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Original Article

Intradialytic Feeding Practice and Nutritional Status of Maintenance Hemodialysis Patients in Alexandria, Egypt

Yasmine A. Elkeraie [1¥], Ezzat K. Amine [2], Yasmine S. Naga [3], Doaa T. Mohamed [2]

1 Fellow of Nutrition Department, High Institute of Public Health, Alexandria University, Egypt
2 Department of Nutrition, High Institute of Public Health, Alexandria University, Egypt
3 Department of Internal Medicine, Nephrology Unit, Faculty of Medicine, Alexandria University, Egypt

Abstract

Background: Malnutrition is a common complication of hemodialysis that needs to be prevented, properly diagnosed and treated. Intra-dialytic feeding is a controversial yet effective method to help improve nutritional status.

Objective(s): To assess intradialytic dietary pattern and nutritional status of hemodialysis patients and determine the energy and protein adequacy on hemodialysis and non-hemodialysis days.

Methods: A cross sectional study was conducted using a predesigned interview questionnaire, 3-day 24-hour diet recall, anthropometric measurements, serum albumin and total iron binding capacity measurements, and malnutrition inflammation score (MIS) for 150 hemodialysis patients.

Results: More than three quarters of the patients reported eating during the hemodialysis session with 71.3% of them eating due to the long session hours. Mean energy and protein intake on hemodialysis days was 1743.0 ± 718.1 kcal and 73.78 ± 37.15 g, respectively, which was significantly higher among patients who eat than those who don't eat during the hemodialysis session ($p<0.001$). Although mean serum albumin was higher in patients who eat during dialysis session and MIS was lower, there was no statistically significant difference between both groups.

Conclusion: Intradialytic feeding is a common practice in chronic hemodialysis patients. Both energy and protein intakes and their adequacies were found to be higher in patients who eat during the dialysis session. This hints at the importance of utilization of dialysis session time to enhance the patients' nutritional status. Therefore, it is recommended to individualize the advice of intradialytic feeding according to the patient's needs.

Keywords: End stage renal disease, hemodialysis, malnutrition, intradialytic feeding, energy adequacy, protein adequacy, malnutrition inflammation score

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¥*Correspondence*:
Email: koraie_1993@hotmail.com

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INTRODUCTION

Chronic Kidney Disease (CKD) is emerging as one of the leading causes of mortality in the 21st century due to the increasing incidence of risk factors such as type 2 diabetes mellitus (T2DM) and hypertension. Without treatment, CKD progresses to end stage renal disease (ESRD) requiring initiation of renal replacement therapy (RRT). [1]

End stage renal disease patients on hemodialysis (HD) are at risk of malnutrition, specifically protein energy wasting (PEW) with a varying prevalence between 17-85% commonly due to metabolic acidosis, systemic inflammation, intestinal dysbiosis, anabolic hormone resistance, uremic toxin accumulation, and decreased protein intake. [2] Various diagnostic criteria have been put for PEW. The International Society of Renal Nutrition and Metabolism (ISRNM) expert panel criteria consisted of 4 categories: biochemical (serum albumin, prealbumin and cholesterol), body mass (body mass index, unintentional weight loss and body fat %), muscle mass (loss of muscle mass, mid-upper arm muscle circumference, creatinine appearance) and dietary intake (dietary protein intake and dietary energy intake). One or more criterion in at least three categories should be met to provide a diagnosis of PEW. [3]

An early nutritional support helps prevent and treat malnutrition. Meeting the energy and protein requirements has a positive effect on improving the clinical status, reducing catabolism, improving quality of life, and reducing mortality. [4]

Intradialytic feeding is a controversial practice. The idea of providing meals within the dialysis session historically started when HD sessions were delivered for 8 to 12 hours and were considered the best timing to have a full-on unrestricted meal. [5] Moving on to when the HD sessions became 4 or less hours, the need of having intradialytic meals diminished with some dialysis centers abandoning this practice and some still keeping it. As with many dialysis practices, intradialytic feeding has its pros and cons with no reached consensus on the best way to administer it. Feeding practices and policies during the dialysis sessions are highly variable from one dialysis unit to another and between nephrologists. [6] In a survey for clinicians in the ISRNM Conference; eighty-five percent of clinics allowed patients to eat during the dialysis session while fifteen percent did not. [7]

The aim of present study was to assess the intradialytic dietary pattern and nutritional status of chronic hemodialysis patients in Alexandria in terms of assessment of the intradialytic feeding habits, malnutrition inflammation score (MIS), determination of energy and protein adequacy on HD and non-HD days and exploring the relation between albumin, and MIS and other parameters.

METHODS

A cross-sectional study design was conducted in one private dialysis center (the Kidney and Urology Center) and one University hospital (Elmowassat hospital) in Alexandria. The study included end stage renal patients on maintenance hemodialysis aged 18 years and above of both sexes and on HD therapy for at least 6 months. The sample size was calculated assuming the effect size of nutrient and protein adequacy between ESRD-HD patients who eat and those who don't eat during dialysis sessions is 0.3 and using an alpha error of 0.05, the sample size was 150 patients. The achieved power was 95.4%. Sample size was calculated using G-power. A convenience sample of end stage renal disease patients on maintenance hemodialysis in the private and university hospitals who fulfilled the inclusion criteria and accepted to participate in the study were included consecutively until the required sample size was fulfilled.

Data collection tools and methods

The study was conducted over 8 months from August 2021- March 2022.

A. A pre-designed structured interview questionnaire was used to collect the following data:

1. **Personal data** including age and sex
2. **Medical and hemodialysis history**
3. **Dietary pattern during the dialysis session:** whether they eat or not and their reasons.
4. **Dietary intake which was obtained through:**

- **24-h dietary recall for three days,** one hemodialysis day (HDD) and two non-hemodialysis days (NHDD). The 24-h dietary recall is a structural interview intended to capture all food and beverage intake in detail during the past 24 hours, including the type and quantity of food. [8] Dietary intake during the hemodialysis session was also recorded.
- The nutritional content of the daily diet was obtained using Egyptian Food Composition Tables for both energy and protein. [9] Total energy and protein in the two non-HD days were averaged for easier comparison with the HD days.
- Percent adequacy was calculated relative to the required daily intake.
  - **Energy adequacy:** adequacy was calculated by comparing actual energy intake relative to the estimated energy requirements.[10]
  - **Estimation of energy requirements:** Based on calculations that account for an individual's age, sex, weight, height, physical activity level, energy intake, and energy expenditure.[11] Resting energy expenditure was calculated using **MHDE-SCr (2016):** [12]
    - Male REE = 1024.41 − (4.90*Age) + (10.21*Weight) − (3.25*SCr)
    - Female REE = 802.00 − (4.90*Age) + (10.21*Weight) − (3.25*SCr)

Where age (years), post-dialysis weight (kg), and SCr: serum creatinine (mg/dl).

  - **Protein adequacy:** adequacy was calculated by comparing actual protein intake to protein requirements of hemodialysis patients, which is dry weight multiplied by 1.2 g according to the latest National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) clinical practice guidelines for renal nutrition 2020. [11]

B. **Malnutrition Inflammation Score (MIS):** It is a quantitative tool to assess malnutrition in patients with ESRD. It is validated by the KDOQI. The MIS includes the seven components of the Subjective Global Assessment (SGA) (weight change, gastrointestinal symptoms, dietary intake, functional capacity, comorbid conditions, fat stores and muscle wasting), in addition to three non-SGA components which are the serum albumin, body mass index, and total iron binding capacity. All components are summed up together to yield a final MIS score which ranges between zero (normal) to thirty (severely malnourished). A higher score indicates a higher degree of inflammation and malnourishment. [13]

C. Anthropometric measurements were assessed: [14]

- **Dry body weight after session:** The dry weight is defined as the amount of body mass (weight) without extra fluid (water). It was measured and recorded for every patient after the dialysis session wearing minimum clothes using a balance and was rounded to the nearest 0.5 kg.
- **Height:** was measured while the patient was standing using non-stretch tape after removing shoes and was recorded to the nearest 0.5 cm.

D. Body Mass Index (BMI): was calculated using the equation = weight in kg/ height in m^2.[15]

E. Laboratory investigations:

A blood sample was withdrawn by the dialysis unit nurse from each participant before, during and after the dialysis session. The samples were transferred to the clinical pathology and hematology laboratory within 30 minutes and tested for serum albumin and total iron binding capacity which was measured to calculate the MIS.

Statistical analysis

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0 (Armonk, NY: IBM Corp).[16] Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean and standard deviation. The significance of the obtained results was judged at the 5% level; P value <0.05 was considered statistically significant. The used tests were; **Kolmogorov-Smirnov and Shapiro-Wilk** test to verify the normality of distribution, **Chi-square test** for categorical variables, and to compare between different groups, **Monte Carlo correction** for chi-square when more than 20% of the cells have expected count less than 5, **Student t-test** for normally distributed quantitative variables, to compare between two studied groups, **Paired t-test** for normally distributed quantitative variables, to compare between two periods, and **Pearson coefficient** to correlate between two normally distributed quantitative variables.

Ethical considerations

This study was approved by the ethics committee at the High Institute of Public Health (HIPH), Alexandria University, Egypt (IRB number: 00013692). The researcher complied with the International Guidelines for Research Ethics and the Helsinki declaration. An informed written consent was taken from all study participants after explanation of the purpose and benefits of the research. Anonymity and confidentiality were assured and maintained. There was no conflict of interest.

RESULTS

The present study was conducted on 150 HD patients (59.3% were males and 40.7% were females) with a mean age of 54.25 ± 14.20 years. The main cause of renal failure was hypertension in 30.0% of the patients with a mean duration of hemodialysis of 6.34 ±6.30 years.

More than three quarters (81.3%) of the patients reported eating during the hemodialysis session. 71.3% of those who reported eating during dialysis session were eating due to the length of session, 24.6% because the hospital provides food, 5.7% due to the doctor's advice, and only 4.1% due to feeling dizzy during session. On the other hand, reasons for not eating were difficulty in eating during session (39.3%), hypotension while eating 28.6%, doctor's advice not to eat (14.3%), nausea and vomiting (14.3%), and dizziness while eating during session (7.1%) **(Table 1)**.

Table 1: Distribution of hemodialysis patients according to dietary pattern during the dialysis session

Dietary pattern	Haemodialysis patients (n=150)	
	No.	%
Eating during the dialysis session		
Yes	**122**	**81.3**
No	28	18.7
If yes, reasons for eating #	**(n = 122)**	
Due to length of session	87	71.3
Hospital provides food	30	24.6
Doctor's advice	7	5.7
Feeling dizzy during treatment	5	4.1
If no, reasons for not eating #	**(n = 28)**	
Difficulty eating during treatment	11	39.3
Doctor's advice	4	14.3
Nausea/Vomiting	4	14.3
Other (Hypotension while eating)	8	28.6
Other (Dizziness while eating)	2	7.1

#: More than one answer

Regarding dietary intake, patients who were eating during the dialysis session had significantly higher total energy and protein intakes and energy as well as protein adequacy on HD days (p-value <0.001) **(Tables 2 and 3)**.

Table 2: Distribution of hemodialysis patients according to total energy intake and energy adequacy on hemodialysis and non-hemodialysis days by eating pattern

		Eating (n = 122)	Not eating (n = 28)	Total (n = 150)	t	p
Total energy intake/ Kcal/ day	**HD day**					
	Min. – Max.	117.7 – 4954.0	538.5 – 2073.7	117.7 – 4954.0	6.418^*	$<0.001^*$
	Mean ± SD.	1863.8 ± 720.6	1216.6 ± 406.8	1743.0 ± 718.1		
	Non-HD days					
	Min. – Max.	743.0 – 3450.8	829.4 – 1994.8	743.0 – 3450.8	1.567	0.122
	Mean ± SD.	1516.8 ± 548.9	1389.8 ± 338.6	1493.1 ± 517.6		
	t_0 (p_0)	**7.096^* ($<0.001^*$)**	**2.865^* (0.008^*)**	**5.617^* ($<0.001^*$)**		
Energy adequacy (%)	**HD day**					
	Min. – Max.	40.0 – 196.5	37.20 – 110.0	37.20 – 196.5	6.371^*	$<0.001^*$
	Mean ± SD.	101.98 ± 34.72	70.04 ± 20.67	96.02 ± 34.82		
	Non-HD days					
	Min. – Max.	39.15 – 141.6	55.10 – 112.10	39.15 – 141.6	0.449	0.655
	Mean ± SD.	82.03 ± 23.65	80.33 ± 16.39	81.71 ± 22.44		
	t_0 (p_0)	**7.528^* ($<0.001^*$)**	**3.058^* (0.005^*)**	**5.863^* ($<0.001^*$)**		

SD: Standard deviation t: Student t-test t_0: Paired t-test p: p value for comparing between patients who eat and patients who don't during dialysis session p_0: p value for comparing between HD day and non-HD days *: Statistically significant at p <0.05

Table 3: Distribution of hemodialysis patients according to protein intake and protein adequacy on hemodialysis and non-hemodialysis days by eating status during dialysis

		Eating (n = 122)	Not eating (n = 28)	Total (n = 150)	t	p
Total Protein (g/ day)	**HD day**					
	Min. – Max.	14.55 – 312.80	20.10 – 88.05	14.55 – 312.80	5.728^*	$<0.001^*$
	Mean ± SD.	78.85 ± 38.69	51.69 ± 16.91	73.78 ± 37.15		
	Non-HD days					
	Min. – Max.	24.05 – 482.48	34.30 – 98.70	24.05 – 482.48	0.867	0.387
	Mean ± SD.	73.60 ± 51.30	65.04 ± 19.61	72.01 ± 47.10		
	t_0 (p_0)	**1.277 (0.204)**	**3.463^* (0.002^*)**	**0.511 (0.610)**		
Protein adequacy (%)	**HD day**					
	Min. – Max.	18.60 – 281.0	31.20 – 104.8	18.60 – 281.0	4.704^*	$<0.001^*$
	Mean ± SD.	87.28 ± 45.47	61.46 ± 19.20	82.46 ± 42.99		
	Non-HD days					
	Min. – Max.	23.05 – 191.50	41.40 – 123.85	23.05 – 191.50	0.089	0.929
	Mean ± SD.	76.91 ± 33.05	77.34 ± 20.20	76.99 ± 31.0		
	t_0 (p_0)	**3.191^* (0.002^*)**	**3.456^* (0.002^*)**	**1.889 (0.061)**		

SD: Standard deviation t: Student t-test t_0: Paired t-test p: p value for comparing between patients who eat and patients who don't eat during dialysis session p_0: p value for comparing between HD day and non-HD days *: Statistically significant at p <0.05

Serum albumin level was higher in patients who were eating during the dialysis session (mean was 3.74 ± 0.56 g/dl) with a normal albumin level in 62.3%. Meanwhile, in patients who were not eating during the dialysis session the mean albumin level was 3.55 ± 0.55 g/dl with normal albumin level in only 39.3% with a statistically significant difference (p=0.026). The mean MIS was 9.24 ± 4.38 and higher among those who reported not eating during the dialysis session (10.29 ± 4.10 vs. 9.0 ± 4.42, respectively) with no statistically significant difference between both groups (p=0.162) **(Table 4)**.

Table 4: Distribution of hemodialysis patients according to albumin level (pre-dialysis sample) and malnutrition inflammation score by eating status during dialysis

Laboratory parameters	Eating (n = 122)		Not eating (n = 28)		Total (n = 150)		Test of Sig.	p
	No.	%	No.	%	No.	%		
Albumin (g/dL)								
Low (<3.7)	46	37.7	17	60.7	63	42.0	χ^2= 4.949*	0.026*
Normal (3.7-5.6)	76	62.3	11	39.3	87	58.0		
Min. – Max.	2.26 – 4.90		2.30 – 4.55		2.26 – 4.90		t= 1.661	0.099
Mean ± SD.	3.74 ± 0.56		3.55 ± 0.55		3.71 ± 0.56			
MIS								
Min. – Max.	2.0 – 21.0		2.0 – 17.0		2.0 – 21.0		t= 1.406	0.162
Mean ± SD.	9.0 ± 4.42		10.29 ± 4.10		9.24 ± 4.38			

SD: Standard deviation t: Student t-test χ^2: Chi square test MC: Monte Carlo p: p value for comparing between patients who eating and patients who are not eating during dialysis session *: Statistically significant at p <0.05

In addition, there was a statistically significant positive correlation between serum albumin and all investigated parameters except age (r=-0.051). A moderate positive correlation was found between albumin and total energy intake (r=0.460). There was a weak positive correlation between albumin and energy adequacy (r=0.308), total protein intake (r=0.351), protein adequacy (r=0.335), TIBC (r=0.270), dry body weight (r=0.226) and BMI (r=0.188) (Table 5).

Table 5: Correlation between albumin with some dietary intake and anthropometric parameters (n =150)

Parameter	Albumin (g/dL)	
	r	p
Age	-0.051	0.536
Total energy intake/ Kcal/ day	0.460	<0.001*
Energy adequacy (%)	0.308	<0.001*
Total Protein (g/ day)	0.351*	<0.001*
Protein adequacy (%)	0.335*	<0.001*
TIBC	0.270*	0.001*
Dry body weight (kg)	0.226*	0.005*
BMI	0.188*	0.021*

r: Pearson coefficient *: Statistically significant at p <0.05

The results show that there is a statistically significant negative correlation between MIS and all investigated parameters except age (r=0.221). There was a moderate negative correlation with total energy intake (r=-0.468), a weak negative correlation with energy adequacy (r=-0.216), total protein intake (r=-0.368), protein adequacy (r=-0.267), dry body weight (r=-0.341) and BMI (r=-0.282) **(Table 6)**.

Table 6: Correlation between malnutrition inflammation score and some dietary intake and anthropometric parameters (n =150)

Parameter	Malnutrition Inflammation Score	
	r	p
Age	0.221*	0.007*
Total energy intake/ Kcal/ day	-0.468*	<0.001*
Energy adequacy (%)	-0.216*	0.008*
Total Protein (g/day)	-0.368*	<0.001*
Protein adequacy (%)	-0.267*	0.001*
Dry body weight (kg)	-0.341*	<0.001*
BMI	-0.282*	<0.001*

r: Pearson coefficient *: Statistically significant at p <0.05

DISCUSSION

Malnutrition in hemodialysis patients is a highly prevalent global burden with a negative impact on the quality of life. [17] Intradialytic feeding is one approach to increase energy intake to combat the increasing morbidity and mortality resulting from malnutrition. [18] In this study, 81.3% of patients reported that they eat during the dialysis session, while 18.7% reported that they don't. In a follow-up survey study investigating the feeding practice within several large dialysis organizations in the United States, the number of organizations not allowing patients to eat during the dialysis session decreased between 2011 and 2014 from 28.6% to 22.6% with an overall shift in clinical practice (p<0.001). [19] These findings shows that there is an increasing trend in allowance of intradialytic feeding in medical practices.

It is well appreciated that energy intake varies in hemodialysis patients according to level of illness, presence of depression, uremia, chronic inflammation, anorexia, and aging. [20] Energy intake also varies on HD and NHD days, and according to eating or not during the HD session. In the present study, mean total energy intake was significantly higher on HDD than on NHDD. The literature provides conflicting reports when it comes to dietary intake, most recently in 2022 a multi-center study reported that mean energy intake on HDD was 1345.5 ± 539.4 kcal/day lower than on NHDD as 1523.5 ± 537.8 kcal/day. [21] Similarly, Burrowes et al. (2003), reported that the mean energy intake was significantly lower in HDD 1488 ± 620 kcal/ day than on NHDD 1566 ± 636 kcal/ day ($p<0.0001$).[22] Also, the non-eating group during the hemodialysis sessions had significantly lower mean energy intake of on HDD than the group who were eating during the HD session, which proves how significant the impact of eating during the HD session is on improving the dietary intake and adequacy.

A similar result was found in a study comparing dietary intake between Chinese and UK patients on HDD and NHDD. The Chinese hemodialysis population also had higher intake on HDD than NHDD because they provided a meal during their dialysis session. [23] A justifiable reason for the higher results is that when patients tend to eat during HD their energy intake is significantly increased leading to a higher total energy intake on HDD. This could offer a potential space for improvement in the energy intake of HD patients when they are given intradialytic feeding.

In addition to energy intake, protein intake is highly variable and often inadequate leaving hemodialysis patients with worse PEW. In the current study, the mean total protein intake on HDD was slightly, but insignificantly higher than on NHDD. These results were slightly higher than the ones observed in the first 1000 patients enrolled into the HEMO study (2002), at baseline where their mean protein intake was 63.5 ± 24.6 g/day. [24] On the other hand Saglimbene et al. (2021), reported higher protein intake levels where the mean protein intake of 6827 hemodialysis patients in 10 European countries was 96 g/day. [25] One possible explanation for the higher protein intake in the former study is that they included patients that were just recently initiated on dialysis within only 90 days, while in the present study the inclusion criteria included a minimum of 6 months since initiation of dialysis. This difference could have led to underestimation of dialysis-anorexia in the study conducted by Saglimbene et al. [25] Burrowes et al. (2003), reported that the mean protein intake on HDD was 58 ± 23.3 g/day, while it was 68 ± 26.2 g/day on NHDD.[22] As seen by the previous results, variability in the protein intake is very common in HD patients. The present study also found a significant statistical difference in protein intake on HDD, which was higher in the group of patients who were eating during the dialysis session (than the group who did not eat during the dialysis session. The difference in the mean protein intake in HDD in relation to intradialytic feeding has not been previously reported in the literature.

In the current study, the mean albumin level was just above the lower normal range 3.71 ± 0.56 g/dl with no statistically significant difference between those who reported eating during dialysis sessions and those who didn't. Previous studies yielded variable results with some coinciding with the present results including; Uludag et al (2021) who reported that the mean serum albumin level was 3.5 ± 0.5 g/dL, [26] and the study by Jones et al (2002) where the predialysis mean serum albumin level was 3.69 g/dL.[27] On the contrary, other studies reported higher mean levels e.g, Santos et al. (2003) reported mean serum albumin level of 4.2 ± 0.4 g/dL. In their study, they only included only clinically stable HD patients with normal inflammatory markers and who only have started dialysis recently, which explains the higher level of mean albumin.[28] Serum albumin levels are affected by various factors other than the nutritional status, however, a correlation between albumin level and nutritional intake levels provides a good insight. The present study found a statistically significant negative correlation between albumin levels and energy intake, energy adequacy, protein intake, protein adequacy, dry body weight, and BMI. Although the mean albumin level in the research done by Santos et al was higher than in the current study, both studies found a statistically significant correlation between serum albumin level and energy intake ($r=0.43$; $p=0.04$) and ($r=0.460$; $p<0.001$) respectively. Despite that, the present study did not find a significant correlation between age and albumin levels, while Santos et al found that serum albumin correlated inversely with age ($r=-0.32$; $p=0.02$). The higher mean albumin level and the inverse correlation with age in their study could be justified by their lower mean age (37.6 ± 12.2 years) versus the present study patients' higher mean age (54.25 ± 14.20 years).

Th present study found that the mean MIS was 9.24 ± 4.38 with a minimum of 2 and maximum of 21. Lower results have been reported by Borges et al who studied 215 hemodialysis patients using MIS, where the mean MIS was 5, with a minimum of 0 and maximum of 26.[29] In a four-year follow-up study of survival rates in hemodialysis patients, 100 patients were enrolled, initially 16 patients had MIS score <11, 55 patients had scores 12 or 13, and 29 patients had scores >14.[30] Although the present study did not investigate any correlation with mortality as it is a cross-sectional study, it was found that there was significant correlation between MIS and age ($r = 0.221$), total energy intake ($r = -0.468$), total protein intake (r = - 0.368), dry body weight (r = -0.341) and BMI (r = -0.282). Gencer et al (2019) did not find any significant correlation between age and MIS (r = 0.097), they also found a significant negative correlation between MIS and body weight (r = -0.312).[31] In regards to the relation of MIS to intradialytic feeding, slightly higher score was found in patients who don't eat during the dialysis session than those who do but with no statistically significant difference (p=0.162).

CONCLUSION AND RECOMMENDATIONS

Although intradialytic feeding is a controversial practice and is not applied in all hemodialysis centers, it has some prominent positive effects like enhancement of energy and protein intake, and elevation of blood albumin levels which help in proper management of malnutrition. However, intradialytic feeding should be an individualized approach weighing on risks and benefits while integrating nephrologists and nutritionists in the decision-making. Based on the study findings it is recommended to properly educate patients on the target energy and protein intake in HD, continuously survey, monitor, and modify their dietary intake. It is also recommended to individualize the advice of intradialytic feeding according to the patient's needs. Larger studies should be conducted to identify proper intradialytic feeding practices for producing a more favorable outcome without compromising the patient's health.

CONFLICT OF INTEREST
The authors have no conflict of interest to declare.

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