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Predictors of Adherence to Treatment in Hemodialysis Patients: A Structural Equation Modeling

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Abstract

Background: Non-compliance to the treatment is a major problem in hemodialysis patients. This study aimed to determine factors predicting adherence to treatment in hemodialysis patients in selected cities of Khuzestan province, Iran..

Methods: This cross-sectional study was conducted on 500 patients undergoing hemodialysis in Ahvaz, Shush, Shushtar, and Dezful cities. The data collection tools were ESRD-AQ, perceived health, perceived social support, Beck Depression, self-efficacy, and demographic and clinical factors questionnaires. Data were analyzed using descriptive statistics, t-test, ANOVA, and Pearson's correlation coefficient. Structural equation modeling (SEM) was employed to analyze the relationship between various exogenous and endogenous or mediating variables.

Results: The results showed that all predicting variables of perceived social support, depression, self-efficacy, and perceived health had been associated with the variable of adherence to treatment. Accordingly, there was a reverse correlation between social support and depression ($p< 0.001$, $r= -0.94$), as well as depression and self-efficacy ($p< 0.001$, $r= -0.87$). There was a direct correlation between self-efficacy and perceived health ($p< 0.001$, $r= 0.79$), perceived health and adherence to treatment ($p< 0.001$, $r= 0.72$). Fitness indices also indicate the adequacy of the proposed model ($X2/df= 4.94$, $CD=0.937$, $SRMR=0.076$, $TLI= 0.870$, $CFI= 0.873$, $RMSEA= 0.071$).

Conclusion: The results showed that high social support, low level of depression, high perceived self-efficacy, and high perceived health predicted better compliance with the treatment in hemodialysis patients. The proposed model can be used as a framework to improve adherence to treatment regimens in hemodialysis patients.

Keywords: Dialysis, Social Support, Depression, Health, Self-Efficacy, Treatment Adherence And Compliance, Kidney Failure

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Introduction

Chronic kidney disease (CKD) is a term to describe kidney damage or reduce the amount of Glomerular Filtration Rate (GFR) for 3 months or longer (1), which is considered as one of the most important public health problems around the world (2). Accor ding to the latest international division, CKD is classified into 5 stages. In the fifth and final stage, the kidneys do not have the ability to dispose of waste due to body metabolism or regulatory

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↑What is "already known" in this topic:
Evidence showed that non-compliance to the treatment is a major problem in hemodialysis patients. Given the importance of following treatment in promoting the health and survival of these patients, identifying factors that predict behavior is very important for health professionals.

→What this article adds:
In this study, some factors that appeared to play a role in predicting treatment adherence were examined, and interesting evidence was obtained that could be considered by health professionals in encouraging hemodialysis patients to adhere to treatment.

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functions. This causes End-Stage Renal Disease (ESRD) which requires the treatments of dialysis or kidney transplant (3). The exact prevalence of ESRD is not available in many countries. The number of ESRD patients worldwide has been reported to be approximately 3,730,000 by the end of 2016, with an estimated 5 to 7 percent annual increase (4). According to statistics released by the Iranian Dialysis Consortium in 2016, the number of patients with renal failure was approximately 58,000 people (5).

Since hemodialysis cannot completely replace kidney function, patients' adherence to treatment is of particular importance in maintaining patient health (4). However, studies have shown that adherence to the treatment in these patients is not at a good level. According to studies, many studies have shown no adherence to dietary (56%), fluid restrictions (44%) and medication treatment (18-71%) in hemodialysis patients (6, 7); therefore, identifying the determinants of adherence to treatment in hemodialysis patients has been considered as researchers.

Research on patients with different medical conditions shows that the perception of disease and treatment, depression, the feeling of well-being (8), quality of life (9), social support (10) as well as self-efficacy (11) are among the factors influencing adherence to treatment in patients.

Depression with a prevalence of 20-30% is the most common problem in hemodialysis patients (12), and it has a direct relationship with non-adherence to treatment (13-15), reduced quality of life, functional disorders (12) and increased mortality (16). Health perceptions or a person's sense of well-being (17) is not only a reliable indicator of public health and well-being. It can predict future health status (18), mortality rate, and health care utilization (10, 11). On the other hand, an increase in perceived health and an increase in quality of life can be a factor in improving adherence to the treatment regimen in hemodialysis patients (19).

Other factors that affect treatment adherence in ESRD patients are perceived social support (20). Due to long-term treatment, patients gradually lose the support and attention of family and friends (21) which can affect adherence to the treatment. Some studies have shown that positive self-efficacy can improve attitudes and increase motivation to follow treatment (22), increase self-confidence, self-esteem, and sense of efficiency and thus improve self-care (23). Improving self-care leads to compliance with treatment and other activities to adapt to symptoms of illness and stress (24).

Although the available evidence has studied the relationship and role of different variables in treatment adherence individually, the simultaneous effect of these variables on the variable of treatment adherence has not been investigated. Therefore, the present study aims to test the hypothetical model of treatment predictors in hemodialysis patients.

Methods

This cross-sectional study was conducted between June and September 2019 at four dialysis centers in Ahvaz (Golestan, Emam Khomeini, and Razi hospitals), Shushtar (Khatam Alanbiae hospital), Dezful (Emam Hassan hospital), and Shush (Nezam Mafi hospital).

Since the structural equation model has been used in this study, according to the nature of these studies, the maximum possible sample size was used in this study (25). Therefore, the sample size consisted of 500 adult patients undergoing hemodialysis in selected hospitals of Khuzestan province who were selected through a convenience sampling method based on inclusion criteria. Inclusion criteria included age of 18 years or older and at least 3 months of hemodialysis treatment.

The data collection tools were the ESRD -Adherence Questionnaire (ESRD-AQ), perceived health (SF-12), Multidimensional Scale of Perceived Social Support (MSPSS), Beck Depression Inventory (BDI-II), General Self-Efficacy (GSE-10), and demographic and clinical information questionnaire.

Depression was measured by a short form of BDI. The BDI-II was designed and developed by Beck (1972) to measure depressive symptoms such as emotional, cognitive, motivational, and physiological depression (26). This questionnaire is a short 13-item self-report form that is graded on a four-choice Likert scale with a score range from zero to three. Therefore, the score of the subject in this questionnaire varies from 0 to 39, and a higher score indicates a higher rate of depression.

Perceived social support was measured by the MSPSS scale. This self-report 12-item scale was designed by Zimet et al. in 1988 which measures perceived support from three dimensions of a family (4 phrases), friends (4 phrases), and a significant other (4 phrases). The total score of this scale varies from 12 to 60. Getting a higher score means higher social support. A score between 12 and 24 indicates low social support, a score between 24 and 36 indicates moderate social support, and a score above 36 indicates high social support (27).

Self-efficacy was measured by the GSE-10 questionnaire. This questionnaire consists of 10 items with a four-choice Likert scale with a range of 1 to 4. The minimum and maximum scores of the whole questionnaire are 10 and 40, respectively. A score between 10 and 15 indicates low self-efficacy, a score between 15 and 25 indicates moderate self-efficacy, and a score above 25 indicates high self-efficacy (28).

Perceived health was measured by the SF12 questionnaire. This self-report questionnaire with two general dimensions of physical and mental health includes 12 questions in terms of physical performance, physical health, emotional problems and mental health (2 questions each), physical pain, vitality, social performance, and a general understanding of health (one question each). Each question score is based on a four-choice Likert scale with a range of 1 to 4. The sum of these scores shows the state of health perceived in the individual. A score between 12 and 14 indicates poor perceived health, a score between 25 and 36 indicates poorly understood health, and a score between 37 and 48 indicates well-understood health (29).

The ESRD-AQ was used to measure compliance with treatment, including 5 sections of general information about treatment (5 questions), acceptance of hemodialysis treatment (14 questions), acceptance of medication thera-

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py (9 questions), fluid restriction (10 questions), and the recommended diet (8 questions). The scoring of questions includes a combination of scoring, including the Likert scale, multiple-choice, and yes-no questions. The overall test score varies from zero to 1200, and a higher score indicates better treatment adherence (4).

Validity and reliability of instruments

The validity of the Persian version of the short form of the BDI has been confirmed by Rajabi et al. The reliability of the questionnaire was also reported using Cronbach's alpha coefficient by 0.89 for the whole questionnaire (30).

The reliability of the social support questionnaire was reported by Salimi and Bozorgpour using Cronbach's alpha coefficient for three dimensions of social support received by family, friends, and a significant other, .82, .86 and .86, respectively. They investigated the validity of the measures by factor analysis method (26).

The validity of the Persian version of the General Self-efficacy Questionnaire has also been confirmed by Rajabi et al. The reliability of the instrument has also been reported using Cronbach's alpha coefficient for the overall scale of 0.82 (30).

The validity and reliability of the Persian version of SF12 have been determined by Montazeri. Cronbach's alpha coefficient for the physical component was 0.73 and the mental component was 0.72 (31).

The content validity for the items of the ESRD-AQ questionnaire was calculated to be 0.98, which is a good score in terms of content validity; also, the reliability of the questionnaire was calculated to be 0.85, which is acceptable score (4).

Analysis of data

Data was analyzed by descriptive statistics, t-test, ANOVA, and Pearson's correlation coefficient using SPSS software (version 16, SPSS Inc., Chicago, IL, USA). The structural equations model (SEM) was applied to investigate the relationship between latent and observed variables. The fitting SEM was conducted by STATA-13 software with model parameters estimated using the maximum likelihood method. Model fit appraised by the goodness of fit indices: The Comparative Fit Index (CFI), $\chi 2/df$, Tucker–Lewis's coefficient (TLI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and Coefficient of Determination (CD).

CD is an incremental index with a value between 0 and 1. The higher this index, the better the model. CFI and TLI values range from 0 to 1, with larger values indicating better fit (32). The absolute fitness index (X2 / df) less than 2 indicates excellent fit, between 2 to 5 good fits, and greater than 5 indicates poor and unacceptable fit of the model (33). The RMSEA, the criteria recommended by Browne & Cudeck, were used. Thus, values above 0.1 indicate poor fit, between 0.08 and 0.1 medium fit, between 0.05 and 0.08 appropriate fit, and lower than 0.05 indicate excellent fit of the model (34).

Ethical Considerations

This study was approved by the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1398.266). Ethical considerations, including informed consent of the participants, explanation of the research goals, voluntary participation in the research, and confidentiality of participants' information, were taken into consideration.

Results

In the present study, 500 patients undergoing hemodialysis participated. The participants' mean (Standard Deviation: SD) age was 58.32 (15.44) with minimum and maximum ages of 20 and 91 respectively. The majority of the patients in the study were men (62%), married (61.8%), under diploma (78.4%), employed (43.4%), with moderate economic status (60.6%), and with a history of 6 to 10 years of dialysis (74.8%) (Table 1).

Results showed that most of the participants had severe depression (98.2%), high perceived social support (54.4%), and moderate self-efficacy (67%), perceived health (45.2%), and adherence to treatment (Table 2).

Regarding the relationship between demographic variables and the variables of self-efficacy, depression, perceived social support, perceived health, and adherence to

Table 1. Frequency (%) of demographic variables in the studied dialysis patients (n = 500)

Variable		Frequency	Percent
Gender	Male	310	62.0
	Female	190	38.0
Marital Status	Single	134	26.8
	Married	309	61.8
	Spouse died or divorced	57	11.4
Education Level	Illiterate	107	21.4
	Pre-diploma	392	78.4
	University degree or higher	1	0.2
Employment	Unemployed	195	39.0
	Employed	217	43.4
	Retired	88	17.6
Economic status	Low	45	9.0
	Middle	303	60.6
	Good	152	30.4
Dialysis duration	1-5 year	112	22.4
	6-10 year	374	74.8
	11-20 year	14	2.8

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Table 2. Mean (SD) and score range of predictor variables and adherence to treatment in the studied patients (n =500)

Variable	Mean (SD)	Range
Self-perceived health	21.68 (6.55)	10-40
Depression	29.34 (6.58)	12-38
Perceived social support	39.82 (12.16)	12-60
Perceived health	32.15 (7.38)	12-44
Adherence to treatment	720.7 (246.64)	200-1200

SD: standard deviation

treatment, the findings showed that variables of gender and education level had no significant relationships with studied variables. However, the variables of age, marital status, and economic status had a statistically significant relationship with all the variables studied ($p< 0.001$). Employment status was also significantly associated with all variables studied except depression ($p< 0.05$). Also, years under hemodialysis were significantly associated only with the variables of perceived social support, perceived health, and adherence to treatment ($p< 0.05$) (Tables 3 and 4).

The findings showed that all four variables of perceived social support, depression, self-efficacy, and perceived health were associated with the dependent variable of treatment adherence. Accordingly, there is a strong and inverse relationship between the variables of social support and depression, as well as between depression and self-efficacy ($p< 0.001$). However, there is a strong and direct correlation ($p< 0.001$) between the variables of self-efficacy and perceived health as well as perceived health and adherence to treatment (Table 5). Data analysis of the proposed model's fitness adequacy is also presented in Table 6 and Figure 1. These results showed that all predicting variables of perceived social support, depression, self-efficacy and perceived health had been associated with the variable of adherence to treatment. Accordingly, there is a strong and reverse correlation between social support and depression ($p< 0.001$, $r= -0.94$), as well as depression and self-efficacy ($p< 0.001$, $r= -0.87$). There was a strong and direct correlation between self-efficacy and perceived health ($p< 0.001$, $r= 0.79$), perceived health and adherence to treatment ($p< 0.001$, $r= 0.72$). In this study, there were five latent variables, including self-efficacy, perceived social support, depression, perceived health, and adherence to treatment. SEM was established for assessing the relations between latent variables. In the model measurement section, the latent variables were linked to the corresponding index variables based on the literature. In the structural part, adherence to treatment was considered as a latent response, while self-efficacy, perceived social support, perceived health, and depression was considered as latent predictors. The X2/df indicator in this study is estimated to be 94.4, which is shown to be a good fit according to the acceptance range of the proposed model. RMSEA indicator is estimated to be 0.071 which according to the acceptance range of the proposed model,

Table 3. Comparision of Mean (SD) of self-efficacy, depression, perceived social support, perceived health, and adherence to treatment in groups according to demographic variables

Variables		Self-Efficacy Mean (SD)	Depression Mean (SD)	Social Support Mean (SD)	Perceived Health Mean (SD)	Treatment Adherence Mean (SD)
Gender	Female (n=190)	21.72 (6.287)	9.33 (6.546)	39.73 (12.219)	32.26 (7.657)	739.74 (242.820)
	Male (n=310)	21.66 (6.726)	9.76 (6.617)	39.88 (12.150)	32.10 (7.220)	709.03 (248.627)
	t	-0.090	0.713	0.133	-0.237	-1.352
	p-value	0.928	0.476	0.894	0.813	0.177
Level of education	Illiterate (n=107)	21.58 (6.478)	9.59 (6.422)	39.44 (4.922)	32.05 (7.251)	717.22 (244.799)
	Pre-diploma (n=392)	21.94 (6.767)	9.65 (7.210)	41.08 (12.973)	32.55 (7.898)	729.44 (251.922)
	t	0.515	0.83	1.237	0.624	0.455
	p-value	0.607	0.934	0.217	0.533	0.649
Marital status	Single	25.34 (7.776)	7.37 (7.184)	45.34 (13.663)	35.34 (8.607)	834.14 (260.089)
	Married	20.40 (5.754)	10.39 (6.218)	37.90 (11.223)	30.94 (6.691)	682.12 (235.112)
	Widow and divorced	20.04 (3.659)	10.58 (5.925)	37.32 (9.099)	31.28 (5.493)	663.16 (187.089)
	F	31.94	10.899	20.305	18.277	21.074
	p-value	<0.001	<0.001	<0.001	<0.001	<0.001
Economics Status	Poor	20.18 (5.165)	10.46 (6.259)	37.28 (10.969)	30.90 (6.697)	682.73 (233.144)
	Medium	22.14 (7.050)	9.30 (6.567)	40.49 (12.416)	32.43 (7.478)	726.82 (246.341)
	Good	23.699 (6.438)	8.09 (7.413)	43.91 (12.834)	34.58 (8.267)	807.78 (271.769)
	F	7.009	3.412	6.451	4.900	4.770
	p-value	0.001	0.034	0.002	0.008	0.009
Employment status	Unemployed / housewife	21.65 (6.342)	9.65 (6.646)	39.73 (12.581)	32.46 (7.032)	711.41 (246.472)
	Employed	20.94 (6.233)	10.02 (6.482)	38.47 (11.270)	31.00 (7.429)	683.18 (246.631)
	Retired	23.58 (7.464)	8.44 (6.650)	43.38 (12.768)	34.34 (7.544)	833.81 (213.988)
	F	5.162	1.817	5.194	6.811	12.448
	p-value	0.006	0.164	0.006	<0.001	<0.001
Duration of hemodialysis (year)	1-5	20.96 (6.348)	9.89 (6.341)	38.28 (12.471)	31.36 (7.543)	678.13 (253.647)
	6-10	22.00 (6.693)	9.38 (6.639)	40.59 (12.070)	32.60 (7.309)	739.24 (243.830)
	11-20	19.07 (2.401)	13.14 (6.455)	32.57 (8.881)	26.88 (5.641)	566.07 (169.163)
	F	2.241	2.358	4.128	5.007	5.577
	p-value	0.107	0.096	0.017	0.007	0.04

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Table 4. Correlation between age and self-efficacy, depression, perceived social support, perceived health, and adherence to treatment in hemodialysis patients

Variable	Pearson Correlation coefficient r	p-value
Perceived Self-efficacy	0.118	0.008
Depression	-0.154	<0.001
Perceived Social Support	0.167	<0.001
Perceived Health	0.175	<0.001
Adherence To Treatment	0.333	<0.001

Table 5. Correlation between self-efficacy, depression, perceived social support, perceived health and adherence to treatment

Variables	Perceived self-efficacy	Depression	Perceived social support	Perceived health	Adherence to treatment	p-value
Perceived self-efficacy	1	-0.707	0.757	0.667	0.589	<0.001
Depression	-0.707	1	-0.846	-0.882	-0.623	<0.001
Perceived social support	0.757	-0.846	1	0.849	0.667	<0.001
Perceived health	0.667	-0.882	0.849	1	0.727	<0.001
Adherence to treatment	0.589	-0.623	0.667	0.727	1	<0.001

Table 6. Fit indicators of the proposed model

Fit indicators	X^2/df	RMSEA	CFI	TLI	SRMR	CD
Model estimates	4.94	0.071	0.873	0.870	0.076	0.937

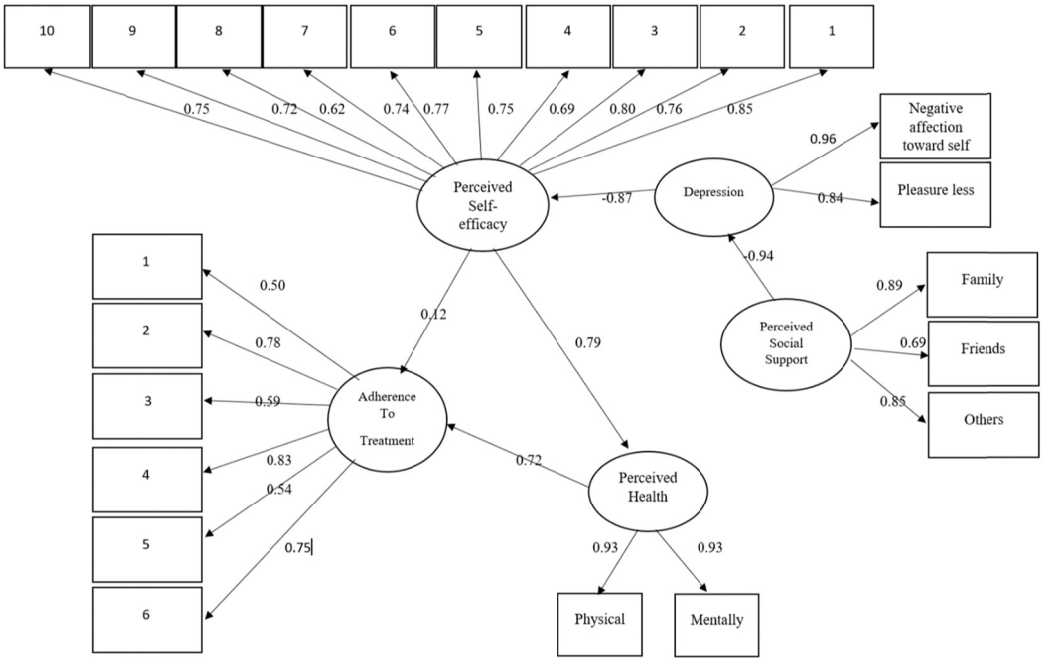

Fig. 1. Proposed model in relation to factors influencing adherence to treatment

has a good fit and shows that the model is fully consistent with the observed data. Fitting the model according to the SRMR indicator estimated at 0.076 ; results less than 1 indicate a good model fit. The CFI and TLI indicators in the present study are estimated at 0.873 and 0.870, respectively that both of which are close to one and this indicates a good model fit.

Discussion

The aim of this study was to investigate the predictors of adherence to treatment in patients undergoing hemodialysis. In relation to demographic variables, the results of this study showed that two variables of gender and education were not related to any predictive variables as well as adherence to the treatment. Variable of years undergoing hemodialysis was related to perceived social support and perceived health and adherence to the treatment. The variables of age, marital status, and economic status were significantly correlated with adherence to treatment and all predictive variables (depression, perceived health, perceived social support, and self-efficacy). Thus, with increasing age, the participants reported adherence, self, perceived social support, and perceived health significantly higher and reported less depression. Also, single persons compared with married and spouse who died or divorced and persons with a good economic status compared to individuals with poor and moderate economic status reported higher adherence to treatment, self-

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perceived social support and perceived health; and they showed less depression. There was a significant relationship between the employment status and adherence to the treatment and all the predictive variables except depression. In other words, retired people were reported higher self-perceived social support and perceived health as compared to employed and unemployed individuals.

Studies have individually examined the variables of this study, have reported a variety of results about the relationship between demographic variables and these variables. For example, the study of Haugland et al. showed that gender variables, education level and life alone or with a group are not associated with self-efficacy (35). Taghipour et al. in their study, introduced age, sex, marital status, education level and economic status, the most important predictors of depression prevalence in hemodialysis patients (36). A study by Taher et al. also showed employment status, marital status and education level in relation to social support. People who are unemployed, married and with an undergraduate diploma have a higher level of social support (37). In the study of Khalili et al. also, no relationship was observed between the variable levels of education. They introduced the variables of age, gender, and marital status as predictors of adherence to treatment in hemodialysis patients (38), which has been inconsistent with the results of the present study. It seems that the difference of the studied samples in terms of sexual distribution in the two studies is related to different findings; Because in this study, most people in the participants formed the men.

The present study showed that social support has a reverse relationship with the rate of depression and a direct relationship with adherence to treatment in patients. The results of the study of Royani & Asadi (39) and Tezel (40) indicate a relationship between social support and depression and the study of Poshtchaman et al. (41) also indicates the relationship between social support and adherence to treatment. Hemodialysis patients, following changes in their way of life, experience psychological problems such as depression, anxiety, social isolation, loneliness, and hopelessness. Social support from family, friends and others can protect the person in coping with these stresses and can decrease anxiety, depression and increased self-confidence. The permanent and unconditional support of family and specific persons of the patient's life are related factors to reduce the amount of depression in these individuals, as well as hemodialysis people, may have less willingness to communicate with people except their families and this leads to greater dependence and the sense of perceived support from the family and specific people that patient is living with.

Results indicated that self-efficacy had a reverse relationship with depression and a direct relationship with perceived health. Lin et al. (42) and Tak et al. (43) have also pointed out an inverse relationship between self and depression in their studies. The study of Cramm et al. (44) and Hoseinzadeh et al. (45) reported a direct relationship between self-efficacy and perceived health. According to Bandura's theory, self-efficacy involves the confidence of being able to self-care so that the person will achieve favorable results in their health and achieving goals, thus increasing perceived self-efficacy through the increasing sense of overcoming problems, the ability to change and adapting to new conditions of life can lead to improved perceived health, increased self-care, and reduced depression in patients.

Although, according to previous studies (46, 22), it was expected that perceived self-efficacy resulted in increased adherence to the treatment regimen in patients, the findings showed that there was no significant relationship between them and these results were incompatible with previous studies. In previous studies, the relationship between self-efficacy and adherence to the treatment regimen has been assessed without considering other variables but in the present study, the relationship between these two variables is assessed by considering variables such as perceived health, depression and perceived social support that this could be due to contradiction between the results of these studies.

The results of the present study showed that there is a direct relationship between perceived health and adherence to the treatment, and higher perceived health can lead to improved adherence to treatment in these patients that. This is consistent with the results of the study of Nabolsi et al. (19). The higher perceived health by encouraging to maintain the level of health is a motivation for the person to follow the treatment, and it leads to more adherence.

Conclusion

The findings of this study showed that perceived social support, depression, and perceived self-efficacy through mediating role and perceived health could directly affect the adherence to treatment. However, in this study, the effect of perceived self on increasing adherence to the treatment regimen did not confirm that it requires further investigation. Health care providers can use the proposed model in this study to improve adherence to treatment in hemodialysis patients as an important factor in promoting the health of these patients. It is suggested that in future research, more predictors such as cognitive impairment, coping strategies, quality of life have been investigated to achieve a comprehensive model for these patients.

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Conflict of Interests

The authors declare that they have no competing interests.

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