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Predictive role of spiritual health, resilience, and mental well-being in treatment adherence among hemodialysis patients

Fahimeh Saedi[1,2] , Mahlagha Dehghan[3] , Najmeh Mohammadrafie[4,5], Xiao Xu[6] , Alaa Hamza Hermis[7] and Mohammad Ali Zakeri[8,9]*

Abstract

Background End-stage renal disease (ESRD) causes numerous physical and psychological problems in patients, so that they must adhere to their treatment regimen to recover their disease, alleviate these problems, and increase their lifespan. The present study aimed to determine the predictive role of spiritual health, resilience, and mental well-being in treatment adherence among hemodialysis patients.

Methods This correlational cross-sectional study investigated some variables related to treatment adherence in 184 patients undergoing hemodialysis referred to two dialysis centers in Kerman, southeastern Iran. A census method was used to select the participants and data were collected using socio-demographic characteristics questionnaire, Adherence to Treatment Questionnaire (ATQ), Conner-Davidson Resilience Scale, Reef Psychological well-being Questionnaire, and Spiritual Well-Being Scale (SWBS).

Results The overall treatment adherence score was 155.42 ± 27.98 and we found a positive significant correlation between spiritual health, resilience, psychological well-being, and treatment adherence ($p < 0.001$). The mean scores of resilience, spiritual health and psychological well-being were 70.59 ± 17.02, 90.09 ± 12.01, and 77.88 ± 11.72, respectively. Spiritual health, psychological well-being, resilience, gender and marital status predicted 54% of the variance of treatment adherence, with psychological well-being being the best predictor ($p < 0.001$).

Conclusions Spiritual health, psychological well-being, and resilience are factors that influence treatment adherence of the patients undergoing hemodialysis, with psychological well-being having the greatest contribution to improving patient's treatment adherence. Interventions effective in improving psychological well-being, spiritual health and resilience can improve treatment adherence of patients undergoing hemodialysis. Healthcare workers must pay more attention to the factors affecting treatment adherence of patients undergoing hemodialysis.

Keywords Treatment adherence, Spiritual health, Resilience, Well-being, Hemodialysis

*Correspondence:
Mohammad Ali Zakeri
ma.zakeri115@gmail.com; mazakeri@rums.ac.ir
Full list of author information is available at the end of the article

Background

Diabetes and hypertension have changed end-stage renal disease (ESRD) into a life-threatening complication in the world [1]. End-stage renal disease is a progressive disorder that interferes with the body's ability to balance fluid and electrolyte and accumulates waste materials in the body [2].

The results obtained from 167 countries showed that the global median prevalence of chronic kidney disease was 9·5% in 2022. The annual median costs of kidney replacement therapy (KRT) were US$19 380 per person for hemodialysis and $18 959 for peritoneal dialysis [3]. Many factors may contribute to the poor outcomes of patients with end-stage renal disease, including shorter dialysis sessions, inadequate dialysis, low economic status of patients with end-stage renal disease, lack of follow-up care, and lack of dietary compliance [1].

Although increasing awareness improves treatment adherence, informed patients still have no appropriate treatment adherence [4]. While patients with end-stage renal disease must follow dietary recommendations, limit fluids, take prescribed medications and attend hemodialysis sessions, studies have reported moderate or poor treatment adherence in patients with end-stage renal disease [5]. Ghimire et al. (2017) indicated that more than half of the participants did not adhere to their medication regimen (56.7%). They mentioned following factors for their treatment non-adherence: factors related to patients (knowledge, awareness, attitude, self-efficacy, and functional control), factors related to health system/healthcare team (quality of interaction and mistrust), factors related to treatment (physical characteristics of drugs, package and side effects), factors related to disease (severity of symptoms) and socio-economic factors (access to drugs and moderate economic status) [6]. Treatment non-adherence causes many problems in almost half of the patients who skip their dialysis sessions, so that 11% of them need more treatment, leading to increased healthcare costs and workload of the dialysis department [7]. Factors affecting treatment adherence in patients undergoing hemodialysis may be related to treatment, conditions, health system, or socioeconomic factors [7].

Spiritual health is a psychological factor effective in the treatment adherence of patients under dialysis [8]. According to the World Health Organization (WHO), health is a state of complete physical, mental, and social well-being. Some experts believe in paying serious attention to spiritual health [9]. Spirituality plays an important role in adapting to stressful conditions caused by chronic diseases. Spiritual counseling aims to change the attitudes of people to solve their psychological problems. Spirituality helps a client to explore spiritual issues related to his/her recovery [8]. Spirituality mechanisms (collaborative coping style, internal control and being supported in stressful times) have an effect on mental health [10] and increase patients' resistance to disease problems.

Resilience increases patients' resistance to disease problems, is an important process in the management of chronic diseases, and is an important determinant of treatment adherence [11]. Research shows that resilience plays an important role in increasing psychological well-being and quality of life in stressful situations [12]. Resilience refers to the dynamic process of successfully adapting to unfortunate life experiences within the context of stress [13]. People with strong resilience adapt to conditions faster, have the ability to plan for long-term goals, recover from injury faster, and become less anxious, but people with low resilience act inflexibly in stressful situations, which leads to maladaptive behavior [14]. Resilience not only increases the tolerance and adaptability of a person in dealing with problems, but also keeps and improves mental health [15]. Studies show that resilience associates with better mental health and well-being; as patients under dialysis have poor mental health, they poorly adhere to their treatment, which brings irreparable risks such as death [16].

Mental health is extremely important for patients under dialysis [16]. Patients with chronic renal failure (CRF) undergoing dialysis experience emotional instability, psychological distress, reduced social support and increased financial burden [17], which have a direct impact on their quality of life, performance and autonomy [18]. Mental health is directly related to a positive view of dialysis. People with chronic renal failure and positive emotions are able to manage the negative emotions of anger, sadness, disappointment, boredom, annoyance, and worry, and experience the positive emotions of happiness, joy, gratitude, and optimism [19].

Mental well-being is a general evaluation of life and emotional experiences, such as satisfaction with life, satisfaction with health and specific feelings, and it reflects the way a person reacts to life events and conditions [20]. A study on mental well-being differentiated the real and mental conditions of people and analyzed people's evaluation of different aspects of their lives [21]. Mental well-being refers to a person's evaluations of life, such as happiness or pleasant emotions, satisfaction with life and the absence of unpleasant emotions) and includes two types: cognitive well-being (satisfaction with life) and emotional well-being (positive and negative affects) [22]. Today's mental health models emphasize the positive psychology, such as well-being and its promotion [23].

Based on the available evidence, misunderstanding of chronic diseases reduces the mental well-being [24], prevents effective self-management [25], and lowers the quality of life in chronically-ill patients [26], which have

negative effects on their treatment adherence and cause many problems in future.

Suganthi et al. (2020) showed that 52.5% of the participants adhered to their dietary restrictions and poor adherence to prescribed medications associated with emotional distress [27]. Darvishi et al. (2020) found that spirituality had a positive effect on quality of life, sleep, treatment adherence and satisfaction in patients under dialysis [28]. Freire de Medeiros et al. (2017) reported that religion associated with adherence to dialysis but not with medication adherence, while resilience associated with medication adherence but not with adherence to dialysis sessions [29]. The review of the literature suggested that although some studies tried to identify the factors related to treatment adherence [30, 31], such as spiritual health [28], resilience [29], no comprehensive study is available to identify the relationship between spiritual health, resilience, mental well-being, and the treatment adherence of patients undergoing hemodialysis.

Patients with end-stage renal disease suffer from persistent physical symptoms as well as many psychological symptoms; therefore, they must adhere to their treatment to recover and reduce physical and psychological problems. We must obtain more information about the factors related to treatment non-adherence of the patients with end-stage renal disease. Patients undergoing hemodialysis require adherence to treatment has a great impact on the patients' lifespan, but few studies are available in this field. The present study was conducted with the following specific objectives: (a) spiritual health, resilience and mental well-being status of the participants, (b) association of participants' demographic characteristics adherence to treatment, (c) the association between spiritual health, resilience, mental well-being and adherence to treatment and (d) assessing the association of all important study variables with adherence to treatment using multiple regression analysis.

Materials and methods
Study design and setting
This correlational cross-sectional study measured some variables (spiritual health, resilience, and psychological well-being as independent variables) related to the treatment adherence (dependent variable) among patients undergoing hemodialysis who referred to Kerman dialysis centers (Shafa hospital and Javad-Alaemeh Clinic). In this study, the consultation of mental health professionals was used to design the study. All urban and rural patients undergoing hemodialysis were eligible to participate in the study through a census method. Based on studies by Javanmardifard et al. [32] ($r=0.21$) with 95% confidence and 85% test power, the sample size was considered 200 patients according to the following formula.

$$\omega = \frac{1}{2} Ln \frac{1+r}{1-r}$$

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^2}{\left(\omega \right)^2} + 3$$

There are two hemodialysis centers (with a population of 207 people) in Kerman where a specialist visits patients undergoing hemodialysis. In this study, the research population and sample are the same. Inclusion criteria were patients aged 18–65 years undergoing hemodialysis for at least six months, without known psychological problems (depression, bipolar disorder), the absence of cognitive problems, familiarity with Persian language to understand the questions, with reading and writing ability, and no hearing and speaking problems. Exclusion criteria were who filled in the questionnaires incompletely.

Measurements
Data were collected with a four-part questionnaire: socio-demographic characteristics, Adherence to Treatment Questionnaire (ATQ), Conner-Davidson Resilience Scale, Reef Psychological well-being Questionnaire, and Spiritual Well-Being Scale (SWBS).

Socio-demographic characteristics
Socio-demographic characteristics included age, sex, marital status, number of children, education level, occupation, income, living with family, history of diabetes, history of hypertension, history of cardiovascular disease, vascular access, and infection with the coronavirus.

Adherence to treatment questionnaire (ATQ)
Seyed Fatemi et al. (2018) developed this questionnaire on a 6-point Likert scale ranging from five to zero. This questionnaire includes seven dimensions: focus on treatment, willingness to participate in treatment, ability to adapt, adapting the treatment with life plan, adherence to treatment, commitment to treatment, and uncertainty in the implementation of treatment, with 75–100%, 50–74%, 26–49%, and 0–25% reflecting very good, good, moderate, poor treatment adherence, respectively. Face validity was determined qualitatively with the participation of 10 patients and 10 specialists, and content validity was determined qualitatively and quantitatively. The mean content validity index of the questionnaire was 0.914. The questionnaire's internal consistency was calculated by using Cronbach's alpha ($\alpha=0.921$) and the questionnaire's reliability was stable by performing a re-test after 2 weeks ($r=0.875$) [33]. In the present study, the Cronbach's alpha for the ATQ was 0.93.

Conner-davidson resilience scale

The Conner-Davidson resilience scale (CD-RISC) was used to measure the level of resilience by Connor & Davidson (2003). This scale consists of 25 items with five subscales: personal competence, trust in one's instincts, tolerance of negative affect, positive acceptance of change and secure relationships, control and spiritual influences [34]. The items are evaluated on a five-point Likert scale from 0 to 4 (0=not at all true, 4=always true). Minimum score is zero, while maximum is 100. The internal consistency (Cronbach's α) for the full scale was 0.89. Test-retest reliability was confirmed with a correlation coefficient of 0.87. For convergent validity, CD-RISC scores have been positively correlated with hardiness scores (r=0.83) [34]. Zakeri et al. in Iran reported Cronbach's alpha of 0.93 for this questionnaire [35]. In addition, the Cronbach's alpha of Conner-Davidson Resilience scale in the current study was 0.91.

Reef psychological well-being questionnaire

Psychological well-being questionnaire was designed by Reef in 1989 and revised in 2002. Reef psychological well-being questionnaire includes six components: (1) self-acceptance, (2) positive relationships with others, (3) autonomy, (4) environmental mastery, (5) purpose in life, and (6) personal growth. The items were evaluated on a six-point Likert scale from 1 (strongly agree) to 6 (strongly disagree). Ten items were scored directly, while eight ones were scored inversely, with a higher score indicating higher psychological well-being. Sedghi and Cheraghi in Iran reported the Cronbach's alpha coefficient of 0.84 for this questionnaire [36]. In addition, the Cronbach's alpha of this scale in the current study was 0.79.

Spiritual well-being scale (SWBS)

Palutzian and Ellison's spiritual well-being scale (1991) has been used to measure spiritual health, which includes 20 items with two subscales of religious well-being (RWB) (10 items) and existential well-being (EWB) (10 items). These items were evaluated on a 6-point Likert scale ranging from one (strongly disagree) to six (strongly agree). The total score of the spiritual well-being scale is between 20 and 120, with 20–40, 99–41, and 120–100 indicating low, moderate, and high spiritual well-being. The RWB subscale had an alpha reliability of 0.77 and EWB subscale had an alpha reliability of 0.78 [37]. Its validity and reliability have been confirmed in Iranian studies with alpha coefficient of 0.82 [38]. In the present study, the Cronbach's alpha for the SWBS was 0.87.

Data collection procedure

After obtaining the necessary permits, the researcher went to three public hospitals in Kerman and collected the required samples in the dialysis department. She explained the study goals and method to the patients, and coordinated with them the time to complete the questionnaires. The patients undergoing hemodialysis had to be willing and have enough time to complete the questionnaires. Sampling lasted from September 2020 to April 2021.

Statistical analysis

SPSS 24 and AMOS 24 were used to analyze descriptive and inferential data. Descriptive statistics (frequency, percentage, mean and standard deviation) were used to describe the characteristics of patients undergoing hemodialysis. Independent t-test, Mann-Whitney U, Kruskal-Wallis H, and ANOVA tests were used to examine the mean differences in treatment adherence according to demographic and clinical variables. Pearson's correlation coefficient was used to check the relationship between the variables.

To determine the effects of spiritual health, resilience, and mental well-being variables in the presence of other demographic variables on the overall score of treatment adherence from multiple linear regression used. All assumptions related to multiple linear regression were valid in the examined data. The histogram of the overall score of treatment adherence (dependent variable) was symmetrical and similar to the normal distribution, and the Kolmogorov-Smirnov test also showed no significant deviation from the normal distribution. The significance level of 0.05 was considered. In addition, the structural equation modeling was used to test the relationship between spiritual health, resilience, and psychological well-being in treatment adherence. In the path analysis model, the regression weight is predicted by the model and then, the goodness of fit statistic is calculated in order to see the fitting of the model. Expected fit indices should confirm the model's adequacy [Root Mean Square Error of Approximation (RMSEA)<0.08 and Comparative Fit Index (CFI)>0.90].

Results

The mean age of the participants was 53.92±13.89 years (Min=22 and Max=87). The majority of the samples were male (n=111; 60.4%), married (n=130; 70.7%), had diploma (n=66; 35.9%), and lived with their families (n=163; 88.6%). Only 42 (24.9%) patients were infected with COVID-19. The majority of the participants had arteriovenous fistula (n=121; 66.5%) (Table 1).

Table 2 shows the participants' scores on the seven aspects of treatment adherence. The total treatment adherence score was 155.42±27.98., with focus on treatment (35.70±7.54) and uncertainty in implementation (11.87±3.70) receiving the highest and lowest mean scores, respectively. One hundred and twenty-three participants (66.8%) had very good treatment adherence,

Table 1 Association between participants' demographic characteristics and treatment adherence (*n* = 184)

Variable		Frequency (%)	Treatment Adherence			Statistical test (*P* value)
			Mean	SD	Median	
Age (yr.)	≤ 50	67 (36.4)	152.02	35.98	163.0	
	50–70	99 (53.8)	158.20	21.99	164.0	H = 0.60 (0.73)
	> 70	18 (9.8)	152.77	22.69	160.0	
Sex	Male	111 (60.3)	153.70	28.03	160.0	t = -1.02 (0.30)
	Female	73 (39.7)	158.04	27.88	167.0	
Marital status	Single Divorced/widow(er)	54 (29.3)	147.01	36.75	160.0	t = -2.21 (0.03)
	Married	130 (70.7)	158.91	22.66	164.0	
Number of children∗	0	72 (39.3)	152.36	34.06	162.5	H = 5.20 (0.07)
	1–3	56 (30.6)	163.30	18.00	166.0	
	4 ≤	55 (30.1)	151.20	26.44	158.0	
Education level	Uneducated	14 (7.6)	144.64	32.54	152.5	F = 3.99 (0.009)
	Middle/high school	54 (29.3)	148.22	31.77	159.0	
	Diploma	66 (35.9)	156.45	28.82	165.0	
	Academic	50 (27.2)	164.86	16.30	166.0	
Occupation	Employed	27 (14.7)	165.74	16.69	170.0	F = 3.79 (0.01)
	Unemployed	53 (28.8)	146.35	37.27	158.0	
	housewife	53 (28.8)	160.24	22.52	167.0	
	Retired	51 (27.7)	154.37	24.03	160.0	
Income (Million Tomans) ‡	< 2	81 (44.0)	155.11	31.27	164.0	H = 1.03 (0.59)
	2–5	64 (34.8)	157.12	24.70	160.0	
	> 5	39 (21.2)	153.28	26.25	163.0	
Family Life	Yes	163 (88.6)	155.50	28.55	163.0	Z = -0.41 (0.67)
	No	21 (11.4)	154.76	23.67	164.0	
Diabetes	Yes	106 (57.6)	154.05	29.65	163.0	Z = -0.66 (0.50)
	No	78 (42.4)	157.28	25.60	163.0	
History of Hypertension	Yes	132 (71.7)	154.00	29.75	163.0	Z = -0.73 (0.46)
	No	52 (28.3)	159.01	22.73	164.0	
History of cardiovascular disease∗	Yes	35 (19.0)	145.37	31.64	149.0	Z = -2.28 (0.02)
	No	149 (81.0)	157.78	26.61	164.0	
Vascular access∗	Fistula	121 (66.5)	154.99	26.64	160.0	Z = -0.85 (0.39)
	Graft/Permcath /Shaldon	61 (33.5)	156.39	30.71	166.0	
Duration of dialysis ∗	< 3	39 (25.0)	159.66	20.38	164.0	
	3–5	67 (42.9)	155.20	33.99	166.0	H = 4.78 (0.09)
	5 >	50 (32.1)	151.80	23.35	158.0	
Infection with the coronavirus∗	Yes	42 (24.9)	158.11	18.67	163.0	t = 1.02 (0.30)
	No	127 (75.1)	154.08	29.97	163.0	

∗Missing value, SD = Standard Deviation, t = Independent t test, F = Analysis of variance, H = Kruskal-Wallis H; Z = Mann-Whitney U; ‡ = One Dollar is 25,000 Tomans

55 (29.9%) had good treatment adherence, 2 (1.1%) had moderate treatment adherence, and only 4 (2.2%) had poor treatment adherence.

The mean score of resilience was 70.59±17.02, with personal competence (22.30±6.51) and spiritual influences (6.41±1.29) receiving the highest and lowest mean scores, respectively. The mean score of psychological well-being was 77.88±11.72, which was greater than the midpoint of the questionnaire (54). Autonomy (14.05±2.62) and purpose in life (11.51±2.80) received the highest and lowest mean scores, respectively.

The mean score of spiritual health was 90.09±12.01, which was greater than the midpoint of the questionnaire (60). One hundred and thirty-seven participants (74.5%) had moderate level of spiritual health, while 47 (25.5%) had high level of spiritual health.

We found a positive significant correlation between spiritual health, resilience, psychological well-being, and treatment adherence (*p* < 0.001). The present study showed a significant positive relationship between spiritual health, psychological well-being and resilience (Table 3). Among the demographic variables, only the marital status (*P* = 0.03), education level (*P* = 0.009), occupation (*P* = 0.01) and cardiovascular disease (*P* = 0.02) had a significant relationship with treatment adherence.

The result showed that R^2 for treatment adherence was 0.529, indicating that spiritual health, psychological well-being and resilience could predict nearly 53% of the

Table 2 Distribution of the spiritual health, resilience, psychological well-being and treatment adherence in patients undergoing hemodialysis (*n* = 184)

	Variable	Median	Mean	SD	Min	Max
Treatment adherence	Focus on treatment	38.00	35.70	7.54	7	45
	Willingness to participate	31.00	29.65	5.78	2	35
	Ability to adapt	28.00	26.19	5.97	9	35
	Adapting the treatment	19.00	18.31	4.68	0	25
	Adherence to treatment	17.00	16.06	4.31	1	20
	Commitment to treatment	18.00	17.60	5.03	3	25
	Uncertainty in the implementation of treatment	13.00	11.87	3.70	0	15
	Total	163.00	155.42	27.98	35	195
Resilience	Personal competence	23.00	22.30	6.51	2	32
	Trust instincts	19.00	18.46	5.35	2	28
	Positive acceptance	16.00	15.07	3.22	4	20
	Control	9.00	8.32	2.81	0	12
	Spiritual influences	7.00	6.41	1.29	1	8
	Total	73.00	70.59	17.02	14	100
Psychological Well being	Self-acceptance	13.00	12.91	2.98	4	18
	Positive relationships with others	13.00	12.98	3.03	3	18
	Autonomy	15.00	14.05	2.62	6	18
	Environmental mastery	13.00	12.89	2.89	4	18
	Purpose in Life	12.00	11.51	2.80	4	17
	Personal growth	13.50	13.51	3.03	6	18
	Total	80.00	77.88	11.72	34	104
Spiritual health	Existential health	40.00	40.19	6.19	25	55
	Religious health	50.00	49.90	7.82	25	60
	Total	89.00	90.09	12.01	54	114

Table 3 Correlation between the spiritual health, resilience, psychological well-being and treatment adherence in patients undergoing hemodialysis (*n* = 184)

Variable	Pearson's correlation coefficient (*P* value)		
	1	2	3
1. Spiritual health	1		
2. Resilience	0.60 (< 0.001)	1	
3. Psychological well being	0.58 (< 0.001)	0.66 (< 0.001)	1
4. Treatment adherence	0.63 (< 0.001)	0.61 (< 0.001)	0.65 (< 0.001)

Table 4 Standardized path coefficients of the modified model (*n* = 184)

Direct Path	Estimate	S.E.	C.*R.*	*P* value
Treatment Adherence <-- Spiritual Health	0.72	0.15	4.65	< 0.001
Treatment Adherence <-- Psychological Well being	0.78	0.16	4.66	< 0.001
Treatment Adherence <-- Resilience	0.34	0.11	2.88	0.004

S.E: Standard error; C.R: Critical ratio

variance of treatment adherence in patients undergoing hemodialysis.

The results of the path analysis showed a significantly direct correlation between the variables. We found a positive correlation between treatment adherence, spiritual health (Standardized β = 0.310, 95%

Confidence interval = 0.41–1.03, *P* value < 0.001), psychological well-being (Standardized β = 0.33, 95% Confidence interval = 0.45–1.12, *P* value < 0.001), and resilience (Standardized β = 0.21, 95% Confidence interval = 0.10–0.57, *P* value = 0.004) (Table 4) (Fig. 1).

We tested multiple regression models with backward method to explore how demographic variables could predict treatment adherence. As shown in Table 5, spiritual health, psychological well-being, resilience, gender and marital status predicted 54% of the variance of treatment adherence, with psychological well-being being the best predictor (*p < 0.001*).

Discussion

The present study aimed to determine the relationship between treatment adherence, resilience, spiritual health and mental well-being in patients under dialysis. The study results indicated that 66.8% of the participants had a very good treatment adherence, with focus on treatment receiving the highest level of treatment adherence and uncertainty in the implementation of treatment receiving the lowest level. Khalili et al. supported our results and reported a high rate of treatment adherence in patients under dialysis [39]. Cheiloudaki et al. agreed with us and found satisfactory treatment adherence in patients with a stroke [40]. Some authors reported different results; Naalweh et al. reported moderate to poor
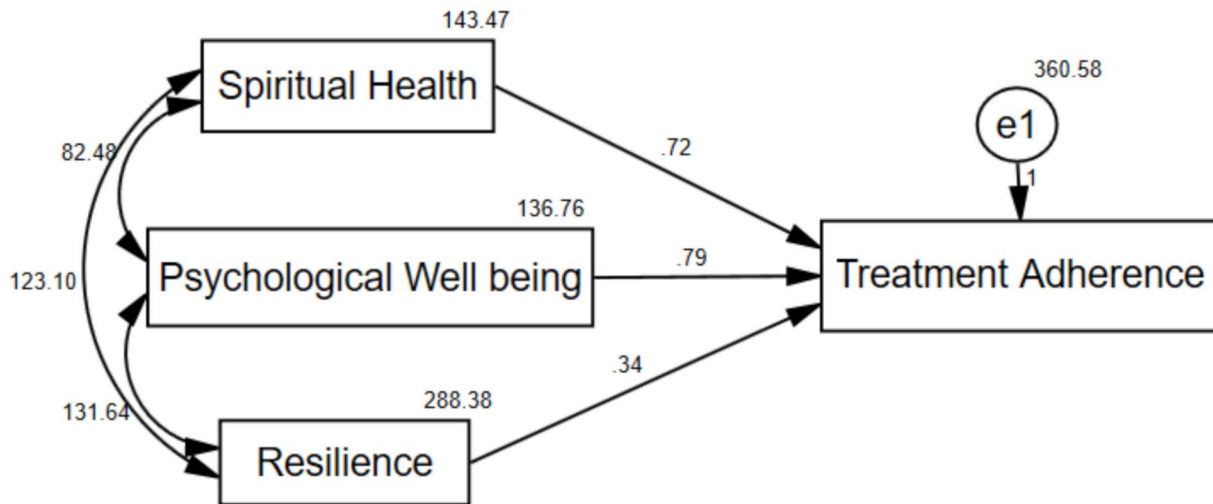
Fig. 1 Standard coefficients of the modified model

Table 5 Multiple regression analysis summary for underlying variables of the adherence treatment of patients undergoing hemodialysis (*n* = 184)

	Variable	B	SE‡	β	t	P	95% Confidence interval for B	R^2
Treatment Adherence	(Constant)	-15.88	13.39	-	-1.18	0.23	-42.31 _ 10.54	%54
	Spiritual health	0.65	0.15	0.28	4.20	< 0.001	0.34 _ 0.95	
	Psychological well being	0.83	0.16	0.34	4.97	< 0.001	0.50 _ 1.16	
	Resilience	0.32	0.11	0.19	2.76	0.006	0.09 _ 0.55	
	Gender	7.79	3.03	0.13	2.57	0.01	1.81 _ 13.77	
	Marital status	8.15	3.29	0.13	2.47	0.01	1.65 _ 14.64	

‡: Standard error; Gender (male = 1 and female = 2); Marital status (single/divorced /widowed = 1 and married = 2)

treatment adherence in patients under dialysis [5] and Mukakarangwa showed that only 51% of the patients under dialysis had high treatment adherence [41]. Rafiee and Shafie reported moderate rate of treatment adherence in patients under dialysis [42]. Tanharo et al. revealed that patients with diabetes had a low level of treatment adherence [43]. Different results may be due to different demographic characteristics of the patients, different levels of health literacy, as well as the different tools used to measure patients' treatment adherence. Treatment adherence means the patient's compliance with the recommendations provided by the healthcare providers (diet, fluids and medicines), so treatment non-adherence causes many problems in almost half of the patients who skip their dialysis sessions, including the increased healthcare costs and workload of the dialysis department [7]. Due to the importance of treatment adherence in reducing disease complications and treatment costs, patients must increase their awareness to follow the principles of treatment regimen.

The study results showed a positive correlation between spiritual health and treatment adherence. Freire de Medeiros et al. [29] and Mukakarangwa et al. [41] agreed with our results; Musavi Ghahfarokhi et al. (2020) found a positive relationship between spirituality and hope, which resulted in patient's adaptation to the disease condition [44]. Alvarez et al. also found a positive relationship between spirituality and treatment adherence in patients with heart failure [45]. Spiritual health is important in dealing with the problems and stresses caused by the disease. It is associated with a sense of identity, perfection, satisfaction, happiness, beauty, respect, positive attitude, inner balance, purpose in life, and hope [46], which lead to greater adaptation to the disease and higher treatment adherence [47]. Therefore, health managers should pay much more attention to interventions to improve spiritual health and treatment adherence in patients undergoing hemodialysis.

The current study indicated a positive correlation between resilience and treatment adherence. Medeiros et al., Ma et al. and Noghan et al. supported our results [29, 48, 49], but Zher and Bahari found no relationship between treatment adherence and resilience [50]. Different results can be due to the small sample size and the

low mean age of the participants. According to the literature review, resilience is a person's ability to prevent, limit, and overcome the harmful effects of difficult conditions, including chronic illness [51]. People with stronger resilience adapt to conditions faster, have the ability to plan for long-term goals, recover faster from injury, and become less anxious, but people with low resilience act inflexibly in stressful situations, leading to maladaptive behavior [14]. Therefore, health managers must pay more attention to the factors affecting resilience to increase the treatment adherence in patients under dialysis.

The present study showed a positive correlation between psychological well-being and treatment adherence. Hamiltone et al. studied 976 young patients with end-stage renal disease, who underwent kidney transplant or hemodialysis. They confirmed our results and found that patients with mental disorders, including depression, had the lowest rate of treatment adherence [52]. Kim et al. also concluded that patients under dialysis had a more negative perception of their disease and a lower treatment adherence rate [53]. Knudsen et al. supported our results and reported poor treatment adherence in 67 depressed patients with cystic fibrosis [54], but Zher and Bahari found no significant relationship between depression, behavioral disorder, and treatment adherence [50]. Different results can be due to the small sample size and the young age of the samples. Our findings showed that improving the level of mental well-being had a positive effect on increasing the individual's performance and treatment adherence and reducing the complications of chronic diseases. Therefore, it is necessary to pay more attention to the psychological well-being of patients under hemodialysis to improve their treatment adherence.

The present study showed that spiritual health, psychological well-being, resilience, gender and marital status were predictors of treatment adherence, with psychological well-being being the best predictor. Naalweh et al. (2017) agreed with us and reported the highest adherence to treatment in older men, with marital status determining the treatment adherence [5], but Seyed Fatemi et al. found no relationship between gender and treatment adherence [33]. One of the reasons for the higher treatment adherence in men can be their supporting role for the family that improves treatment adherence and reduces the disease complications in future.

Zher and Bahari [50] and Kim et al. [53] considered age as one of the predictors of treatment adherence, because older people were more concerned about their health status than younger people. Mukakarangwa supported our results and found no relationship between the level of education and treatment adherence [33]; although, higher education helps to better understand the importance of treatment adherence and the necessary measures

to promote it. In this regard, the use of new technologies such as the mobile health application (mHealth app) based on the microlearning method with face-to-face training can be effective on treatment adherence in hemodialysis patients [55, 56].

Our findings provide a new insight into the factors influencing treatment adherence in patients undergoing hemodialysis, but further studies are necessary due to various influencing factors and cultural and social differences.

Strengths and limitations
The strengths of the present study include examining multiple dimensions of patient health in relation to treatment adherence, focusing on hemodialysis patients as a critical population, and investigating variables relevant to clinical practice. The findings of this study can be used to develop targeted interventions to enhance treatment adherence, ultimately improving patient outcomes and quality of life. The insights gained from this study can be directly applied in clinical settings, helping healthcare providers support hemodialysis patients more effectively by implementing interventional studies such as spiritual empowerment and resilience programs to improve treatment adherence.

The current study also had limitations: we conducted this research in southeastern Iran, so generalization of the results to other societies should be done with caution due to the cultural and social differences and the existing conditions of the patients. This study was cross-sectional, which cannot determine the cause-and-effect relationship between variables. We used self-report questionnaires, which might have affected the results. In the present study, the sample size is small given the type of study needed to measure the correlation between several variables. Therefore, one should be cautious in generalizing the data and plan studies in larger communities.

Conclusion
The results of the present study showed that spiritual health, psychological well-being, and resilience are factors that affect treatment adherence in patients undergoing hemodialysis. However, psychological well-being has the greatest impact on improving treatment adherence among these patients. Focusing on implementing effective interventions to enhance psychological well-being, spiritual health, and resilience can improve treatment adherence in hemodialysis patients. Health policymakers and managers should identify and address the factors associated with poor treatment adherence by improving patients' resilience, spiritual health, and psychological well-being. Healthcare providers should pay greater attention to the factors influencing treatment adherence in hemodialysis patients to prevent increased

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hospitalizations and complications through effective patient education.

Author contributions
Conceptualization: FS and MAZ. Data curation: FS and MD. Formal analysis: M.D and MAZ. Methodology: FS and MAZ. Proj¬ect administration: FS and M.A. Visualization: M.D and M.A. Writing –original draft: MAZ, XX, NM and AH. Writing – review & editing: FS, XX, NM and AH. & MAZ.

Data availability
The datasets generated and/or analyzed during the current study are not publicly available due to agreement between data holders but are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
The ethics committee of Kerman University of Medical Sciences approved the present study with Reg. No. 99000851 and code of ethics No. IR.KMU. REC.1400.184. At the beginning of the research, the researcher provided the patients undergoing hemodialysis with an information sheet and a consent form, explained about the study objectives, the confidentiality of information and their withdrawal from the study at any time. All procedures performed in studies involving human participants were in accordance with the ethical standards of the research committee Kerman University of Medical Sciences and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Health in Disasters and Emergencies Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran
[2]Present address: Shafa Hospital, Kerman University of Medical Sciences, Kerman, Iran
[3]Department of Critical Care Nursing, Nursing Research Center, Kerman University of Medical Sciences, Kerman, Iran
[4]Geriatric Care Research Center, Rafsanjan University of Medical Sciences, Rafsanjan, Iran
[5]Present address: Cardiac Care Unit Center, Ali Ibn Abi Talib Hospital, Rafsanjan University of Medical Sciences, Rafsanjan, Iran
[6]Department of Nursing, Nantong Health College of Jiangsu Province, Nantong, China
[7]Nursing College, Al-Mustaqbal University, Hillah, Babil 51001, Iraq
[8]Pistachio Safety Research Center, Rafsanjan University of Medical Sciences, Rafsanjan, Iran
[9]Clinical Research Development Unit, Ali-Ibn Abi-Talib Hospital, Rafsanjan University of Medical Sciences, Rafsanjan, Iran

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