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# Evaluation of the effect of integrated trainings on nutritional status and dialysis adequacy in hemodialysis patients

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**ABSTRACT**

**Background:** Today, one of the most serious problems of hemodialysis patients is poor nutrition, significantly affected by inadequate dialysis. Not only it is necessary to have sufficient knowledge in this area, but it is also important to find more effective educational methods in this regard. With this background in mind, this study aimed to evaluate the effect of integrated trainings on nutritional status and dialysis adequacy in hemodialysis patients.

**Methods:** This clinical trial was conducted on hemodialysis patients, referred to one of the hospitals of Shiraz, Iran in 2015. In total, 56 patients were selected through randomized convenience sampling and divided into two groups of intervention and control. Integrated trainings was provided for the participants of intervention group in the form of five group and individual sessions of 10-30 minutes during hemodialysis. The nutritional status and dialysis adequacy of all the participants were evaluated before, one month and two months after the intervention in the dialysis ward based on subjective global assessment and KT/V, respectively. Data analysis was performed in SPSS version 21 using Fisher's exact test, independent t-test, repeated measures ANOVA, Chi-square and Cochran test.

**Results:** In this study, the nutritional status of the participants was significantly improved one and two months after the intervention (P<0.0001). Moreover, mean score of dialysis adequacy was significantly increased in the intervention group from 1.21±0.27 to 1.35±0.28 after the intervention (P=0.007).

**Conclusion:** According to the results of this study, integrated trainings was associated with a significant improve in dialysis adequacy and nutritional status of hemodialysis patients. Therefore, it is recommended that this educational method be used in hemodialysis wards.

## 1. Introduction

Chronic kidney disease (CKD) is progressive and irreversible loss of renal function, which could endanger health[1, 2] and lead to the loss of 90% of renal function and death in the severe stage.[3]

The prevalence of chronic renal failure is rising globally for various reasons.[1] The incidence of this disease is reported to be 242 cases per million population, which is annually rising 8% approximately. Moreover, about 1,200-1,600 Iranians are added to this population every year.[4]

In the end-stage CKD, when renal function reaches 10-15% of its normal function, use of alternative methods to sustain life is essential to compensate for the abnormal function of the kidneys. These alternative treatments include hemodialysis, peritoneal dialysis, and kidney transplantation,[2] while hemodialysis is the most common one among others.[5]

Following the initiation of hemodialysis, these patients are faced with several requirements and complications and need to make a lot of modifications in their lifestyle to sustain life.[6] One of the most prevalent complications of hemodialysis is protein-energy malnutrition, which is reported to be 52-36% in various studies.[7-9] Nutritional status has a significant relationship with increased risk of chronic diseases, duration of hospital stay, reduced quality of life, and increased mortality rate.[10, 11] Regarding this, nutritional evaluation for diagnosis, prevention,

and treatment should be part of the patient care program.[12]

One of the causes of malnutrition is inadequate hemodialysis,[13] which causes the loss of appetite, reduced quality of life, and increased risk of mortality;[14, 15] however, adequate dialysis less than acceptable limits has been reported frequently in regions across Iran.[16-19] Several studies have examined the factors affecting the quality of dialysis and reported diet and proper training as some of the most considerable factors.[18, 20] Although the nutritional knowledge of these patients is higher than other people, they have wrong choices in their food resources.[12]

Shomali (2012) introduced patient training as the most important nursery activities for patients undergoing hemodialysis, which could improve their health and prevent further complications.[21] In this regard, Morante et al. (2014) pointed out the necessity of using educational methods to improve nutrition in hemodialysis patients. Furhtemore, they proposed nutrition education as a means of improving the food knowledge and the relevant nutritional serum parameters in these patients.[12] Moreover, Garagarza et al. (2015) acknowledged that empowering patients in order to achieve effective dialysis and improving their nutritional status through education is an important step toward self care.[22] Additionally, Hassanzadeh et al. (2011) introduced education as a crucial issue in improving attitudes toward diet and liquids in hemodialysis patients.[23]

According to the literature, although the trainings conducted by on-call nurse during hospital stay is considered the first step in patient education, this period is not satisfactory. On the other hand, the use of on-site training sessions has the limitations of time and place. Therefore, supplemental actions regarding the patient education is necessary.[24, 25]

One method to empower and train the patients is employing integrated training methods.[26] The integrated method is the use of two or more training methods, including individual training, group training, giving lecture, and virtual training. Moreover, the educational technology such as film screenings, pamphlets, booklets, phone call follow-ups, and online trainings are used in these methods.[27] In this comprehensive program, the trainee and the trainer are more motivated to learn and information seeking; as a result, the learning experience would be deeper and so more appropriate.[28]

Given the inappropriate nutrition and inadequacy of dialysis,[7, 9, 14, 15] the number of these patients is gradually increasing.[29] The current study aimed to determine the effect of integrated training on the nutritional status and dialysis adequacy in hemodialysis patients.

## 2. Methods

### 2.1. Design

This study was a clinical trial conducted on the patients undergoing hemodialysis in the dialysis unit of a hospital in Shiraz, Iran, in 2015.

### 2.2. Participants and setting

In this study, Following a study by Saei et al. (2012),[30] ($\bar{X}_2$=1.04, $\bar{X}_1$=1.28, $S_2$=0.22, $S_1$=0.28, f (α,β)=10.5) the sample size was calculated to be 23.11 participants, which was changed to 30 in order to cover the drop-out. Patients were selected by random sampling method, and then were randomly assigned into two groups of 30 patients, using the intervention and control groups. In order to ensure the lack of communication between the participants in the intervention and control groups, the participants were selected in two separate days. Random group assignment was performed with a coin toss, i.e., even days were assigned into the intervention group and odd days were assigned into the control group.

Inclusion criteria were as follows: 1) age range between 18 and 65 years, 2) undergoing hemodialysis for at least six months and double three-hour sessions per week, 3) lack of acute and chronic infections, inflammatory diseases, and malignancies, and 4) no cognitive and psychological disorders. Exclusion criteria included: 1) the inability of the patient to regularly participate in the training program, 2) changes in clinical status of the patient, 3) the inability to comply with the proposed diet, 4) need admission, 5) need to receive emergency interventions, 6) participation in other training courses during the study, and 7) the patient mortality. All the information was recorded through interviewing with the patients and checking their medical records by the researcher.

### 2.3. Instruments

For data collection, this study employed demographic characteristics questionnaire, Subjective Global Assessment, Kt/V (Clearance time/Volume) index, and a weighing scale.

Demographic characteristics questionnaire included information, such as gender, literacy level, vascular access type, number of hemodialysis sessions per week, underlying diseases, duration of hemodialysis, and the patient's age and weight.

Subjective global assessment, which was initially used by Detsky et al. (1987) to assess the nutritional

status of surgical patients,[31] is one of the most common and widely accepted qualitative tools for assessing the nutritional status of patients undergoing dialysis.[8] This tool is recommended by the National Kidney Foundation in the clinical guideline of Kidney Disease Outcomes Quality Initiative (NKF KDOQI) to assess the nutritional status of patients on dialysis,[32] which consists of two parts, namely the medical history and physical examination. The medical history entails five parts which are as follows: evaluating weight changes in the previous six months and in the last two weeks, evaluating the amount of energy and types of food, assessing the duration and frequency of gastrointestinal symptoms such as nausea, vomiting, diarrhea, and loss of appetite, evaluating the physical activity and its variations in the past two weeks, and evaluating the number and severity of conditions such as physical injuries, burns, inflammatory diseases, infections, and malignancies.[33] Physical examination section consists of three parts including analysis and visual assessment of subcutaneous tissue in the area under the eyes, the biceps and triceps muscles, the analysis of the temporal muscle mass, clavicle notch, and upper shoulder area, and the assessment of edema as well as ascites and its intensity.[33] Based on the examination, each part is rated with A, B, and C scores in case it is not impaired (in natural state), moderately impaired, and severely impaired, respectively. The severity of the level of impairment depends on the evaluator's opinion and the variation range specified in the tool. For instance, 10% weight loss is scored as C, 5-10% weight loss is scored as B, and 5% < weight loss is scored as A. For calculating the final score, if most of the components get an A score, the questionnaire's score will be A and the nutritional status of the subject is rated appropriate. If most parts get a B score, questionnaire's score will be B and patient is suffering from mild to moderate malnutrition. Similarly, if most of the parts get a C score, questionnaire's score will be C and the individual is severely malnourished.[33, 34] In Afaghi's study (2014), this questionnaire was filled in for 20 patients twice within 30 days interval, which showed 0.85 of coefficient agreement between the two times of measurement.[35] Since the instrument used in this study is observational and qualitative, inter-rater agreement was utilized to determine the reliability of the tool. For this aim, two assessor used the instrument simultaneously and independently for 10 hemodialysis patients and coefficient agreement between assessors was measured to be 78%.

Kt/V index was used to assess the adequacy of dialysis. This index is a ratio without unit that reflects the volume of plasma cleared over volume of urea distribution at the time of dialysis.[36] According to the NKF-DOQI, the Kt/V target for patients with three times a week dialysis was 1.4 and the least acceptable rate was 1.2 in 2015.[36] Furthermore, dialysis adequacy was calculated on the basis of Daugirdas II formula.[37]

To evaluate the nutritional status and dialysis adequacy of the patients prior to the intervention, the researcher investigated the patients' medical records, interviews, and observations in both the intervention and control groups. Additionally, blood samples were obtained to register urea nitrogen levels. Based on the NKF-DOQI recommendations, blood sampling was performed before diluting the blood with normal saline or heparin, using arterial needles. At the end of dialysis, pump speed was reduced to 100 ml/min and the arterial needle sampling was performed 15 sec after stopping the pump. This was done to ensure that the blood in the tubes would not re-entered and be obtained for the sample.[37] All the samples were analyzed by the same operator in the laboratory of the same center. The devices were used after being tested for their appropriate function and accuracy of performance (calibrated according to the manufacturer's instructions).

To evaluate body weight, a digital scale (Dand brand) was used. The scale was calibrated before being used. The reliability of the scale was evaluated through measuring the weight of a standard one kilogram weight for ten times and correlation coefficient of 1 was obtained. It was attempted to establish the same conditions for measuring patients' weight (no shoes and light clothing on).

### *2.4. Data Collection*

While the patients in the control group received only routine training, those in the intervention group received integrated trainings along with the routine care and training. The educational content for the intervention group was derived from reliable scientific sources,[1, 6, 38, 39] which was approved by ten experts in the field of nutrition and renal disorders (Table 1).

Trainings were held in five sessions (individual and group trainings) simultaneously with hemodialysis within two consecutive weeks. Moreover, group sessions were held with two to three patients in the vicinity. Group sessions lasted 30 min, whereas the individual sessions were about 5-10 min, which sometimes changed based on the need and desire of the individuals. At the end of the sessions, the patients were given training pamphlets, which covered the provided educational content.

After completing the training intervention, the researcher called the patients every week during the

first month and every two weeks during the second month to answer their questions and stress their compliance with the recommended diet. In the end, for ethical reasons, training pamphlets were provided to the patients in the control group.

With frequent face to face and telephone follow-ups for synchronizing patients' hemodialysis with the time of the post-test, the information required for evaluating nutritional status and dialysis adequacy in both intervention and control groups were collected one and two months after the intervention.

### 2.5. Ethical considerations

At the beginning of the study, when the patients visited the hospital for hemodialysis, the study objectives were individually explained for each patient participating in the study. In addition, they were assured that participation in the study is completely voluntary and lack of cooperation would not have any effect on their routine treatment. They were also ensured that the researcher would be available during the whole study and would respond to the likely questions and needs of the patients. Subsequently, the researcher obtained the participants' informed consents for participating in the study.

### 2.6. Statistical analysis

For the purpose of data analysis, this study used descriptive statistics methods, Fisher's exact tests (comparing the groups in terms of gender, education, type of vascular access, number of weekly dialysis sessions, and SGA levels), independent t-test (comparing the age, duration of hemodialysis, weight, and Kt/V between groups), repeated measures ANOVA (within-group analysis of Kt/V variations), Scheffe's test (comparing the values of Kt/V over months), McNemar's test (comparing dietary changes over months), chi-square test (comparing the groups in terms of the underlying disease), and Cochran's Q test (analyzing the SGA changes within groups). The analysis was performed, using SPSS version 21.

**Table 1.** Contents of the integrated training sessions

| Session No. | Type of training | Method of training | Educational content |
|---|---|---|---|
| First | Individual training | Lectures with questions and answers | Assessing training requirements according to the interviews and evaluating the result of the experiments |
| Second | Group training (consisting of 2-3 individuals) | Lectures with questions and answers<br>Using experienced patients<br>Providing pamphlets | The importance of nutrition in hemodialysis<br>Dos and Don'ts in nutrition<br>Understanding the complications as the result of non-compliance with diet |
| Third | Individual training | Lectures with questions and answers | Emphasizing on nutritional training requirements based on the underlying disease and the initial assessment<br>Answering the questions |
| Fourth | Group training (consisting of 2-3 individuals) | Lectures with questions and answers<br>Using experienced patients<br>Providing pamphlets | The importance of aerobic and anaerobic exercises in hemodialysis<br>Appropriate exercise during dialysis and after dialysis<br>The importance of vascular access care<br>Training on how to care for vascular access<br>Importance of the drug regimen |
| Fifth | Individual training | Lectures with questions and answers<br>Providing pamphlets | Emphasizing training requirements based on the underlying disease and the initial assessment<br>Answering the questions |

## 3. Results

Based on the exclusion criteria, four patients were excluded from the study due to kidney transplantation and mortality. Consequently, the study ended with 27 patients in the intervention group and 29 patients in the control group. Demographic characteristics of the participants are shown in Table 2. As the results indicated, there were no significant differences between the variables in the two groups prior to the intervention.

In this study, the adequacy of dialysis in the intervention and control groups changed from 1.21 ± 0.27 to 1.35 ± 0.28 (P=0.007) and 1.37 ± 0.27 to 1.36 ± 0.29 (P=0.061), respectively. According to Scheffe's test, the variations of dialysis adequacy in the intervention group were not significant in the first month, compared to the pre-intervention period (P=0.19). However, these variations significantly increased in the second month, compared to the first month (P=0.005) and before the intervention (P=0.043) (Table 3).

Based on nutritional evaluation, none of the subjects had severe malnutrition; however, 74.1% of the patients in the intervention group and 55.2% of those in the control group had mild to moderate malnutrition at the beginning of the study. Nutritional status in the intervention group was significantly improved during the study (P<0.0001). Furthermore, McNemar's test and Bonferroni correction demonstrated that dietary variations in the intervention group were significant in the first (P=0.004) and second months (P=0.002),

compared to the pre-intervention period. Nevertheless, concerning the control group, these variations showed no significant difference in the first month, compared to the second month(Table4).

**Table 2.** Demographic characteristics of the participants

| Variables | Group | Intervention | Control | P-value |
|---|---|---|---|---|
| | | N.(%) | N.(%) | |
| Gender | Male | 12(44.4) | 18(62.1) | * 1.86 |
| | Female | 15(15.6) | 11(37.9) | |
| Education | Primary education | 20(70.1) | 21(72.4) | *0.55 |
| | Diploma | 4(14.8) | 6(20.7) | |
| | Higher education | 3(11.1) | 2(6.9) | |
| Vascular access | Fistula | 17(63) | 25(86.2) | *0.56 |
| | Two-channel catheter | 10(37) | 4(13.8) | |
| The number of dialysis sessions per week | Two sessions | 9(33.3) | 13(44.8) | *0.42 |
| | Three sessions | 18(66.7) | 16(55.2) | |
| Underlying disease | Diabetes mellitus | 8(29.6) | 10(34.5) | **0.3 |
| | Hypertension | 7(25.9) | 5(17.2) | |
| | Diabetes and hypertension | 5(18.5) | 5(17.2) | |
| | Other diseases | 7(25.9) | 9(40) | |
| Duration of hemodialysis | M±SD | 49±39.52 | 47.73±37.72 | ***0.9 |
| Age (years) | M±SD | 57.6±11.33 | 56.9±12.42 | ***0.82 |
| Weight (kg) | M±SD | 69.51±13.84 | 61.51±19.3 | ***0.082 |

*Fisher's exact test, **Chi-square test, ***Independent t-test

**Table 3.** Comparison of hemodialysis adequacy of the patients in both groups pre- and post-intervention

| Group | Intervention | Control | *P-value |
|---|---|---|---|
| **Dialysis adequacy** | **M±SD** | **M±SD** | |
| **Before the intervention** | 1.37±0.27 | 1.21±0.27 | 0.0064 |
| **A month after the intervention** | 1.26±0.32 | 1.26±0.28 | 0.94 |
| **Two months after the intervention** | 1.36±0.29 | 1.36±0.29 | 0.93 |
| ****P-value** | 0.007 | 0.006 | |

*Independent t-test, **Repeated measures ANOVA

**Table 4.** Comparison of the nutritional status of the hemodialysis patients in both groups pre- and post-intervention

| Nutrition / Group | Intervention | | Control | | *P-value |
|---|---|---|---|---|---|
| | Appropriate | Mild malnutrition | Appropriate | Mild malnutrition | |
| | No.(%) | No.(%) | No.(%) | No.(%) | |
| **Before intervention** | 7(25.9) | 20(74.1) | 13(44.8) | 16(55.1) | 0.14 |
| **One month after intervention** | 16(59.2) | 11(40.7) | 14(82.2) | 15(51.7) | 0.41 |
| **Two months after intervention** | 20(74.1) | 7(25.9) | 17(56.6) | 12(41.3) | 0.22 |
| ** P-value | <0.0001 | | 0.0074 | | |

*Fisher's exact test, **Cochran's Q test

## 4. Discussion

The findings of the current study suggested that the integrated training might lead to improvement in nutritional status of the hemodialysis patients. Morante et al. (2014) reported that nutritional training, in addition to improving nutritional knowledge, could lead to improved nutritional laboratory parameters such as albumin, ferritin, iron, cholesterol, triglycerides, creatinine, and urea two months after the study.[12] In addition, Garagaza et al. (2015) introduced individual nutritional counseling as a factor improving the laboratory indices related to nutrition such as albumin, calcium, phosphorus, and potassium a month after the study,[22] which is in line with the results of the current study. This similarity may be due to the fact that in chronic diseases, patient's understanding of the etiology of disease and its aggravating and mitigating factors plays a critical role in patient's active participation in self care and treatment acceptance.[40]

In a study conducted by Moattari et al. (2012), patient training, which aimed to empower the patients for performing self care, did not improve nutritional serum parameters, which is inconsistent with the results of this study.[41] This difference can be due to the repeated follow-ups in the present study since tracking could be a useful tool for exchanging of information, training patients, answering their

questions, and ensuring the patients and their family.[25]

Based on our findings, the integrated trainings resulted in improvement of dialysis adequacy in these patients. Moreover, in a study conducted by Talebpour and Husseini (2001), nutrition training, performed to improve dialysis adequacy, led to similar results to those of the present study.[42] Perhaps the similarity of the results is due to similar employment of training sessions, educational pamphlets, and follow-ups in the two studies. In line with this study, Saei et al. (2012) demonstrated that integrated method training, using continuous care model resulted in improvement of dialysis adequacy in the intervention group.[30] The reason for reaching the same results in these two studies may be related to the duration of follow-up training and the use of similar educational material on the diet, protecting vascular access, and the recommended exercises during hemodialysis. However, Reddy et al. (2009) reported that nutritional training did not result in any significant change in dialysis adequacy after one month of intervention,[43] which is not in line with the results of the present study. This difference can be ascribed to the short duration of the intervention and evaluating the adequacy of dialysis only one month after the intervention.

Mohseni et al. (2013) stated that the inclusion of physical exercise to the training program during dialysis leads to improvement in patient's adequacy of dialysis.[44] The results of the mentioned study are consistent with those of the present study, which is probably due to the similarity in the method of performing the exercise, its duration, and the follow-up period after the intervention. Likewise, Parson et al. (2006) reported that adding exercises to the training program improved adequacy of dialysis and patients' physical fitness,[45] which is consistent with the result of the current study. The reason for this similarity could be due to the nature of the exercise since exercise can result in the removal of more wastes out of tissues into the vascular bed by increasing cell membrane permeability to water soluble molecules such as creatinine, enhancing the blood flow to active muscles, and boosting the dilated capillaries near the surface of the skin, which finally improve the adequacy of dialysis.[46, 47] However, some studies rejected the significant and positive influence of education on nutrition and dialysis adequacy. Afshar et al. (2010) reported no significant changes in the adequacy of dialysis despite using trainings and exercises within the same time period as this study,[46] which is not consistent with the results of this study. A possible cause of this difference may be due to the factors affecting the patient's adequacy of dialysis, such as pump's circulation speed, vascular access function, type of buffer, filter type, and duration of dialysis, which can have a significant impact on the adequacy of dialysis. However, in the present study, the integrated training was used, which partially embodied physical exercise. Riahi et al. (2012) evaluated the effects of training program combined with exercises during hemodialysis on improving dialysis adequacy, which resulted in no significant change in dialysis adequacy.[47] The mentioned study is also inconsistent with the results of the present study and the cause of this difference is probably due to difference in the duration of hemodialysis. In the mentioned study, the patients were hemodialyzed for at least 3 years, while those in the present study had only 3 months of dialysis. Longer duration of treatment with dialysis and longer-terms of vascular access could lead to impaired blood flow.[48]

In a study by Su et al. (2009), which was conducted on peritoneal dialysis patients, integrated training did not lead to improvement of dialysis adequacy or nutrition; however, it increased the patients' self-care knowledge,[49] which is not in line with the results of the present study. These differences are probably related to the study population, lack of training on sports activities, and other effective factors in improving the adequacy of peritoneal dialysis.

In this study, it was not possible for the researcher to use the identical dialysis machines for all the patients in evaluating the adequacy of dialysis. Moreover, patients' personal differences might have affected the outcomes of the study, which is considered as a limitation of the study.

## 5. Conclusion

The results of this study suggested that integrated training can improve dialysis adequacy and nutritional status of the hemodialysis patients. As a result, regarding the nurses' special role in patient training and their contact with the patients, they are recommended to apply the integrated training methods. It is also suggested to conduct similar studies with random sampling method and longer follow-ups for evaluating the reliability of the trainings.

## Conflicts of interest

The authors declare no conflicts of interest.

## Authors' contributions

Mojtaba Rayati: Design and implementation of the study, drafting the article. Maryam Jadid Milani: Participation in the implementation of the study and drafting the article. Amir Hosein Pishgooei: Drafting

the article, data analysis. Maryam Pakfetrat: Participation in the implementation of the study and drafting the paper.

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