



Original Article

Determinants of Adherence to Hemodialysis Treatment: A Predictive Analysis

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Abstract:

Background: Treatment adherence in end-stage renal disease is a key component of successful hemodialysis. This study aims to identifying the factors that determine treatment adherence among hemodialysis patients in Telafer city.

Methods: This cross-sectional study of sixty hemodialysis patients was conducted from September 2024 to May 2025 in the dialysis center of Telafer city, Nineveh governorate, Iraq. Study Data were collected by a specialized questionnaire consisting of the End Stage Renal Disease-Adherence Questionnaire (ESRD-AQ) and TPB constructs scale. The Statistical Package for Social Sciences (SPSS) software for Windows version 26 were used to analyze descriptive and inferential statistics.

Results: The study shown that the mean age of participants is (49.75±17.87). Regarding TPB constructs, the result demonstrates that the mean score of attitudes is (34.93±2.61), perceived subjective norms is (21.75±1.38), perceived behavioral control is (30.00±1.61), and intention to hemodialysis is (7.86±0.79). The finding of the study demonstrated that four factors (knowledge, subjective norms, perceived behavioral control and intention) are determine treatment adherence ($P<0.05$). The odds ratio for these factors was = 1.214; 95% CI (1.061-1.431), 1.658; 95% CI (1.045-2.903), 1.214; 95% CI (0.804-1.86) and 0.957; 95% CI (0.45-2.019) respectively. Path analysis of TPB constructs indicated that (38%) of the variance in intention could be explained by perceived subjective norms and perceived behavioral control. Also, (65%) of the variance in adherence can be explained by intention.

Conclusion: This study presented that knowledge about hemodialysis, perceived Subjective norms, perceived Behavioral control and intention are factors that predict adherence to hemodialysis treatment.

Keywords: Treatment adherence, Chronic Kidney Disease, Hemodialysis, Theory of Planned Behavior

Introduction:

Chronic kidney disease (CKD) is a significant health issue that requires ongoing management, including regular dialysis, adherence to pharmacological treatments, dietary limitations, and daily medical supervision (Cockwell & Fisher, 2020; Debal & Sitote, 2022; George et al., 2017; Kaufman et al., 2025; Zsom et al., 2022). Compliance to haemodialysis therapy is crucial for improving patient outcomes, decreasing complications, lowering hospital readmission rates, and enhancing overall quality of life (Dantas et al., 2019; de Cássia Bitencourt & Marina dos Reis, 2024; El Shamy & Teakell, 2023). Nevertheless, studies reveal that a substantial percentage of dialysis patients exhibit poor adherence to appropriate therapies, presenting a compelling challenge for healthcare interventions (Asadizaker et al., 2022).

It's known that Adherence to treatment is a complex behaviour influenced by numerous biological factors (e.g., age, gender), psychological factors (e.g., anxiety, depression), sociocultural factors (e.g., economic status, social support), behavioural factors (e.g., self-efficacy, knowledge), and health care system factors (e.g., access to dialysis centres, complexity of treatment regimen) (Bazrafshan et al., 2022; Fernandez-Lazaro et al., 2019). Furthermore, a substantial amount of evidence has established that inadequate therapeutic communication and insufficient health education are the primary determinants of low adherence levels (Alshalawi et al., n.d.; Khawagi et al., 2025; Thompson & McCabe, 2012). In this context, the psychological theoretical frameworks such as the Theory of Planned Behavior (TPB) provide a suitable means for understanding the divers' factors that determine treatment adherence behavior (Khani Jeihooni, Jormand, et al., 2021; Martin & Nahar, 2017). This theory explains that each health-related behavior is based on three main components: attitude, subjective norms, and self-perceived behavioral control (Conner & Norman, 2015; Dilekler et al., 2021; Rich et al., 2015). The TPB offers a comprehensive conceptual framework that elucidates the internal and external factors influencing patients' adherence to treatment and aids in the development of tailored behavioral interventions that sustainably improve

this adherence (Kamyab et al., 2024; McDonald et al., 2002; Sanad et al., 2022; Sheikh et al., 2022). Despite the usefulness of this theory in analyzing treatment adherence behavior, studies on its application to dialysis patients remain limited, especially in Arab cultural contexts (Ho & Lee, 2014; Kopelowicz et al., 2015; Sheikh et al., 2022). This confirms the need to employ this theory in predictive models and future applied research (Baktash & Aziz, 2023; Haynes et al., 2002; Pakpour et al., 2011).

The significance of this study emerges from its effort to identify the actual factors that determinant the dialysis patients' adherence to treatment within the local cultural context, which is crucial for enhancing the effectiveness healthcare program and improving patients' quality of life (Khani, et al., 2021; Sheikh et al., 2022). Additionally, the study seeks to offer a precise, data-driven predictive model that can be applied in routine clinical practice, allowing for the early identification of patients at risk of poor adherence and thereby assisting in the prevention of non-adherence and its complications. From another perspective, integrating the theory of planned behavior into this study as a theoretical framework provides an important insight into the comprehensive understanding of the factors determining treatment adherence among dialysis patients.

Although there are several studies that have addressed treatment adherence among hemodialysis patients, most have relied on descriptive analyses or addressed a limited number of variables (Alatawi et al., 2024; Arsan et al., 2025; Mirzaei-alavijeh et al., 2023). The stated studies were inadequate to develop a holistic predictive model that integrates the biopsychosocial, behavioral, and cultural factors within a combined theoretical framework (Baktash & Sulaiman, 2024; Jaam et al., 2017; Naalweh et al., 2017). Furthermore, there is a limited number of research concerning this area within the context of Arab culture (Ghaddar et al., 2009). This limitation has led to ambiguity in considering cultural and social specificities that may directly or indirectly determine treatment adherence among hemodialysis patients. Hence, this study seeks to fill this gap by identifying the factors that

determine treatment adherence among hemodialysis patients in Telafer city.

Methodology:

Aim of the Study: This study aims to identifying the factors that determine treatment adherence among hemodialysis patients in Telafer city.

Design of the study: This cross-sectional study measured variables (Demographic characteristics, knowledge, concepts of the theory of planned behavior as independent variables) related to treatment adherence as the dependent variable.

Setting and Time: This study is conducted from September 2024 to May 2025 in Telafer city, Nineveh governorate, Iraq. Patient information is collected from the dialysis center of Telafer General Hospital.

Sampling: the study population consisted of 72 patients with end stage renal disease. The sample size calculated by using the cross-sectional study sample size equation which indicated that at list 40 subject is necessary to conducting the study. Sample recruiting process resulted in acceptance of 60 hemodialysis patient from both genders aged 12 and older to participate in the study. This number of subjects was sufficient for conducting the study as planned.

Data collection and Instrumentation: a specialized constructed questionnaire consisting of 3 parts is used collect data from the participants, as follow:

The first part of the questionnaire designed to evaluate the participants demographic characteristics, such as age, gender, marital status, educational level, residence, cause of kidney failure, previous kidney transplant, and duration of hemodialysis.

The second part designed on the bases of the End Stage Renal Disease-Adherence Questionnaire (ESRD-AQ). This scale developed by Kim et al. (2010) and consists of 46 items divided into five subscales. The first subscale of questionnaire included general information of patients, the rest of the subscales consisted of questions related to the four dimensions of adherence (Hemodialysis treatment, medications, fluid restrictions, and dietary restrictions). The total score of the four dimensions of adherence ranged from 0 to 1200, with the highest score represents the best degree

of adherence (Kim et al., 2010). This scale also included questions related to knowledge/perceptions about Hemodialysis attendance, medication, fluid restriction, and dietary recommendations. The questionnaire items were measured by a Likert scale, a yes/no answer, and multiple-choice questions. The score for knowledge and perception questions ranged from (1very low to 5very high). The total score for knowledge/perception of the four dimensions of adherence ranges from 8 to 40, with a higher score indicating higher knowledge/perception of behavior.

The third part of the questionnaire is based on concepts related to the components of the theory of planned behavior and involves 36 items distributed over 4 subscale; the perceived attitude subscale (14 items), subjective norms subscale (8 items), the perceived behavior control (11 items) and intention subscale (3 items) (Sheikh et al., 2022). All scale items were answered using a 5-point Likert scale range of 1 to 5 (1-strongly disagree, 5-strongly agree), except the perceived power was reversed in the sense of (1-strongly agree, 5-strongly disagree). The questionnaire total scores range from 36 to 180, and the highest score represents the best degree of concepts of the theory of planned behavior (positive attitude, perceived subjective norms, and perceived behavioral control) related to adherence behavior.

Data Analysis

The Statistical Package for Social Sciences (SPSS) software for Windows version 26 were used to analyze descriptive and inferential statistics and ($P < 0.05$) was considered statistically significant. Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to measure patients' characteristics. Inferential statistics of the Spearman test was used to measure the correlation between variables. Finally, the binary logistic regression and path analysis was used to assess the relationship between treatment adherence and variables.

Ethical Considerations

All procedures implemented in this study comply with ethical principles and standards of the 1964 Helsinki Declaration. The study obtained ethical approval from the University of Mosul (reference number 45-CCMRE-NUR, data 28 October 2024.

Informed consent was obtained from all study participants in writing before conducting the study.

Results:

Assessing the association between demographic characteristics, Knowledge, Constructs of the theory of planned behavior, and treatment adherence, nonadherence

Table (1) indicates the association between demographic characteristics, Knowledge, Constructs of the theory of planned behavior, and treatment adherence, nonadherence for participants. The table indicates that the mean age of participants is (49.75±17.87). Concerning other demographics characteristics, the table shows that most of participants are male (58.3%), married (61.7%), illiterate (60%), and residents in urban area (61.7%). Dialysis vintage(≥12months) is (65%) while the mean score of knowledge of hemodialysis is (32.13 ±4.89). Regarding TPB constructs, the table demonstrates that the mean score of attitude is (34.93±2.61), mean score of perceived subjective norms is (21.75±1.38), the

mean score of perceived behavioral control is (30.00±1.61), and the mean score for intention to hemodialysis is (7.86±0.79)

On the other hand, the Spearman test of association revealed that there is a negative correlation between total knowledge and nonadherence ($r=-.291$). Conversely, there is a positive association between total knowledge and each of adherence ($r=.278$), and normative belief ($r=.283$).

Finally, the Table 2 shows the relationship between independent variables (Demographic characteristics, knowledge, TPB constructs) and binary dependent variables (Adherence, nonadherence). Binary logistic regression analysis was conducted to determine the association between variables, demonstrating that four factors (knowledge, subjective norms, and perceived behavioral control and intention) are the only variables with statistical significance($P<0.05$). The odds ratio for these factors was = 1.214; 95% CI (1.061-1.431), 1.658; 95% CI (1.045-2.903) 1.214; 95% CI (0.804-1.86) and 0.957; 95% CI (0.45-2.019) respectively.

Table 1: Descriptive Statistics and Correlation between demographic characteristics, Knowledge, Constructs of the theory of planned behavior for Participants (n=60)

Variables	F (%)	Nonadherence (n= 26)	Adherence (n= 34)
Demographic characteristics			
Gender (Male)	35(58.3)	-.084	-.011
Social status (Married)	37(61.7)	.112	.067
Education level (illiterate)	36(60.0)	-.076	-.110
Residence (Urban area)	37(61.7)	.028	-.071
HD vintage(≤12months)	39(65.0)	-.039	-.007
Variables	M(SD)	Nonadherence (n= 26)	Adherence (n= 34)
Age	49.75(17.87)	-.172	-.152
Knowledge about			
Hemodialysis	8.68(2.02)	.250	.299
Medication	8.55(1.48)	.115	.130
Fluid	7.20(2.88)	.322	.186
Diet	7.70(2.21)	-.105	-.035
Total knowledge	32.13(4.89)	.291	.278
Concepts of TPB			

Behavioral belief	17.25(1.61)	-.150	-.110
Evaluation outcome	17.68(1.43)	-.145	-.044
Attitude	34.93(2.61)	-.196	-.127
Normative belief	10.98(.74)	.190	.283
Motivation to follow	10.76(.85)	.099	.132
Subjective norms	21.75(1.38)	.130	.198
Controlling belief	15.70(1.12)	.029	.014
Perceived power	14.30(.84)	.103	.156
Perceived behavioral control	30.00(1.61)	.098	.118
Intention	7.86 (.79)	-.082	-.067

F: Frequency; %: Percentage; M: Mean; SD: Standard Deviation; TPB: Theory of Planned Behavior

Table 2: Binary logistic regression analysis of variables.

Predictors	Estimate	Standard Error	Z-value	P-value	OR	OR 2.5% Lower limit	OR 97.5% Upper limit
Intercept	-3.127	2.668	-1.172	0.241	0.044	0	8.221
Age							
(21-30)	-1.613	1.653	-0.976	0.329	0.199	0.005	4.523
(31-40)	-1.563	1.509	-1.036	0.3	0.21	0.007	3.619
(40- over)	-2.362	1.408	-1.678	0.093	0.094	0.003	1.153
Gender							
Female	0.505	0.919	0.55	0.583	1.657	0.271	10.878
Marital status							
Married, Widow, Divorce	-0.801	0.796	-1.007	0.314	0.449	0.086	2.064
Educational status							
Educated	-0.796	0.865	-0.92	0.358	0.451	0.075	2.389
Residence							
Rural	-0.719	0.652	-1.101	0.271	0.487	0.127	1.704
HD vintage							
≥ 12 months	-0.173	0.65	-0.266	0.79	0.841	0.229	3.016
Knowledge	0.194	0.075	2.584	0.01	1.214	1.061	1.431
Concepts of TPB							
Intercept	-7.867	6.338	-1.241	0.215	0	0	68.178
Attitude	-0.238	0.141	-1.687	0.092	0.789	0.586	1.025
Subjective norms	0.505	0.256	1.976	0.048	1.658	1.045	2.903
Perceived behavioral control	0.194	0.211	0.918	0.035	1.214	0.804	1.86
Intention	-0.044	0.377	-0.118	0.029	0.957	0.45	2.019

OR: Odds ratio

Assessing the association between Constructs of the theory of planned behavior and treatment adherence

Table (3) indicates the association between concepts of the theory of planned behavior and treatment adherence for participants. The Spearman test was used to measure the

relationship between theoretical variables, where the average correlation between the variables was significant ($P < 0.05$), ranging from $-.025$ to 0.866 , as shown in the Table. 3. The results showed that the intention is positively correlated with each of attitude ($r=.308$), and PBC ($r=.495$).

Table 3: Correlation between concepts of the theory of planned behavior for Participants.

No.	Variable	1	2	3	4	5	6	7	8	9
1.	Behavioral beliefs									
2.	Evaluation outcome	.375								
3.	Attitude	.859	.765							
4.	Normative belief	.137	.307	.255						
5.	Motivation to follow	.133	.136	.124	.454					
6.	Subjective norms	.195	.417	.351	.812	.866				
7.	Controlling belief	.091	.264	.158	.128	.494	.395			
8.	Perceived power	.255	.122	.218	-.025	.214	.112	.354		
9.	PBC	.488	.266	.441	.102	.445	.341	.860	.766	
10.	Intention	.178	.383	.308	-.050	-.025	-.066	.544	.303	.495

Table 4 shows that a path analysis was conducted to determine the association between attitude, subjective norms, and PBC as independent variables with intention as a dependent variable, and in addition to the association between adherence behavior as a dependent variable and intention as an independent variable. The R-square for intention is 0.380, which suggests that

(38%) of the variance in intention could be explained by perceived subjective norms and perceived behavioral control. Also, show that R-square is 0.647, which suggests that (65%) of the variance in adherence can be explained by intention. No statistically significant associations were observed between attitude and Intention.

Table 4: Path Analysis of the Theory of Planned Behavior (n = 60)

Dependent	Predictors	Estimate(β)	Standard Error	Z-value	P-value	R-Square
Intention	Positive Attitude	0.090	0.053	1.643	0.367	0.380
	Subjective Norms	0.380	0.061	6.229	0.021	
	PBC	0.617	0.090	6.655	0.046	
Adherence	Intention	0.451	0.216	2.087	0.034	0.647

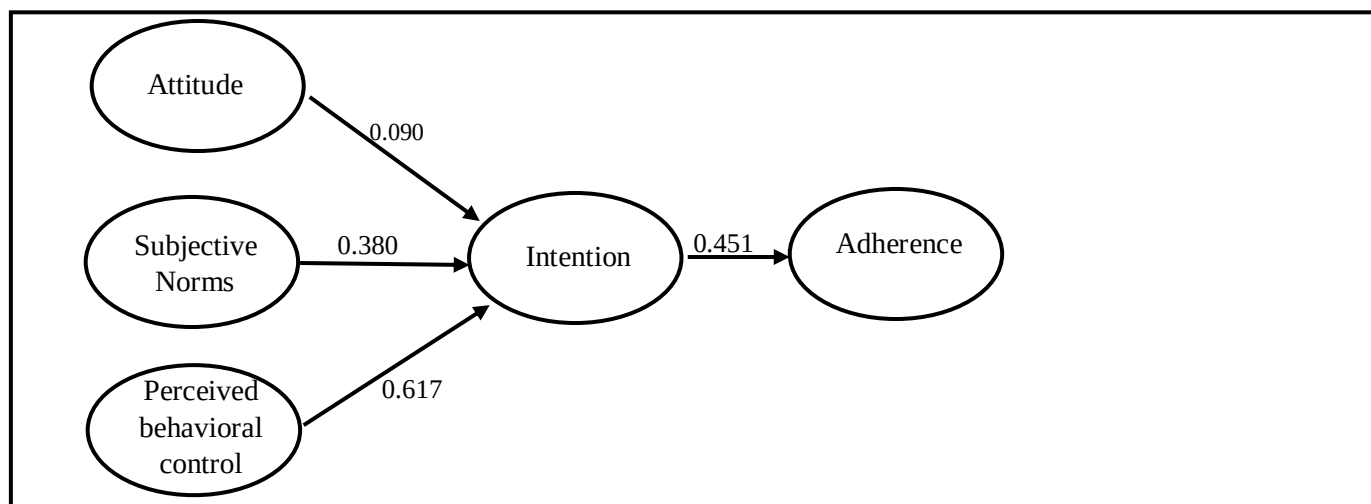


Figure (1): Path Analysis of the Theory of Planned Behavior Construct and Treatment Adherence among Hemodialysis Patients (n=60)

Discussion:

Adherence to hemodialysis treatment is extremely difficult, a challenge faced by many patients due to the factors that hinder it (Lnu et al., 2024; Nour & Baktash, 2022; Ozen et al., 2019). This is the first study that employed the Theory of Planned Behavior to identify the factors that determine treatment adherence among hemodialysis patients from Arabic culture.

Based on the results, the low level of knowledge and awareness is associated with non-adherence behavior, this findings aligns with the study conducted by Kim et al., 2010; Sousa et al., 2023; Spies et al., 2021, which reported that adherence to treatment is improved through increased knowledge (Kim & Cho, 2021; Sousa et al., 2023; Spies et al., 2021). Therefore, this study encourages the healthcare providers including nurses to offer health information and explanations about the ESRD and benefits of adherence to treatment as part of routine dialysis care practice.

The results also showed that treatment adherence behavior is strongly linked to the subjective norms, perceived behavioral control and intention. These three TPB constructs indicated a positive impact on adherence behavior. This means that family, friends, perceived of ability to control adherence and intention to adherence could play a vital role in actual adherence behavior. This conclusion is consistent with the findings of the study carried out by (Kopelowicz et al., 2015) which presented that perceived subjective norms

and perceived behavioral control strongly influence the treatment adherence behavior.

From theory of planned behavior perspective, the Figure (1) and Table (4) reveals that there is a network of interconnections between SN, PBC, intention, and adherence behavior. The subjective norms and perceived behavioral control do not directly affect adherence, but they have a stronger impact on intention, which in turn shapes adherence behaviour. This implies that the subjective norms and perceived behavioral control play a role in enhancing a patient's intention towards adherence behavior, in other words the SN and PBC are the factors that shape the intention to adherence. This result is paramount importance, since the table (4) indicated that intention is strongly and directly linked to behavior. Therefore, it becomes clear to us that the subjective norms and perceived behavioral control have an indirect role in influencing treatment adherence behavior among hemodialysis patients through their effect on intention, which acts as a mediator. This means that the intention to adhere to treatment can be improved by increased awareness about SN and PBC, and this improvement in intention will be reflected in increased adherence. This result aligns with the studies conducted by Ajzen (1991), which shown the strength of intention among adherence patient's (Ajzen, 1991).

Finally, based on these results, any behaviour modification programs should primarily focus on enhancing intention, considering the aspects of the subjective norms and perceived behavioral control

by improving them, either through education or designing behavioural interventions. This results come in line with the study conducted by Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010 which indicated that treatment adherence is influenced by perceived behavioral control and improved intention (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010) (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010)(Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010) (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010) (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010) (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010) (Ajzen, 2011, 2019; Bashirian et al., 2020; Topa & Moriano, 2010).

Therefore, this study recommends that treatment adherence among hemodialysis patient is determined directly and indirectly by four key elements (knowledge, perceived subjective norms and perceived behavioral control and intention).

Conclusion:

The results indicate a strong positive relationship between intention and adherence behaviour, suggesting that individuals with a clear intention are more likely to engage in adherence behaviour. Perceived behavioral control and subjective norms are also showed indirect impact in enhancing this adherence behaviour, as it enables individuals to overcome obstacles and achieve the desired goals with increasing intention. Knowledge contributed to enhancing awareness and the ability to make informed decisions that support the desired intention and adherence behaviour. The study showed that the interaction between these factors produces adherence behaviour. This positive alignment enhances the effectiveness of behavioural models in understanding individual motivations. Therefore, enhancing intention and knowledge, along with perceived behavioral control and subjective norms, is considered an effective approach to changing positive behaviour.

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