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Original Article

Predictive Factors of Recurrent Heart Attack in Patients with Myocardial Infarction: a comprehensive study of various factors

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ABSTRACT

Background: Myocardial infarction (MI) is one of the most common presentations of coronary artery diseases that the age of its prevalence is decreasing. Survivors of MI are at an increased risk of the recurrence of the disease. This study aimed to determine the frequency of recurrent MI and its ppredictive factors in patients with MI.

Methods: This descriptive cross-sectional study was conducted on 398 patients with MI referred to Dr. Heshmat hospital in Rasht, the exclusive heart center in Guilan province (north of Iran). Convenience sampling method was used and a valid six-part questionnaire including demographic information, patient's desire to improve knowledge, adherence to the Mediterranean diet, patients' awareness of factors predisposing to re-MI, depression status, and adherence to the therapeutic regimen was employed to collect data. The data were analyzed using descriptive statistics and analytical statistics in SPSS21 at the significance level of P≤ 0.05.

Results: The results of the Logistic regression analysis performed by LR method indicated illness duration (OR=0.97, 95% CI=0.95-0.99), history of receiving education (OR=0.1, 95% CI=0.02–0.7), MI type (OR=0.04, 95% CI=0.01–0.34 and OR=0.006, 95% CI=0.001–0.1, respectively for Ant-MI and Post-MI than non-ST-elevation MI) and level of patients' awareness of predisposing factors to MI occurrence (OR=7.31, 95% CI=1.17–45.71, moderate level than good level) as predictors of re-MI.

Conclusion: The findings of this study urges policymakers and planners to consider the necessity of applying educational programs related to factors affecting the recurrence of MI.

Keywords: Myocardial infarction, Heart attack, Recurrent, Patients

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Introduction

Cardiovascular diseases (CVD) are the global leading cause of premature death, especially in Iran (1, 2). The majority of CVD deaths are due to ischemic heart disease (IHD) and myocardial infarction (MI) that one third of them occur in those at the age of less than 70 years; the age of MI development and prevalence is decreasing (1). About 17 million deaths per year are attributed to cardiovascular causes (two times as many deaths as was caused by cancer) and the number is expected to grow to 23.3 million by 2030 (3).

According to the World Health Organization's MONICA Project (monitoring trends and determinants in cardiovascular disease), when the MI event occurs, within 28 days after the first clinical manifestation, if an attack occurs, it is not a separate attack; however, if after the midnight of the 28th day, a heart attack occurs, it is considered as a new attack and recurrent MI (4). Survivors of MI are at an increased risk of recurrent MI, which shows these people are 4 or 5 times more at risk than people who do not have CAD and are at the same age (5). The relative risk for all-cause death and cardiovascular outcomes (recurrent MI, cardiovascular death) is at least 30% higher in survivors of MI than that in a general reference population at both 1-3 years and 3-5 years after MI (6).

The importance of intervention to prevent recurrent MI is determined by the fact that considerable scientific evidence asserts that some interventions can reduce the risk of further cardiovascular attacks in patients with a history of MI; and if it is done properly, lethal and non-fatal attacks could be prevented (5, 7-9). Several studies suggested many interventions for the prevention of recurrent MI event and reduction of its mortality, including: lifestyle changes, following Mediterranean diet and eating proper nutrition, drug treatment, informing patients, and socioeconomic support of patients (5, 7, 8, 10).

Medication treatment, in association with lifestyle changes, can lead to an overall decrease of mortality, and coronary events (11). Studies have shown that adherence to the Mediterranean diet, and smoking cessation after MI significantly decrease the risk of recurrent MI and mortality by 30% to 50%, nevertheless, many patients continue to smoke (10, 12).

Another issue that can increase the chances of recurrent MI and subsequent mortality is depression, which in these patients, mild and severe depression is observed (13). The findings showed that organized post MI-treatment during the first six month following the acute MI, with emphasis on the desired level of health education and medical control and awareness rising, along with stress management and exercise is directly associated with a lower death rate after MI (14, 15).

Another barrier mentioned is the costs of care (16); Hospital admission can create a significant financial burden for patients, which is sometimes beyond the financial capacity of the individual, and these costs can sometimes be a barrier to the treatment process of acute MI in hospitals (16, 17).

Therefore, considering the above-mentioned issues, the researcher's experience in the field of heart, frequent hospitalizations in these patients causing patient-family problems and financial burden on health care systems, few studies on the frequency of re-MI related factors in the researcher's review, as well as the perceived need to review and know the existing conditions for future care planning based on the deficiencies and patient needs this study was conducted with the aim of determining the frequency of re-MI and its predictive factors in patients with MI referred to a Hospital in Rasht.

Materials and Methods

This study was carried out based on an analytical cross-sectional study design. All patients with MI, who referred to the only specialized heart center affiliated to Guilan University of Medical Sciences in Rasht, from mid-March to the end of August 2018, were included in the research. The patients who were admitted to the Internal Cardiac Department were selected through the convenience sampling method. Inclusion criteria were: approved diagnosis of MI by a cardiologist, having a previous history of hospitalization due to MI, having no history of neurological problems (Cerebrovascular events, TIA, Short term memory impairment or Dementia), mental stability (due to documents), having no history of psychiatric drug and the ability to speak Persian for completing the questionnaire (the researcher read the questions to the patients and asked them to answer the questions orally).

Based on a pilot study conducted on 30 patients, with 95% confidence, 5% standard error, and P= 30% (re-MI percentage) and based on the sample size formula, the required sample size was calculated as 323 people. According to a study on the relationship between re-MI and the demographic factors, 5 samples were added per variable and the final sample size was calculated as 398 people.

Questionnaires and interviews were used for collecting data. Six questionnaires were used: "Demographic characteristics", "Assessing the patient's desire to improve knowledge about the CVDs", "Adherence to the Mediterranean diet in cardiovascular patients", and "Assessing the level of patients' awareness of factors predisposing to re-MI ", "Assessing depression status", and" Evaluation of patients' adherence to the therapeutic regimen".

1. Demographic variables and patient's clinical status were: age, gender, marital status, education level, occupation status, housing status, place of residence, living condition, illness duration, history of receiving education, blood pressure, history of MI in the last year (NST-MI, ST-MI, Neglect MI, Primary PCI), MI type, history of diabetes, history of hypertension, history of hyperlipidemia, and family history of heart disease.

2. The questionnaire which used to assess the level of patients' awareness of factors predisposing to MI was first used by Heydari *et al.* in 2010 (18). This questionnaire contains 7 four-choice questions, 7 true-false questions, and one multiple choice question. The total score of the questionnaire is 16. The scores on the Awareness Form are classified on a 0-100 scale (Poor: 0-50, moderate: 50-75, Good: 75-100). The tool's validity and reliability were investigated by the researcher. To determine the validity of the questionnaire, it was given to 10 faculty members of Guilan University of Medical Sciences and after collecting their ideas, the questionnaire was revised. The tool's scientific validity CVI was estimated at 0.83 and over. The tool`s reliability was also determined by internal correlation and Cronbach's alpha ($\alpha = 0.88$).

3. The learning needs of patients about coronary disease were identified by Mildred L. Czar in 1997 and a questionnaire was designed for evaluation of patient's desire to learn about CVDs (19). This inventory is a 38-item questionnaire that includes the following subjects: cardiac anatomy and physiology, food restrictions, symptom recognition, sex, drug therapy, smoking, work, stress and general concerns. The responses are ranked from 1 to 5 in which 1 is assigned as "not important" and 5 is considered as' "very important". Lastly, the level of learning need is classified based on the total score as "high" (score: 38-88), "medium" (score: 89-139), and" low "(score: 140-190). The tool's validity and reliability were investigated by the researcher. The tool's scientific validity CVI was estimated at 0.81 and over. The tool`s reliability was also determined by internal correlation and Cronbach's alpha ($\alpha = 0.85$).

4. The Zung Self-Rating Depression Scale (Zung 1965) is composed of 20 items that the patient can select one of the following choices: seldom, sometimes, usually, and often. The depression scale measures the affective, cognitive, behavioral, and psychological aspects of depression. Each question is scored on a scale of 1-4. There are ten positively worded and ten negatively worded questions. Based on the obtained scores, depression grades are classified as follow (20): normal range and without the psychological disorder (score<50), mild to moderate depression (score: 50-59), moderate to overt depression (score: 60-69), severe depression (score ≥70). The validity of this scale was verified by Habibpour in 2003 (21). The tool's reliability was investigated by the researcher and determined by internal correlation and Cronbach's alpha ($\alpha = 0.87$).

5. The evaluation of adherence to the Mediterranean diet is a validated questionnaire with 13 items that patient's answer is whether Yes or No scored 1 and 0 respectively. The results were classified as low adherence (score: 0-5), moderate (score: 6-9) and high adherence (score ≥10). The content and face validity of the questionnaire have been evaluated and validated by two experts in the field of nutrition (22, 23). In Iran, the tool`s validity was investigated by the researcher. The tool's scientific validity CVI was estimated at 0.83 and over. In the initial pilot study, after completing 30 questionnaires, the internal reliability of the questionnaire was calculated by using the internal correlation method and Cronbach's Alpha ($\alpha = 0.92$).

6. The patient's adherence to the therapeutic regimen questionnaire, at first was identified by Heydari *et al.*, entitled "The evaluation of the re-hospitalization frequency and its related factors

in cardiac patients referred to selected hospitals in Mashhad in 2010". This questionnaire consists of 12 items which each question has 4 choices including never, seldom, often, and always (scored from1to 4). The scoring method is reverse for questions 1, 2, 4, 9, and 11. The minimum and maximum scores obtained from this questionnaire are 12 and 48, respectively and is classified as poor adherence (score: 12-24), moderate adherence (score: 24-36) and good adherence (score: 36-48). The validity of the instrument has been assessed through content validity and its reliability was examined through measurements between evaluators by Heydari *et al.* (18). The tool's reliability was investigated by the researcher and determined by internal correlation and Cronbach's alpha ($\alpha = 0.91$).

After approving the project and receiving the introduction letter from the Vice Chancellor for Research, samples of this study were selected. Patients were included in the study if desired and their consent was obtained at the beginning of the study. The anonymity and confidentiality of participants were secured. Questionnaires were filled in after 2-3 days of hospitalization for patient`s status stability and obtaining their informed consent. The questionnaires were not completed in one step and were completed according to the patient's condition.

After completing the questionnaires, the data were analyzed through SPSS21 and using Kolmogorov-Smirnov test to determine the normal distribution of data, descriptive (frequency, percentage, mean, standard deviation) and inferential (Chi-square test, Fisher's exact test, Mann-Whitney U test, and regression coefficient to estimate the odds ratio) statistical tests.

Results

Results showed that the majority of the participants were male (71.1%), married (95.2%), had a literacy for reading and writing (39.4%), resided in the city (70.4%), were self-employed (30.4%) and had a mean age of 61.82 ± 12.06 years (Table 1). In whole, 14 (3.5%) of the participants had a re-MI. In the evaluation of the level of patients' awareness of predisposing factors to MI occurrence, the patients' awareness mean score was 11.91±4.75 out of a possible score of 16 and 29 (7.3%) of the participants had poor, 235 (59%) had moderate, and 134 (33.7%) got good level of awareness. In assessing the patients' desire to improve knowledge about the CVDs, the mean score of the patients' learning needs was148.14±16.01 out of 190. One patient (0.3%) had high learning needs, 114 (28.6%) patients had a moderate level, and 283 (71.1%) had a low level of learning needs. The patients' mean score on depression questionnaire was 43.78±5.82 out of a possible score of 80 and 375 (94.2%) patients had a normal mood and without psychological disorder, 19 (4.8%) ones had a mild to moderate depression, 3 (0.8%) patients had moderate to overt depression, and 1 (0.3%) patient was severely depressed. The mean score of the patients' adherence to the Mediterranean diet was 8.16±2.12 out of 13 and 49 (12.3%) of the patients had low (inappropriate), 241 (60.6%) ones had moderate, and 108 (27.1%) patients had high adherence. The mean score of patients' adherence to therapeutic diet was 33.12±3.61 out of 48. Three patients (0.8%) had poor, 330 (82.9%) ones had moderate, and 65 (16.3%) patients had high adherence.

Table 1. The Socio-demographic and clinical characteristics of participants

Socio-demographic & clinical characteristics	NO. (%)
Gender:	
- Female	115 (28.9)
- Male	283 (71.1)
Age, Mean (SD)	61.82 (12.06)
Marital status:	
- Married	379 (95.2)
- Unmarried (Single, Divorced, Widowed)	19 (4.8)
Level of Education:	
- Illiterate	139 (34.9)
- Reading and writing literacy	157 (39.4)
- Under the high school diploma	82 (20.7)
- High school Diploma and higher	20 (5)
Housing status:	
- Leased	60 (15.1)
- Personal	338 (84.9)
Place of residence:	
- City	280 (70.4)
- Village	118 (29.6)
Living conditions:	
- alone	14 (3.5)
- With wife	202 (50.8)
- With wife and children	4 (1)
- With children	178 (44.7)
- With others (parents, tenants, ...)	0 (0)
Occupation status:	
- Retired & Employee	60 (15.1)
- Worker & Unemployed	111 (27.9)
- Self-employed	121 (30.4)
- Housewife	106 (26.6)
Type of MI:	
- Ant-MI	80 (20.1)
- Inf-MI	62 (15.6)
- Post-MI	9 (2.3)
- Lat-MI	5 (1.3)
- NSTEMI	242 (60.8)
Duration of illness (month), Mean (SD)	7.21 (23.04)
Systolic blood pressure, Mean (SD)	118.69 (21.05)
Diastolic blood pressure, Mean (SD)	74.76 (38.84)
Family history of heart disease:	
- Yes	71 (17.8)
- No	327 (82.2)
History of HTN:	
- Yes	213 (53.5)
- No	185 (46.5)
History of HLP:	
- Yes	66 (16.6)
- No	332 (83.4)
History of DM:	
- Yes	116 (29.1)
- No	282 (70.9)
History of receiving education:	
- Yes	83 (20.9)
- No	315 (79.1)

In relation to the association between variables and recurrent MI, results confirmed that illness duration (P<0.001), occupation status (P<0.02), living condition (P<0.05), family history of heart disease (P<0.02), history of receiving education (P<0.001), MI type (P<0.001), and the level of patients' awareness of predisposing factors to MI occurrence (P<0.05) had significant association with re-MI. Retired and employed patients had more re-MI than others. Patients who lived with their children, people with positive family history of heart disease than those who do did not have a family history, patients without a history of receiving education than those who had such a history, patients with Post-MI diagnosed and subjects who had poor awareness than those with moderate and good awareness were more susceptible to developing re-MI.

In Logistic regression analysis by LR method, the duration of the illness, history of receiving education, type of MI and level of

awareness of predisposing factors to MI were identified as predictors of re-MI; in which with an increase of one month of illness duration, the chance of re-MI decreased 0.97 times (OR=0.97, 95% CI=0.95-0.99, P=0.002). Patients with history of receiving education had less chance for re-MI than those without history of it (OR=0.1, 95% CI=0.02-0.7, P=0.02). In terms of MI type, patients with Ant-MI and Post-MI had less chance to re-MI than patients with NSTEMI (OR=0.04, 95% CI=0.01-0.34, P=0.003 and OR=0.006, 95% CI=0.001-0.1, P=0.001 respectively). Also, patients with moderate level of awareness about predisposing factors to MI occurrence compared to patients with good level of awareness had more chance to re-MI occurrence (OR=7.31, 95% CI=1.17-45.71, P=0.003). The results have been presented in Table 2.

Table 2. Regression coefficients of re-MI predictors based on logistic regression (LR method)

Predictors		B	SE	OR	95% CI		P Value
					Min	Max	
Duration of illness		-0.03	0.01	0.97	0.95	0.99	0.002*
History of receiving education	Yes	-2.26	0.98	0.1	0.02	0.7	0.02*
	No	Reference	-	-	-	-	-
Type of MI	Ant-MI	-3.17	1.07	0.04	0.01	0.34	0.003*
	Inf-MI	-1.58	1.07	0.21	0.03	1.68	0.14
	Post-MI	-5.19	1.48	0.006	0.001	0.1	0.001*
	Lat-MI	16.31	41.16	120.05	0.001	5.96	0.99
	NSTEMI	Reference	-	-	-	-	-
Level of awareness	Poor	2.45	1.3	11.6	0.9	149.12	0.06
	Moderate	1.99	0.93	7.31	1.17	45.71	0.03*
	Good	Reference	-	-	-	-	-

*Significance level: P≤ 0.05.

Discussion

Despite the progress made in the treatment of heart diseases, the recurrence rate and readmission of this group of patients are still relatively high and are considered as major health problems (18). ‹Therefore, the study on the frequency of recurrent rate in patients with MI and its related factors are important.

According to the findings of the current study, the frequency of readmission in patients with MI was 3.5%; whereas, Kociol *et al.* reported 11.5% for this frequency (24) and in the study of Sadeghi *et al*., the frequency of re-hospitalization due to MI post-CABG was 0.4% (25). The reason of the different results may be due to admission conditions and underlying diseases of patients, and differences in physicians' performance in the treatment of patients on the outpatient or inpatient basis.

In the present study, MI prevalence in retired and employed subjects was more than others, while Heydari *et al*. assessed the frequency of re-MI considering gender differences and demonstrated that MI and readmission in unemployed and retired men were more prevalent than women. Also, in another study without considering gender differences, recurrent MI and readmission were higher in working people (18). In our view, stress is the leading cause of MI and its post hospitalization; therefore, working people, especially employees (because of discipline in the workplace) than unemployed people and housewives are exposed to a higher risk of stressors that can justify this result. Also, since this group of people is considered as low-income groups of society, the economic pressure can directly affect the incidence of re-MI and indirectly their medication adherence and consequently leads to re-MI.

According to the results of the present study, patients with positive family history of heart diseases than patients without a positive family history had more re-MI. Similarly, Nunes *et al.* have reported that non-modifiable factors such as the family history of heart disease cause higher risk for MI and readmission (26).

The results of the present study revealed that poor awareness and lack of history of receiving education about MI had a significant relationship with the incidence of re-MI and readmission; that is, moderate level of awareness compared to good level increased the recurrent MI chance many times over. In line with the results of current study, two studies indicated that a high percentage of readmission cases can be prevented through an educational model, pre-discharge preparations, and home care (18, 25). In this context, our study results confirmed that patients with a history of receiving an education had a lower chance to re-MI, and according to this finding, it can be concluded that scrutinizing

in associated factors with readmission in heart diseases, as well as identifying the unmet medical, educational, and psychological needs of patients can result in a significant reduction in readmission rates.

According to the results, the risk of re-MI in NSTMI patients was higher than other types of MI. Kociol *et al.* showed that one of the predictors of readmission in myocardial infarction patients can be the type of MI, especially inferior MI; however, this difference in results can be related to the fact that the pathophysiology of NSTMI is multifactorial, while the pathophysiology of STMI can be due to the coronary artery thrombosis and this can be better controlled with treatment measures such as thrombolytic therapy (24). In this context, our study revealed that treatment and care had better control over STMI or this difference can be attributed to the greater frequency of NSTMI in Guilan province.

According to the findings of our study, with increase of the illness duration and hospitalization, the chance of re-MI decreases, which was similar to the results of another similar study (18). We believe that with the presence of patients in the hospital environment and obtaining the necessary training in the field of MI risk factors in various ways, including the active presence of hardworking nursing staff, which play a key role in promoting clients' health and a better understanding of post-discharge care, the chance of a re-MI decreases.

Given the significant cases of readmission and the fact that they can be prevented, identifying the predisposing factors of MI plays an important role in extending the life expectancy of patients. It is necessary to gain a broader insight into these factors to improve the management of heart diseases.

One of the limitations of the present study was the convenience sampling method which led to an imbalance and inequality in the number of different states of the studied variables, especially the main variable of the study. It is suggested that further studies be conducted as randomized clinical trials with matched groups or higher sample sizes and multicenter studies.

Conclusion

The findings of the present study urges policymakers and planners to consider factors affecting the frequency of re-MI that their prevention can improve all aspects of patients' lives. This study suggests that programs should be developed to inform medical staff about the importance of educating patients in identifying the factors affecting re-MI. Plans for creating continuous and long-term learning along with regular follow-up courses such as home visit, and home care programs are suggested. Such programs may prevent many problems such as disease exacerbation and frequent readmissions that can reduce the patients' quality-of-life and increase the financial burden on health care systems.

Ethical Considerations

The approval for this study was obtained from the Ethics Committee of the Research Deputy of Guilan University of Medical Sciences, Rasht, Iran (approval code: IR.GUMS.REC.1396.165). Written informed consent was obtained from all participants in accordance with the principles of the Declaration of Helsinki. All participants were assured of the data confidentiality. Moreover, participation in the study was voluntary and participants could leave the study at will.

Conflict of interest

The authors declare that there is no conflict of interest.

Authors' contributions

Fatemeh Moaddab and Arsalan Salari designed the present study and were responsible for the overall management of the study; Fatemeh Moaddab and Sarina Ramtin organized the analysis of the study; Fatemeh Moaddab and Iman Emadi prepared the manuscript. The statistical analyses were conducted by Fatemeh Moaddab and Arsalan Salari. All authors contributed to the final version of the manuscript.

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