ORIGINAL RESEARCH ARTICLE

Treatment Adherence and Associated Factors in Patients with Coronary Artery Disease Discharged from Urmia Hospitals in 2024

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Published: 22 June 2025

Abstract

Background Coronary artery disease remains a leading cause of global mortality, and its management requires strict adherence to prescribed treatments. Given the importance of this issue, the present study aimed to assess the treatment adherence status of patients with coronary artery disease discharged from Seyed Al-Shohada and Ayatollah Taleghani hospitals in Urmia in 2024.

Methods This descriptive cross-sectional study was conducted on 430 eligible individuals who met the inclusion criteria and were selected using convenience sampling. Data were collected using demographic and treatment adherence questionnaires. Descriptive statistics (means, frequencies) were used for data analysis, while Pearson correlation and linear regression were applied to examine relationships and make predictions between variables. T-tests and ANOVA were used for analytical calculations.

Results The results showed that the level of adherence to treatment among the patients studied was generally satisfactory (142.49 ± 49.92). In addition, Significant predictors, including education level, gender, type of treatment, and severity of disease (number of vessels involved), affect the level of adherence to treatment in patients with coronary artery disease ($R^2 = 0.033$, $p < 0.05$). Notably, patients with lower education levels had better adherence to treatment, while those with higher education and patients with more extensive vascular involvement showed lower adherence. Also, women had higher adherence to treatment compared to men ($p<0.05$).

Conclusion This study revealed that treatment adherence in patients with coronary artery disease is influenced by multiple factors, including education level, treatment type, disease severity, and gender. Therefore, targeted educational and supportive interventions tailored to the needs of patients, particularly those in high-risk groups, can enhance treatment adherence and ultimately contribute to improved disease management. We recommend that healthcare officials develop comprehensive support and educational policies and implement programs to screen and identify patients at risk of non-adherence to treatment.

Keywords Treatment Adherence, Coronary Artery Disease, Patient Compliance, Hospitals

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Received: 14 March 2025/ Revised: 11 April 2025/ Accepted: 21 May 2025

1 Introduction

Non-communicable diseases (NCDs) are the leading cause of death worldwide.[1] Among these, cardiovascular disorders, particularly coronary artery diseases (CADs), have been identified as the most common cause of mortality and disability across all age groups and genders.[2, 3] In 2018, CAD was the leading cause of death in North Africa, accounting for 21% of all mortalities.[4] According to a study conducted on the global burden of CAD, there will be a 161% increase in CAD cases in the Middle East by 2026. The study also reported that the average age of myocardial infarction patients in this region is 51 years—about 12 years younger than the average in Western Europe. Therefore, this issue is considered a major public health concern in both developing and developed countries.[5]

In Iran, the main cause of death has shifted from infectious and diarrheal diseases to cardiovascular diseases (CVDs) over the past few decades.[6] In Ardabil Province, CVDs have been reported as the leading cause of death, accounting for 39% of all fatalities, primarily due to heart failure and related conditions.[7] Additionally, a study conducted in this province on hospitalized CAD patients showed that 92.4% were hospitalized for less than 7 days, and 53.9% had only one hospitalization. With regard to temporal trends, the highest rate of hospitalization with an increasing trend was observed in Khalkhal, while a decreasing trend was noted in Ardabil city.[8] In the United States, heart disease incurred an annual cost of approximately $229 billion between 2017 and 2018.[9]

Despite established clinical guidelines and widespread access to effective medications, many CAD patients do not achieve their therapeutic goals.[10] For medications to be effective, they must not only be appropriate but also adhered to by patients. Inappropriate prescribing and poor adherence to treatment are both associated with increased complications and mortality in CAD patients.[11]

According to the World Health Organization, treatment adherence is defined as the extent to which a person's behavior—taking medication, following a diet, engaging in physical activity, and/or implementing lifestyle changes—corresponds with agreed recommendations from a healthcare provider.[12] Treatment adherence is typically assessed in four domains: medication adherence, dietary adherence, physical activity adherence, and lifestyle adherence.[13] Medication adherence is often defined as the ratio of doses taken to the total number of doses prescribed over a specified time period.[14] Dietary adherence refers to the process of following a nutritional plan through self-monitoring, maintenance, and relapse prevention.[15] Physical activity adherence is the extent to which a patient follows the recommended frequency, intensity, and type of exercise.[16] Lifestyle adherence refers to the degree of alignment between an individual's health behaviors and healthcare recommendations.[17]

Medication adherence encompasses more than just taking medication. It is well-established that adherence is a multifaceted issue influenced by factors such as disease perception, self-efficacy, cognitive abilities (including memory, coping, and problem-solving skills), and psychosocial elements (including personal and cultural beliefs about treatment). Therefore, non-adherence to treatment regimens presents a significant challenge in the long-term management of patients suffering from post-myocardial infarction.[18] Moreover, poor adherence has a negative impact on treatment efficacy, duration, patient safety, and healthcare costs. Furthermore, it leads to adverse therapeutic, social, and economic outcomes—not only for the patient but also for healthcare providers, physicians, and even medical researchers. This makes it a global challenge and a critical factor in the success and safety of many treatments. [19–21]

Thus, identifying the factors associated with treatment adherence provides a valuable strategy for healthcare providers to offer tailored treatment plans and enhance adherence. Estimating and understanding these factors can guide the design of interventions and inform future studies aimed at improving adherence to treatment regimens.[22] In Iran, there is limited data on the level of treatment adherence among CAD patients after hospital discharge. Although these patients require ongoing care and strict adherence to medical instructions, the lack of accurate data in this area hampers the development of effective strategies to improve adherence. Studies conducted in some provinces in Iran have indicated that many patients do not receive adequate follow-up care after discharge, leading to increased hospital readmissions and reduced quality of life.[23]

Given the importance of this issue, the present study aims to determine the status of treatment adherence and its influencing factors among patients with coronary artery disease who were discharged from Seyed al-Shohada and Ayatollah Taleghani hospitals in Urmia in 2024. This study seeks to answer the fundamental question: What is the level of post-discharge treatment adherence among CAD patients, and what factors influence it?

2 Methods

This study is a descriptive, cross-sectional correlational study. The research proposal was approved by the Faculty of Nursing and Midwifery at Ardabil University of Medical Sciences, and the sample size for the study group was determined. After obtaining permission from the Research Deputy of the Nursing and Midwifery Faculties in Ardabil and Urmia, as well as receiving an ethics code from the Ethics Committee of Ardabil University of Medical Sciences, the researcher visited

educational and therapeutic hospitals. After introducing themselves and providing necessary explanations about the study, 430 patients were selected using convenience sampling. Written informed consent was obtained from the participants, and they were assured that their information would remain completely confidential.

The inclusion criteria for the study were patients with coronary artery disease who had been discharged from Seyed Al-Shohada and Ayatollah Taleghani hospitals in Urmia at least one month earlier. Additionally, patients had to be prescribed at least one cardiovascular medication such as aspirin, statins, beta-blockers, or ACE inhibitors, and be willing to participate by signing the consent form. Patients who did not cooperate during the study or completed the questionnaire incompletely were excluded from the study.

Data collection tools included two questionnaires: a demographic information form containing questions about demographic characteristics such as age, gender, marital status, number of children, education level, occupation, age at disease onset, duration of illness, type of treatment received, risk factors, number of medications used, and number of affected coronary arteries; and a treatment adherence questionnaire designed to assess adherence in patients with coronary artery stenosis. This questionnaire was developed and psychometrically validated by Dehghan Nayeri et al. in 2015. The treatment adherence questionnaire consists of 35 questions across four domains: dietary adherence (13 questions), adherence to a healthy lifestyle (7 questions), medication adherence (11 questions), and activity adherence (4 questions). The questionnaire uses a 5-point Likert scale ranging from "always" (score 5) to "never" (score 1). Maximum and minimum scores can be calculated for each domain, and higher scores indicate greater adherence. According to the scores, adherence is categorized as poor (1–105), moderate (106–140), and desirable (above 140). The validity and reliability of the tool were confirmed in the original study by the designers. The overall reliability measured by Cronbach's alpha was 0.97.[24] In the present study, reliability was confirmed with a Cronbach's alpha, and was 0.93. Descriptive statistics (frequency tables, mean, and standard deviation) were used, and for inferential statistics, Pearson's correlation coefficient was applied to examine the correlation between treatment adherence scores and some demographic characteristics. Linear regression was used to determine the predictive power of demographic characteristics on treatment adherence. Data were analyzed using SPSS 25, with a p-value < 0.05.

3 Results

The results showed that the mean age of the patients was 57.14 years with a standard deviation of 12.14, and the age of patients in this study ranged from 18 to 92 years. The mean age at disease onset was reported as 49.07 years with a standard deviation of 12.03, ranging from 1 to 80 years. Additionally, the average duration of the disease among patients was 8.08 years with a standard deviation of 7.14, varying from 0 to 49 years.

In the section on qualitative variables, the gender distribution of patients indicates that 54% of participants were male and 46% were female. An examination of marital status shows that 70.5% of the patients were married, 17.4% were single, and 12.1% fell into the "others" category. In terms of education level, 25.1% of patients were only literate, 17.4% had primary education, 23.3% had middle school education, and 34.2% had a high school diploma or higher. An examination of employment status reveals that 34.7% of patients were housewives, 24% were self-employed, 17.9% were employees, 15.6% were retirees, and 7.9% were workers. Regarding the number of children, 13.5% of patients had no children, 12.6% had one child, 36.0% had two children, 24.7% had three children, and 13.3% had four or more children. The financial status revealed that 19.5% of the patients had an income of less than five million Tomans, 24.4% had an income between 5 and 10 million Tomans, and 56% had an income of more than 10 million Tomans.

As for treatment type, 20.5% underwent surgery, 29.8% underwent angiography, 32.3% received hybrid treatment, and 17.4% received other treatments. Regarding risk factors, 13% of patients were smokers, 7.7% had high cholesterol, 17.7% had hypertension, 12.1% had diabetes, and 49.5% had other risk factors such as obesity or family history. Regarding the number of medications used, 6.3% of patients took one medication, 24.2% took two, 21.6% took three, 20.0% took four, and 27.9% took five or more. Finally, regarding the number of coronary arteries involved, 38.1% of patients had one, 43.7% had two, and 18.1% had three coronary arteries involved.

The results show that the mean treatment adherence score among women (147.29 ± 42.96) was higher than that of men (138.40 ± 42.56), and this difference was statistically significant ($P = 0.032$), indicating that gender may influence treatment adherence.

The results of the one-way ANOVA showed no significant difference among singles, married individuals, and other groups ($P = 0.983$). Therefore, marital status does not have a substantial effect on treatment adherence.

However, educational level was significantly associated with adherence ($P = 0.001$), such that individuals with primary education (158.45 ± 19.79) showed the highest adherence, while those with a diploma or higher education (134.44 ± 49.11) had the lowest adherence.

Other variables, including employment status ($P = 0.230$), number of children ($P = 0.299$), and financial status ($P = 0.973$), did not have significant impacts on treatment adherence, as the means across different groups did not

Table 1 Association between treatment adherence and socio-demographic characteristics in coronary artery disease patients

Variable	Variable level	Treatment adherence (Mean ± SD)	P value
Gender	Male	138.40 ± 42.56	*P=0.032
	Female	147.29 ± 42.96	
Marital status	Single	143.25 ± 41.30	**P=0.983
	Married	142.41 ± 43.34	
	Other	141.88 ± 43.59	
Education level	Literate	145.35 ± 42.95	**P<0.001
	Elementary	158.45 ± 19.79	
	Middle school	139.27 ± 42.80	
	High school or higher	134.44 ± 49.11	
Occupation	Housewife	146.85 ± 41.32	**P=0.230
	Worker	136.65 ± 45.64	
	Employee	146.99 ± 38.31	
	Self-employed	139.83 ± 43.76	
	Retired	134.70 ± 47.94	
Number of children	No children	144.47 ± 36.88	**P=0.299
	1 child	138.81 ± 45.17	
	2 children	147.77 ± 39.56	
	3 children	139.20 ± 46.69	
	4 children	135.75 ± 47.39	
Income	<5 million Tomans	143.13 ± 40.56	** P=0.973
	5-10 million Tomans	141.71 ± 42.82	
	> 10 million Tomans	142.61 ± 43.92	

* Independent t-test ** One-way ANOVA

Table 2 Association Between Treatment Adherence and Clinical Characteristics in Coronary Artery Disease Patients

Variable	**Variable Level**	**Treatment Adherence (Mean ± SD)**	**P value**
Type of Treatment	Surgery	132.78 ± 45.59	**P= 0.035
	Angiography	145.38 ± 41.28	
	Hybrid	148.44 ± 39.75	
	Other	137.93 ± 46.38	
Risk Factors	Smoking	150.39 ± 34.29	**P= 0.497
	Hyperlipidemia	147.61 ± 40.42	
	Hypertension	139.03 ± 48.09	
	Diabetes	144.00 ± 41.35	
	Other	140.49 ± 43.79	
Number of Medications	1 drug	148.63 ± 35.83	**P= 0.519
	2 drugs	142.76 ± 44.36	
	3 drugs	142.15 ± 39.01	
	4 drugs	142.13 ± 43.46	
	> 4 drugs	137.54 ± 45.62	
Number of Affected Coronary Arteries	1 vessel	151.2 ± 37.2	**P value= 0.003
	2 vessels	135.75 ± 46.99	
	3 vessels	140.82 ± 41.60	

show meaningful differences. These results indicate that gender and educational level are influential factors in treatment adherence, whereas the other variables did not show a statistically significant role (Table 1).

The results also showed that the type of treatment has a statistically significant effect on treatment adherence (P = 0.035). Patients who underwent hybrid treatment (148.44 ± 39.75) had the highest adherence, while those who underwent surgery showed the lowest adherence (132.78 ± 45.59).

Underlying risk factors (P = 0.497) and number of medications taken (P = 0.519) did not significantly affect adherence. However, the average adherence was relatively higher among smokers (150.39 ± 34.29) and patients who took only one medication (148.63 ± 35.83). On the other hand, the number of affected coronary arteries had a significant effect on adherence (P = 0.003). Patients with one affected coronary artery had the highest adherence (151.2 ± 37.2), while those with two affected arteries had the lowest (135.75 ± 46.99). These findings suggest that some factors, such as treatment type and number of involved arteries, can influence patients' treatment adherence. In contrast, other factors, such as medication use and certain risk factors, did not have a significant impact (Table 2).

The regression analysis results indicate that the proposed model explains 3.3% of the variance in treatment adherence ($R^2 = 0.033$), and the adjusted R^2 is 2.8% (Adj. $R^2 = 0.028$), reflecting a relatively weak effect of the predictor variables on the dependent variable.

Coefficient analysis shows that both education level ($p = 0.004$, $\beta = -0.139$) and number of affected arteries ($p = 0.014$, $\beta = -0.117$) have significant but adverse effects on adherence, meaning that higher education levels and a greater number of affected arteries are both associated with lower treatment adherence.

The intercept ($\beta = 168.40$, $p < 0.001$) was also statistically significant, indicating the baseline level of adherence in the absence of the predictive variables (Table 3).

Table 3 Regression Analysis Results for Predicting Treatment Adherence Based on Number of Affected Arteries and Education Level

Dependent variable	Predictor	B	S.E	Beta	T	P Value
Treatment adherence	Intercept	168.40	7.20	-	23.38	<0.001
	Education	-5.03	1.72	-0.14	-2.92	0.004
	Vessels	-6.952	2.82	-0.117	-2.46	0.014
Adj. R^2=0.028, R^2=0.033, R=0.180						

4 Discussion

This study aimed to determine the status of treatment adherence and its influencing factors among patients with coronary artery disease after hospital discharge. The findings revealed that adherence to treatment in these patients is influenced by variables such as gender, education level, type of treatment, and disease severity or the number of affected arteries. Specifically, women, patients with lower levels of education, and those with fewer affected arteries reported higher levels of treatment adherence.

The results showed that education level and the number of affected arteries significantly influenced treatment adherence in patients with CAD. The negative coefficient for education indicates that higher levels of education are associated with lower adherence to treatment. This could be due to the fact that individuals with higher education levels typically possess greater knowledge about their condition and the various treatment options, which may cause them to question or hesitate in following the recommended treatments. These individuals may also exhibit greater independence in making treatment decisions and may be less inclined to strictly follow medical advice. Additionally, an increased number of affected arteries was associated with lower adherence. This might be due to greater disease severity, which can lead to discouragement about treatment effectiveness or greater complexity in managing treatment, thereby reducing motivation to follow medical recommendations. Physical limitations may also hinder adherence to treatment regimens. However, the model's coefficient of determination indicates that only a small portion of the variance in treatment adherence is explained by these variables. This means that other factors, not examined in this model, are also playing roles in patients' adherence to treatment. Factors such as social support, individual beliefs, economic conditions, and patients' awareness of their illness may significantly impact adherence.

The current study's findings showed that patients with education levels below high school had better treatment adherence, whereas those with higher education levels were less likely to adhere. At first glance, this may seem contradictory, as higher education is generally associated with better access to health information and a greater understanding of the importance of medical care. However, further investigation reveals several possible explanations. One interpretation is that individuals with lower education levels are more reliant on the advice of healthcare providers and are less likely to obtain medical information from alternative sources (such as the internet or social media). As a result, they tend to follow medical advice without question and are more compliant with medication and treatment recommendations. On the

other hand, individuals with higher education levels may take a more critical and autonomous approach to medical advice, consult multiple sources for decision-making, and in some cases, prefer alternative treatment methods.

Several studies support this interpretation. For example, the study by Uchmanowicz et al. revealed that patients with lower education adhered better to treatment due to higher trust in physicians, whereas those with higher education were more inclined to seek medical information independently and sometimes ignored medical instructions.[25] Education level can also be linked to other factors such as lifestyle and socioeconomic status, which influence treatment adherence. Individuals with higher education often lead busier lives and may perceive treatment regimens or lifestyle changes as burdensome, which can lead to reduced adherence. In contrast, patients with lower education levels may have more structured or sedentary lifestyles, which can facilitate better adherence. A study by Guix-Comellas et al. showed that patients with higher education levels often work in high-stress environments, which may lead to forgetting medication or neglecting medical appointments. Meanwhile, individuals with lower levels of education and more traditional occupations were more likely to follow treatment plans due to their more regular lifestyle.[26] Another critical factor is health literacy and personal control over health. Research has shown that more educated individuals often feel more capable of managing or modifying their treatment. These patients might adjust their medication based on personal understanding or sometimes substitute prescribed drugs with herbal remedies or supplements.[27, 28] A study by Lim et al. showed that highly educated patients occasionally discontinued or changed medications based on online information, negatively affecting adherence. Patients with lower education levels may take their illness more seriously and fear the consequences of non-adherence, while those with higher education may perceive the disease as less threatening and seek alternative management approaches.[29] A study by Simon et al. found that patients who perceived their illness as more serious were more likely to follow treatment recommendations. In contrast, higher-educated patients who had greater awareness of disease progression sometimes viewed it as less threatening and did not see adherence as necessary.[30]

These results suggest that treatment adherence is influenced not only by education level but also by attitudes toward illness, lifestyle, trust in physicians, and access to health information. Therefore, educational and counseling programs should consider patients' education levels. For highly educated patients, it is essential to emphasize the importance of medical adherence and correct any misconceptions about treatment. For individuals with lower educational backgrounds, improving health literacy and providing clear, easy-to-understand information can facilitate effective disease management. These findings underscore the importance of tailoring health programs to individual differences in adherence, with the goal of enhancing the quality of life for patients with coronary artery disease.

The study also showed that women adhered to treatment better than men. This aligns with many previous studies and may be attributed to psychological differences, lifestyle, social roles, and sensitivity to health.[30] Ek et al.'s study showed that women exhibit more health-oriented behaviors and are more attentive to medical advice than men. This may be due to personality traits such as conscientiousness and greater health concern.[31] A study by Bouchard et al. found that women experience more stress when dealing with chronic illnesses like coronary artery disease, resulting in higher motivation to adhere to treatment regimens.[32] Women are also more likely to follow medical advice, whereas men may prefer autonomy in medical decision-making and disregard some recommendations. Other studies have shown that women practice more self-care than men, which plays a crucial role in better treatment adherence.[33, 34]

In many societies, women often assume caregiving roles within families, making them more aware of health issues, both their own and those of others. They are often responsible for scheduling doctor visits, reminding family members to take medication, and managing dietary routines, which increases their awareness of the importance of adherence. A study by Clarke et al. revealed that women are more proactive in seeking medical information, more consistent in attending medical consultations, and more cooperative with healthcare providers. These factors may explain better adherence among women.[35] In contrast, men often downplay or ignore illness. According to research by Rad et al., men tend to view illness as a sign of weakness and are less likely to adhere to treatment in order to preserve their independence. This could explain their lower treatment adherence.[36]

Another factor could be differences in lifestyle and the prevalence of risky behaviors between genders. Men are generally more likely to engage in unhealthy habits such as smoking, alcohol consumption, and poor diets, which negatively impact adherence. Studies by Mukamal et al. and Mansour et al. showed that men with coronary artery disease are more likely to continue smoking and drinking, while women are more likely to quit such habits and follow medical advice.[37, 38] These findings suggest that lifestyle differences play a role in treatment adherence. Health literacy is another factor affecting adherence.

In reviewing studies related to the number of affected arteries and treatment adherence in patients with coronary artery disease, it has been reported that increased disease

severity may reduce adherence. A study on diabetic and cardiac patients showed that those with more complex conditions requiring long-term treatment are less likely to follow treatment regimens due to treatment fatigue and doubts about its effectiveness.[39] This is consistent with our study, which found lower adherence in patients with a greater number of affected arteries.

Furthermore, other research has shown that psychological interventions can improve adherence, even though they did not directly examine the number of affected arteries. These findings align with the results of our study,[40] suggesting that patients with more extensive coronary involvement may need more psychological support. Overall, the related literature suggests that factors such as education level, health literacy, and psychological interventions can impact adherence in patients with coronary artery disease. However, variations in study outcomes highlight the complexity of this issue and the need for further research to identify influencing factors more accurately.

Regarding the number of affected arteries, some patients may feel more motivated to follow treatment as the severity of the disease increases, while others may feel overwhelmed by the complexity, leading to reduced adherence. This highlights the need for personalized interventions and the importance of providing educational and psychological support for high-risk patients

5 Conclusion

The results of this study demonstrated that multiple factors influence treatment adherence in patients with coronary artery disease, including education level, gender, and disease severity as measured by the number of affected vessels. Patients with lower educational levels exhibited better treatment adherence compared to those with higher academic levels. Similarly, patients with greater vascular involvement showed lower adherence rates. Women demonstrated significantly higher treatment adherence than men, likely reflecting differences in lifestyle factors, health-related attitudes, and available social support systems. However, this model's explanatory power was limited, suggesting that additional unmeasured factors, such as economic circumstances, personal health beliefs, and health literacy levels, likely play important roles in determining adherence behaviors. These findings suggest several important considerations for clinical practice and health policy. For highly educated patients, interventions should focus on addressing treatment misconceptions and enhancing patient-provider communication. For patients with limited education, simplified health messaging and reinforcement of the importance of treatment are recommended. Special consideration should be given to patients with multi-vessel disease, who may require additional support to maintain treatment adherence. Furthermore, gender-specific strategies should be developed, with a particular focus on improving adherence among male patients.

Declarations

Acknowledgments

This work originated from a Master's thesis completed in 2024 with support from Urmia and Ardabil Universities of Medical Sciences. The authors express sincere gratitude to faculty members of the Nursing and Midwifery Schools at both universities, staff at Urmia teaching hospitals, and all participating nurses who contributed to this research.

Authors' Contributions

All authors contributed substantially to this study through conceptual development, research design, data collection, and manuscript preparation. Each author reviewed and approved the final manuscript without reservation, confirming complete agreement with its content.

Availability of Data and Materials

The data and materials used in this study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no competing interests related to this work.

Consent for Publication

All authors have read and approved the final manuscript and provided their consent for publication.

Funding

This research received support from Ardabil and Urmia Universities of Medical Sciences.

Ethical Considerations

The study protocol received ethical approval from Ardabil University of Medical Sciences (IR.ARUMS.REC.1403.125). All participants provided informed consent after being fully advised of the study's voluntary nature and data confidentiality protections. The research team strictly maintained participant confidentiality throughout the study.

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