BMC Nephrology

RESEARCH

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The effect of an educational video about healthy diet on metabolic control of patients on hemodialysis: an interventional study with a one-year follow-up

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Abstract

Background Adherence to diet is effective for metabolic control in patients on hemodialysis. There are educational pamphlets or booklets to improve patients' knowledge about healthy diets. As video presentation is more desirable than the presentation of readable materials, we designed an educational video on healthy diets in renal failure patients who was played during several sessions of hemodialysis. We compared the effect of this modality on the knowledge, attitudes and metabolic control of the patients before and after the intervention.

Methods In this interventional study, all the patients who were referred to the hemodialysis ward at Ashrafi-Esfahani Medical Center (Tehran, Iran) between May 2018 and March 2019 were enrolled ($N=190$). Totally, 130 patients had inclusion criteria. An educational video about a healthy diet was shown seven times (once a week in the first month, once every two weeks in the second month, and once in the third month) during hemodialysis for the patients. The nephrologist prepared a video in the form of a lecture with graphic images for 20 min based on the healthy nutrition of the Kidney Federation of Iran's Guide for hemodialysis patients. The questionnaire was completed in terms of awareness and attitudes, and blood and urine tests were performed at the 1st, 3rd, and 12th months. Serum parameters, including electrolytes, lipid profile, CBC-diff, dialysis efficacy (Kt/V), and the URR (urine filtration rate) were examined. Pre and post intervention values were compared via the statistical analysis performed using IBM SPSS. *P*-Value < 0.05 was significant.

Results The data of 128 people were analyzed at the end of the study. 55% of patients were 10–40 years old and 60% were male. 56% of patients were illiterate or had an elementary school education. The most common underlying diseases were hypertension and diabetes mellitus. Ten to 19% of participants had enough knowledge about the various components of a healthy diet for patients on hemodialysis. Approximately 25%, 14%, and 45% of the participants consumed a healthy diet for breakfast, lunch and dinner, respectively. A comparison of the mean values of the serum parameters before and after the intervention revealed significant changes in phosphorus, blood urea nitrogen, and hemoglobin with mean differences of -118.41 ± 22.84, 21.51 ± 10.38 (both $P<0.001$), and 0.29 ± 1.18 ($P=0.044$), respectively. The mean Kt/V was similar at all phases.

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Conclusion The use of an educational video was effective for normalizing the metabolic parameters in patients under hemodialysis and can be an appropriate option, especially for illiterate patients.

Trial registration IRCT2016082229481N1.

Keywords Kidney, Hemodialysis, Video-Audio Media, Education; metabolism, Electrolytes, Biomarkers

Background

Renal failure, one of the most common diseases worldwide, is a progressive disease that can lead to complete loss of kidney function and requires renal replacement therapy (RRT) [1]. This treatment includes kidney transplant and dialysis. Dialysis, a common type of RRT, can include hemodialysis (HD), peritoneal dialysis, and hemofiltration [2]. The type of dialysis is chosen based on the patient's condition and availability of the dialysis apparatus at medical centers. HD is the most common type of dialysis performed in Iran [3]. Therefore, it is important to pay greater attention to different aspects of HD in our country.

It is well known that dialysis impairs patients' quality of life and imposes a great economic and social burden on patients and the health care system. Therefore, additional care is required to improve dialysis efficiency and improve the patient outcomes; one of the important steps in this regard is adherence to a healthy diet that can reduce weight and edema, improve the control status of the underlying disease, and decrease the need for phosphate binder therapy. These recommendations include controlling the intake of potassium, phosphorus, sodium, and fluids; consuming of fresh foods; restricting the consumption of pasta, rice, and sweet potato, and choosing foods with less than 400 mg sodium/100 g [4, 5]. Although the guidelines clearly define the dietary recommendations, many patients have problems adhering to a healthy diet. Therefore, education on dietary and fluid compliance is required to reduce the risk of complications [6] and improve quality of life [7]. It is important to design additional strategies to educate patients about healthy diets and improve their adherence to their diet. The educational strategies suggested include pamphlets and/or booklets, nurse-led telephone follow-up, mobile applications or text messaging [8, 9].

However, using these educational materials requires adequate literacy to be able to read and therefore is not appropriate for illiterate patients or those who cannot read Persian. Patients with a lower educational level have a greater risk of limited health literacy and thus greater risk of death [10]. Some have suggested that video-based education during dialysis is as effective as face-to-face education [11, 12]. It has been shown that video-based education presented during dialysis can also improve patients' quality of life [13, 14]. To evaluate the efficacy of video intervention, it is important to investigate changes in electrolytes and serum parameters. Therefore, in the present study, we designed an educational video, and played it at each session of HD for the patients; then we compared its effect on the level of knowledge, attitude, performance and metabolic control of the patients.

Methods

This study is an interventional study with a one-year follow-up. In this study, we have compared the level of knowledge, attitude, performance and metabolic control of patients before and after showing an educational video about healthy nutrition in patients on hemodialysis. All the patients who were receiving hemodialysis at Ashrafi-Esfahani Medical Center from May 1, 2018 to June 30, 2019 were enrolled in the study ($N=190$). *The inclusion criteria* for patients were as follow: Aged 18–70 years, underwent hemodialysis 2–3 times a week for at least 3–4 h each at the study center.

The exclusion criteria for patients were as follow: known psychological problems, inability to understand Persian language speech or inability to attend to the video and/or not regularly referred for the HD sessions.

The researcher explained the study objectives to the eligible patients and asked them to read and sign the written informed consent. The participants were enrolled in the study by a nonrandomized (convenient) sampling method ($N=130$). The flowchart of the study is given in Fig. 1. After selecting the samples, the initial questionnaire was completed by the project nurse in terms of the basic characteristics and level of awareness of the patients before the intervention and examinations. The first clinical examination was performed in the fasting state before hemodialysis, and other evaluations were performed after the completion of hemodialysis. Initially, 10 cc of venous blood was taken from the patient after 12 h of fasting to measure the serum levels of sodium (Na), potassium (K), calcium (Ca), phosphorus (P), magnesium (Mg), blood urea nitrogen (BUN), creatinine (Cr), albumin (Alb), hemoglobin (Hb), hematocrit (Hct), parathyroid hormone (PTH), cholesterol (Chol), triglyceride (TG), HDL-C (high density lipoprotein- cholesterol; urea and creatinine in the urine for dialysis efficacy (Kt/V), and URR (urine filtration rate). All the tests were performed on the same day.

Then, the training video was played 7 times (once a week in the first month, once every two weeks in the second month, and once in the third month) during

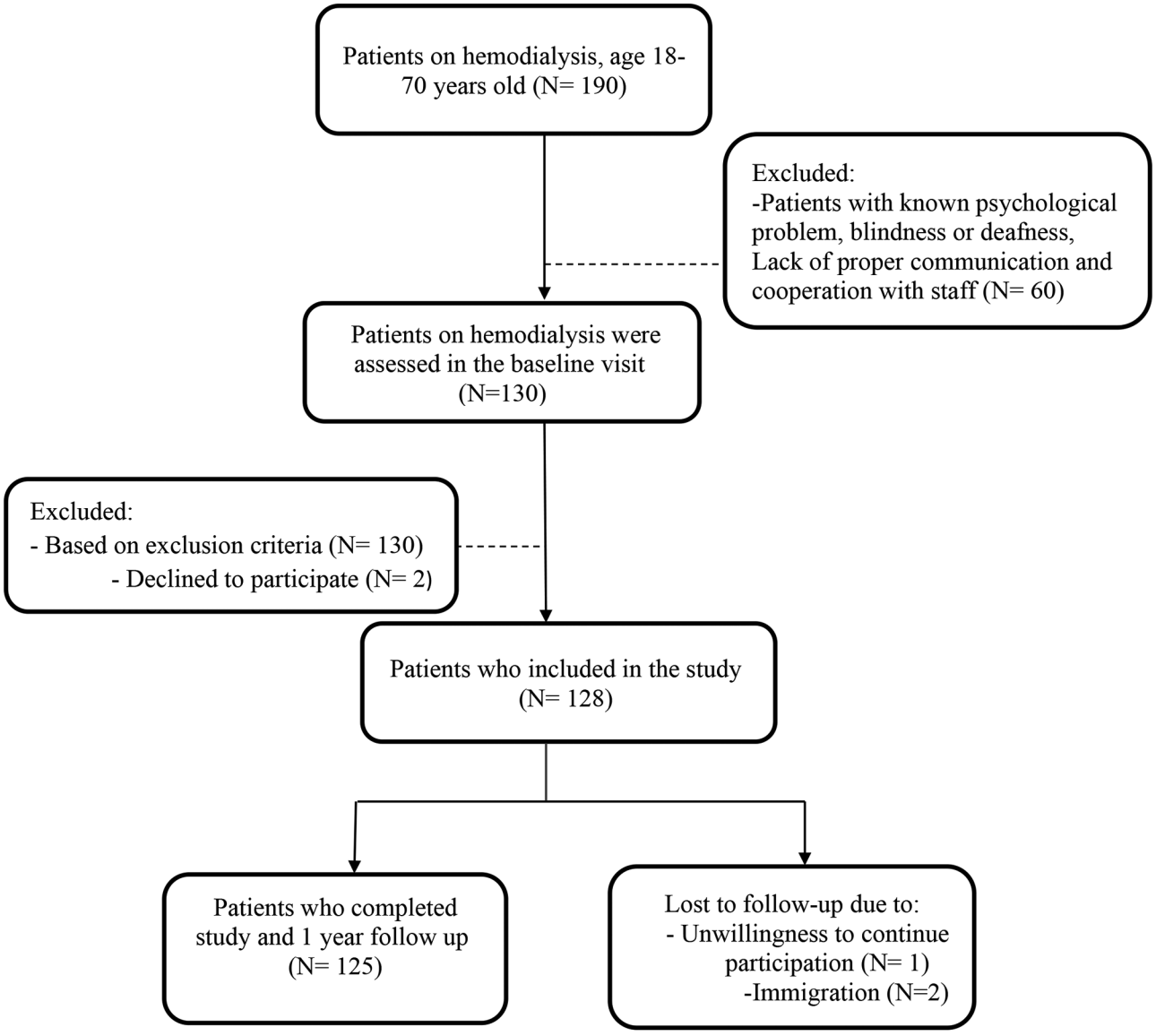

Fig. 1 Study fellow chart

hemodialysis for the patients. The questionnaire was completed again in terms of knowledge and attitudes and blood and urine tests were repeated at the end of the third and 12th months.

Height was measured with a metal stadiometer (0.5 cm accuracy) while the participants were in a standing position. Blood pressure was measured after 15 min of rest with a standard mercury sphygmomanometer from the right hand while the patients were lying down before dialysis in a fasting state.

The educational video was prepared by Dr. Yasari (nephrologist) based on the Guideline of the Iranian Society of Kidney Disease (ISKD) as a PowerPoint show [15]. This PowerPoint show lasts 20 min. First, a video of the doctor's lecture on the importance of nutrition in the metabolic control of hemodialysis patients was prepared and attached to PowerPoint. Then, the graphic slides were prepared with respect to the principles of proper nutrition in patients on hemodialysis and healthy or harmful foods. The doctor's speech was added to the slides which were broadcast during the slide show. In addition, the important principles of healthy nutrition were reviewed by Dr. Yasari as another attached video in last slide.

Before playing the video, the researchers checked the patients' level of awareness of the proper diet content (knowledge). They asked the participants what ingredients in the diet are important for the health of hemodialysis patients. At this stage, those who pointed out

the restriction of salt, liquid, fat, protein and phosphorus consumption and increased consumption of iron and calcium were considered people with appropriate knowledge.

After showing the educational video, the researcher asked the participants the following questions to check the level of knowledge of the patients about proper diet:

Which food contains high amounts of sodium, potassium, calcium, phosphorus and protein? How can you limit the consumption of liquids, salt (sodium), potassium, phosphorus and protein? What foods can increase the amount of calcium and iron?

To investigate patient attitudes, the researchers prepared a list of various healthy or unhealthy food items for each meal for hemodialysis patients and suggested this list to the participants as a breakfast, lunch or dinner menu. Then the participants were asked to choose a suitable diet from this hypothetical menu. A participant who chose a healthy diet was recorded as having a positive attitude, and a participant who chose an inappropriate diet was recorded as having a negative attitude.

At the end of the study, serum parameters and dialysis adequacy indicators were considered criteria for evaluating patient performance.

Serum levels of Na, K, Ca, P, and Mg were measured using BT3000 spectrophotometric chemical analysis. Serum urea and creatinine levels were measured by the Jaffe kinetic colorimetric method with an automatic analyzer (Vital Scientific, Spankeren, Netherland) using commercial kits (Pars Azmoun Company, Tehran, Iran). The serum Alb level was measured by an autoanalysis machine (COBASMIRA, ROCH, France) with the "Albumin and Protein Kit" (Biochem Company, Iran). Hb and Hct were measured with a fully automatic analyzer (Sysmex KX-21NTM, Japan). Serum levels of vitamin D and intact PTH were measured with an enzyme-linked immunosorbent assay (ELISA) kit. FBS was measured by the glucose oxidase method, cholesterol by the cholesterol oxidase method, triglycerides by the glycerol phosphatoxidase method and HDL-C by the direct enzyme method. Biosystem kits (S.A.casta Brava 3, Barcelona, Spain) were used for serum lipid profiles in the autoanalyzer (Biosystem A25, Spain). The devices were calibrated every day.

The normal ranges of these laboratory parameters in adults are as follows: Na, 135–145 meq/L; K, 3.5–5.3 meq/L; alcium, 8.6–10.3 mg/dl; P, 2.5-5 mg/dl; Mg, 1.5–2.6 mg/dl; Cr,0.5–1.5; Urea, 10–50 mg/dl; Alb,3.5–4.5 g/l; Hb,12.3–15.3 g/dl for women and 14–17.5 g/dl for men; Hct, 36-44.6% for women and 41.5–50.4% for men; FBS, 70–100 mg/dl; Cholesterol, up to 200 mg/dl; Triglyceride, up to 200 mg/dl and HDL- Cholesterol, more than 34 mg/dl.

The normal PTH level was less than 65 pg/ml.

To check the adequacy of dialysis, kt/v was calculated with nephrology calculator [16].

The URR is calculated as [17]:

URR=[(predialysis BUN−postdialysis BUN) / predialysis BUN] ×100%.

The serum levels of sodium, phosphorus, hemoglobin, etc. were measured and compared with those measured before the study.

The protocol of the study was approved by the Ethics Committee of the National Research Institute of Tuberculosis and Lung Disease - Shahid Beheshti University of Medical Sciences (approval ID: IR.SBMU.NRITLD.REC.1399.206) [18]. This trial is registered in Iran clinical trials with ID: IRCT2016082229481N1.

Statistical analysis

The results were presented as the mean ± standard deviation (SD) for quantitative variables. The one–sample Kolmogorov–Smirnov test was used to determine the normality of the distribution of the data and Levene's test was used to test the equality of variances. Continuous variables were compared using t-tests or Mann-Whitney U tests, whenever the data did not appear to have a normal distribution or when the assumption of equal variance was violated across the study groups. The trends of the changes in the serum parameters over the 12 months are depicted in the figures. The mean differences in the last value (month 12) and baseline value (pre-intervention) were calculated and compared using paired sample t-tests. For the statistical analysis, the statistical software SPSS (IBM SPSS Statistics for Windows version 21.0, IBM Corp.) was used. P values < 0.05 were considered to indicate statistical significance.

Results

In this interventional study, 130 people were eligible to participate (see Fig. 1).

In terms of age, 8%, 55% and 37% of people were in the age groups of 20-39.9, 40-59.9 and more than 60 years, respectively. Seventy-seven people (60%) were male. The patients underwent hemodialysis 3.98 times a week for 3.85 h each, and the average weight gain during the dialysis intervals was 2.4 kg. About half of the patients had urinary excretion, edema and muscle cramps. In terms of vein access routes, 2%, 35%, 61% and 2% of patients had temporary catheters, permanent catheters, arteriovenous fistulas and grafts, respectively. Thirty-four, 23, 36 and 8% of patients were illiterate, had a primary education, had a diploma and had a higher education, respectively. In terms of underlying disease, 95% of the patients had diabetes, hypertension or both. 10% of people do not take any of their medications.

Less than 20% of the participants were aware of the various components of the suitable diet for hemodialysis

Table 1 The level of awareness of patients about the content of food by ingredients

Variable	Before Intervention (*N*, %)	After Intervention (*N*, %)	*P*-Value
Knowing Sodium[a]	18 (14)	24 (19)	0.070
Knowing Potassium[b]	21 (16)	49 (38)	< 0.001
Knowing Phosphor[c]	13 (10)	39 (30)	< 0.001
Knowing protein[d]	24 (19)	66 (52)	< 0.001
Knowing method of reduce fluid[e]	23 (18)	33 (26)	0.070

[a] Knowing foods containing sodium, [b] Knowing Foods containing potassium, [c] Knowing Foods containing phosphor , [d] Knowing Foods containing protein , [e] Knowing how to reduce drinking fluid , [a] Knowing Foods containing potassium,

patients (10%, 16%, 18%, 19% and 19% in terms of phosphorus, potassium, fluids, sodium and protein food content, respectively) at baseline. After watching the educational video, the level of awareness of the patients about the food content about reducing the consumption of sodium, potassium, protein and phosphorus in the diet increased by 5%, 22%, 20%, 34% and 20%, respectively(*P*-Value < 0.05 for K, P, Protein and fluid). Please see Table 1.

To check the attitudes of the patients, they were asked to choose their food from a hypothetical food list (containing healthy and unhealthy food for dialysis patients) for three meals: breakfast, lunch and dinner. Only 10% of patients select healthy foods before intervention. After watching the educational video, 25, 14 and 47% of patients chose healthy food for breakfast, lunch and dinner, respectively. The selection of healthy foods from the list of suggested foods increased significantly after the intervention (10% vs. 26%; *P*-Value < 0.05).

In order to check the performance of the people, the level of serum parameters and the adequacy of dialysis were checked. After the intervention, the mean serum levels of sodium, phosphorus, iPTH (intact PTH) and creatinine and pre or postdialysis urea decreased and the mean serum levels of calcium, hemoglobin and hematocrit and the KTV of urea increased significantly. After the intervention, the reduction in the average serum urea after dialysis (the difference between the serum urea levels before and after dialysis) increased compared to that before the intervention (Table 2).

Discussion

In this interventional study, we have compared metabolic control of patients before and after showing an educational video about healthy nutrition in patients on hemodialysis. Less than a fifth of patients were aware of the various components of the suitable diet for hemodialysis patients. The awareness of patients about healthy diet increased by 20% after watching the educational video. The attitude of the patients was checked by choosing healthy food from a hypothetical menu. The selection of healthy foods increased significantly after the intervention (10% vs. 26%). The results of the present study revealed significant changes in the serum parameters of the study group after video presentation. After the intervention, the mean serum levels of sodium, phosphorus, iPTH and creatinine and pre- or post-dialysis urea decreased and the mean serum levels

Table 2 Serum levels of blood parameters and dialysis adequacy before and after intervention in the participants

Variable (Mean ± SD)	Before Intervention	After Intervention	*P*-Value*	One year follow up	*P*-Value **
Sodium (mEq/L)	135.8 ± 3.27	137.5 ± 3.05	< 0.001	137.6 ± 2.95	< 0.001
Potassium (mEq/L)	5.02 ± 0.63	5 ± 0.64	0.703	4.92 ± 0.60	0.319
Calcium (mg/dl)	8.14 ± 0.83	8.38 ± 0.84	< 0.001	8.42 ± 0.80	< 0.001
Phosphor (mg/dl)	5 ± 1.30	4.6 ± 1.22	< 0.001	4.55 ± 1.13	< 0.001
iPTH (pg/dl)	527.33 ± 45.03	440.37 ± 43.34	< 0.001	428.1 ± 44.6	0.049
Albumin (g/dl)	4.09 ± 0.54	3.92 ± 0.61	< 0.001	4.16 ± 0.53	0.196
Creatinine (mg/dl)	9.38 ± 2.58	7.33 ± 2.06	< 0.001	7.23 ± 2.12	< 0.001
Hemoglobin (g/dl)	10.69 ± 1.94	11.19 ± 1.59	< 0.001	11.28 ± 1.55	< 0.001
Hematocrit (%)	33.97 ± 5.61	34.48 ± 4.53	< 0.001	33.19 ± 7.59	0.037
Cholesterol (mg/dl)	138.88 ± 37.18	149.03 ± 66.11	0.002	151.2 ± 67.53	0.046
Triglyceride (mg/dl)	147.71 ± 88.68	147.51 ± 87.44	< 0.001	147.3 ± 88.48	0.461
Pre-dialysis Urea (mg/dl)	134.63 ± 33.66	120.01 ± 0.627	< 0.001		
Post-dialysis Urea (mg/dl)	44.69 ± 15.22	36.67 ± 13.49	0.013		
Pre-post dialysis Urea (mg/dl)	90.62 ± 19.32	84.02 ± 20.77	< 0.001		
KTV of urea* ** (mg/dl)	1.377 ± 0.26	1.45 ± 0.03	< 0.001	1.50 ± 0.38	0.021
URR** (%)	0. 66 ± 0.08	0.68 ± 0.01	0.090	0.68 ± 0.11	0.150

* *P*-Value for comparison before and after intervention; * *P*-Value for comparison before intervention and one-year follow up; ***Kt/V urea, K: dialyzer urea clearance, t: total dialysis session time, and V is volume of distribution of urea; ****URR, urine filtration rate

of calcium, hemoglobin and hematocrit and the Kt/V of urea increased significantly.

In this study, after watching the educational video, the level of awareness of the patients about healthy diet increased twice and positive attitude change was seen in a quarter of the patients. Others have also referred to the significance of knowledge of patients undergoing hemodialysis about dietary recommendations and the influence of educating patients about these instructions [6, 7]. In the study of Monaghi et al., face-to-face training was more effective than non-face-to-face training. They showed that with the increase in the frequency of training sessions, the patients' attitudes changed more positively [19]. However, face-to-face education requires a separate room for performance, educated staff to present the information to each patient, and the patient should attend the class/presentation [7]. These factors may prevent education for all patients. Video presentation is an easy method for patients; first, the educator presents it once and no additional time is required to present the information to each patient separately; only, the recorded video is presented for all patients. This will also homogenize the information presented to patients. Furthermore, there is no need for the patient to schedule additional time for the presentation, as the video is presented to the patient during hemodialysis, when the patient has to stay under a dialysis device for hours. In addition to these benefits, comparisons of face-to-face education with video presentations revealed similar changes in biochemical parameters [6], adherence to the instructions [7, 12], and quality of life of patients [14, 20] under hemodialysis.

The results of the present study showed that after the intervention, the Na, Ca, and Chol levels and Kt/V ratio increased, while the P, Cr, Htc, PTH and BUN levels decreased. In the study by Baraz and colleagues, the video presentation revealed a significant increase in mean Ca levels (from 8.63 to 9.62 mg/dl; $P=0.001$) and a decrease in P (from 6.25 to 5.16 mg/dl; $P=0.007$), and uric acid (from 7.17 to 6.32 mg/dl; $P=0.036$) but no significant changes in Cr, Na, K, BUN or Alb [6]. The increase in Ca and decrease in *P* values, documented in this study are consistent with the results of these studies. In a recently published study in Iran, a mobile application was provided to patients and the results showed significantly decreased mean K, P, TC/TG, and ferritin levels in this group of patients [21]; these results are consistent with the results presented in the present study, considering the decrease in P levels. According to the evidence, noncompliance with P can result in important adverse events, such as bone demineralization and renal bone disease, in the long run; as its effect presents late, the patient may not pay sufficient attention to this biochemical agent, but he/she may suffer from its long-term influence [22]. Therefore, it is important to notify patients about controlled dietary P loads by avoiding foods that are rich in P or have high P/protein, and processed food with P-containing preservatives [22, 23].

Nonadherence to Na has also been suggested to be an important factor in patients under hemodialysis, as excessive Na intake thirsts patients, which leads to increased fluid intake and interdialytic weight gain; therefore, it is important to restrict Na intake in these patients [23–25]. The results of the present study showed that the mean Na value was greater after the intervention but the difference was not significant. Similarly, others have reported no difference in Na levels according to dietary education [26]. An increase in the serum levels of total Chol in the present study also showed that the patients did not undergo close observation of their dietary regimen; this will put the patients at risk of complications. Therefore, more emphasis is required on the salt and fat intake of patients undergoing hemodialysis in educational programs or other strategies used for improving patients' knowledge and awareness.

Anemia is a common complication in patients under hemodialysis and increases the risk of cerebrovascular and cardiovascular diseases, infection and hospitalization; therefore, it is important to maintain a target-range Hb level in patients under hemodialysis [27]. Anemia may be the result of secondary hyperparathyroidism, mediated via multiple pathways, such as bone-derived fibroblast growth factor 23 [28, 29]. The results of the present study showed that Hb levels improved and PTH levels decreased, which is in line with the results of studies suggesting an adverse association between Hb and PTH levels [28, 29]. Therefore, it is important to pay attention to these serum parameters in patients undergoing hemodialysis.

Adequacy of hemodialysis, Kt/V, is an important factor in the outcome of patients undergoing hemodialysis, as it is associated with patient mortality, anemia, and hypoalbuminemia. In the present study, Kt/V increased significantly after the intervention, which may be due to the influence of diet education on these patients; however, studying the mean difference was not significant. Other researchers have also reported no difference in the mean Kt/V before and after repeated educational programs [30], which is consistent with the results of the present study.

One of the limitations of the present study was the lack of a control group to compare the results of this intervention with those of a group that did not receive this intervention to observe the pure effect of the intervention. Another limitation of the present study was related to the nonrandomized enrollment of patients in the study and the selection of patients from one medical center; these limitations increase the chance of confounders affecting the study results.

Conclusion

The present study showed that the educational video was effective for assessing metabolic/serum parameters in patients on hemodialysis and can be an appropriate option for improving the knowledge/awareness of patients under hemodialysis and their dietary compliance. Therefore, it is suggested to consider the inclusion of a video presentation in the strategies planned for patients undergoing hemodialysis.

Abbreviations

Alb	albumin
BUN	blood urea nitrogen
Ca	calcium
CBC-diff	cell blood count- differentiation
Chol	cholesterol
Cr	creatinine
ELISA	enzyme-linked immunosorbent assay
FBS	fasting blood suger
Hb	hemoglobin
Hct	hematocrit
HD	hemodialysis
HDL-C	high density lipoprotein- cholesterol
iPTH	intact PTH
ISKD	Iranian Society of Kidney Disease
K	potassium
Kt/V	K: dialyzer urea clearance, t: total dialysis session time, and V is volume of distribution of urea
Mg	magnesium
Na	sodium
N	number
P	phosphorus
PTH	parathyroid hormone
RRT	renal replacement therapy
SD	standard deviation
TG	triglyceride
URR	urine filtration rate

Acknowledgements

The authors of the present study sincerely thank the patients who participated in the study and the staff of the dialysis department of Ashrafi-Esfahani Medical Center (Tehran, Iran) for their cooperation in this project.

Author contributions

F.Y. designed and worked in all steps of the project. She designed and prepared the educational video. She wrote and revised the manuscript in all steps.M.T contributed to the study design and educational video preparation. She played video in each session and collected the data. M.A. contributed to completing the missing data and wrote the primary draft of the manuscript. M.V. supervised the investigation. She reviewed and edited the manuscript.

Funding

The authors declare that there are no any financial or other conflicts of interest related to this study. The present study was financially supported by the credit of the Research Vice President of the National Research Institute of Tuberculosis and Lung Diseases (NRITLD), Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The protocol of the study was approved by the Ethics Committee of the National Research Institute of Tuberculosis and Lung Disease - Shahid Beheshti University of Medical Sciences (approval ID: IR.SBMU.NRITLD.REC.1399.206).

Consent for publication

Fatemeh Yasari, Masoumeh Taherian, Meshkat Akbarian, and Maryam Vasheghani would like to submit this original research article entitled "The Effect of an Educational Video about a Healthy Diet on the Metabolic Control of Patients on Hemodialysis: An interventional study with a one-year follow-up" for consideration for publication by the "BMC Nephrology journal". We confirm that the study is original. This study has not been published elsewhere, nor is it currently under consideration for publication elsewhere. The manuscript dose not contains information or images that would lead to the identification of a study participant and are therefore "not applicable" for consent for publication.

Competing interests

The authors declare no competing interests.
The researcher explained the study objectives to the eligible patients and asked them to read and sign the written informed consent.

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Received: 5 March 2024 / Accepted: 2 August 2024
Published online: 14 August 2024

References

1. Palevsky PM. Renal replacement therapy in acute kidney injury. Adv Chronic Kidney Dis. 2013;20(1):76–84.
2. Murdeshwar HN, Anjum F. Hemodialysis. 2020.
3. Nafar M, Aghighi M, Dalili N, Abedi BA. Perspective of 20 years hemodialysis registry in Iran, on the road to progress. Iran J Kidney Dis. 2020;14(2):95.
4. Saglimbene VM, Wong G, Ruospo M, Palmer SC, Garcia-Larsen V, Natale P, et al. Fruit and vegetable intake and mortality in adults undergoing maintenance hemodialysis. Clin J Am Soc Nephrology: CJASN. 2019;14(2):250.
5. Su G, Saglimbene V, Wong G, Natale P, Ruospo M, Craig JC, et al. Healthy lifestyle and mortality among adults receiving hemodialysis: the DIET-HD study. Am J Kidney Dis. 2022;79(5):688–98. e1.
6. Baraz S, Parvardeh S, Mohammadi E, Broumand B. Dietary and fluid compliance: an educational intervention for patients having haemodialysis. J Adv Nurs. 2010;66(1):60–8.
7. Ebrahimi H, Sadeghi M, Amanpour F, Dadgari A. Influence of nutritional education on hemodialysis patients' knowledge and quality of life. Saudi J Kidney Dis Transplantation. 2016;27(2):250–5.
8. Arad M, Goli R, Parizad N, Vahabzadeh D, Baghaei R. Do the patient education program and nurse-led telephone follow-up improve treatment adherence in hemodialysis patients? A randomized controlled trial. BMC Nephrol. 2021;22:1–13.
9. Stevenson J, Tong A, Gutman T, Campbell KL, Craig JC, Brown MA, et al. Experiences and perspectives of dietary management among patients on hemodialysis: an interview study. J Ren Nutr. 2018;28(6):411–21.
10. Cavanaugh KL, Wingard RL, Hakim RM, Eden S, Shintani A, Wallston KA, et al. Low health literacy associates with increased mortality in ESRD. J Am Soc Nephrology: JASN. 2010;21(11):1979.
11. Hasanzadeh F, Shamsoddini S, Moonaghi HK, Ebrahimzadeh S. A comparison of face to face and video-based education on attitude related to diet and fluids adherence in hemodialysis patients. Intern Med Today. 2011;17(3):34–43.
12. Moonaghi HK, Hasanzadeh F, Shamsoddini S, Emamimoghadam Z, Ebrahimzadeh S. A comparison of face to face and video-based education on

attitude related to diet and fluids: adherence in hemodialysis patients. Iran J Nurs Midwifery Res. 2012;17(5):360.
13. Maslakpak MH, Shams S. A comparison of face to face and video-based self care education on quality of life of hemodialysis patients. Int J Community Based Nurs Midwifery. 2015;3(3):234.
14. Baloochi Beydokhti T, Ghadimifar A. Comparison of the effect of face-to-face and video diet training on the quality of life of hemodialysis patients: a clinical trial. J Nurs Educ. 2022;11(5):32–45.
15. https://www.irankf.com/note/
16. Kt/v refrence. https://www.tinkershop.net/nephro.htm
17. Allen R, Nissenson RN, Fine R, Mehrotra. Joshua Zaritsky. Handbook of Dialysis Therapy 6th Edition, Elsevier, 2022, Sect. 2.
18. https://ethics.research.ac.ir/PortalProposalList.php
19. Karimi Moonaghi H, Hasanzadeh F, Shamsoddini S, Emamimoghadam Z, Ebrahimzadeh S. A comparison of face to face and video-based education on attitude related to diet and fluids: adherence in hemodialysis patients. Iran J Nurs Midwifery Res. 2012;17(5):360–4. PMID: 23853648; PMCID: PMC3703076.
20. Baraz S, Zarea K, Dashtbozorgi B. Comparing the effect of two educational programs on the quality of life of hemodialysis patients in Iran. Iran Red Crescent Med J. 2014;16(8).
21. Torabikhah M, Farsi Z, Sajadi SA. Comparing the effects of mHealth app use and face-to-face training on the clinical and laboratory parameters of dietary and fluid intake adherence in hemodialysis patients: a randomized clinical trial. BMC Nephrol. 2023;24(1):194.
22. Cupisti A, Gallieni M, Rizzo MA, Caria S, Meola M, Bolasco P. Phosphate control in dialysis. Int J Nephrol Renovascular Disease. 2013:193–205.
23. Baldwin DM. Viewing an educational video can improve phosphorus control in patients on hemodialysis: a pilot study. Nephrol Nurs J. 2013 Sep-Oct;40(5):437–42. quiz 443. PMID: 24308110.
24. Clark-Cutaia MN, Ren D, Hoffman LA, Burke LE, Sevick MA. Adherence to hemodialysis dietary sodium recommendations: influence of patient characteristics, self-efficacy, and perceived barriers. J Ren Nutr. 2014;24(2):92–9.
25. Nerbass FB, Morais JG, Santos RGd, Kruger TS, Sczip AC. Luz Filho HAd. Factors associated to salt intake in chronic hemodialysis patients. Brazilian J Nephrol. 2013;35:87–92.
26. Hanifi N, Ezzat LS, Dinmohammadi M. Effect of consultation and follow-up phone calls on biochemical indicators and intradialytic weight gain in patients undergoing hemodialysis. Oman Med J. 2019;34(2):137.
27. Kuragano T, Matsumura O, Matsuda A, Hara T, Kiyomoto H, Murata T, et al. Association between hemoglobin variability, serum ferritin levels, and adverse events/mortality in maintenance hemodialysis patients. Kidney Int. 2014;86(4):845–54.
28. Tanaka M, Komaba H, Fukagawa M. Emerging association between parathyroid hormone and anemia in hemodialysis patients. Therapeutic Apheresis Dialysis. 2018;22(3):242–5.
29. Aghsaiefard Z, Hossenifard Z, Alizadeh R, Ramim T. The relationship between hemoglobin level with PTH level and dialysis adequacy in chronic hemodialysis patients. Tehran Univ Med J. 2018;76(4):257–64.
30. Ryu H, Jeon HJ, Sun H-K, Han KH, Whang CG, Han SY. Repeated education improves diet compliance in maintenance Hemodialysis patients. Int J Urol Nephrol. 2014;2:63–8.

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