

Research Article



The Impact of Intervention Based on Protection Motivation Theory on Treatment Adherence in Patients with Ischemic Heart Disease

Masoomah Zakipoor¹, Kobra Hajalizadeh^{2*}, Mohammadreza Seirafi³, Marziyeh Nikparvar⁴, Sedigheh Abedini⁵

¹Department of Health Psychology, Kish International Branch, Islamic Azad University, Kish Island, Iran

²Department of Psychology, Bandar Abbas Branch, Islamic Azad University, Bandar Abbas, Iran

³Department of Psychology, Karaj Branch, Islamic Azad University, Karaj, Iran

⁴Cardiovascular Research Center, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

⁵Social Determinants in Health Promotion Research Center, Hormozgan Health Institute, Hormozgan University of Medical Sciences, Bandar Abbas, Iran

Abstract

Background: Patients with ischemic heart disease (IHD) gradually reduce their follow-up treatment due to the vulnerable physical condition and high involvement with the disease-related treatment process. The purpose of this research was to investigate the effect of intervention based on the protection motivation theory (PMT) on treatment adherence in patients with IHD.

Methods: This quasi-experimental research used a pretest-posttest design with a control group. The statistical population included all patients with IHD referred to the Payambar Azam hospital in Bandar Abbas, Iran for more than once between March 2019 and May 2020. A total of 16 patients were selected through the matched targeted sampling and randomly assigned into two equal groups of experimental and control (n = 8 each). The test group received an intervention based on the PMT in six 90-minute sessions within 45 days. We used the Modanloo Treatment Adherence Questionnaire (TAQ), and the data were analyzed using the analysis of covariance (ANCOVA) in the SPSS23 statistical software.

Results: The results of ANCOVA showed that the intervention based on the PMT significantly increased the treatment adherence and its subscales in patients with IHD ($P < 0.001$).

Conclusion: Intervention based on the PMT can be used as an effective intervention to increase treatment adherence in patients with IHD, depending on proper nutrition training, self-care skills, awareness-raising, and relaxation exercises.

Keywords: Ischemic heart disease, Treatment adherence, Self-care, Protection motivation theory

*Correspondence to

Kobra Hajalizadeh,
Email: ph_alizadeh@yahoo.com



Received December 29, 2020, Accepted: September 6, 2021, Published Online: March 29, 2022

Background

Cardiovascular diseases are the most critical cause of death worldwide. They are known as one of the most important health threats in different countries, and their prevalence is increasing (1). Ischemic heart disease (IHD) is one of the most common cardiovascular diseases, killing millions of people worldwide annually. According to the World Health Organization (WHO), 49% of heart attacks are related to this disease (2). The leading causes of this disease are the accumulation of large amounts of low-density lipid (LDL) and cholesterol deposits on the arteries' inner wall, arterial thrombosis, spasms, and finally a decrease in the diameter of the coronary artery (3).

There are various manifestations of IHD depending on the degree of vascular occlusion and the incidence of acute or chronic obstruction and the mechanism of occlusion. The first type is angina pectoris, a condition in which the patient suffers from chest pain due to problems

in the coronary arteries and lack of sufficient oxygen to the heart muscle. This pain occurs mainly in the left mediastinum area with the possibility of spreading (mainly in the unstable type) to the left arm (sometimes both arms), the jaw, and the middle part of the two shoulders (4). The second type is Prinzmetal or variant angina, in which irregular heartbeat and chest pain occur. As a result of coronary artery spasm, a sudden increase in adrenaline occurs, usually at rest, and the pain resolves with standard treatment (5). The third type is myocardial infarction, commonly known as a heart attack. This type is the permanent and irreversible cell destruction and death of the heart's myocardial muscle that occurs due to severe IHD in this part of the heart (6).

People with IHD mainly suffer from problems such as pain, intolerance to activity, ineffective adaptation to the disease (7), anxiety, and severe psychological manifestations (8). Statistics show that IHD causes the highest disability (9) and financial burden (direct costs:

hospitalization and treatment; indirect costs: absenteeism and unemployment) compared to other diseases, which has attracted the special attention of health researchers to perform diagnostic, control, and prevention tests (10).

Since IHD is a chronic disease with no definitive cure, it is essential to manage the disease throughout the patient's life. In addition to the medication, treatment adherence is essential to prevent disease progression and recurrence (11). Patients' lack of adherence or poor treatment adherence is one of the main reasons for treatment failure, increased disease complications, prolonged treatment, increased costs of care, and even devaluation of the best treatment regimens (12). The ultimate goal of any prescription is to achieve optimal therapeutic results and better management of the disease (13). Meanwhile, treatment adherence is the most important key factor in reducing chronic patients' complications and mortality (14). Iakovleva (15) defined treatment adherence as the degree to which a person's behavior conforms to health recommendations and medication. Lack of treatment adherence in different patients is associated with frequent hospitalizations, lack of treatment benefits, high treatment costs, and many physician visits (16). In addition, mortality in patients who do not adhere to their treatments is twice as high as in other patients (17).

Despite the provision of appropriate pharmacological methods, surgeries, and treatments to control IHD, the ratio of its successful results to other diseases is disappointing. Lack of awareness of self-care behaviors and behaviors related to treatment adherence are significant problems for these patients. They also have questions and confusions about self-care, medication, diet, and side effects when discharged and left alone at home (18). Therefore, these patients need another intervention strategy to modify and change self-care behaviors, medication, and diet that should be taught to patients considering behavioral models as a specific intellectual framework while paying attention to causal demands.

Behavioral theories are valuable tools for recognizing and solving a wide variety of behavioral problems and provide a good opportunity and context for individuals to understand a particular high-risk or protective behavior (19). The protection motivation theory (PMT) (20) is among these theories applied to examine the factors affecting motivation and patients' behavior. In this regard, several studies (21-25) concluded that protective motivation could lead to improved health and self-care behaviors in different patients. This theory explains that arousing fear of a health hazard (e.g., disease), as a behavioral recommendation, directly affects people's choice and motivation to protect themselves (26). In other words, PMT assesses the threats through perceived vulnerability structures, perceived severity, internal and external rewards relying on motivation, and predicts different types of preventive and protective behaviors

through structures of self-efficacy, response efficiency, protection motivation, and response costs; then, it emphasizes the development of adaptation skills (coping assessment) of individuals (27). Generally, the structures of this theory are included in two cognitive mediating processes of threat assessment (examining unhealthy behaviors and factors affecting the likelihood of engaging in them) and coping assessment (ability to cope with and avert the threatened threat) (28). Therefore, protective behaviors are guided by people's assessment of threats to deal with them according to theoretical arguments and empirical results. In this case, the threat assessment may affect the target orientation and individuals' confrontation (29).

Behavioral theory models, in addition to predicting intent and behavior, can also be valuable in predicting emotional responses such as treatment adherence (diet, exercise, medication, etc) (30). Accordingly, adopting and maintaining health behaviors that reduce the risk of heart disease, especially in IHD patients, is considered a challenge for patients and medical staff. Despite centuries of medication and advice for health care, non-compliance with medical and protective advice is still an obstacle to achieving therapeutic goals.

Objectives

It seems that using theoretical-functional methods in changing and modifying behavioral patterns and controlling chronic diseases such as IHD is essential. The purpose of this research was to investigate the effect of intervention based on the PMT on treatment adherence in patients with IHD.

Materials and Methods

This quasi-experimental research had a pretest-posttest design with a control group. The statistical population included all IHD patients referred to the Payambar Azam hospital in Bandar Abbas, Iran for more than once between March 2019 and May 2020. The subjects were selected through the targeted sampling method. Patients aged 50 years and older diagnosed with IHD confirmed by a specialist physician with a minimum literacy were selected. Finally, a total of 16 eligible patients were selected in a peer-to-peer manner and randomly assigned to two equal groups of experimental and control ($n = 8$ each). The experimental group received six 90-minute sessions based on the PMT, while the control group did not receive the intervention.

The inclusion criteria were having various types of IHD (approved by a specialist), being over 50 years old, having a minimum literacy, signing a consent form to participate in the research, and not having other acute and chronic physical and psychological diseases (according to their health records and advice). The exclusion criteria were as follows: not attending more than two sessions, lack of cooperation, lack of doing the assignments specified

in the class, and unwillingness to continue attending the research process.

Research Tools

Treatment Adherence Questionnaire (TAQ)

The 40-item TAQ was designed by Modanloo in 2013 for chronic and psychometric patients. This questionnaire is formulated based on a five-point Likert scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5). The scores of each item related to that subscale are summed to calculate the score of each subscale. The scores of all related items are summed to calculate the score of the questionnaire. Minimum and maximum scores in the areas of care in treatment (9-45), willingness to participate in treatment (7-35), ability to adapt (7-35), integration of treatment with life (5-25), clinging to treatment (4-20), commitment to treatment (5-25), and prudence in the implementation of treatment (3-15) are calculated. The total score range of the questionnaire is from 40 to 200. A higher score indicates greater treatment adherence. The face and content validity of this tool in Modanloo's research was confirmed by experts, and the reliability of the treatment adherence tool was measured using the retest method, and the correlation coefficient was $r = 0.875$ (12). Poshtchaman et al (31) also confirmed the validity and reliability of this tool. The reliability of subscales of care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in the implementation of treatment, and the total score of the questionnaire were calculated by Cronbach's alpha coefficient as 0.78, 0.81, 0.85, 0.79, 0.77, 0.75, 0.74, and 0.80, respectively.

Research Implementation Process

A total of 16 patients with IHD were included in the study. First, we obtained the needed permissions from the hospital managers. Then, the subjects were randomly assigned to experimental and control groups ($n = 8$ each). The experimental group received six 90-minute sessions based on the PMT withing 45 days, while the control group did not receive this intervention. The patients' consent to participate in the intervention program was obtained. The control group was also assured that they would receive this intervention after completing the research process. Both groups were also assured that their information would remain confidential.

Valid scientific references and the medical staff's views of IHD patients were used to design a PMT training package. The references included published papers in scientific journals from 2017 to 2020 on the PMT (21-25, 32-34). The protection motivation structures were identified based on these references. The identified structures included perceived sensitivity (vulnerability), perceived severity, self-efficacy, response efficiency, and response costs. A structured interview was organized to

emphasize these patients' issues in the topics of treatment and health care to identify the examples of extracted structures in IHD patients. This interview consisted of seven questions. According to the guidelines defined in the PMT and structured interview information, a training package based on the PMT was set up for IHD patients. The content validity of this package was confirmed by eight psychologists.

In this research, two levels of descriptive and inferential statistics were used to analyze the data. The mean and standard deviation were used for descriptive statistics. Shapiro-Wilk test was used to investigate the normality of data at the level of inferential statistics. Levene's test was used to examine the equality of variances. The analysis of covariance (ANCOVA) was used to test the research hypothesis. The statistical results were analyzed using SPSS 23 statistical software.

Results

The participants' age range was more than 50 years, with a mean age of 55.50 years in the experimental group and 55.66 years in the control group. The education level ranged from high school to post-diploma, among which diploma had the highest frequency in both groups – 5 (62.5%) individuals in experimental and 5 (50%) individuals in control.

The mean and standard deviation of treatment adherence and its subscales (care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in the implementation of treatment) in pre-test and post-test stages for experimental and control groups are presented in Table 2.

Levene's test was used to examine the homogeneity of variances. The results showed that homogeneity of variance was established in the variable of adherence to the default treatment in the post-test stage ($P < 0.05$). The box test results to examine the similarity of variance-covariance matrices showed that the variance-covariance matrices were also established in the post-test stage ($P < 0.05$). The Shapiro-Wilk test results showed the normal distribution of data in the treatment compliance variable in experimental and control groups in the pre-test and post-test stages is established ($P < 0.05$). Finally, the regression results line homogeneity study showed that the interaction of the pre-test with the grouping variable in the post-test stage was not significant in the treatment follow-up variable ($P < 0.05$). This means that the homogeneity of the slope of the regression line in this variable was established.

According to the results of Table 3, the independent variable (intervention based on the PMT) caused a significant difference in the mean scores of the dependent variable (treatment adherence in patients with IHD) in the post-test stage at the error level of 0.05. Therefore, the mean scores of treatment adherence in patients with

Table 1. Intervention Package Based on PMT for IHD Patients

Sessions	Session Description
First	This session included a lecture to introduce and familiarize patients with various types of IHD, providing general information about the heart's structure and function, high-risk behaviors, proper nutrition, dangers of smoking, the need for exercise, proper medication, and self-care skills. Information was also provided through pamphlets or educational slides to be more effective and lasting in mind.
Second	Motivational Needs Assessment: Assessing the patients' needs based on stress, anxiety, insomnia, sexual problems, etc. Providing appropriate solutions and relaxation exercises (1 visualization and feeling, 2 mental commands, 3 will and indoctrination, 4 feelings of relaxation).
Third	Perceived Sensitivity and Intensity: Applying Supportive Motivational Theory to Attract Fear Attraction and Change Attitudes (Rogers). The following objectives should be achieved at the end of the session to demonstrate the message's persuasive power: 1. Convince the audience that the risks mentioned are serious; 2. The audience believes that dangers are possible. These things convince the patient that they need to change their behavior.
Fourth	Self-efficacy: Increasing awareness by matching method (Bandura); patients participating in the research were given the necessary training and information using the peer group to be convinced of their effectiveness by comparing and observing their peer group. The following goals were set to be achieved at the end of the session: 1. The audience agrees that the recommendations are effective; 2. The audience is convinced that they can take the requested advice and actions. Observing a peer group gives the patient heart strength to make the necessary behavioral changes to avoid danger.
Fifth	Effectiveness of the answer (confrontational symbolic modeling): Playing the educational video of the symbolic model and watching the film of a person who has been able to overcome the disease repeatedly can help the person to understand the different aspects of dealing with his/her disease.
Sixth	Response costs: Conducting comparisons and motivational interviews

Table 2. Mean and Standard Deviation of Treatment Adherence and its Subscales in Experimental and Control Groups

Components		Groups	Pre-test		Post-test	
			Mean	Standard Deviation	Mean	Standard Deviation
Total score of treatment adherence		Experimental	115.12	9.40	137.50	11.40
		Control	114.12	9.75	111.75	10.79
Care in treatment		Experimental	27.25	5.11	32.62	6.71
		Control	26.62	5.12	26.62	5.37
Willingness to participate in treatment		Experimental	18.75	4.43	22.50	4.62
		Control	18.75	4.62	17.25	2.60
Ability to adapt		Experimental	19.25	5.09	23.25	5.75
		Control	18.87	3.04	18.25	4.10
Sub-scales of treatment adherence	Integration of treatment with life	Experimental	15.12	3.88	18.12	3.95
		Control	15.25	3.83	15.12	3.41
Clinging to treatment		Experimental	11.62	2.61	13.75	2.37
		Control	10.37	2.32	10.37	2.44
Commitment to treatment		Experimental	15.12	2.88	17.87	3.23
		Control	16	3.69	16.25	3.15
Prudence in the implementation of treatment		Experimental	8	1.06	9.37	2.13
		Control	8.25	1.03	7.87	1.99

Table 3. The Results of ANCOVA to Evaluate the Effect of Intervention Based on the PMT on Treatment Adherence in Patients With IHD

Source of Change	Sum of Squares	Degrees of Freedom	Mean Square	F Value	P Value	Effect Size	Power
The effect of pre-test	362.03	1	362.03	4.42	0.05	0.25	0.49
The effect of independent variable	2485.68	1	2485.68	30.38	0.0001	0.61	1
Error	1063.47	13	81.80				
Total	252580	16					

IHD significantly changed after intervention based on the PMT by controlling the intervening variable (pre-test).

Regarding the change direction, the intervention based on the PMT increased treatment adherence in IHD patients. The effect of intervention based on the PMT on the treatment adherence in IHD patients was equal to 0.61. This means that 61% of treatment adherence

changes in IHD patients are explained by presenting an independent variable (intervention based on the PMT).

Table 4 shows the effect of intervention based on the PMT on the dimensions of treatment adherence (care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in

the implementation of treatment).

Given the significant multivariate covariance test of Table 4, it is concluded that there should be a significant difference between the test and control groups due to the intervention based on the PMT, at least in one of the treatment variables of care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in the implementation of treatment. Therefore, the univariate covariance was analyzed to investigate this significance.

According to the results of Table 5, the independent variable (intervention based on the PMT) caused a significant difference in the mean scores of the variables of care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in the implementation of treatment in patients with IHD in the post-test stage at an error level of 0.05. Therefore, the

mean scores of these variables were significantly increased in patients with IHD after providing an intervention based on the PMT by controlling the intervening variable (pre-test). The effect size of the intervention based on the PMT on care in treatment, willingness to participate in treatment, ability to adapt, integration of treatment with life, clinging to treatment, commitment to treatment, and prudence in the implementation of treatment was 0.48, 0.66, 0.49, 0.30, 0.44, 0.35, and 0.62, respectively.

Conclusion

The purpose of this research was to investigate the effect of intervention based on the PMT on treatment adherence in patients with IHD. The results showed that the intervention based on PMT significantly increased treatment adherence and its subscales in patients with IHD, which was consistent with the results of Clarke et al (21), Yoo et al (22), Chamroonsawasdi et al (23), Mousavi et al (24), and Wu (25). These researchers showed that

Table 4. The Results of Multivariate ANCOVA to Evaluate the Effect of Intervention Based on the PMT on the Dimensions of Treatment Adherence in Patients With IHD

	Value	F Value	Degree of Freedom of Hypothesis	Degree of Freedom of Error	P Value
Pillai's trace	0.92	14.52	7	1	0.001
Wilks's lambda	0.08	14.52	9	11	
Hotelling's trace	11.88	14.52	9	11	
Roy's largest root	11.88	14.52	9	11	

Table 5. The Results of Univariate ANCOVA to Evaluate the Effect of Intervention Based on the PMT on the Dimensions of Treatment Adherence in Patients With IHD

Source of Change	Variable	Sum of Squares	Degrees of Freedom	Mean Square	F Value	P Value	Effect size	Power
Group	Care in treatment	69.32	1	69.32	6.48	0.03	0.48	0.88
	Willingness to participate in treatment	126.94	1	126.94	21.98	0.002	0.66	0.98
	Ability to adapt	82.55	1	82.55	7.77	0.03	0.49	0.90
	Integration of treatment with life	26.17	1	26.17	5.57	0.04	0.30	0.87
	Clinging to treatment	25.02	1	25.02	6.52	0.04	0.44	0.88
	Commitment to treatment	28.47	1	28.47	7.09	0.03	0.45	0.90
	Prudence in the implementation of treatment	17.11	1	17.11	21.32	0.002	0.62	0.98
Error	Care in treatment	74.85	7	10.69				
	Willingness to participate in treatment	40.42	7	5.77				
	Ability to adapt	100.67	7	14.38				
	Integration of treatment with life	59.90	7	8.55				
	Clinging to treatment	31.74	7	4.53				
	Commitment to treatment	32.72	7	4.67				
	Prudence in the implementation of treatment	5.61	7	0.80				
Total	Care in treatment	14704	16					
	Willingness to participate in treatment	6628	16					
	Ability to adapt	7288	16					
	Integration of treatment with life	4526	16					
	Clinging to treatment	2455	16					
	Commitment to treatment	4773	16					
	Prudence in the implementation of treatment	1238	16					

protective motivation could lead to improved health and self-care behaviors in different patients.

In the PCT, the individual considers him/herself responsible for protective behaviors and pays special attention to health threats to have the least harm from exposure to the disease or to achieve definitive treatment as soon as possible (24). In other words, this theory exposes the patient to cognitive processes based on threat assessment and coping assessment process. The threat assessment process begins when a person needs to recognize the threat before assessing coping behaviors. Threat assessment includes threat severity, threat vulnerability, and reward. The severity of a perceived threat is a person's belief in the extent of the threat, while the perceived threat vulnerability is the likelihood of a particular threat, and reward includes external and internal advantages and strengths that a person can use to make decisions against offers and treat threats. This process is optimal and systematic metacognition that consciously exposes the individual to disease and treatment. Therefore, training based on the PMT can motivate the individual to consciously take care of him/herself based on knowledge and follow his/her treatment process to achieve the best possible result. The PMT provides patients with a crucial cognitive description of protective behaviors (21) to pursue their health-related behaviors, such as self-care and treatment adherence, in more seriously way to accelerate their health process. It also evaluates threats through perceived vulnerability structures depending on motivation (23) and helps IHD patients to learn and use different types of preventive and protective behaviors and improve their adaptation skills through the use of psychological components effective in creating psychological empowerment such as self-efficacy, response efficiency, and protection motivation. This process causes patients with IHD to consider their disease-related behaviors and activities more seriously by learning protective and adaptive skills to improve treatment adherence.

The major limitations of this research included the limited research scope of patients with IHD referred to Payambar Azam hospital in Bandar Abbas; some uncontrolled variables such as family status of patients; the financial status of families; number of children and their social status; lack of using random sampling methods; and lack of follow-up. Therefore, it is recommended to conduct this research in other cities, regions, and communities with different cultures, other diseases, control of the mentioned factors, random sampling method, and follow-up to increase the generalizability of the results. Given the effectiveness of the intervention based on the PMT on treatment adherence in patients with IHD, it is recommended to present intervention based on the PMT to hospital counselors and clinical psychologists at the practical level. Using this educational model can be a practical step to increase treatment adherence of patients

with IHD.

Acknowledgments

The present paper was extracted from a PhD thesis by Masoumeh Zakipour at the Islamic Azad University, Kish International Branch, Iran. We would like to express our appreciation to all the patients in the research, their families, and the officials of the Payambar Azam Hospital in Bandar Abbas for their sincere collaboration.

Conflict of Interests

The authors declared that they have no competing interests.

Ethical Approval

The ethics committee of Hormozgan University of Medical Sciences approved the study protocol (code: IR.HUMS.REC.1399.141).

References

1. Hsu JH, Chien IC, Lin CH. Increased risk of ischemic heart disease in patients with bipolar disorder: a population-based study. *J Affect Disord*. 2021;281:721-6. doi: [10.1016/j.jad.2020.11.083](https://doi.org/10.1016/j.jad.2020.11.083).
2. Mehta PK, Wei J, Wenger NK. Ischemic heart disease in women: a focus on risk factors. *Trends Cardiovasc Med*. 2015;25(2):140-51. doi: [10.1016/j.tcm.2014.10.005](https://doi.org/10.1016/j.tcm.2014.10.005).
3. Kumar A, Shariff M, Doshi R. Association between past hepatitis B infection and ischemic heart disease: an analysis from the 2007-2016 NHANES data. *Am J Med Sci*. 2020;360(4):372-7. doi: [10.1016/j.amjms.2020.05.034](https://doi.org/10.1016/j.amjms.2020.05.034).
4. Wei H, Wang C, Guo R, Takahashi K, Naruse K. Development of a model of ischemic heart disease using cardiomyocytes differentiated from human induced pluripotent stem cells. *Biochem Biophys Res Commun*. 2019;520(3):600-5. doi: [10.1016/j.bbrc.2019.09.119](https://doi.org/10.1016/j.bbrc.2019.09.119).
5. Gräni C, Benz DC, Gupta S, Windecker S, Kwong RY. Sudden cardiac death in ischemic heart disease: from imaging arrhythmogenic substrate to guiding therapies. *JACC Cardiovasc Imaging*. 2020;13(10):2223-38. doi: [10.1016/j.jcmg.2019.10.021](https://doi.org/10.1016/j.jcmg.2019.10.021).
6. Kasprzyk M, Wudarczyk B, Czyz R, Szarpak L, Jankowska-Polanska B. Ischemic heart disease—definition, epidemiology, pathogenesis, risk factors and treatment. *Postępy Nauk Medycznych*. 2018;31(6):358-60. doi: [10.25121/pnm.2018.31.6.358](https://doi.org/10.25121/pnm.2018.31.6.358).
7. Yasuhara Y, Takada S, Tanioka T, Kawanishi C, Locsin RC. Illness experiences of patients with ischemic heart disease during their transitional phase from hospitalization to discharge in Japan. *J Med Invest*. 2010;57(3-4):293-304. doi: [10.2152/jmi.57.293](https://doi.org/10.2152/jmi.57.293).
8. Celano CM, Daunis DJ, Lokko HN, Campbell KA, Huffman JC. Anxiety disorders and cardiovascular disease. *Curr Psychiatry Rep*. 2016;18(11):101. doi: [10.1007/s11920-016-0739-5](https://doi.org/10.1007/s11920-016-0739-5).
9. Rahimi G, Tecson KM, Elsaid O, McCullough PA. Role of ischemic heart disease in major adverse renal and cardiac events among individuals with heart failure with preserved ejection fraction (from the TOPCAT trial). *Am J Cardiol*. 2021;142:91-6. doi: [10.1016/j.amjcard.2020.11.034](https://doi.org/10.1016/j.amjcard.2020.11.034).
10. Dai X, Liu H, Chen D, Zhang J. Association between ambient particulate matter concentrations and hospitalization for ischemic heart disease (I20-I25, ICD-10) in China: a multicity case-crossover study. *Atmos Environ*. 2018;186:129-35. doi: [10.1016/j.atmosenv.2018.05.033](https://doi.org/10.1016/j.atmosenv.2018.05.033).
11. Jelínek L, Václavík J, Ramík Z, Pavlů L, Benešová K, Jarkovský J, et al. Directly measured adherence to treatment in chronic heart failure: LEVEL-CHF registry. *Am J Med Sci*. 2021;361(4):491-8. doi: [10.1016/j.amjms.2020.12.004](https://doi.org/10.1016/j.amjms.2020.12.004).
12. Seyed Fatemi N, Rafii F, Hajizadeh E, Modanloo M.

- Psychometric properties of the adherence questionnaire in patients with chronic disease: a mix method study. *Koomesh*. 2018;20(2):179-91. [Persian].
13. Chen F, Bailey CE, Alvarez RD, Shu XO, Zheng W. Adherence to treatment guidelines as a major determinant of survival disparities between black and white patients with ovarian cancer. *Gynecol Oncol*. 2021;160(1):10-5. doi: [10.1016/j.ygyno.2020.10.040](https://doi.org/10.1016/j.ygyno.2020.10.040).
 14. Wabe NT, Angamo MT, Hussein S. Medication adherence in diabetes mellitus and self management practices among type-2 diabetics in Ethiopia. *N Am J Med Sci*. 2011;3(9):418-23. doi: [10.4297/najms.2011.3418](https://doi.org/10.4297/najms.2011.3418).
 15. Iakovleva MV. Adherence to treatment after coronary bypass surgery: psychological aspects. *Rev Iberoam Psicol Salud*. 2016;7(1):9-14. doi: [10.1016/j.rips.2015.10.003](https://doi.org/10.1016/j.rips.2015.10.003).
 16. Coskun S, Bagcivan G. Associated factors with treatment adherence of patients diagnosed with chronic disease: relationship with health literacy. *Appl Nurs Res*. 2021;57:151368. doi: [10.1016/j.apnr.2020.151368](https://doi.org/10.1016/j.apnr.2020.151368).
 17. Takemura M, Mitsui K, Itotani R, Ishitoko M, Suzuki S, Matsumoto M, et al. Relationships between repeated instruction on inhalation therapy, medication adherence, and health status in chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis*. 2011;6:97-104. doi: [10.2147/copd.s16173](https://doi.org/10.2147/copd.s16173).
 18. Matsuoka S, Tsuchihashi-Makaya M, Kayane T, Yamada M, Wakabayashi R, Kato NP, et al. Health literacy is independently associated with self-care behavior in patients with heart failure. *Patient Educ Couns*. 2016;99(6):1026-32. doi: [10.1016/j.pec.2016.01.003](https://doi.org/10.1016/j.pec.2016.01.003).
 19. Kristoffersen AE, Sirois FM, Stub T, Hansen AH. Prevalence and predictors of complementary and alternative medicine use among people with coronary heart disease or at risk for this in the sixth Tromsø study: a comparative analysis using protection motivation theory. *BMC Complement Altern Med*. 2017;17(1):324. doi: [10.1186/s12906-017-1817-x](https://doi.org/10.1186/s12906-017-1817-x).
 20. Hodgkins S, Orbell S. Can protection motivation theory predict behaviour? A longitudinal test exploring the role of previous behaviour. *Psychol Health*. 1998;13(2):237-50. doi: [10.1080/08870449808406749](https://doi.org/10.1080/08870449808406749).
 21. Clarke M, Ma Z, Snyder SA, Hennes EP. Understanding invasive plant management on family forestlands: an application of protection motivation theory. *J Environ Manage*. 2021;286:112161. doi: [10.1016/j.jenvman.2021.112161](https://doi.org/10.1016/j.jenvman.2021.112161).
 22. Yoo CW, Lee J, Yoo C, Xiao N. Coping behaviors in short message service (SMS)-based disaster alert systems: from the lens of protection motivation theory as elaboration likelihood. *Inf Manage*. 2021;58(4):103454. doi: [10.1016/j.im.2021.103454](https://doi.org/10.1016/j.im.2021.103454).
 23. Chamroonsawasdi K, Chottanapund S, Pamungkas RA, Tunyasitthisundhorn P, Sornpaisarn B, Numpaisan O. Protection motivation theory to predict intention of healthy eating and sufficient physical activity to prevent diabetes mellitus in Thai population: a path analysis. *Diabetes Metab Syndr*. 2021;15(1):121-7. doi: [10.1016/j.dsx.2020.12.017](https://doi.org/10.1016/j.dsx.2020.12.017).
 24. Mousavi R, Chen R, Kim DJ, Chen K. Effectiveness of privacy assurance mechanisms in users' privacy protection on social networking sites from the perspective of protection motivation theory. *Decis Support Syst*. 2020;135:113323. doi: [10.1016/j.dss.2020.113323](https://doi.org/10.1016/j.dss.2020.113323).
 25. Wu D. Empirical study of knowledge withholding in cyberspace: Integrating protection motivation theory and theory of reasoned behavior. *Comput Human Behav*. 2020;105:106229. doi: [10.1016/j.chb.2019.106229](https://doi.org/10.1016/j.chb.2019.106229).
 26. Boss SR, Galletta DF, Lowry PB, Moody GD, Polak P. What do systems users have to fear? Using fear appeals to engender threats and fear that motivate protective security behaviors. *MIS Q*. 2015;39(4):837-64.
 27. Wang J, Liu-Lastres B, Ritchie BW, Mills DJ. Travellers' self-protections against health risks: an application of the full protection motivation theory. *Ann Tour Res*. 2019;78:102743. doi: [10.1016/j.annals.2019.102743](https://doi.org/10.1016/j.annals.2019.102743).
 28. Ling M, Kothe EJ, Mullan BA. Predicting intention to receive a seasonal influenza vaccination using Protection Motivation Theory. *Soc Sci Med*. 2019;233:87-92. doi: [10.1016/j.socscimed.2019.06.002](https://doi.org/10.1016/j.socscimed.2019.06.002).
 29. Hsu JS, Shih SP. When does One Weight Threats more? An Integration of Regulatory Focus Theory and Protection Motivation Theory. *Proceedings of the 10th Pre-ICIS Workshop on Information Security and Privacy*; December 13, 2015; Ft. Worth.
 30. Claude JA. An Application of Health Behaviour Models to Diabetic Treatment Adherence: A Comparison of Protection Motivation Theory and the Theory of Planned Behaviour [thesis]. Regina, Saskatchewan: University of Regina; 2011.
 31. Poshtchaman Z, Jadid Milani M, Atashzadeh Shorideh F, Akbarzadeh Baghban A. Assessing patient adherence to treatment after coronary artery bypass graft. *J Sabzevar Univ Med Sci*. 2015;22(4):668-75. [Persian].
 32. Menard P, Bott GJ, Crossler RE. User motivations in protecting information security: protection motivation theory versus self-determination theory. *J Manag Inf Syst*. 2017;34(4):1203-30. doi: [10.1080/07421222.2017.1394083](https://doi.org/10.1080/07421222.2017.1394083).
 33. van Bavel R, Rodríguez-Priego N, Vila J, Briggs P. Using protection motivation theory in the design of nudges to improve online security behavior. *Int J Hum Comput Stud*. 2019;123:29-39. doi: [10.1016/j.ijhcs.2018.11.003](https://doi.org/10.1016/j.ijhcs.2018.11.003).
 34. Oakley M, Mohun Himmelweit S, Leinster P, Casado MR. Protection motivation theory: a proposed theoretical extension and moving beyond rationality—the case of flooding. *Water*. 2020;12(7):1848. doi: [10.3390/w12071848](https://doi.org/10.3390/w12071848).