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The Association between Perceived Stress and Worse Adherence to Medical Discharge Instructions After Acute Myocardial Infarction

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Abstract

Objectives: This study prospectively followed a cohort of 349 individuals recovering from an acute myocardial infarction (AMI) to investigate the relationship between their perceived stress and their adherence to medical discharge instructions.

Background: Experiencing a heart attack is stressful, and stress post-MI leads to poor outcomes. Worse adherence to discharge instructions can be a pathway, but no prior research has investigated the impact of perceived stress on AMI patients' ability to comply with discharge instructions.

Methods: We assessed adherence to hospital discharge instructions over 12 months among 349 individuals who were hospitalized with AMIs. Linear mixed-effects regression model was used with adjustment for demographic and clinical factors.

Results: Patients with higher perceived stress had significantly lower adherence to discharge instructions (β= -1.957, $p<0.001$) after adjusting for sociodemographic factors, clinical presentation, and health status. This relationship did not vary over time, but was stronger for females and participants with lower education level.

Conclusions: These findings suggest that clinicians could adopt perceived stress as a tool to identify and target potentially noncompliant patients who are at risk of poor health outcomes after AMI.

Keywords: perceived stress, myocardial infarction, adherence, discharge instruction

Abbreviation and Acronyms

ADL = Activities of Daily Living

AMI = acute myocardial infarction

CCI = Charlson Comorbidity Index

CES-D = Center for Epidemiologic Studies Depression

ECG = electrocardiography

ENRICHD = Enhancing Recovery in Coronary Heart Disease

PSS = Perceived Stress Scale

SPMSQ = Short Portable Mental Status Questionnaire

STEMI = ST-segment elevation myocardial infarction

Introduction

Acute myocardial infarction (AMI) constitutes the highest proportion of cardiovascular deaths in the United States [1]. Despite the recent advancement in treating and preventing AMI, there remain significant risks of recurrent heart attack, poor quality of life, and mortality after hospital discharge [1]. Thus, it is important to improve recovery for patients suffering from AMI.

Post-discharge education plays a key role in recovery. The American College of Cardiology and American Heart Association highly recommend that patients be advised on multiple risk-management factors upon AMI discharge [2]. Areas covered include engaging in physical activity, paying attention to body weight, following a healthy diet, taking medications as instructed, going to follow-up appointment promptly, and watching out for certain cardiac symptoms [2, 3]. Documentation of discharge instructions correlates with reduced readmission rates [2], and patients' adherence to these discharge instructions is associated with better outcomes after AMI, including quality of life, health status, psychological well-being, survival, and recurrence of AMI [4-8]. Therefore, it is important to ensure that patients follow discharge instructions properly.

Despite the importance of these discharge instructions, AMI patients still have sub-optimal adherence to them. According to Decker *et al*., for some topics in discharge instructions, such as cardiac rehabilitation, the percent of patients adhering carefully is as low as 35% [4]. The reason for low adherence is not well understood. Thus, it is critical for clinicians to clarify the underlying factors affecting discharge instruction adherence in AMI patients.

Psychosocial factors have long been implicated in cardiovascular health. One important factor is perceived stress. It has been shown to be associated with poor cardiovascular health, including worse recovery after AMI [9-11]. Poor adherence to discharge instructions associated

with perceived stress is a potential pathway. Previous studies conducted with individuals that have not recently experienced an AMI have suggested that a higher level of perceived stress is associated with unhealthy behaviors and decreased adherence to treatment regimens among HIV/AIDS and kidney transplant patients [11-15]. Higher perceived stress is also related to poorer cognitive performance, including worse encoding and worse recall [16, 17]. Therefore, more stressed individuals might be more likely to have trouble understanding, remembering, and consequently following instructions. However, many of these studies were cross-sectional or did not consider long-term adherence, which has a larger impact on health outcomes. These research results may not apply to AMI patients either, because most of these prior studies focused on drug regimens in other conditions. For AMI patients, many instructions involve behavioral changes, including cardiac rehabilitation and life style adjustment. Thus, more research is needed to investigate the impact of perceived stress on AMI patients' adherence to hospital discharge instructions. If a relationship can be established, clinicians might consider assessing their patients' perceived stress and using this as a tool to identify those at a higher risk of noncompliance to discharge instructions, which is consequently linked to poorer health outcomes. Clinicians can also encourage patients with higher perceived stress to engage in stress-reduction activities. In addition, clinicians can adjust their communication style with these patients and advise patients' family and close ones to do the same, in order to improve treatment outcomes for this group of patients.

Despite the importance of this topic, no research has been done to investigate how perceived stress among AMI patients affects their compliance to medical discharge instructions. Thus, this study focused on this important relationship using a prospective cohort design. Based

on current knowledge, we hypothesized that patients with higher perceived stress would be less likely to adhere to instructions.

Methods

Study population

The study cohort consisted of participants in the Yale Mind-Heart Study. 411 participants were recruited from four hospitals: Yale-New Haven Hospital, Bridgeport Hospital, Hospital of Saint Raphael, and St. Vincent's Medical Center. Eligibility criteria for AMI were based on the Enhancing Recovery in Coronary Heart Disease (ENRICHD) study [18, 19]. In addition, participants had to receive a score of at least 6 on the Short Portable Mental Status Questionnaire (SPMSQ) [20] and commit to being available for one year of follow-up visits. For the analysis of this study, individuals were excluded if they had incomplete measure of perceived stress, did not have documented discharge instructions, or were missing all follow-up measures of discharge instruction adherence. After careful screening, the final cohort included 349 participants. The 62 individuals excluded from the analyses were similar to those included in the current study with regards to age ($p=0.337$), gender ($p=0.380$), race ($p=0.667$), education level ($p=0.788$), marital status ($p=0.610$), living arrangement ($p=0.960$), AMI severity ($p=0.641$), history of depression ($p=0.598$), baseline depressive feelings ($p=0.931$), daily functioning ($p=0.460$), mental status ($p=0.192$), and comorbidity score ($p=0.840$).

Data collection

Trained research nurses affiliated with the Yale Program on Aging collected baseline patient data by medical chart abstraction and in-person interviews within two weeks of

hospitalization. 202 baseline interviews took place at the hospital, while 128 interviews were conducted at participants' homes. The rest took place at rehabilitation centers, individuals' work places, or other meeting places. Follow-up interviews were conducted in person at 1, 8, and 12 months after discharge. The baseline interview lasted about 30 minutes while the follow-up interviews were about 60 minutes each.

Perceived Stress Assessment

Perceived stress after the heart event was measured using the 4-item version of the Perceived Stress Scale (PSS) [21]. This instrument measures the degree to which one appraises a situation in life as stressful. Questions on this scale are general in nature and thus apply to many different populations, including those undergoing an acute health event [21]. One month after the AMI, participants were asked about stress during the previous month. The four items on this scale ask the participants how often they felt or thought in a certain way during the previous month. Each item is evaluated based on a 5-point Likert scale (0=*never*, 1=*almost never*, 2=*sometimes*, 3=*fairly often*, 4=*very often*). The total score out of 16 was used to indicate the perceived stress, with a higher score corresponding to more stress. We also classified participants into stress-level groups. In accordance to prior work [11], we defined the highest quintile (PSS scores 8-16) as "high stress group", the lowest quintile (PSS scores 0-3) as "low stress group", and the rest as "moderate stress group" (PSS scores 4-7).

Adherence to Behavioral Instructions

At each follow-up interview, participants reported how closely they adhered to instructions on the following topics: 1) eating a healthy diet; 2) attending cardiac rehabilitation;

3) engaging in physical activity; 4) taking prescribed medications; and 5) watching for AMI symptoms to inform the doctor about. These behaviors were chosen based on previous studies and recommendations from the American College of Cardiology [4, 22, 23]. Participants were evaluated based on a 4-point Likert scale (1=*never*, 2=*hardly ever*, 3=*sometimes*, 4=*often*). They were categorized as adherent to the instruction they received if they reported following them often, corresponding to a score of 4 on the scale. The overall degree of adherence was calculated as the percent of received instructions that a person was adherent to.

Covariates

Information on sociodemographic factors, physical and mental functioning, clinical history and presentation, and social support were collected at baseline. These covariates were chosen *a priori* based on clinical relevance to AMI recovery [24, 25]. Sociodemographic factors included age, gender, race, marital status, and education level. Physical functioning was assessed by the Activities of Daily Living (ADL) scale (scores ranging from 16 to 80), with a higher score indicating more impaired functioning [26]. Mental functioning at baseline was assessed with SPMSQ, a 10-item scale with scores from 0-10 [20]. Higher scores correspond to better cognitive ability. Patients were excluded if they scored lower than 6. The study also examined patients' depressive feelings at baseline with the short form of the Center for Epidemiologic Studies Depression (CES-D) Scale [27]. This scale contains 11 items, asking participants how often they have been feeling a particular way during the past week of the interview. Each item was scored out of 3 (0=*rarely or never*, 1=*some of the time*, 2=*much of the time*, 3=*most or all the time*). The total score was calculated (ranging from 0 to 33), with a higher score indicating greater depression. Clinical history and presentation included the Charlson Comorbidity Index

(CCI) [28], history of depression, and electrocardiographic (ECG) classification of AMI to indicate severity [29]. Social support was assessed by whether participants were living alone or with others.

Statistical Analysis

Variables were compared across the different levels of perceived stress, using Pearson chi-squared or Fisher's exact tests for categorical variables and t tests for continuous variables. In the statistical models, we used the total perceived stress score as a continuous variable to achieve higher sensitivity and accuracy. Since the data did not show significant skewness or excess Kurtosis, multivariate linear regression model was utilized to determine the association between perceived stress and the degree of adherence to discharge instructions (percent of received instructions that the patient followed often), while controlling for covariates at each time point. We also compared the perceived stress scores for each individual instruction at each time point between patients who followed the instruction often and those who did not, using t-tests. Longitudinal analysis integrating all three time points was performed with the linear mixed-effects model to examine the relationship between patients' perceived stress and their overall adherence to all five instructions (measured repeatedly at 1, 8, and 12 months). All models controlled for covariates and also clustering effect by hospital sites. In addition, we examined the variation over time in the relationship between perceived stress and adherence by including a stress-by-time interaction term. We also assessed any potential differences in the association between stress and adherence by gender and education level with stratification.

All analyses were performed with SAS, version 9.3 (SAS Institute Inc., Cary, North Carolina). Tests for statistical significance was 2-sided at $\alpha=0.05$.

Results

The 349 patients included in the analyses, on average, were about 64 years old and were predominantly non-Hispanic White (72.8%), with higher than high school education (59.0%), were married or had a partner (58.7%), and were living with others (73.6%). The majority (80.2%) did not have any history of depression. On average, they had very good intellectual capability, with a mean SPMSQ score of 9.7 (±0.7). They also had little impairment of daily functioning, with a mean ADL score of 18.3 (±6.3). In addition, most did not have depression at baseline according to the mean CES-D score of 8.8 (± 6.2). On average, they had a comorbidity score of 4.5 (±2.3). Approximately half of them had ST-segment elevation myocardial infarction or STEMI (45.9%). Patients in the high stress group were significantly more likely to be younger, females, Hispanic or Black, and had lower than high school education (Table 1). In addition, they tended to have history of depression, more current depressive experiences and worse daily functioning at baseline.

Overall, participants reported failure to adhere to about 40% of the instructions they received at each given follow-up time point (Table 2). Adherence averaged over time was 88.1% for the instruction on prescribed medication, followed by 67.6% for the instruction on symptoms and 61.8% for that on healthy diet. Less than 50% of participants adhered well to instructions on physical activity (44.6%) and cardiac rehabilitation (13.2%). The instruction on cardiac rehabilitation had an exceptionally low adherence rate.

Results also showed that adherence decreased with increasing perceived stress (Table 2, Figure 1). This trend was observed for each of the five instruction items at all follow-up time points (Table 3). Adherence to instructions on diet, prescribed medication, cardiac rehabilitation, and physical activity was particularly sensitive to stress during the recovery period (Table 3).

Multivariate linear regression model indicated that at 1, 8, and 12 months, perceived stress was significantly and negatively related to adherence to discharge instructions, as measured by the percent of received instructions that the participant followed often (Table 4). Each 1-point increase of PSS score was associated with approximately 2% decrease on adherence. At 1 month, Hispanic race was significantly and positively correlated with adherence. At 12 month, history of depression was significantly and negatively correlated with adherence. Other variables were not found to be significantly associated with adherence.

In addition, results from longitudinal analyses using the mixed-effects regression model showed that perceived stress was significantly and inversely associated with adherence to hospital discharge instructions during the follow-up period, averaged across time (Table 5). Perceived stress was the only variable significantly related to adherence across time (β=-1.957, $p<0.001$). Every 1-point increase of PSS score was associated with about 2% decrease on adherence. In addition, mean adherence did not change significantly over time. The stress-by-time interaction term also did not show significance ($p=0.998$), meaning that there was no significant variation over time in the relationship between perceived stress and adherence to instructions. Similar findings were observed in each gender group (β=-1.588, $p=0.018$ for males; β=-2.339, $p=0.019$ for females) and education level (β=-3.863, $p=0.026$ for lower than high school group; β=-2.759, $p=0.021$ for high school graduates; β=-2.076, $p=0.003$ for post-secondary education group). Overall, perceived stress was more strongly associated with adherence for females and for patients with lower education (Tables 6 and 7).

Discussion

Findings from the present study supported our hypothesis that patients' perceived stress after AMI was inversely related to adherence to hospital discharge instructions during recovery. This relationship was consistent over time. Sociodemographic factors, clinical history and presentation at baseline did not significantly affect adherence. To our knowledge, this study was the first to prospectively examine the impact of perceived stress on adherence to hospital discharge instructions among AMI patients.

The current study has several strengths. Prior research on adherence among patients with cardiac events or other conditions mainly adopted cross-sectional designs. They also mostly assessed whether patients have received a certain instruction through self-reporting. Our study used a prospective design and more accurately assessed the instructions received by patients by making sure that all participants had a copy of the hospital discharge instructions that they had signed to acknowledge receipt in their medical charts. In addition, many previous studies have investigated adherence to medication, and suggested that factors including older age, lower socioeconomic status, and post-traumatic stress disorder are linked to poor adherence [30, 31]. Studies that considered adherence to multiple instructions have also revealed that low emotional support and depression correlate with nonadherence [22, 32]. These factors have been shown to be associated with higher life stress as well [33-35]. Thus, perceived stress may be an overarching factor linked with adherence. Instead of spreading the resources to deal with each factor investigated by previous studies, clinicians could mainly target stress coping in order to more efficiently improve patients' compliance with discharge instructions.

Results also showed that on average, more people followed the instruction on prescribed medication (88.1%), followed by instructions on symptoms to inform doctors about (67.6%) and

on healthy diet (61.8%). Instruction on cardiac rehabilitation had the lowest adherence (13.2%). These findings were similar to rates reported in other studies [4, 22]. The low adherence to cardiac rehabilitation is concerning, but is also consistent with the fact that older patients generally have lower enrollment rates (below 20%) in these programs [36, 37]. Since cardiac rehabilitation can significantly improve patients' health [37], it is important for practitioners to improve patients' adherence to these programs. Stress management may be necessary to achieve better compliance.

Furthermore, we observed that the negative impact of perceived stress on adherence was stronger among females and patients with lower education, two groups that tend to have worse AMI recovery [38, 39]. These results were consistent with findings that women are more likely to report stress [40], and that low education is associated with more life stress and poor health [41]. Therefore, our findings provide evidence for a potential mechanism that leads to poor health outcomes among these patients. Females and people with low education attainment are vulnerable to higher stress, and the association between stress and poor adherence to discharge instructions is more pronounced in these groups. This could lead to them experiencing worse recovery after AMI. These patients may especially benefit from stress-reduction exercises.

Perceived stress could influence adherence in several ways. Higher levels of perceived stress are related to lower cognitive function [16]. Chronic stress can also impair learning and memory [17]. Consequently, patients who experience higher perceived stress would have more difficulties understanding, encoding, and remembering discharge instructions. In addition, the shock from the AMI event and the limited time spending with health practitioners upon discharge also contribute to poor retaining of information on these instructions. Therefore, without fully understanding and remembering these instructions, patients with higher perceived

stress would have poor adherence. Researchers have explored many strategies in stress management, including physical relaxation techniques, cognitive-focused techniques, structured problem solving, communication skills and time management training [42]. Research will need to establish whether clinicians can improve patients' adherence to discharge instructions by incorporating these tools when interacting with patients with high stress during their hospitalization.

Several limitations could be noted in our study. Adherence to a given instruction was self-reported. Future studies could adopt additional measures of adherence, such as pill count and activity monitors, to improve accuracy. However, previous studies have found that self-report of these health behaviors highly correlate with these performance measures [43]. Also, the study did not assess the quality of the communication of the instructions. However, we have accounted for clustering effects by hospital sites. Therefore, differences in the quality of discharge document at different hospitals were unlikely to influence results. In addition, at all hospitals, printed instructions were given to participants for them to take home. Both health care providers and participants signed the instructions to acknowledge that they were given and received.

In our study, nurses documented whether a patient has received the instruction at baseline. Thus, this study more likely examined the communication between nurses and patients. Future studies could more specifically investigate the communication between physicians and patients. Also, in addition to evaluating specific discharge instruction, researchers could design studies to assess the quality of general communication between health practitioners and patients.

Conclusion

The present study has demonstrated that higher perceived stress after AMI predicted poorer adherence to hospital discharge instructions during recovery. This relationship was stronger for females and participants with lower education level. In addition, this relationship did not vary significantly over time. Findings from this study suggest that stress management in the hospital may be worthwhile to consider for AMI patients, in order to enhance their adherence to discharge instructions when they leave the hospital and to improve their health outcomes.

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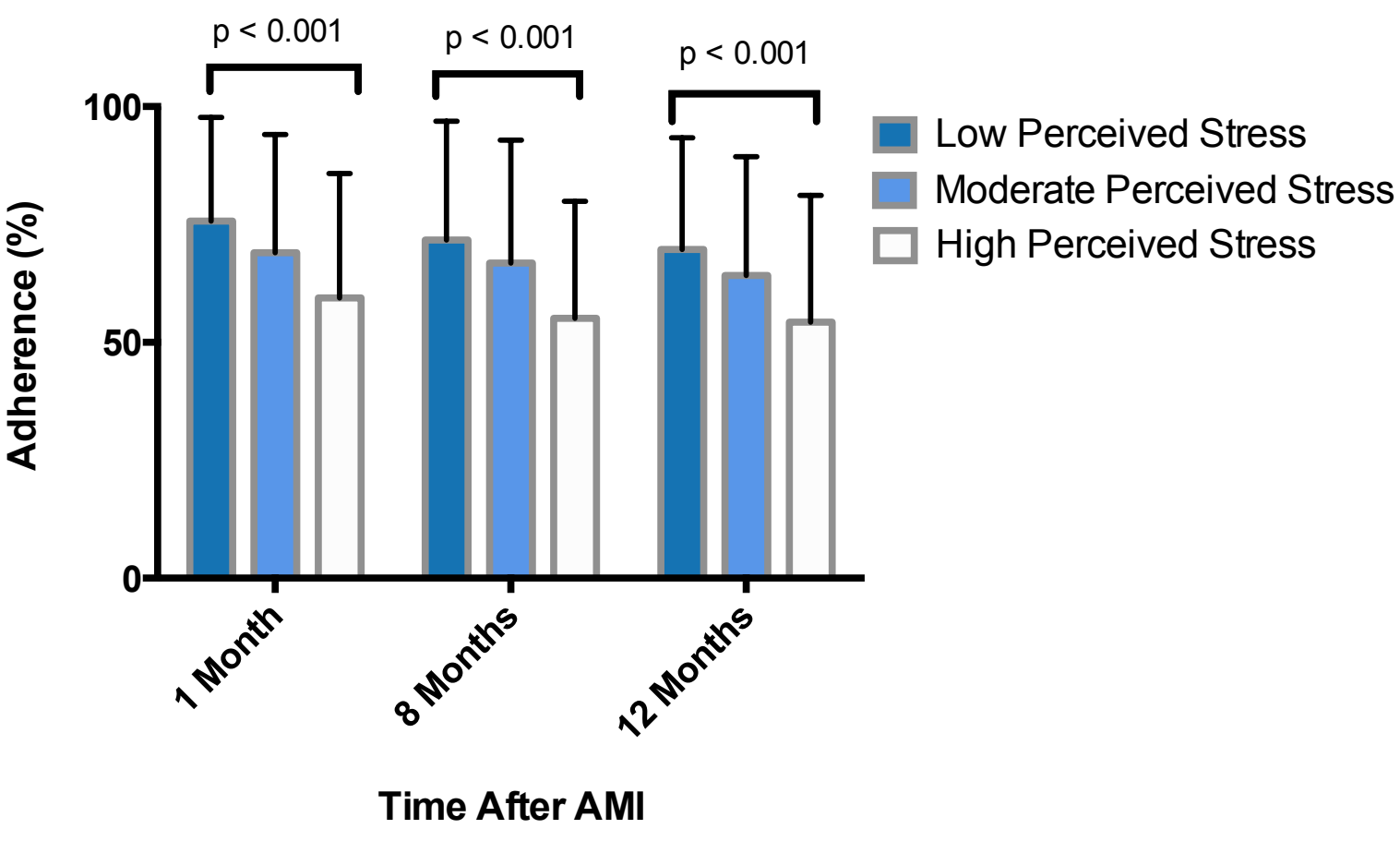

Figure 1: Adherence to Instructions over Time by Levels of Perceived Stress at Baseline.

Adherence was calculated by the percent of received instructions that a patient followed often.
AMI = Acute Myocardial Infarction

Table 1: Baseline Characteristics by Levels of Perceived Stress.

Characteristic	Total (N=349)	Perceived Stress			p value*
		Low (N=94)	Moderate (N=155)	High (N=105)	
Sex					0.030
Male	216 (61.9)	63 (29.2)	99 (45.8)	54 (25.0)	
Female	133 (38.1)	31 (23.3)	51 (38.4)	51 (38.4)	
Race					0.010
Non-Hispanic White	254 (72.8)	77 (30.3)	115 (45.3)	62 (24.4)	
Non-Hispanic Black	45 (12.9)	10 (22.2)	16 (35.6)	19 (42.2)	
Hispanic	42 (12.0)	6 (14.3)	15 (35.7)	21 (50.0)	
Other	8 (2.3)	1 (12.5)	4 (50.0)	3 (37.5)	
Age	64.3 ± 10.4	66.2 ± 10.4	64.5 ± 10.5	62.3 ± 10.1	0.029
Education level					0.006
Lower than highschool	58 (16.6)	8 (13.8)	21 (36.2)	29 (50.0)	
Highschool	82 (23.5)	25 (30.5)	37 (45.1)	20 (24.4)	
Post-secondary	206 (59.0)	60 (29.1)	91 (44.2)	55 (26.7)	
Marital Status					0.100
Married/partner	205 (58.7)	60 (29.3)	96 (46.8)	49 (23.9)	
Separated	6 (1.7)	1 (16.7)	3 (50.0)	2 (33.3)	
Divorced	63 (18.1)	11 (17.5)	23 (36.5)	29 (46.0)	
Widowed	48 (13.8)	15 (31.3)	17 (35.4)	16 (33.3)	
Never married	27 (7.7)	7 (25.9)	11 (40.7)	9 (33.3)	
History of depression					<0.001
Yes	33 (9.5)	2 (6.1)	11 (33.3)	20 (60.6)	
No	280 (80.2)	86 (30.7)	120 (42.9)	74 (26.4)	
CCI	4.5 ± 2.3	4.4 ± 2.1	4.3 ± 2.3	4.8 ± 2.5	0.238
CES-D score	8.8 ± 6.2	6.0 ± 5.3	8.0 ± 5.6	12.2 ± 6.2	<0.001
ADL score	18.3 ± 6.3	17.3 ± 4.4	17.8 ± 4.8	20.0 ± 8.8	0.005
SPMSQ score	9.7 ± 0.7	9.8 ± 0.6	9.7 ± 0.6	9.6 ± 0.7	0.096
ECG Class of Infarction					0.753
STEMI	160 (45.9)	42 (26.3)	72 (45.0)	46 (28.8)	
Others	183 (53.4)	51 (27.9)	75 (41.0)	57 (31.2)	
Living arrangement					0.245
Living alone	92 (26.4)	22 (23.9)	36 (39.1)	34 (37.0)	
Living with others	257 (73.6)	72 (28.0)	114 (44.4)	71 (27.6)	

Values are mean ± SD for continuous variables and n (%) for categorical variables.

CCI = Charlson Comorbidity Index; CES-D = Center for Epidemiologic Studies Depression; ADL = Activities of Daily Living; SPMSQ = Short Portable Mental Status Questionnaire; ECG = electrocardiography; STEMI = ST-segment elevation myocardial infarction

* P-value is for t-test (continuous variables) or chi-squared test (categorical variables)

Table 2: Adherence to Instructions Over Time by Levels of Perceived Stress at Baseline.

Time	Low Perceived Stress		Moderate Perceived Stress		High Perceived Stress		p value	Overall	
	Adherence	SD	Adherence	SD	Adherence	SD		Adherence	SD
1 month	75.7%	22.0%	69.0%	25.1%	59.4%	26.4%	<0.001	67.9%	25.4%
8 months	71.7%	25.2%	66.8%	26.1%	55.1%	24.8%	<0.001	64.7%	26.2%
12 months	69.7%	23.7%	64.2%	25.2%	54.3%	26.9%	<0.001	62.8%	25.9%

Adherence was calculated by the percent of received instructions that a patient followed often.

Table 3: Perceived Stress Over Time for Adherent and Non-Adherent Patients.

Instruction	Adherence at 1 month					Adherence at 8 months					Adherence at 12 months				
	Yes*		No		p value	Yes		No		p value	Yes		No		p value
	Mean PSS score	SD	Mean PSS score	SD		Mean PSS score	SD	Mean PSS score	SD		Mean PSS score	SD	Mean PSS score	SD	
Healthy diet	5.0	3.0	6.6	3.4	<0.001	4.8	3.1	6.6	3.2	<0.001	4.7	3.0	6.7	3.1	<0.001
Cardiac rehabilitation	4.1	3.0	5.8	3.1	0.018	4.0	3.0	5.5	3.1	0.043	4.1	3.0	5.4	3.1	0.135
Physical activity	4.8	3.1	6.3	3.1	<0.001	4.5	3.0	6.2	3.2	<0.001	4.6	3.2	6.0	3.0	<0.001
Prescribed medications	5.5	3.1	7.6	3.8	0.016	5.3	3.2	6.9	2.5	0.035	5.4	3.1	6.8	3.8	0.048
Symptoms to inform doctors about	5.4	3.3	5.9	3.1	0.278	5.3	3.2	5.7	3.3	0.353	5.3	3.2	5.7	3.1	0.324

*Patients were categorized as adherent to the instruction they received if they reported following them often, corresponding to a score of 4 on the adherence scale.

Table 4: Multiple Linear Regression Model Estimating Adherence at Three Time Points.

Characteristic	1 month			8 months			12 months		
	Adjusted β	SE	p value	Adjusted β	SE	p value	Adjusted β	SE	p value
PSS score	-2.097	0.528	<0.001	-1.858	0.581	0.002	-1.979	0.589	0.001
Male	3.354	3.402	0.325	0.456	3.746	0.903	-0.652	3.688	0.860
Race									
Non-Hispanic White	Reference								
Non-Hispanic Black	-3.310	4.447	0.457	-0.171	5.122	0.974	-4.468	5.064	0.379
Hispanic	12.732	5.206	0.015	-7.314	5.631	0.195	-6.407	5.635	0.257
Other	-2.456	10.083	0.808	-2.035	10.540	0.847	4.654	10.528	0.659
Age	0.015	0.191	0.936	0.101	0.208	0.627	0.204	0.207	0.325
Education level									
Lower than highschool	Reference								
Highschool	-1.745	5.144	0.735	3.372	5.665	0.552	-10.448	5.686	0.067
Post-secondary	4.766	4.818	0.324	3.614	5.371	0.502	-7.791	5.391	0.150
Marital Status									
Married/partner	Reference								
Separated	-14.628	10.311	0.157	-7.549	10.839	0.487	4.981	10.821	0.646
Divorced	-4.254	4.617	0.358	-8.749	5.105	0.088	-4.698	4.985	0.347
Widowed	-3.737	5.347	0.485	-1.173	5.873	0.842	-10.728	5.933	0.072
Never married	-1.104	6.280	0.861	-4.369	6.748	0.518	-6.260	6.772	0.356
History of depression	-4.890	5.302	0.357	-7.166	5.779	0.216	-13.256	5.756	0.022
CCI	-0.792	0.880	0.369	-1.176	0.956	0.220	-0.203	0.963	0.833
CES-D score	0.086	0.264	0.744	-0.240	0.286	0.403	-0.121	0.286	0.673
ADL score	-0.048	0.261	0.856	0.189	0.305	0.537	-0.338	0.289	0.243
SPMSQ score	2.184	2.662	0.413	-2.886	2.858	0.314	-0.961	3.164	0.762
STEMI	0.592	3.089	0.848	-2.705	3.467	0.436	-1.322	3.434	0.701
Living alone	0.395	4.169	0.925	3.437	4.534	0.449	4.970	4.542	0.275

Adherence was calculated by the percent of received instructions that a patient followed often.

PSS = Perceived Stress Scale; CCI =: Charlson Comorbidity Index; CES-D = Center for Epidemiologic Studies Depression; ADL = Activities of Daily Living; SPMSQ = Short Portable Mental Status Questionnaire; STEMI = ST-segment elevation myocardial infarction

Table 5: Mixed-Effects Regression Model Estimating Adherence Over Time Using Repeated Measures of Adherence.

Characteristic	Overall Adherence		
	Adjusted β	SE	p value
PSS score	-1.957	0.521	<0.001
Time	-0.577	0.311	0.065
Male	1.014	2.800	0.718
Race			
Non-Hispanic White	Reference		
Non-Hispanic Black	-3.273	3.702	0.377
Hispanic	1.973	4.281	0.645
Other	-0.046	8.209	0.996
Age	0.089	0.157	0.574
Education level			
Lower than highschool	Reference		
Highschool	-3.371	4.224	0.426
Post-secondary	0.624	3.979	0.876
Marital Status			
Married/partner	Reference		
Separated	-6.517	8.406	0.439
Divorced	-5.518	3.792	0.147
Widowed	-4.493	4.419	0.310
Never married	-4.246	5.146	0.410
History of depression	-7.660	4.369	0.081
CCI	-0.642	0.725	0.377
CES-D score	-0.054	0.217	0.804
ADL score	-0.103	0.217	0.635
SPMSQ score	0.171	2.174	0.937
STEMI	-0.734	2.556	0.774
Living alone	2.399	3.415	0.483
Interaction between stress and time	0.001	0.049	0.998

Adherence was calculated by the percent of received instructions that a patient followed often.

PSS = Perceived Stress Scale; CCI =: Charlson Comorbidity Index; CES-D = Center for Epidemiologic Studies Depression; ADL = Activities of Daily Living; SPMSQ = Short Portable Mental Status Questionnaire; STEMI = ST-segment elevation myocardial infarction

Table 6: Mixed-Effects Regression Model Estimating Adherence Over Time by Gender Using Repeated Measures of Adherence.

Characteristic	Male			Female		
	Adjusted β	SE	p value	Adjusted β	SE	p value
PSS score	-1.588	0.662	0.018	-2.339	0.978	0.019
Time	-0.484	0.358	0.179	-0.727	0.607	0.234
Race						
Non-Hispanic White	Reference					
Non-Hispanic Black	-2.889	4.905	0.557	-2.017	6.638	0.762
Hispanic	-1.085	5.699	0.849	4.926	7.242	0.498
Other	-2.259	10.197	0.825	7.393	15.761	0.640
Age	0.068	0.210	0.746	0.104	0.292	0.723
Education level						
Lower than highschool	Reference					
Highschool	2.687	5.834	0.646	-7.214	7.356	0.329
Post-secondary	7.591	5.538	0.173	-8.742	6.716	0.196
Marital Status						
Married/partner	Reference					
Separated	-6.490	9.237	0.483	-17.940	24.296	0.462
Divorced	-10.010	5.885	0.091	-5.926	5.818	0.311
Widowed	-3.452	6.856	0.615	-8.240	6.734	0.224
Never married	-2.245	7.833	0.775	-7.764	7.796	0.322
History of depression	-6.792	7.222	0.349	-9.368	6.445	0.149
CCI	-0.701	1.058	0.509	0.085	1.164	0.942
CES-D score	0.004	0.278	0.989	-0.075	0.390	0.848
ADL score	0.219	0.431	0.612	-0.213	0.279	0.446
SPMSQ score	-0.977	3.109	0.754	2.131	3.704	0.566
STEMI	1.415	3.227	0.662	-5.579	5.024	0.270
Living alone	5.325	5.572	0.341	0.393	5.270	0.941
Interaction between stress and time	-0.049	0.060	0.417	0.066	0.088	0.454

Adherence was calculated by the percent of received instructions that a patient followed often.

PSS = Perceived Stress Scale; CCI =: Charlson Comorbidity Index; CES-D = Center for Epidemiologic Studies Depression; ADL = Activities of Daily Living; SPMSQ = Short Portable Mental Status Questionnaire; STEMI = ST-segment elevation myocardial infarction

Table 7: Mixed-Effects Regression Model Estimating Adherence Over Time by Education Level Using Repeated Measures of Adherence.

Characteristic	Lower Than High School			High School			Post-Secondary		
	Adjusted β	SE	p value	Adjusted β	SE	p value	Adjusted β	SE	p value
PSS score	-3.863	1.669	0.026	-2.759	1.166	0.021	-2.076	0.680	0.003
Time	-0.563	1.179	0.636	-0.309	0.667	0.645	-0.628	0.362	0.085
Male	-4.377	6.197	0.484	-5.083	7.294	0.489	4.217	3.912	0.283
Race									
Non-Hispanic White	Reference								
Non-Hispanic Black	-6.484	8.596	0.455	13.753	10.427	0.192	-4.176	5.021	0.407
Hispanic	-1.634	6.771	0.811	-3.349	8.633	0.700	-0.095	8.437	0.991
Other	-23.507	19.513	0.235	-4.187	13.722	0.761	10.301	12.240	0.401
Age	-0.117	0.337	0.731	0.423	0.343	0.223	0.054	0.221	0.806
Marital Status									
Married/partner	Reference								
Separated	-10.578	25.978	0.686	-15.136	14.858	0.313	7.389	12.223	0.546
Divorced	-0.833	7.242	0.909	-9.329	7.608	0.225	-9.273	5.492	0.094
Widowed	4.013	8.464	0.638	-1.712	9.566	0.859	-7.112	6.510	0.276
Never married	-22.559	13.507	0.103	-25.759	10.142	0.014	4.951	7.028	0.482
History of depression	-27.410	11.564	0.023	6.639	9.598	0.492	-2.363	6.237	0.705
CCI	0.468	1.662	0.780	-1.235	1.644	0.456	-0.679	0.969	0.485
CES-D score	0.322	0.638	0.616	0.423	0.386	0.278	0.226	0.336	0.502
ADL score	-0.581	0.343	0.098	0.427	0.730	0.561	-0.252	0.417	0.547
SPMSQ score	0.776	4.660	0.869	1.518	4.249	0.722	-3.103	4.125	0.453
STEMI	-9.810	7.099	0.175	2.827	5.620	0.617	1.623	3.458	0.640
Living alone	0.759	8.579	0.930	-7.006	7.425	0.349	4.840	4.926	0.328
Interaction between stress and time	0.059	0.157	0.710	-0.020	0.105	0.853	-0.025	0.061	0.687

Adherence was calculated by the percent of received instructions that a patient followed often.

PSS = Perceived Stress Scale; CCI =: Charlson Comorbidity Index; CES-D = Center for Epidemiologic Studies Depression; ADL = Activities of Daily Living; SPMSQ = Short Portable Mental Status Questionnaire; STEMI = ST-segment elevation myocardial infarction