidney Failure Patients. *Jurnal Berita Ilmu Keperawatan*, *13*(1), 54–61. https://doi.org/10.23917/BIK.V13I1.11603

Bello, A. K., Okpechi, I. G., Osman, M. A., Cho, Y., Htay, H., Jha, V., Wainstein, M., & Johnson, D. W. (2022). Epidemiology of haemodialysis outcomes. In *Nature Reviews Nephrology* (Vol. 18, Issue 6, pp. 378–395). *Nature Research*. https://doi.org/10.1038/s41581-022-00542-7

Borzou, S. R., Mahdipour, F., Oshvandi, K., Salavati, M., & Alimohammadi, N. (2016). Effect of Mealtime During Hemodialysis on Patients' Complications. *Journal of Caring Sciences*, *5*(4), 277. https://doi.org/10.15171/JCS.2016.029

Chazot, G., Bitker, L., Mezidi, M., Chebib, N., Chabert, P., Chauvelot, L., Folliet, L., David, G., Provoost, J., Yonis, H., & Richard, J. C. (2021). Prevalence and risk factors of hemodynamic instability associated with preload-dependence during continuous renal replacement therapy in a prospective observational cohort of critically ill patients. *Annals of Intensive Care*, *11*(1). https://doi.org/10.1186/S13613-021-00883-9

Elkeraie, Y. A., Amine, E. K., Naga, Y. S., & Mohamed, D. T. (2023). Intradialytic Feeding Practice and Nutritional Status of Maintenance Hemodialysis Patients in Alexandria, Egypt. *Journal of High Institute of Public Health*, *53*(2), 82–89. https://doi.org/10.21608/JHIPH.2023.336230

Filipska, A., Bohdan, B., Wieczorek, P. P., & Hudz, N. (2021). Chronic kidney disease and dialysis therapy: incidence and prevalence in the world. *Pharmacia*, *68*(2), 463–470. https://doi.org/10.3897/PHARMACIA.68.E65501

Fortuna, T. A., Karuniawati, H., Purnamasari, D., & Purlinda, D. E. (2023). Faktor – Faktor yang Mempengaruhi Komplikasi pada Pasien Diabetes Mellitus di RSUD Dr. Moewardi. *Pharmacon: Jurnal Farmasi Indonesia*, *20*(1), 27–35. https://doi.org/10.23917/PHARMACON.V20I1.21877

Fotiadou, E., Georgianos, P. I., Chourdakis, M., Zebekakis, P. E., & Liakopoulos, V. (2020). Eating during the hemodialysis session: A practice improving nutritional status or a risk factor for intradialytic hypotension and reduced dialysis adequacy? *Nutrients*, *12*(6), 1–11. https://doi.org/10.3390/nu12061703

Fotiadou, E., Georgianos, P. I., Vaios, V., Kotzakioulafi, E., Divanis, D., Varouktsi, G., Chrapis, P., Chourdakis, M., & Liakopoulos, V. (2023). Intradialytic Meal Consumption During Hemodialysis Session Reduces Dialysis Adequacy. *Clinical Nutrition ESPEN*, *54*(10), 548. https://doi.org/10.1016/j.clnesp.2022.09.268

Fotiadou, E., Georgianos, P. I., Vaios, V., Sgouropoulou, V., Divanis, D., Karligkiotis, A., Leivaditis, K., Chourdakis, M., Zebekakis, P. E., & Liakopoulos, V. (2022). Feeding during Dialysis Increases Intradialytic Blood Pressure Variability and Reduces Dialysis Adequacy. *Nutrients 2022, Vol. 14, Page 1357*, *14*(7), 1357. https://doi.org/10.3390/NU14071357

Gharib, M. S., Nazeih, M. S., & El Said, T. W. (2023). Effect of intradialytic oral nutritional supplementation on nutritional markers in malnourished chronic hemodialysis patients: prospective randomized trial. *BMC Nephrology*, *24*(1). https://doi.org/10.1186/S12882-023-03181-7

Goyal, S., Bhat, A., & Kumar, S. (2023). The effect of intradialytic food intake on hemodialysis adequacy and blood pressure; a quasi-experimental study. *Journal of Nephropathology*, *13*(3), e21460–e21460. https://doi.org/10.34172/JNP.2023.21460

Jelicic, I. (2021). Relationship of food intake during hemodialysis and symptomatic intradialytic hypotension. *Hemodialysis International*, *25*(3), 333–337. https://doi.org/10.1111/HDI.12923

Kistler, B. M., Benner, D., Burrowes, J. D., Campbell, K. L., Fouque, D., Garibotto, G., Kopple, J. D., Kovesdy, C. P., Rhee, C. M., Steiber, A., Stenvinkel, P., ter Wee, P., Teta, D., Wang, A. Y. M., & Kalantar-Zadeh, K. (2018). Eating During Hemodialysis Treatment: A Consensus Statement From the International Society of Renal Nutrition and Metabolism. *Journal of Renal Nutrition*, *28*(1), 4–12. https://doi.org/10.1053/J.JRN.2017.10.003

Kuipers, J., Verboom, L. M., Ipema, K. J. R., Paans, W., Krijnen, W. P., Gaillard, C. A. J. M., Westerhuis, R., & Franssen, C. F. M. (2019). The Prevalence of Intradialytic Hypotension in Patients on Conventional Hemodialysis: A Systematic Review with Meta-Analysis. *American Journal of Nephrology*, *49*(6), 497–506. https://doi.org/10.1159/000500877,

Lestari, Y. S., & Hudiyawati, D. (2022). Effect of Foot Massage on Reducing Fatigue in Patients Undergoing Hemodialysis. *Journal of Vocational Health Studies*, *5*(3), 166-173. https://doi.org/10.20473/JVHS.V5.I3.2022.166-173

Lianti, D., & Rosyid, F. N. (2024). Family support and self-care management of patients with chronic kidney disease undergoing hemodialysis. *Malahayati International Journal of Nursing and Health Science*, *7*(8), 1025-1032. https://doi.org/10.33024/MINH.V7I8.291

Liao, R., Li, J., Lin, L., Sun, S., Wang, L., Xiong, Y., Li, Y., Han, M., Liu, Q., & Su, B. (2019). The association between long- and intra-dialytic blood pressure variability with all-cause mortality in hemodialysis patients. *Blood Purification*, *48*(1), 43–50. https://doi.org/10.1159/000496561,

Mufidah, N., Kristinawati, B., & Pratama, A. P. (2019). Intradialytic Exercise and Progressive Relaxation as Evidence Based Nursing to Stabilize Blood Pressure Chronic Kidney Failure Patients Undergoing Hemodialysis. *Prosiding Akademi Keperawatan Widya Husada Semarang*, *1*(1), 1-10. https://prosiding.d3per.uwhs.ac.id/index.php/eproc/article/view/1

Preka, E., & Shroff, R. (2023). Hemodialysis. *Evidence-Based Nephrology, Second Edition: Volumes 1,2*, *2*, 412–425. https://doi.org/10.1002/9781119105954.ch66

Premlatha, S., Vasa, H., Swetha, A., Vaishnavi, G., Priyanka, S., & Anandh, U. (2020). Eating during dialysis: An observational cohort study from India. *Journal of Renal Nutrition and Metabolism*, *6*(4), 97. https://doi.org/10.4103/JRNM.JRNM_6_21

Rhee, C. M., You, A. S., Parsons, T. K., Tortorici, A. R., Bross, R., St-Jules, D. E., Jing, J., Lee, M. L., Benner, D., Kovesdy, C. P., Mehrotra, R., Kopple, J. D., & Kalantar-Zadeh, K. (2017). Effect of high-protein meals during hemodialysis combined with lanthanum carbonate in hypoalbuminemic dialysis patients: Findings from the FrEDI randomized controlled trial. *Nephrology Dialysis Transplantation*, *32*(7), 1233–1243. https://doi.org/10.1093/ndt/gfw323

Rosyid, F. N., Sugiharto, S., Dhani, S. R. A., Vera, L. S., & Safitri, L. N. (2025). Self-Care is Associated with Quality of Life in Chronic Kidney Disease Undergoing Hemodialysis . *Jurnal Aisyah : Jurnal Ilmu Kesehatan*, *10*(1). https://doi.org/10.30604/jika.v10i1.3073

Wayunah, W., Saefulloh, M., & Yanganto, Y. (2023). Factors affecting hemodialysis adequacy in patients undergoing hemodialysis: a cross-sectional study. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*, *8*(S1), 215-220. https://dx.doi.org/10.30604/jika.v8iS1.1699

Sidiq, M. N. (2021). Faktor-faktor yang Menyebabkan Hipotensi Intradialisis : Literature Review. *Jurnal Berita Ilmu Keperawatan*, *14*(1), 49–56. https://doi.org/10.23917/BIK.V14I1.11601

Wang, J. Z., Sikora, L., Farrell, P., Hiremath, S., & Clark, E. G. (2025). Definitions of Hemodynamic Instability Related to Renal Replacement Therapy in Critically Ill Patients: A Systematic Review Protocol. *Canadian Journal of Kidney Health and Disease*, *12*. https://doi.org/10.1177/20543581241312631/SUPPL_FILE/SJ-DOCX-2-CJK-10.1177_20543581241312631.DOCX

Wayunah, W., Kunto Prabowo, R., Fatimah, I., Saefulloh, M., (2023). Quick of Blood Sebagai Salah Satu Faktor yang Mempengaruhi Tercapainya Adekuasi Hemodialisa. *HEALTHY BEHAVIOR JOURNAL*, *1*(2), 48–55. https://doi.org/10.30989/HBJ.V1I2.1171

Zhang, X., Xu, L., Zhou, P., Song, D., Wu, J., & Jia, L. (2022). Intradialytic BP variability is associated with cardiovascular mortality and hospitalization in HD patients. *Therapeutic Apheresis and Dialysis*, *26*(3), 624–631. https://doi.org/10.1111/1744-9987.13745