

## **Effect of Tele-Nursing Education Intervention on Knowledge and Adherence to Therapeutic Regimen of Hemodialysis Patients**

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**Abstract: Background:** Tele-nursing is considered one of the most important technological events of the late century as the gateway to the modern nursing care to improve patients' knowledge and adherence to therapeutic regimen. Purpose of the study was to examine the effect of tele-nursing education intervention on knowledge and adherence to therapeutic regimen of hemodialysis patients. **Design:** A quasi-experimental (study and control group) with pre and post research design was used. **Setting:** This study was conducted at kidney dialysis unit at AL Shuhada Central Hospital and kidney dialysis unit affiliated with the Association for the Preservation of the Holy Quran at Al Shuhada district, Menoufia Governorate, Egypt. **Sample:** A purposive sample of 100 hemodialysis patients who was assigned randomly into two equal groups (study group and control group 50 subjects for each one). **Instruments for data collection:** - A structured interviewing questionnaire including socio-demographic characteristics as well as patients' knowledge about kidney and chronic kidney diseases questionnaire and adherence to therapeutic regimen questionnaire. **Results:-** There was a significant improvement in mean scores and levels of knowledge and adherence to therapeutic regimen at post-test1 and post-test 2 than pre-test of tele-nursing education intervention among the study group compared to the control group. **Conclusion:** Tele-nursing education intervention was an effective method to improve hemodialysis patients' knowledge and adherence to therapeutic regimen among the study group compared to the control group. **Recommendation:** Empowering nurse practitioners with tele-nursing knowledge and hands-on skills through training programs.

**Key words:** *Adherence to therapeutic regimen, Hemodialysis, Knowledge, Tele-nursing educational intervention*

### **Introduction**

Hemodialysis (HD) is a vital and lifesaving procedure represents the main therapeutic modalities for treatment of chronic kidney diseases

gives more chance of living to the patients, filters waste, removes extra fluids and electrolytes from the body using a semipermeable artificial

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membrane through ultrafiltration and diffusion to maintain fluid and electrolytes in normal homeostasis. Water molecules and low-molecular-weight solutes can pass through membrane pores, but larger solutes as proteins cannot pass through semipermeable barrier (Priyadharshini, 2019).

Disease related knowledge for patients undergoing HD is a vital part for patients' health. Many benefits associated with improving HD patients' knowledge include improving ability to manage them-selves, empowering individuals to become confident enough to make medical decisions and improving adherence to therapeutic regimen (Glyde et al., 2019).

Inadequate awareness remains a major gap in caring for hemodialysis patients. Web-based learning, virtual support groups, text-based outreach, health apps and online group classes for HD education offer a complementary solution to many care gaps. Another trial of dialysis modality education via tele-health revealed remarkable success, where 90% of patients were able to make an informed decision and home modality choices doubled (Easom et al., 2020).

Tele-education has the potential to deliver patient education to more patients over a wider geographical area in a cost-effective manner through real-time interactive video technologies and provides the virtual bridge needed to connect patients in need of education to specialists not available in their community or region. Tele-education simplifies resource allocation and patient access to educational program (Easom et al., 2020).

Hemodialysis patients need to be adherent to the therapeutic regimen that includes adherence to the

prescribed medications, diet, fluid restriction and attendance to HD sessions. Non-adherence to prescribed regimen is a common problem among HD patients and is associated with increasing morbidity and mortality (Canaud & Vienken, 2018).

World Health Organization defines adherence as the extent to which the persons' behavior including medication-taking corresponds with agreed recommendations from a healthcare provider, includes the initiation of the treatment, implementation of the prescribed regimen and discontinuation of the pharmacotherapy. Unfortunately, poor adherence to HD is a prevalent problem in health care that has considerable medical, social and economic consequences among HD patients (Naalweh et al., 2017).

Failure to adhere to the therapeutic regimen is a common problem among patients with chronic diseases, including HD ones. Most HD patients don't stick to their treatment plan. HD patients' adherence to the recommended treatment plan is influenced by a variety of variables, including awareness of the recommended treatment plan, socioeconomic factors, health beliefs, attitude towards therapy and culture. Patients find it challenging to follow dietary guidelines, hydration limits and medications and failure to do so increases risk for various dangers (Ghanbari et al., 2017).

Nowadays, one of the continuous control methods of chronic diseases as end stage renal diseases (ESRD) is the emphasis on strengthening self-care behaviors through use of new technologies. One of these technologies is the use of tele-nursing. Tele-nursing is provided through a wide range of communication technologies as phone, fax, email,

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internet, remote monitoring tools and video clips to overcome the time and distance obstacles to provide better nursing care and other activities as education, patient monitoring, nursing tele-consultations, review of medical tests results and assist physicians in implementation of medical treatment protocols (Mohsen et al., 2020).

Since nurses are the most in touch with patients during HD, they can assist in establishing continuous and dynamic relationship with patients through teaching HD patients using tele-nursing, nursing interventions conducted by means of communication media. This technique saves patients' time and provides the opportunity to educate them remotely. Thus, those living in rural areas are no longer obliged to travel long distances and consequently, both medical costs and self-referrals to the emergency department decrease (Poorgholami et al., 2016).

### **Significance of the study**

Although rapid development of HD technology leads to significant increase in the life expectancy of patients with ESRD, it doesn't change process of the underlying disease. Thus, the patients suffer from some complications as anemia, decrease aerobic capacity, imbalance in body homeostasis, decrease muscle strength and function, infections, increase in duration and number of hospitalizations and impose high costs on patients and health care systems. Ultimately, these problems and complications may have negative impact on HD patients' health (Huang et al., 2019).

Globally, HD is the commonest form of RRT in the world, accounting for 69% of all RRT and 89% of all dialysis (Bello, 2019). Moreover, a study conducted by Amouzegar et al., (2021) to assess "International society of

nephrology global kidney health atlas: structures, organization and services for the management of kidney failure in the Middle East" showed that prevalence of long term HD in some middle east countries as Saudi Arabia was 826 pmp, 152 pmp in the United Arab Emirates, 668.5 pmp in Lebanon and Qatar was 296.4 pmp.

Also, the Annual Report of the Egyptian Renal Data System representing seventy-four dialysis units from 17 Egyptian Governorates who participated with their data with a total number of 6,757 patients estimated that the prevalence of HD in Egypt is 0.61 per 1,000 people with an incidence estimate of 0.192 per 1,000 people (Hassaballa et al., 2022).

Hemodialysis process performed at the hospital or the community services need full monitoring of the patient's progress. The problem occurs when HD patients are not monitored and managed after HD process. Therefore, HD patient management should be a continuous process through using tele-health applications to provide some benefits in more systematic and efficient way to improve care and access to health information, encourage healthy behavior and increase patient participation. Also, it provides an easy and flexible interface for storing patient data and facilitating patient information management (Tohid & Ibrahim, 2021).

### **Purpose of the study:**

The purpose of this study was to examine the effect of tele-nursing education intervention on knowledge and adherence to therapeutic regimen of hemodialysis patients.

### **Operational definition:**

- Tele-nursing  
Defined as using smart phone and social network including Whats-app in providing nursing services

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whenever physical distance exists between the patients and the nurse.

- Adherence to therapeutic regimen  
Defined as commitment of the patients to attend hemodialysis sessions, follow prescribed medications and adhere to fluid and food restrictions.

### **Hypotheses:**

- Knowledge mean score of the study group who receive tele-nursing education will be higher than the control group.
- Adherence to therapeutic regimen mean score of the study group who receive tele-nursing education will be higher than control group.

### **Methods**

#### **Research design:**

A quasi experimental research design (study and control group) with pre and post- test was utilized to achieve the purpose of the study.

#### **Research setting:**

This study was conducted at kidney dialysis unit at AL Shuhada Central Hospital and kidney dialysis unit affiliated with the Association for the Preservation of the Holy Quran at Al Shuhada district, Menoufia Governorate.

#### **Sample:**

A purposive sample of 100 adult patients who are on hemodialysis divided randomly into two equal groups (study group and control group 50 subjects for each one) according to the following criteria.

#### **Inclusion criteria:**

- Patients' age should range between 18 to < 60 years.
- Patients of both sexes who are on regular hemodialysis treatment
- Patients who are fully conscious and free from any life threatening conditions.

- Patients who have ability to read and write and use the internet and mobile phones by themselves or by family members.
- Patients who are not participating in any study before.

#### **Sample size and power of the study:**

Epi website (Open Source Statistics for Public Health) was used, with the equation.

Sample size (n) =  $[DEFF * Np(1-p)] / [(d^2 / Z^2_{1-\alpha/2} * (N-1) + p * (1-p))]$  with the following assumptions.

- Two sided confidence level of 95% =  $(1 - \alpha)$ .
- A power  $(1 - \beta)$  or (% chance of detecting) of 80%.
- Ratio of sample size, unexposed (control), exposed (study group) = 1 %
- Percent of unexposed with outcome (awareness) = 15%
- Then the researcher entered one of four parameters which was % of exposed = 25 % and the others three parameters would be calculated by the Epi website program.

#### **Instruments of the study:**

The instruments used for data collection included the following:

#### **I. Socio-demographic characteristic of the study subjects:-**

It included eight items such as name, age, telephone number, gender, educational level, occupation, income and residence.

#### **II. Patients' knowledge about kidney and chronic kidney diseases**

#### **questionnaire:-**

This questionnaire was developed by the researcher after pertinent literatures as Ahmed et al., (2021); Hamza et al.,

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(2022). It consisted of 48 items, six items about function of the kidney, four items about risk factors for chronic kidney diseases, seven items about medications that impair kidney function, three items about investigations to determine kidney function, five items about signs and symptoms of chronic kidney diseases, seven items about complications of chronic kidney diseases, ten items about food and fluid restrictions for hemodialysis patients, one item about weight gain between hemodialysis sessions and four items about vascular access care.

### **Scoring system**

Response of these questions was in a form of yes or no or don't know, correct response scored 1 and incorrect or don't know response scored zero. Knowledge's grand total score ranged from 0 to 48. Knowledge was categorized into three levels as poor knowledge when the subjects achieved less than 60% of the total score, fair knowledge when the subjects achieved from 60% to 75% of the total score and good knowledge when the subjects achieved > 75% of the total score.

Reliability was applied by the researcher for testing internal consistency of its questions. Test-retest reliability was done using 10 subjects during pilot study with two weeks apart between them and correlation coefficient (Cronbach's alpha) was calculated between the two scores. The Cronbach's alpha coefficient test for knowledge was 0.84 that indicated the tool was reliable.

### **III. Adherence to therapeutic regimen for hemodialysis patients'**

#### **questionnaire:-**

This questionnaire adopted from Alikari et al., (2018) to assess adherence to therapeutic regimen of

patients with hemodialysis. It consisted of eight items exploring three dimensions of hemodialysis adherence, first dimension concerned with medication adherence included four items from 1 to 4. Second dimension concerned with attendance at hemodialysis session included two items from 5 to 6. Third dimension concerned with diet and fluid restrictions included two items from 7 to 8.

### **Scoring system**

Response of questions number one, two and three was in a form of yes or no while response of question number four was in a form of four options and response of questions number five, six, seven and eight was in a form of five options. Correct response scored 1 and incorrect response scored zero. Grand total score ranged from 0-8. Higher scores reflected good adherence to HD regimen. Total adherence to therapeutic regimen score was categorized into two levels as poor adherence when the subjects achieved  $\leq 50\%$  of the total score and good adherence when the subjects achieved more than  $>50\%$  of the total score.

Reliability of the instrument, Cronbach's alpha coefficient test for adherence to therapeutic regimen of patients with hemodialysis was 0.751 that indicated the tool was reliable.

### **Validity of data collection instruments:-**

The validity of the study instruments was determined by three panels of specialists in the fields of community health nursing, community medicine; medical and surgical nursing. Changes were made in response to the panel's suggestions regarding the accuracy of the statements and the relevance of the contents.

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**Ethical consideration: -**

- A written approval of Ethical Research Committee obtained from Faculty of Nursing, Menoufia University.
- Oral and written informed consent was obtained from the study subjects. The subjects who agreed to participate in the study were assured about confidentiality and anonymity of the study. They were informed about their right to withdraw from the study at any time without giving a reason. Also, the purpose of the study was clarified for the subjects by the researcher.

**Pilot study: -**

Before starting data collection, a pilot study was carried out on 10% of the sample size (10 patients) that met the criteria of the study to assess clarity, applicability, feasibility of the study and time needed to fill the tool. The needed modifications were done as revealed from the pilot study. The subjects of the pilot study were excluded from the study sample.

**Procedure for data collection: -**

- A letter was submitted from the dean of the Faculty of Nursing, Menoufia University to directors of kidney dialysis unit including the purpose and methods of data collection.
- Data were collected throughout four months starting in February and completed in May 2023.
- After obtaining written and informed consent from kidney dialysis units' directors to conduct the study, the researcher made formal contact with the head nurses at kidney dialysis units to identify actual number, age of hemodialysis patients at each unit and schedule of

hemodialysis sessions.

- The study sample was selected according to inclusion criteria then were assigned randomly to the study and the control group according to the settings of the study.
- The study group randomly was assigned to kidney dialysis unit at AL Shuhada Central Hospital and the control group was assigned to kidney dialysis unit affiliated with the Association for the Preservation of the Holy Quran at Al Shuhada district.
- Hemodialysis sessions were held from 6 a.m. to 10 a.m., 11 a.m. to 3 p.m., and 3 p.m. to 7 p.m. at the study group's setting.
- Hemodialysis sessions were held from 7am to 11am, second session from 11am to 3pm at the control group's setting.
- The researcher met with the study subjects face to face and gave them a brief summary of the study's purpose and procedure for data collection.
- During pre-phase of the study, data collection were extended from the beginning of February to the middle of February, 2023, from the control group, while from the middle of February to the beginning of March, 2023, from the study group.
- The average number of the subjects from which data are collected each time was 8 subjects.
- The average time taken for completing questionnaire was about 25-30 minutes.
- The data obtained during the pre-phase were used as the baseline assessment.
- The researcher began to contact with the study group online through Whats-Apps.
- The study group was assigned to five groups on Whats-App, each group included ten subjects.

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- The educational intervention was developed by the researcher based on findings obtained from pre-test assessment that revealed hemodialysis patients had poor awareness and adherence to therapeutic regimen of hemodialysis patients.
- The educational intervention aimed to improve hemodialysis patients' knowledge and adherence to therapeutic regimen.
- The researcher first sent a soft copy of the booklet to the study group as a guide including important information about renal failure, hemodialysis, therapeutic regimen, nutritional and fluid awareness.
- Each patient in the study group received three educational sessions through WhatsApps with an average time for each session of 10 - 20 minutes and patients were allowed to send any question from 8 a.m. to 8 p.m. every day.
- Before any session, the researcher sent a power point related to defined element followed by audio recordings and text messages to clarify content of power point.
- First session was about adherence to nutritional and fluid regimen for patients with hemodialysis including importance of healthy nutrition, elements of balanced integrated food, adherence to nutrition for hemodialysis patients, nutrients and renal failure including potassium, phosphorus, protein, sodium, fibers, fluid restriction and effect of fasting on patients with hemodialysis.
- Second session was about medications adherence including medications important for patients with hemodialysis health, medications negatively affect patients with hemodialysis health and ways help patients to take medications on time.
- Third session was about vascular access care including types of vascular accesses, vascular accesses' danger signs require physician consultation and ways to care for vascular access.
- Data were collected for first post-test after one week of the educational intervention.
- Follow-up was conducted 3months later
- The control group not received any instructions during data collection procedure, but received routine care at hemodialysis unit.
- For ethical consideration the researcher provided the control group with the educational booklet at the end of the study.

**Statistical analysis:**

Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package version 22. Graphics were done using excel program. Quantitative data were presented by mean (X) and standard deviation (SD). It was analyzed using student t- test for comparison between two means, and ANOVA (F) test for comparison between more than two means. Qualitative data were presented in the form of frequency distribution tables, number and percentage. It was analyzed by chi-square ( $\chi^2$ ) test. Level of significance was set as P value  $\leq$  0.05 for all significant tests.

**Results**

**Table 1** shows that the majority of the control and the study groups are older than 40 years as the age between 40 to 49 years represented (32% and 48% respectively) with the mean age of the control group is  $42.80 \pm 9.2$  years and of the study group is  $42.9 \pm 9.2$  years with no significant difference between both groups.

Regarding to occupation, 42% of the

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control group not work as well as are house wives while the half of the study group (50%) not work. Also, 62% of the control group and 52% of the study group have not enough income. Moreover, regarding residence, 60% of the control group and 80% of the study group live in the rural areas with no significant difference between both groups.

**Figure (1)** reveals that majority of the control group (78%) and (80%) of the study group have secondary education.

**Table 2** highlights that there is highly statistical significance improvement in total mean score for each domain of knowledge ( $p < 0.0001$ ) as well as total knowledge mean score among the study group compared to the control group at post1 and post2 tele-nursing education intervention. Total knowledge mean score increased from  $24.2 \pm 2.6$  at pre intervention to  $34.6 \pm 4.2$  at post1 intervention to  $39.2 \pm 2.9$  at post2 tele-nursing education intervention and the difference was highly significant among the study group compared to the control group

( $P < 0.0001$ ). On the contrary, the control group's total knowledge mean score not present any improvement at all intervention phases.

**Figure 2** shows that at pre tele-nursing education intervention, 82% of the control group and 94% of the study group have poor knowledge, while good knowledge among the study group significantly increased from 46% at post 1 to 80% at Post 2 tele-nursing education intervention compared to the control group ( $P < 0.0001$ ).

**Figure 3** reveals that at pre tele-nursing education intervention, most of the control group (92%) and the study group (98%) have poor adherence to therapeutic regimen, while good adherence among the study group significantly increased from 2% at pre intervention to 62% at post1 to 96% at post2 tele-nursing education intervention ( $P < 0.0001$ ) compared to the control group with no improvement for the control group at all phases of the intervention.

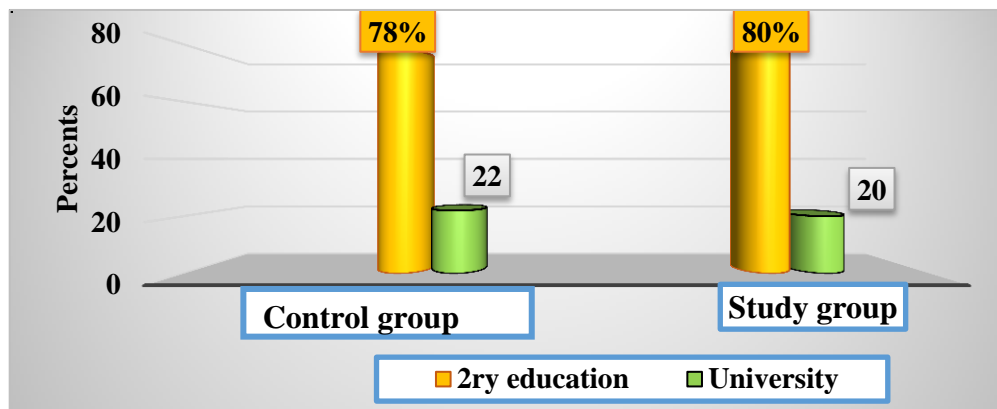
**Table 1: Distribution of the studied patients according to their socio -demographic characteristics (N = 100)**

Socio demographic characteristics	Control group		Study group		$\chi^2 / LR$	P value
	No.	%	No.	%		
<b>Age (years):</b>						
20-	3	6	4	8	3.3	0.34 NS
30 -	15	30	11	22		
40 -	16	32	24	48		
50- <60 years	16	32	11	22		
<b>Mean <math>\pm</math> SD</b>	42.8 $\pm$ 9.2 Y		42.9 $\pm$ 9.2 Y		t= 0.03	0.97
<b>Gender:</b>						
Male	24	48	32	64	0.36	0.54 NS
Female	26	52	18	36		
<b>Occupation:</b>						
Not work	21	42	25	50	2.4	0.59 NS
Housewives	21	42	19	38		
Employee	1	2	5	10		
Free business	7	14	1	2		
<b>Income:</b>						
Enough	31	62	26	52	1.2	0.31 NS
Not enough	19	38	24	48		
<b>Residence:</b>						
Urban	20	40	10	20	1.9	0.16 NS.
Rural	30	60	40	80		
<b>Total</b>	50	100	50	100		



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**Fig.1: Percent distribution of education of the studied patients with hemodialysis (N=100)**



**Table 2: Distribution of studied patients according to knowledge about kidney and chronic kidney diseases mean scores pre intervention, post1 and post2 intervention (N = 100)**

Knowledge about kidney and chronic kidney diseases.	Pre intervention		Post1 intervention		Post2 intervention		Test of Significant -P Values		
	Control group	Study group	Control group	Study group	Control group	Study group	T test P1	T test P2	T test-P3
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD			
Functions of the kidney	2.34 ±0.68	2.20±0.34	2.34±0.68	4.12±0.65	2.34±0.68	6.78±0.46	t =1.4 P=0.18	t =4.5 P<0.0001	t =13.2 P<0.0001
Laboratory investigations to determine efficacy of the kidney	1.84 ±0.58	1.52±0.64	1.84±0.58	2.60±0.49	1.84±0.58	2.88±0.38	t =2.6 P<0.01	t =10.5 P<0.0001	t =7.2 P<0.0001
Medications that affect kidney functions	2.24±0.84	2.02±0.58	2.24±0.84	3.82±0.82	2.24±0.84	4.40±0.75	t =1.51 P=0.13	t =13.5 P<0.0001	t =9.5 P<0.0001
Factors increase risk to chronic kidney diseases	2.46±0.57	2.24±0.55	2.46±0.57	3.54±0.67	2.48±0.57	4.36±0.66	t =1.94 P=0.06	t =15.2 P<0.0001	t =8.6 P<0.0001
Symptoms of chronic kidney diseases	3.92±0.75	3.54±0.73	3.92±0.75	4.42±0.62	3.92±0.75	4.76±0.47	t =2.56 P<0.01	t =6.7 P<0.0001	t =3.51 P<0.001
Complications of chronic kidney diseases	4.74±0.69	4.92±0.48	4.74±0.69	5.12±0.47	4.74±0.69	5.34±0.51	t =1.51 P=0.13	t =4.89 P<0.0001	t =3.18 P<0.002
Foods that hemodialysis patients should avoided and weight gain between sessions	4.76±1.02	4.90±0.61	4.76±1.02	7.50±1.21	4.76±1.02	8.72±0.75	t =0.83 P=0.41	t =12.2 P<0.0001	t =22.2 P<0.0001
Care of vascular access site	3.04±0.49	2.98±0.42	3.04±0.49	3.52±0.54	3.04±0.49	3.94±0.23	t =0.65 P=0.51	t =11.6 P<0.0001	t =4.62 P<0.0001
Mean total knowledge	25.2 ±3.28	24.2±2.61	25.2 ±3.3	34.6±4.2	25.2 ±3.2	39.2±2.9	t =1.75 p =0.08	t =22.3 p<0.0001	t =15.5 p<0.0001

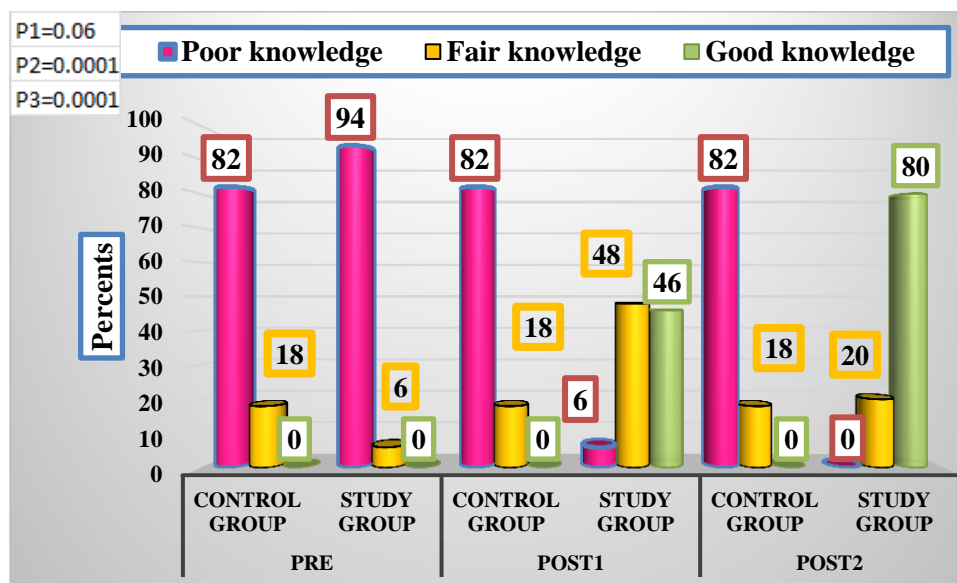
P1=Comparison between mean score of knowledge among the study and the control groups at pre tele-nursing intervention.

P2= Comparison between mean score of knowledge among the study and the control groups at post1 tele-nursing intervention.

P3=Comparison between mean score of knowledge among the study and the control groups at post2 tele-nursing intervention.

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**Fig.2: Levels of knowledge about kidney and chronic kidney diseases among the study and the control groups at pre, post1 and post2 tele-nursing education intervention (N=100)**



**P1**=Comparison between knowledge levels among the study and the control groups at pre tele-nursing education intervention.

**P2**= Comparison between knowledge levels among the study and the control groups at post1 tele-nursing education intervention.

**P3**=Comparison between knowledge levels among the study and the control groups at post2 tele-nursing education intervention.

**Table 3: Distribution of studied patients according to adherence to therapeutic regimen dimensions' mean scores pre intervention, post1 and post2 intervention ((N=100)**

Dimensions of adherence to therapeutic regimen	Pre intervention		Post 1 intervention		Post 2 intervention		Test of Significant -P Values		
	Control group	Study group	Control group	Study group	Control group	Study group	T test- P1	T test- P2	T test- P3
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD			
<b>Medication adherence</b>	1.72±0.7	1.6±0.4	1.72±0.6	2.3±0.61	1.72±0.6	4.48±0.57	t =1.8 P=0.06	t =3.5 P<0.0001	t =4.6 P<0.0001
<b>Attendance at hemodialysis session</b>	0.48±0.2 4	0.82±0.1 2	0.48±0.2 4	3.7±0.6	0.48±0.2 4	3.5±0.1	t =0.0 P=1.0	t =8.9 P<0.0001	t =12.5 P<0.0001
<b>Diet and fluid restrictions</b>	0.0±0.0	0.0±0.0	0.0±0.0	0.66±0.3 0	0.0±0.0	1.36±0.27	NA	t =6.8 P<0.0001	t =17.1 P<0.0001
<b>Mean of total adherence</b>	2.16 ±1.1	1.27±1.1	2.16 ±1.1	4.76±1.2	2.16 ±1.1	5.48 ± 0.76	t =1.6 p =0.09	t =9.8 p<0.0001	t =15.9 p<0.0001

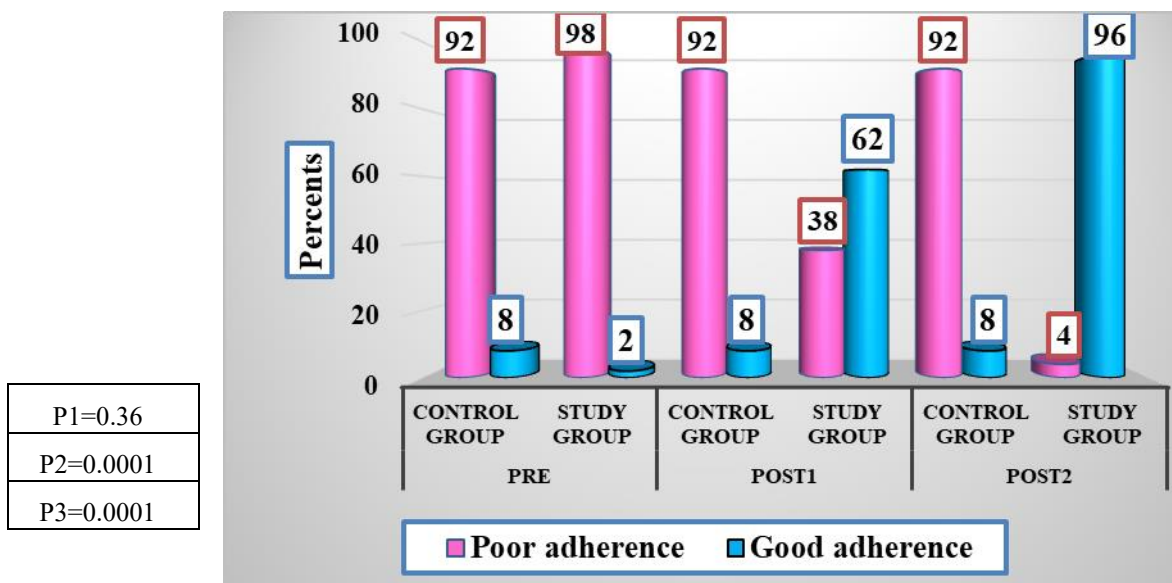
**P1**=Comparison between mean score of adherence to therapeutic regimen among the study and the control groups at pre tele-nursing education intervention.

**P2**= Comparison between mean score of adherence to therapeutic regimen among the study and the control groups at post1 tele-nursing education intervention.

**P3**=Comparison between mean score of adherence to therapeutic regimen among the study and the control groups post2 tele-nursing education intervention.

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**Fig .3: Levels of adherence to therapeutic regimen among the studied patients with hemodialysis groups at pre, post1 and post2 tele-nursing education intervention (N=100)**



P1=0.36
P2=0.0001
P3=0.0001

**P1**=Comparison between levels of adherence to therapeutic regimen among the study and the control groups at pre tele-nursing education intervention.

**P2**= Comparison between levels of adherence to therapeutic regimen among the study and the control groups at post1 tele-nursing education intervention.

**P3**=Comparison between levels of adherence to therapeutic regimen among the study and the control groups at post 2 tele-nursing education intervention.

**Discussion**

Caring for hemodialysis (HD) patients is intensive and expensive as HD alters the life of the patients dramatically. Tele-nursing may improve access and efficiency of HD care for the patients in their own homes or from remote facilities leading to improvement in the patients’ competency and ability to function (Rosner et al., 2017). Thus, the purpose of the current study was to examine effect of tele-nursing education intervention on self-efficacy, quality of life and adherence to therapeutic regimen of hemodialysis patients.

Regarding to knowledge of patients with hemodialysis, the current study findings revealed that before tele-nursing education intervention, most of the control and the study groups had poor knowledge with no statistical

difference between both groups, while there was statistical significant improvement in total knowledge mean score among the study group compared to the control group after tele-nursing education intervention ( $P < 0.0001$ ). These findings matched up with the study findings conducted in Australia by Stevenson et al., (2019) who studied “E-health interventions for people with chronic kidney disease” reported that total knowledge mean score was improved in the study group after the intervention compared to the control group ( $P < 0.0001$ ).

Also, the study findings came in agreement with the study finding conducted in the United States by Gordon et al., (2017) who evaluated “Effect of a mobile web app on kidney transplant candidates’ knowledge about increased risk donor kidneys”

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revealed that knowledge mean score of the study group increased after mobile web app intervention compared to the control group scores. Furthermore, the current study findings matched up with the study finding conducted in England by Cartwright et al., (2021) who assessed “E-health interventions to support patients in delivering and managing peritoneal dialysis at home” and showed that knowledge mean score of the study group increased compared to pre-intervention scores and to the control group.

Furthermore, the current study findings were consistent with the study findings conducted in Australia by Muscat et al., (2020) who studied “Supporting patients to be involved in decisions about their health and care: development of a best practice health literacy app for Australian adults living with chronic kidney disease” showed that after implementation of health literacy app there was statistical improvement in hemodialysis patients’ knowledge about diet, fluids, medication, physical activity, emotional well-being and supportive care to actively participate in self-management and decision-making ( $p < 0.001$ ).

Also, the current study findings were supported by the study findings conducted in Iran by Asl et al., (2018) who studied “Effectiveness of text messaging and face to face training on improving knowledge and quality of life of patients undergoing hemodialysis: a randomized clinical trial” illustrated that knowledge of text messaging group was significantly improved after intervention compared to the control group ( $P < 0.05$ ).

Pertaining to adherence to therapeutic regimen of patients with hemodialysis, the current study revealed that there was statistically significant improvement in therapeutic adherence

mean score from  $1.27 \pm 1.1$  at pre intervention to  $4.76 \pm 1.2$  at post 1 intervention to  $5.48 \pm 0.76$  at post 2 tele-nursing education intervention among the study group compared to the control group ( $P < 0.0001$ ). The current study findings were consistent with the study findings conducted in Iran by Saadatifar, et al., (2022) who studied “Effect of m-health training on treatment adherence in hemodialysis patients” revealed that adherence mean score of the study group increased from  $1067.50 \pm 122.24$  to  $1161.25 \pm 49.98$  after the intervention ( $P < 0.001$ ) with no improvement for the control group.

Also, the current study findings were matched up with the study finding conducted in Iran by Rajabfreydani et al., (2021) who examined “The effect of tele-nursing on adherence to diet in patients underling hemodialysis” reported that there were significant differences between mean dietary adherence among the study group before and after the intervention ( $P < 0.001$ ) compared to the control group. Moreover, the study findings were consistent with the study findings conducted by Fakhri El Khoury et al., (2020) who reported that the app had the potential to improve dietary intakes as the number of patients adhering to dietary guidelines increased after the intervention.

Furthermore, the current study findings came in agreement with the study findings conducted by Arad et al., (2021) who reported that there were no statistically significant differences in the mean scores of HD attendance, medication adherence, adherence to fluid restrictions and adherence to diet recommendations between the study and the control groups before the intervention however, the differences was statistically significant immediately, 1 month and 3 months

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after the intervention ( $P < 0.001$  for each).

Moreover, Arad et al., (2021) revealed that there was no statistically significant difference in mean score of overall treatment adherence between both groups before the intervention ( $P = 0.436$ ). However, the difference showed to be statistically significant among the study group immediately, 1 month and 3 months after the intervention compared to the control group ( $P < 0.001$ ).

### **Conclusion**

Based on the findings of this study, it was concluded that there was a significant improvement in mean scores and levels of knowledge and adherence to therapeutic regimen after tele-nursing education intervention among the study group compared to the control group.

### **Recommendations**

**Based on the study findings, the following important recommendations are proposed:**

- Integrating tele-nursing practice in providing continuous care and follow-up for HD patients.
- Empowering nurse practitioners with tele-nursing knowledge and hands-on skills through training programs.
- Providing hemodialysis patients with necessary knowledge and skills to improve their knowledge and adherence to therapeutic regimen.
- Designing mobile application for patients with hemodialysis.
- Further randomized controlled trials that compare varying elements and strategies for delivering tele-nursing practice for HD patients are needed.

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