The impact of educational interventions on hemodialysis patients' adherence to fluid and sodium restrictions.

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Abstract: *Education enables hemodialysis patients overcome interdialytic weight gain, correct their behaviors, enhance their capabilities, knowledge, and awareness.*

Objective: *The purpose of this study was to investigate the effect of educational interventions on hemodialysis patients' adherence to fluid and sodium restrictions.*

Setting: *The study was conducted at the Hemodialysis unit- Institute of Medical Researches- Alexandria University, Egypt.*

Patients and Methods: *This is a quasi-experimental study. Data were collected from 45 patients, on maintenance hemodialysis for at least 6 months. Socio-demographic and clinically documented data sheet, pre/post knowledge and adherence assessment data sheets were utilized for data collection. Initial assessment of patient's knowledge and adherence to fluid and sodium restrictions was done to obtain base line data. Interdialytic weight gain, serum Na values, and blood pressure were recorded. Educational interventions were carried out in 3 consecutive sessions. One month after the education, the mentioned parameters were re-estimated. Descriptive statistics were calculated for demographic variables.*

Results: *High statistical significant improvements were noted in the mean and standard deviation of percent knowledge score and in all adherence dimensions percent score one month post interventions as compared to baseline (pre interventions assessment). Patients' knowledge percent score increased from 24.39±8.86 to 96.36±6.04 (p<0.001) one month after interventions and the adherence percent score increased from 15.56± 8.06 to 86.67±9.63 after interventions. The mean, and standard deviation of interdialytic weight gain of participants were 4.39± 0.63 kg, before the education, and significantly decreased to 3.71 ± 0.78 kg, one month post education (P <0.001). Mean and standard deviation of participants' systolic blood pressure were 135.56 ± 13.41 mmHg before the education, and significantly decreased to 121.56 ± 12.05 mmHg one month after the education, (P < 0.001). No statistically significant difference was observed in serum Na values post education.*

Conclusions: *Educational interventions in patients undergoing hemodialysis leads to increased adherence with fluid and sodium restrictions as evidenced by decrease in the interdialytic weight gain, and blood pressure values.*

Keywords: *End stage renal disease, Hemodialysis, knowledge, adherence, fluid, Na, restrictions*

I. Introduction

End-stage renal disease (ESRD) has become a public health concern worldwide as the total number of ESRD patients receiving hemodialysis has been grown globally and the cost is increasing substantially[1]. Haemodialysis (HD) is one of the most important and effective treatment modalities that can help to sustain the life of such patients [1,2].

Many of the most common problems experienced by patients having HD are related to their non adherence with the treatment regimens. Fluid overload is the normal condition in most HD patients while excessive fluid overload on the other hand is linked to an increased morbidity [3, 4]. In this context, it has been reported that fluid retention is a major clinical problem in individuals with ESRD since urine production usually falls and the patients experience weight gain between two consecutive dialysis sessions. Also, food intake during the interdialytic period will increase extracellular water volume because of the impaired renal functions [3,4,5].

Sinclair and Parker (2009) mentioned that drinking considerably more fluid than recommended is a familiar experience for many dialysis patients. Patients are aware of the need to be adherent to fluid allotment despite the desire to drink normally. This creates an uncomfortable state, and tension regarding drinking [6]. Also, the ingestion of fluids, and foods with high water content as gelatin or soup, increases weight between treatments. Hence, fluid management is a distinct challenge for most HD patients [7].

Research findings indicated that a majority of the HD patients are drinking in response to the osmometric thirst sensation which is caused typically by sodium intake. Patient will consume one liter of water for every 8 gm salt consumed to regain homeostasis [5]. Moreover, Sarkar et al (2006) stated that higher sodium consumption induces higher water consumption, resulting in excessive interdialytic weight gain (IDWG). Excessive sodium intake may also cause hypertension, peripheral edema especially around the ankles,

pulmonary oedema, and breathlessness. Also, intradialytic cramping, hypotensive episodes, treatments related fatigue, and cardiovascular diseases are the leading cause of mortality with over hydration as a major contributing factor [8].

Therefore, sodium intake is an important part of an HD patient's fluid intake behavior and HD patients must manage themselves to maintain a healthy lifestyle[8,9] . In this regard, Hoffart (2009) stated that promotion of sodium and fluid restrictions are essential even though the importance of sodium restriction might be forgotten or neglected. Moreover, the lack of attention to sodium could also reflect ignorance of current trends in the industrialized food processing, and thus changed dietary habits, as it has become more and more difficult to buy low-salt food [9]

According to the World Health Organization (WHO), adherence is defined as "the extent to which a person's behavior as taking medication, following a diet, and/or executing lifestyle change, corresponds with agreed recommendations from a health care provider [10].

In this regard, Oshvandi (2013) mentioned that many of the most common problems experienced by patients having HD are related to their non- adherence with the treatment regimens, since between 10 to 95% of the haemodialysed patients are non-adherent to their fluid therapy [11]. Holmberg and Stegmayr (2009), and Smith et al (2010) illustrated that the most frequent measure of HD patient's adherence to fluid is (IDWG) which is used as an outcome measure. In order to lower the risk of volume overload between thrice-weekly dialysis, IDWG should be less than 2.5 kg or 5% of dry body weight between sessions [12, 13]. In this regard, Ash et al (2006) indicated that based on evidence and best practice, the HD patient is advised a daily fluid allowance of 500 ml plus the volume equal to daily urine output [14].

Smith et al (2010) mentioned that HD patients have some difficulties in accepting their condition and usually don't adhere to their therapeutic fluid restrictions. This situation will remain until the adverse effects of non-adherence appear and become unbearable [13].

Charra (2007) and Twardowski (2009) mentioned that fluid balance is an integral component of HD treatments to prevent under- or overhydration, which have significant effects on intradialytic morbidity and long-term cardiovascular complications. This implies that the nurse has to ensure that the patient comes off dialysis normovolemic, which is at the dry weight. The term dry weight (also known as ideal weight or target weight) refers to the body weight at which there is no clinical evidence of fluid overload [15, 16]. According to Jaeger , and Mehta (1999) dry weight is defined as the lowest weight a patient can tolerate without the development of hypotension[17].

Charra (2007) illustrated that initial determination of the dry weight is mostly performed by the nephrologists whereas regular assessment of its accuracy is assessed by the nurse and the patient [15]. Welch et al (2006) emphasized that dry weight is essential to enable the nurse to determine the amount of fluid removal required during dialysis. One kilogram is equal to one liter of body fluid, meaning that patient weight is a simple and accurate measure of fluid gain between dialysis treatments. The formula is used to calculate the required fluid removal.

Actual weight – dry weight = weight gain + fluid intake during treatment = total fluid to remove during dialysis

Thus, the amount of fluid that is ultra-filtrated during the subsequent HD session is equivalent to the magnitude of weight gain between treatments with supplying fluids during the treatment session added [18].

Palmer (2009) mentioned that safe and evidence-based HD treatment implies that the nurse should instruct the patient to avoid excessive interdialytic weight gain to prevent intradialytic hypotension. In addition, the rate of fluid removal at dialysis should be less than 10 ml/h/kg dry body weight. A higher rate is associated with an increased risk of intradialytic hypotension [19]. Davenport (2009) claimed that intradialytic hypotension leads to inadequate dialysis as the ultrafiltration needs to be stopped routinely. Consequently, patients are often unable to achieve the desired ultrafiltration goal and are regularly sent home above their current dry weight, i.e. fluid overloaded. In addition, repeated episodes of intradialytic hypotension may cause cardiac fibrosis and cerebral ischemia developing lacunar infarcts [20].

Denhaerynck et al (2007) and Rahimi et al (2014) illustrated that the cut-off defining fluid adherence varies throughout the literature. In order to lower the risk of volume overload between thrice-weekly dialysis, IDWG should be less than 2.5 kg [21,22].

Teaching and learning generally fall within the scope of the independent realm of nursing interventions; the nurse can use them to assist patients to adhere to their therapeutic regimens. If patients receive education regarding their therapeutic regimen in relation to fluid and Na allowance, they will be able to make informed decisions about whether or not to adhere to recommendations and they will consume fluids within the agreed allowance [22,23]. Inherent in the previous statements is the belief that lack of information is the most important factor contributing to non-adherence with therapeutic regimens, especially Na and fluid restrictions, which in turn may lead to an increased morbidity. Conclusively, promotion of patients' education about adherence to fluid and Na restrictions is important, and nurses' role is extremely significant.

Significance of the study:

The burden of chronic disease on health care services worldwide and especially in developing countries like Egypt is growing, and the increased development of educational interventions which help patients to better manage their conditions is evident internationally[24,25,26]

About 400,000 people worldwide are suffering from chronic renal failure, of these; more than 300,000 are under HD treatment [22]. According to the United States Renal Data System annual report 2011 (USRDS), the prevalence of ESRD in the United States is 1811 per million populations. In developing countries like Egypt, there is an increase in prevalence and incidence of ESRD exerting a great burden on health system. In the whole of Egypt, there is no recent exact registered number about the prevalence; however, the last statistics were from 2004 indicated a prevalence of 483 per million populations [22,24, 25, 26]. In addition, Montazeri and Sharifi (2014) reported that, few studies (to date) have examined HD patients' adherence to fluid and sodium restrictions which justifies the significance of the present study [1].

Aim of the study:

This study aimed to investigate the impact of an educational interventions on HD patients' adherence to fluid and sodium restrictions.

Hypothesis:

There would be significant increase of patient's adherence scores after implementation of the educational interventions than before.

II.   Material and Methods

Research Design

Pre / post test quasi-experimental research design (single group) was used to examine the effectiveness of patient education on adherence to fluid and sodium restrictions.

Setting:

The study was conducted at the HD unit- Institute of Medical Researches- Alexandria University, Egypt.

Sample:

A purposive sample of 50 adult male and female patients on maintenance hemodialysis. Only 45 patients completed the study. Of the five dropped cases, 2 patients died, and 3 withdrew. Patients were selected according to the following criteria:

1. Alert patient

2. Aged 20- 60 years old

3. Receiving HD routinely three times a week

4. Having HD for at least 6 month.

5. Having interdialytic weight gain of greater than 2.5 KG.

6. Didn't receive any educational interventions regarding fluid/sodium restrictions.

Tools:

The following tools were used for the purpose of study.

TOOL I: **Patient assessment sheet:**

This sheet was designed by the researcher and consisted of two parts as following:

1. **Sociodemographic data:** It included patients' socio-demographic variables such as age, gender, level of education, marital status, employment status, duration of HD treatment, and associated disease with ESRD.

2. **Clinically documented data:**

These data aimed to assess patients' pre-dialysis serum Na, IDWG, and pre-dialysis blood pressure values. Na values were retrieved from patient's medical records. The interdialytic weight gain (IDWG), defined as the amount of weight gained between two consecutive HD sessions, was calculated. The cut-off point used in this study is IDWG 2.5 KG for thrice-weekly dialysis, which corresponds to a mean daily IDWG 1.25 KG [12,12].

TOOL II: Pre/post knowledge assessment data sheet

This sheet was developed by the researcher based on a review of the related literature, to assess patient's knowledge [1, 2, 11,13,22]. It incorporated three parts dealing with the following items:

1. **General knowledge** related to renal failure and HD as normal functions of the kidney, definition of kidney failure, manifestations of uremia, and definition of HD.

2. knowledge about fluids as definition of fluids, examples of fluids, definition of dry/ideal weight for HD patients, the accepted amount/ kg of Fluid gains between dialysis sessions, the medical complications of fluid non adherence, and the exact amount of fluid needed/day.

3. knowledge about sodium as definition of sodium, the normal value of sodium, sources of sodium in diet, the amount of sodium needed/day, examples of salt substitute, the consequences of too much sodium in diet, and ways to decrease sodium in diet.
- This sheet consisted of 22 questions utilize a true/ partly true/ wrong answer format using the following scoring system:
0= Wrong answer
1= partly true answer (equal to at least half of the true answer).
2= True answer

- Scores less than (< 50%) were considered unsatisfactory level of knowledge.
- Scores from (50 ≥75%) were considered satisfactory level of knowledge.
- Scores from (>75%) were considered good level of knowledge.

TOOL III: Adherence assessment data sheet
It was adapted from Kim et al (2010) to assess HD patient's adherence to fluid and sodium restrictions [27]. It consisted of 12 questions/items related to fluid restrictions (7 items), and Na recommendations (5 items) for the past 14 days. It utilizes a "yes/no" answer format.
- Scores less than (< 50%) were considered unsatisfactory level of adherence.
- Scores from (50 ≥75%) were considered satisfactory level of adherence.
- Scores from (> 75 %) were considered good level of adherence.

Adherence indicators
The cutoff point of adherence indicators used in the present study was (IDWG) >2.5 kg between 2 consecutive sessions.

The educational interventions :
These educational interventions were designed in the form of three teaching sessions. It was structured by the researcher after reviewing related literature [28,29,30,31,32]. It aimed at helping HD patient gain knowledge about their fluid allotment which should be reflected on their adherence to treatment, and IDWG results. The instructional booklet covered the issues related to kidney function, manifestation of renal failure, treatment regimens including Na and fluid restrictions, importance of adhering to fluid therapy, and how to comply with the restricted amount of fluid and sodium. This instructional booklet was presented to the study sample in Arabic version.

III. Methods
1. Permission to carry out the study was obtained from the directors and the responsible specialists of the chosen setting after explaining the aim of the study.
2. Tool (I), Tool (II), and Tool (III) were developed and or/ adapted based on the review of relevant literature.
3. The study tools and the educational interventions were revised by 3 experts in the fields of nephrology and medical surgical nursing for their content validity.
4. The educational interventions were translated into Arabic and revised by 3 experts in the fields of nephrology and adult nursing and the necessary modifications were introduced.
5. A pilot study conducted on 10% of the total sample who were diagnosed with chronic renal failure and fulfilled the inclusion criteria to evaluate the content and test the feasibility, objectivity, clarity, relevancy and applicability of the study tools. Also reliability was calculated using Cronbach's Alpha test (=0.70) which indicated that the tools were reliable.

6. Ethical considerations:
The current study was approved by the research institutional review board. Aim of the study was explained to all the participants, and all of them signed the informed consent before participation, and were assured about the confidentiality and freedom to participate in the study. Data collection was approved from the hospital and unit authorities.
7. Techniques for data collections
Structured interviews were utilized to fill in the study tools.
7. Procedure: The study was conducted through the following phases:-
7. 1. Assessment phase
Subjects were approached during their dialysis sessions, and purpose of the study was explained. Those who agreed to participate were given a consent form to sign. Patient assessment was carried out using tool 1, followed by knowledge assessment sheet tool II and adherence assessment sheet Tool III.

- Data were collected by reading the questions of the tools to the subjects. This method was chosen after consideration that some patients were old, unable to use their dominant hand for writing due to the presence of arteriovenous fistula and its immobilization during HD.
- The data were collected within the initial 2 hours after the initiation of HD in order to ensure that patients were not suffering from dialysis-related discomfort.
- After measuring interdialytic weight gain and collecting demographic data, patients were welcomed to participate in the educational sessions.

7. 2. The intervention phase

The designed educational sessions were delivered to the studied patients:
- The educational interventions consisted mainly of oral and video education. Duration of each session didn't exceed 30 minutes. Participants' clarification and dual discussions were also carried out. Patients were individually approached throughout the three consecutive dialysis sessions / week.
- A supplementary educational film on a video disc system was demonstrated individually throughout dialysis sessions and the associated educational booklet was provided thereafter.

7.3. Evaluation phase:

Evaluating the effectiveness of the educational interventions was carried out one month post interventions based on finding differences or no differences before and after educational interventions using tool II, and tool III as well as checking changes in IDWG.

8. Statistical analysis:

Data were coded and analyzed using IBMSPSS software package version 20.0. Descriptive statistics were generated for all variables. A p- value of less than 0.05 was considered as significant. Paired t-test was used for normally quantitative variables to compare between two periods, and F-test (ANOVA) was used for normally quantitative variables to compare between more than two studied groups

IV. Results

Table (1) revealed that the majority of the participants (53.3%) were male, while (40%) of them were in the middle age 30>40 years old. Third of the participants had diploma degree, while (26.7%) had bachelor degree. Nearly half of the studied patients were on maintenance HD for 1>5 years. Moreover, the majority of patients were married, live in urban area, and hadn't enough income as mentioned by the studied patients. Also, the majority of the studied patients (53.3%) had hypertension, and (60%) of them had ≥100 ml urine output/day.

Table (1):Distribution of the studied patients according to socio-demographic Characteristics.

Socio-demographic characteristics of the studied patients	No (n=45)	percent
Sex		
Male	24	53.3
Female	21	46.7
Age (year)		
20>30	6	13.3
30>40	18	40.0
40>50	9	20.0
50≥60	12	26.7
Marital status		
Single	6	13.3
Married	36	80.0
Widow	3	6.7
Education		
Illiterate	6	13.3
Read and write	12	26.7
Diploma	15	33.3
Bachelor	12	26.7
Occupation		
Clerical	18	40.0
House wife	21	46.7
Retried	6	13.3
Resident		
Urban	42	93.3
Rural	3	6.7
Monthly income		
Enough	3	6.6
Not enough	42	93.4
Duration of HD		

6 month- 1 year	6	21
1>5year	21	46.7
≤5year	18	40.0
Associated disease with ESRD		
None	18	40.0
Hypertension	24	53.3
Diabetes Mellitus	3	6.7
Urine output/day		
≥100 ml	27	60.0
100 – 500 ml	18	40.0

Table (2): Comparison between pre and post education according to clinically documented data of the studied patients (n= 45)

Clinically documented data	Pre – education		One month after- education		t	P value
	Min. – Max	Mean ± SD.	Min. – Max	Mean ± SD.		
IDWD	3.0 – 6.0	4.39 ± 0.63	1.80 – 5.50	3.71 ± 0.78	11.227*	<0.001*
Systolic B.P	110.0–170.0	135.56±13.41	100.0–140.0	121.56±12.05	11.608	<0.001*
Diastolic B.P	80.0 – 110.0	88.22 ± 7.47	80.0 – 90.0	80.67 ± 2.52	7.460*	<0.001*
Mean blood pressure	90.0 – 120.0	104.0 ± 8.40	86.67 – 106.67	94.30 ± 4.53	10.519*	<0.001*
Sodium levels	137.0 – 146.0	142.20±2.62	136.0 – 147.0	142.24±2.81	0.313	0.756

t: Paired t-test

*: Statistically significant at p ≤ 0.05

Table (2) revealed that the mean and standard deviation of IDWG of the participants were 4.39 ± 0.63kg, before the educational interventions, and significantly decreased to 3.71 ± 0.78 kg, one month after the interventions, where P < 0.001. Moreover, the means and standard deviations of participants' both systolic and diastolic blood pressure were significantly decreased one month after the education, (P < 0.001), meaning that there is total improvement in both systolic and diastolic blood pressure after applying the educational interventions. No significance differences in serum sodium values were elicited post interventions.

Table (3): Paired t- test Comparing patients' knowledge score pre and one month after the educational interventions (n= 45)

Knowledge level	Pre- education						One month after education						Test of sig.
	<50% unsatisfactory		50-<75 satisfactory		≥75% good		<50% unsatisfactory		50-<75 satisfactory		≥75% good		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
General knowledge	21	46.7	21	46.7	3	6.7	0	0.0	0	0.0	45	100.0	WSRTp <0.001*
Total score (mean± SD)	3.80 ± 1.29						7.80 ± 0.55						tp <0.001*
% score (mean± SD)	47.50 ± 16.12						97.50 ± 6.85						
Knowledge about fluid	42	93.3	3	6.7	0	0.0	3	6.7	42	93.3	0	0.0	WSRTp <0.001*
Total score (mean± SD)	4.93 ± 2.20						19.47 ± 1.56						tp <0.001*
% score (mean± SD)	24.67 ±11.0						97.33 ± 7.80						
Knowledge about Na	45	100.0	0	0.0	0	0.0	0	0.0	0	0.0	45	100.0	WSRTp <0.001*
Total score (mean± SD)	2.0 ± 2.61						15.13 ± 1.32						tp <0.001*
% score (mean± SD)	12.50 ± 16.32						94.58 ± 8.28						
Overall knowledge	45	100.0	0	00	0	0.0	0	0.0	0	0.0	45	100.0	WSRTp <0.001*
Total score (mean± SD)	10.73 ± 3.90						42.40 ± 2.66						tp <0.001*
% score (mean± SD)	24.39 ± 8.86						96.36 ± 6.04						

t: Paired t-test

WRST: Wilcoxon signed ranks test

*: Statistically significant at p ≤ 0.05

Table (3) it was observed that all patients had unsatisfactory level of knowledge before interventions which improved to satisfactory level one month after interventions. There is significant improvement in the mean total patients' knowledge one month after interventions where p<0.001

Table (4):HD patients' adherence to fluid and sodium pre and one month after applying the educational interventions (n= 45)

Adherence items	Pre education						One month after education						Test of sig.
	<50% unsatisfactory		50-<75 satisfactory		≥75% good		<50% unsatisfactory		50-<75 satisfactory		≥75% good		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Fluid Adherence	45	100.0	0	0.0	0	0.0	0	0.0	12	26.7	33	73.3	WSRTp <0.001*
Total score (mean± SD)	1.27 ± 0.69						5.73 ± 1.01						tp <0.001*
% score (mean± SD)	18.10 ± 9.82						81.90 ± 14.41						
Na Adherence	45	100.0	0	0.0	0	0.0	0	0.0	3	6.7	42	93.3	WSRTp <0.001*
Total score (mean± SD)	0.60 ± 0.72						4.67 ± 0.60						tp <0.001*
% score (mean± SD)	12.0 ± 14.40						93.33 ± 12.06						
Overall Adherence	45	100.0	0	0.0	0	0.0	0	0.0	0	0.0	45	100.0	WSRTp <0.001*
Total score (mean± SD)	1.87 ± 0.97						10.40 ± 1.16						tp <0.001*
% score (mean± SD)	15.56 ± 8.06						86.67 ± 9.63						

t: Paired t-test
WRST: Wilcoxon signed ranks test
*: Statistically significant at p ≤ 0.05

Table (4) showed that there was a high statistically significant improvement in all adherence dimensions one month post interventions as compared with baseline (pre interventions assessment)

Fig (1) Distribution of the studied patients according to percent reduction in IDWG one month after applying the educational interventions.
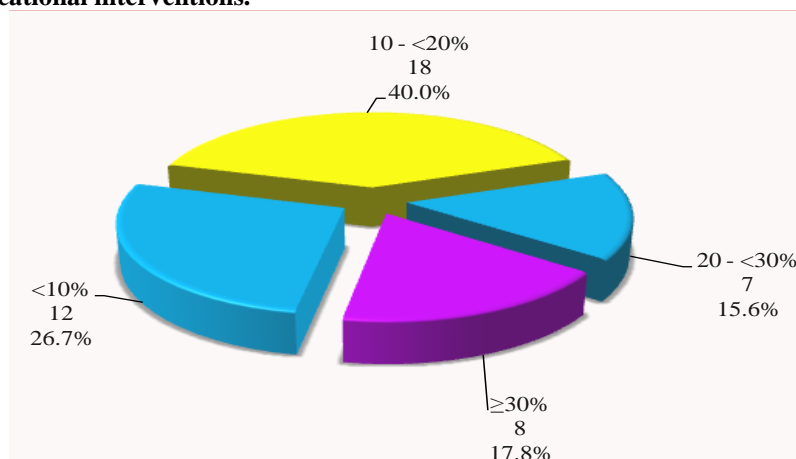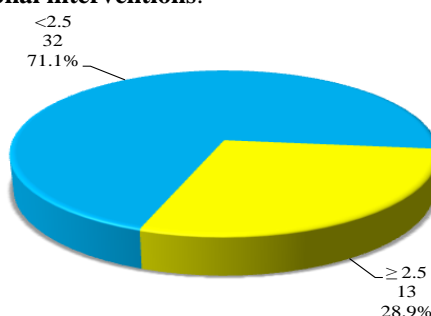

Fig. (1) It revealed that (40%) of the studied patients achieved (10 <20%) reduction in their IDWG, while (17.8%) of them achieved ≥30% reduction one month after education.

Fig (2) Distribution of the studied patients according to reaching the cutoff point (IDWG ☐2.5 kg) one month after applying the educational interventions.

It was noticed that only (28.9%) of the studied patients reached the cutoff point (IDWG ≥2.5 kg), one month after the educational interventions (Fig2).

Table (5): Correlations between socio- demographic characteristics of the studied patients and total knowledge scores pre & one month post educational interventions.

Socio -demographic characteristics of the studied patients		N= 45	Total knowledge scores			
			Pre education		One month post education	
			Mean ± SD	Test of sig.	Mean ± SD	Test of sig.
Sex	Male	24	12.13 ± 3.80	t = 2.743*	43.38 ± 1.13	t = 2.682*
	Female	21	9.14 ± 3.44	p = 0.009*	41.29 ± 3.41	p = 0.013*
Age	20 - <30	6	9.50 ± 1.64		43.0 ± 1.10	
	30 - <40	18	10.33 ± 4.01	F = 3.694	42.83 ± 1.72	F = 5.338*
	40 - <50	9	8.67 ± 2.78	p = 0.019*	39.67 ± 4.44	p = 0.003*
	50 - <60	12	13.50 ± 4.01		43.50 ± 0.90	
Marital status	Single	6	9.50 ± 1.64		43.0 ± 1.10	
	Married	36	11.0 ± 4.28	F = 0.426	42.42 ± 2.91	F = 0.558
	Widow	3	10.0 ± 0.0	p = 0.656	41.0 ± 0.0	p = 0.576
Residency	Rural	42	10.29 ± 3.64	t = 11.962*	42.50 ± 2.73	t = 0.943
	Urban	3	17.0 ± 0.0	p <0.001*	41.0 ± 0.0	p = 0.351
Levels of education	Illiterate	6	7.50 ± 2.74		37.50 ± 3.83	
	Read & write	12	11.0 ± 5.27	F = 1.698	42.50 ± 1.73	F = 18.88*
	Diploma	15	11.20 ± 3.23	p = 0.182	43.0 ± 1.31	p <0.001*
	Bachelor	12	11.50 ± 3.09		44.0 ± 0.0	
Occupation	Clerical	18	10.83 ± 3.49		43.17 ± 1.25	
	House wife	21	9.14 ± 3.44	F = 10.275*	41.29 ± 3.41	F = 4.221*
	Retired	6	16.0 ± 1.10	p <0.001*	44.0 ± 0.0	p = 0.021*
Monthly income	Enough	3	17.0 ± 0.0	t =11.962*	44.0 ± 0.0	t =1.081
	Not enough	42	10.29 ± 3.64	p <0.001*	42.29 ± 2.72	p =0.286
Duration	6 m- 1 year	6	10.50 ± 2.74		43.0 ± 1.10	
	1>5year	21	11.14 ± 2.82	F = 0.213	43.29 ± 1.19	F = 3.649*
	≤5year	18	10.33 ± 5.24	p =0.809	41.17 ± 3.68	p =0.035*

F: F test (ANOVA)
t: Student t-test
*: Statistically significant at p ≤ 0.05

Table(5) revealed that there were statistically significant correlations between patient's socio-demographic characteristics and their total knowledge scores one month after applying the education since male patients, aged 50-60 years, with bachelor degree, retired, and on HD for 1>5 years achieved more significant improvements in their knowledge.

Table (6):Correlations between socio-demographic characteristics of the studied patients and total adherence scores pre and one month post the educational interventions.

Socio demographic characteristics of the studied patients		N	Total Adherence scores			
			Pre education		One month post education	
			Mean ± SD	Test of sig.	Mean ± SD	Test of sig.
Sex	Male	24	2.0 ± 1.25	t = 1.040	11.25 ± 0.68	t = 8.592*
	Female	21	1.71 ± 0.46	p = 0.307	9.43 ± 0.75	p <0.001*
Age	20 - <30	6	2.50 ± 0.55		10.0 ± 1.10	
	30 - <40	18	1.83 ± 0.71	F = 1.054	10.83 ± 1.10	F = 5.131*
	40 - <50	9	1.67 ± 0.50	p = 0.379	9.33 ± 0.50	p = 0.004*
	50 - <60	12	1.75 ± 1.54		10.75 ± 1.14	
Marital status	Single	6	2.50 ± 0.55		11.0 ± 0.0	
	Married	36	1.83 ± 1.0	F = 2.704	10.42 ± 1.20	F = 3.331*
	Widow	3	1.0 ± 0.0	p = 0.079	9.0 ± 0.0	p = 0.045*
Residency	Rural	42	1.93 ± 0.97	t = 1.636	10.43 ± 1.19	t = 2.329*
	Urban	3	1.0 ± 0.0	p = 0.109	10.0 ± 0.0	p = 0.025*
Levels of education	Illiterate	6	1.50 ± 0.55		9.0 ± 0.0	
	Read and write	12	1.25 ± 0.87	F = 7.662*	10.0 ± 1.04	F = 12.595*
	Diploma	15	1.80 ± 0.77	p <0.001*	10.40 ± 1.06	p <0.001*
	Bachelor	12	2.75 ± 0.87		11.50 ± 0.52	
Occupation	Clerical	18	2.0 ± 0.84		11.33 ± 0.77	
	House wife	21	1.71 ± 0.46	F = 0.477	9.43 ± 0.75	F = 37.403*
	Retired	6	2.0 ± 2.19	p = 0.624	11.0 ± 0.0	p <0.001*
Monthly income	Enough	3	0.0 ± 0.0	t =4.007*	11.0 ±0.0	t =3.514*
	Not enough	42	2.0 ± 0.86	p =<0.001*	10.36 ± 1.19	p =0.001*
Duration	6 m> 1 year	6	1.86 ± 1.01		11.50 ± 0.55	
	1> 5year	21	1.50 ± 0.79	F = 6.846*	10.57 ± 1.21	F =6.353*
	≤ 5year	18	1.87 ± 0.97	p =0.003*	9.83 ± 0.92	p =0.004*

F: F test (ANOVA)
t: Student t-test
*: Statistically significant at p ≤ 0.05

Table (6) showed that high significant correlations were found between patient's socio-demographic characteristics and total adherence scores one month after applying the interventions since male patients, those between 30>40 years, single, had clerical work had higher scores of adherence than others.

Also, high significant correlations were found among patients with bachelor degree , and patients on maintenance HD for 6 month to less than 1 year both pre and post interventions.

Table (7):Pearson Correlation coefficients between patients' knowledge and their Adherence to fluid and Na restrictions

Adherence to fluid and sodium restrictions	Patients' knowledge	
	Pre education	One month post education
Fluid restrictions	r = -0.484* p = 0.001*	r = 0.600* p = <0.001*
Na restrictions	r = 0.218 p = 0.151	r = 0.398* p = 0.007*
Overall adherence scores	r = -0.227 p = 0.135	r = 0.590* p = <0.001*

r: Pearson coefficient
*: Statistically significant at $p \leq 0.05$

Table (7) illustrated that there were positive significant correlations between patients' knowledge and their Adherence to fluid and Na restrictions one month after applying the educational interventions

V.   Discussion

This study results indicated that educational interventions is an effective way to improve HD patients knowledge and adherence to fluid and Na restrictions as the results showed that there were significant improvements in patients' knowledge and adherence to fluid and Na restrictions after applying the educational interventions.

There was a high statistically significant improvement in the mean and standard deviation of percent knowledge score and in all adherence dimensions percent score post interventions as compared with baseline (pre interventions assessment). The patients' total knowledge and adherence scores were increased after interventions. These results were in agreement with Ryu et al (2014) who emphasized that incorporation of patient education strategies is beneficial for adherence outcomes [31]. Concerning the effect of applying the educational interventions on percent reduction in IDWG, the results showed that more than one quarter of the studied patients reached the cutoff point ≥ 2.5 kg between two consecutive dialysis sessions.

These findings were in line with the results of a study performed by Dehaghani and Shafaghi (2005) who found that patient's education about fluid and sodium restrictions had a positive effect on patient's weight loss [32]. The significance decrease in subjects' IDWG, observed post education, is in agreement with a study by Baraz et al (2010) who reported that the mean of IDWG between two HD sessions was significantly decreased after education [4]. Also, Salehi et al (2003) reported that the mean of extra weight gained between two HD sessions decreased after education [33].

Nearly three quarter of the studied patients didn't reach the target weight. This could be due to the fact that most of HD patients had difficulty with limiting fluids [7]. Although the majority of the studied patients didn't reach the cutoff point of the study, there was a high statistically significant improvement in adherence to fluid restrictions as reported by patients post interventions.

In this context, Molaison, and Yaolrick (2003) mentioned that HD patients reported to the interviewer that they had followed fluid recommendations to please or to look good to health care professional or to avoid unpleasant response from the professional [34]. Lack of self-assessment may be an additional factor since the majority of the studied patients reported that they didn't weight themselves daily outside the dialysis center which reflects non adherence behavior. Smith et al (2010) found that self-assessment in the form of daily weighing is an important facilitator of adhering to fluid recommendations [13].

As regards blood pressure values, the results revealed that the studied patients' blood pressure values were significantly decreased one month after the education. Baraz et al (2010) and Oshvandi et al (2013) have also reported that their studied patients' blood pressure values were significantly decreased after the education, which is in agreement with the results of the present study [4, 11].

Nevertheless, there were no significant differences in Na values post education. Most patients stated that they can't limit common sources of sodium because salt is a major component of the most Egyptian foods or they eat salty food when they experience poor appetite. This finding is supported by Baraz (2010) who found insignificant differences in the overall means of biochemical parameters including Na [4]. Nurses should emphasize sodium restrictions adherence in patients on HD and explain its adverse effects.

The present study findings revealed that there were statistical significant correlations between patient's total knowledge score and their level of education, since patients with bachelor degree achieved more significant improvement in knowledge. Barnett et al (2008) and Abo Deif (2015) found a significant correlation between educational level and mean knowledge scores in HD patients [35,36].

In addition, there was statistically significant correlation between patient's total knowledge score and duration of HD. This could be interpreted that relatively new patients had less knowledge related to HD and adherence to treatment regimen so they are eager to acquire more knowledge about HD regimen. On the contrary, Montazeri and Sharifi (2014) did not find any significant correlation between the patients' nutritional knowledge and the duration of dialysis [1].

The present study results showed the male patients adhered to fluid and sodium restrictions more than female patients after interventions. In this regard, Cutaia et al (2014) found that females were more likely to report problems of adhering to the HD diet and fluid than males [37]. Also, the studied patients between 30>40 years achieved more adherence than others after interventions. This is supported by Baraz (2010) data which showed that young and, more educated patients were more compliant with the dietary and fluid regimens, and showed better compliance compared with older and less educated patients [4]. Contradicting the results of the current study Park et al (2008) found that older age was associated with higher compliances to fluid restriction [38]. Moreover, the results of our study indicated a high significant correlation between duration of HD and total adherence scores. Lee and Molassiotis (2002) found that subjects with longer duration on HD were more non-compliant [39].

As regards the correlation between patient's knowledge and adherence to fluid and sodium restrictions, the results showed that there was positive significant correlation between patient's total knowledge and adherence to fluid & sodium restrictions post interventions. Coinciding with these results, Smith et al (2010) found that Knowledge has been associated with improved adherence to fluid and sodium restriction [13]. In this regard, Ryu et al (2014) suggested that incorporation of patient education strategies might be beneficial for adherence outcomes [31]. Interestingly, a study conducted by Martin, and Gonzalez (2011) has shown that an increase in knowledge does not necessarily increase a patient's adherence to the prescribed treatment [40].

Effective management of excessive fluid overload in HD patients is dependent on the recognition that the patient is the main manager. Education can ultimately lead to improvement in HD patients, adherence to fluid restrictions which is the ultimate goal of nursing care, especially in chronic diseases.

VI.   Conclusions

One of the most important problems in patients undergoing HD is the non adherence to restriction of fluid and Na intake which result in excessive interdialytic weight gain. The results obtained in this study demonstrated that educational interventions increase patients' knowledge and adherence to fluid and Na restrictions. Undoubtedly, this is an important factor in preserving and improving patients' health. Adhering to medical prescriptions reduces mortality rate, inabilities and HD adverse effects and positively affects their quality of life and life expectancy.

Based on the findings of the present study, the following recommendations are suggested

VII.   Recommendations

- It is suggested that nurses use the adjoining teaching manual to help patients on maintenance HD.
- Other studies, to examine other effects of education, and also in a longer duration to find out long-term effects, are recommended.
- Using dietary counseling techniques that motivate patients to adhere to dietary recommendations, rather than the more traditional approach of information-giving.
- Family support is highly advocated key factor in adherence success.
- Establishment of a hot line contact for trouble shooting of dangerous situations that might be suddenly raised is required.
- Further studies should investigate other barriers to non-adherence to fluid and sodium restrictions.

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