Pre-hospital delay among patients with acute myocardial infarction in Saudi Arabia

A cross-sectional study

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ABSTRACT

الأهداف: تقدير وقت تأخر وصول المرضى للمستشفى بين المرضى الذين يعانون من إحتشاء العضلة القلبية الحاد (الجلطة القلبية) وتحديد العوامل المصاحبه لذلك التأخر.

المنهجية: تم إجراء دراسة مقطعية بين 200 مريض يعانون من الجلطة القلبية في مركز المدينة المنورة للقلب في المدينة المنورة، المملكة العربية السعودية بين نوفمبر 2019م ومارس 2020م. تم جمع البيانات عن طريق مقابلات مباشرة بين الطبيب والمريض. عُدل الاستبيان وفقا لأهداف الدراسة من استبيان سابق يدرس الإستجابه للأعراض وقت حدوثها. تم حساب اختبار مربع كاي و تحليل متعدد المتغيرات لاختبار العوامل المصاحبة بتأخروصول المرضى للمستشفى.

النتائج: كان متوسط وقت التأخر قبل الوصول للمستشفى 3.7 ساعة. من بين جميع المرضى، وصل 126 مريضاً (63%) إلى المستشفى بعد ساعتين. العوامل التي ترتبط بشكل كبير بوقت التأخرقبل الوصول للمستشفى هم المرضى الذين كان لديهم معلومات حول متلازمة الشريان التاجي الحادة السابقة (نسبة الأرجحية المعدلة =0.35، 95% نطاق الثقة 0.1–0.6)، ارتفاع كوليسترول الدم (نسبة الأرجحية المعدلة =2.3، 95% نطاق الثقة 1.1–4.7)، ومن وصلوا عن طريق الإسعاف (نسبة الأرجحية المعدلة = 0.3، 95% نطاق الثقة 0.1–0.8)، ومقياس الألم لديهم (نسبة الأرجحية المعدلة =0.7، 95% نطاق الثقة 0.6–0.9).

الخلاصة: وصل حوالي ثلثي المرضى بعد ساعتين من ظهور الأعراض. المرضى الذين كان لديهم معلومات عن متلازمة الشريان التاجي الحادة السابقة، ولديهم ارتفاع كوليسترول الدم، ومن وصلوا عن طريق الإسعاف إلى المستشفى، ومن كانت شدة الألم لديهم مرتقعه، كانوا أكثر ارتباطا بوقت تأخرهم قبل وصولهم للمستشفى.

Objectives: To estimate the pre-hospital delay time among patients diagnosed with acute myocardial infarction and to determine factors associated with pre-hospital delay.

Methods: A cross-sectional study was conducted among 200 patients with myocardial infarction at Madinah Cardiac Center, Al Madinah Al Munawarah, Saudi Arabia between November 2019 and March 2020. Data were collected by direct physician-subject interviews. We used the validated version of the modified response to symptoms questionnaire. Chi-square test, t test, and multivariate analysis were used to examine factors associated with pre-hospital delay.

Results: The median pre-hospital delay time was 3.7 hours. Among all the patients, 126 patients (63%) arrived at the hospital later than 2 hours from the onset of symptoms. Factors that were significantly associated with pre-hospital delay included a previous information on acute coronary syndrome (adjusted odds ratio [adj OR]=0.35, 95% confidence interval [CI] 0.1-0.6), history of hypercholesteremia (adj OR=2.3, 95% CI 1.1-4.7), arrived by ambulance (adj OR=0.3, 95% CI 0.1-0.8), and increased pain intensity (adj OR=0.7, 95% CI 0.6-0.9).

Conclusion: Approximately two-thirds of the patients arrived later than 2 hours from the onset of symptoms. A previous information about acute coronary syndrome, history of hypercholesteremia, arrived by ambulance, and increased pain intensity were associated with pre-hospital delay. The study recognizes the need for educational programs about acute myocardial infarction symptoms and the benefits of availing an ambulance service.

Keywords: myocardial infarction, ischemic heart diseases, pre-hospital delay, Saudi Arabia

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Cardiovascular diseases (CVDs) are considered the number one cause of mortality worldwide.[1] In 2016, CVD accounted for approximately 31% of all deaths globally and 37% of deaths in Saudi Arabia.[2,3]

The recent improvement in the survival of patients with acute myocardial infarction (AMI) has been mostly attributed to early reperfusion therapy.[4] Mortality reduction approaches 50% if intervention therapy is administered within the first 70 minutes.[5] Pre-hospital delay is the "time between the onset of symptoms and arrival at an emergency department" in patients with AMI.[6] In Saudi Arabia, 2 previous studies in 2013 had reported that the median delay time was 6 hours and in 2016 the median delay time was 3 hours. In the international studies, the median delay time was reported to range from 1.6 to 6.40 hours.[7-9]

Many factors from different domains have been shown to influence pre-hospital delay include the misinterpretation of symptoms, which is attributed to poor or inappropriate knowledge, attitudes, and beliefs of AMI symptoms.[10] In literature, factors associated with late arrival to hospital include female gender, old age, low socioeconomic status, history of chronic diseases, family history or previous history of angina, and failure to be transported by an ambulance.[11] A few studies were conducted in Saudi Arabia with a varied range of pre-hospital delay times, and they showed that the majority of mortality was attributed to CVD. In Saudi Arabia, previous studies were inadequate and did not take in account common factors associated with pre-hospital delay. This study included other factors associated with pre-hospital delay such as knowledge, attitudes, and beliefs.

The aim of this study is to estimate the pre-hospital delay time among patients diagnosed with AMI and to determine the important factors influencing pre-hospital delay.

Methods. This study used a cross-sectional design. For all patients interviewed, file numbers were recorded to ensure that no duplications occurred within the sample set. The study was conducted between November 2019 and March 2020 at Madinah Cardiac Center (MCC), Al Madinah Al Munawarah, Saudi Arabia, a referral hospital for cardiac patients in Al Madinah City.

The target population included all cases that were diagnosed by cardiologists as confirmed cases of AMI according to the most recent guidelines and admitted to the coronary care unit or medical ward within 24 and 72 hours of their admission at MCC during the study period. The study sample size was calculated using OpenEpi web based on the following assumption: the estimated prevalence of late arrival for patients who arrived to the hospital more than 2 hours was 80% (this prevalence was chosen based on previous study in the same region, and the statistical power was 80%, with 95% confidence interval [CI]).[12] Given this assumption, the minimum required number of cases was determined to be 183 patients. A convenient sampling technique was utilized to recruit 200 patients.

Patients were enrolled in the study if they: a) were over 18 years old, b) had a confirmed diagnosis of AMI indicated by either non-ST elevation myocardial infarction or ST-elevation myocardial infarction on electrocardiogram and laboratory results of troponin, creatine kinase-MB, and creatine kinase according to the most recent guidelines,[13] and c) could speak either English or Arabic. Patients were excluded if they: a) had impaired cognitive ability, b) were hemodynamically unstable, c) refused to participate, or d) were in the hospital for any reason when the AMI occurred.

The study instrument consisted of 4 parts. Part one included demographic variables such as gender, age, residential area, marital status, income, education, employment, and health insurance. Part 2 contained the date and time of symptoms onset and arrival at an emergency room. Pre-hospital delay time was defined as the time between the onset of symptoms and hospital arrival.[6,8,9] Patients were classified into 2 groups based on the delay time. Early arrival was considered if the patients came to the hospital within 2 hours after the onset of symptoms. Late arrival was considered if the patients came more than 2 hours after symptoms onset. Two hours was used as a cut-off point because primary percutaneous coronary intervention loses its superiority over fibrinolysis beyond 2 hours following presentation.[14,15] Part 3 contained medical histories such as previous history of chronic diseases and cardiac surgeries that were retrieved from patient's files. It also included questions on patient's experiences of the occurrence of the first symptoms until hospital admission.[16,17] Part 4 included the validated English and Arabic versions of the modified response to symptoms questionnaire that has 3 sections.[18] The first section measured knowledge on coronary heart disease and AMI symptoms (26 items), with a total score ranging from 0 to 26. Higher scores indicate high level of knowledge,

and a score of 18 and above was considered good knowledge. The second section measured attitudes by using a 5-item questionnaire with a 4-point Likert-type scale. The answers for each item ranged from one (not at all) to 4 (very sure), and the total score ranged from 5 to 20. The coefficient alpha for the English version was 0.77 and the Arabic versions was 0.80, which was considered as a good internal consistency. The third section measured beliefs by using a 10-item questionnaire. The answers range from one (strongly agree) to 4 (strongly disagree), and the total score ranged between 10 and 40. Higher scores indicated positive beliefs about AMI. The coefficient alphas for the English was 0.64 and the Arabic version was 0.70, which is considered as a good internal consistency.[17,19]

The data collection was conducted between November 2019 and March 2020. Patients who participated in this study were interviewed using a structured questionnaire. The interview lasted for 15-20 minutes. Some information, such as date and time of arrival at the emergency room and history of chronic diseases, was taken from the medical records within 72 hours of their admission at MCC by trained data collectors. The study was approved ethically by the Institutional Review Board of the General Directorate of Health Affairs, Al Madinah Al Munawarah, Saudi Arabia according to the principles of the Declaration of Helsinki. Informed consent was obtained verbally from all participants. All patients were aware that their participation was voluntary, and their refusal to participate would not affect the quality of health care. All the data in the questionnaire were anonymous and stored in a secured location, only accessible by the research team.

Statistical analysis. Data were entered and subsequently managed using Statistical Package for Social Sciences, version 25 (IBM Corp, Armonk, NY, USA). Percentage and frequency were obtained for the categorical variables and mean±standard deviation (SD) or median (interquartile range [IQR]) for the continuous variables. Chi-square test was performed to assess the association between the categorical variables. Students' t-test was used to compare means across variables. Multiple logistic regression analysis was performed to determine the most important factors associated with pre-hospital delay. Sample size of 200 subjects was sufficient for logistic regression analysis according to the rule of thumb (10 subjects for each variable).

Multicollinearity test, Hosmer-Lemeshow goodness of fit test and the Nagelkerke R Square were obtained in the multiple logistic regression analysis. The accepted level of significance was below 0.05 ($p<0.05$).

Results. Out of the 205 patients diagnosed with AMI, only 200 patients agreed to participate in the study (response rate=97.5%). The median pre-hospital delay time was 3.7 hours (3.5 hours for males and 5.5 hours for females). Of the patients, 37% arrived at the hospital within 2 hours, and 63% arrived later than 2 hours. The mean age was 58.4 (SD=11.9) years, median age was 58 (IQR=50-67) and the ages ranged from 26 to 88 years.

The participants were predominantly Saudi (81%), living inside Al Madinah Al Munawarah (68.5%), male (83.5%), married (97%), and employed (40.5%). Most of them had primary school education or below (40%), income <4000 Saudi Riyal (42.5%), and health insurance (89.5%). Most of the patients also had a history of diabetes mellitus (57.5%) and were never smokers (46%). Approximately, 10.5% arrived at the hospital by ambulance (Table 1).

The mean pain scale score was 8.3 (SD=1.9). The mean knowledge of acute coronary syndrome score was 18.7 (SD=2.5). The mean attitudes score was 10.0 (SD=4.0), and the mean beliefs score was 24.2 (SD=2.0) (Table 2). A statistically significant association was found between smoking status and pre-hospital delay where current smokers were less likely to arrive late ($p=0.049$). Patients who came to the hospital by ambulance were less likely to arrive late (odds ratio [OR]=0.3, 95% CI 0.1-0.9, $p=0.043$). Other sociodemographic variables showed no significant association with pre-hospital delay (Table 3).

Patients who had received previous information on acute coronary syndrome were less likely to arrive late to the hospital (OR=0.4, 95% CI 0.2-0.7, $p=0.003$). Those who had a history of hypercholesteremia were more likely to arrive late to the hospital (OR=2.25, 95% CI 1.1-4.2, $p=0.012$)(Table 4).

The mean pain scale was lower among those with delayed hospital arrival (8.0±2.0) compared with those who arrived early (8.8±1.5) ($p=0.004$). The mean attitudes score was lower among those with delayed hospital arrival (9.2±3.7) compared with those who arrived early (11.3±4.2) ($p<0.001$). The mean knowledge score was higher among those with delayed hospital arrival (19.2±2.2) compared with those who arrived early (18.0±2.9) ($p=0.001$). No statistically significant differences were found in the beliefs score (Table 5).

Factors that were associated significantly with pre-hospital delay in bivariate analysis were entered

Table 1 - Patient characteristics (N=200).

Variable	n (%)
Age, years	
<50	45 (22.5)
50-65	94 (47.0)
>65	61 (30.5)
Medical diagnosis	
ST-segment elevation myocardial infarction	110 (55.0)
Non-ST-segment elevation myocardial infarction	90 (45.0)
Nationality	
Saudi	162 (81.0)
Non-Saudi	38 (19.0)
Residential area	
Inside Al Madinah Al Munawarah	137 (68.5)
Outside Al Madinah Al Munawarah	63 (31.5)
Gender	
Male	167 (83.5)
Female	33 (16.5)
Marital status	
Married	194 (97.0)
Unmarried (single, widowed, divorced)	6 (3.0)
Educational level	
Primary school and below	80 (40.0)
Intermediate or secondary school	78 (39.0)
University or more	42 (21.0)
Employment status	
Employed	81 (40.5)
Retired	59 (29.5)
Unemployed	60 (30.0)
Income (Saudi Riyals)	
<4000	85 (42.5)
4000-8000	49 (24.5)
>8000	66 (33.0)
Insurance	
Yes	179 (89.5)
No	21 (10.5)
Medical history	
Coronary artery disease	39 (19.5)
Previous acute coronary syndrome information	78 (39.0)
Angina	59 (29.5)
Myocardial infarction	50 (25.0)
Cardiac surgery	31 (15.5)
Hypercholesteremia	71 (35.5)
Hypertension	104 (52.0)
Diabetes	115 (57.5)
Obesity	54 (27.0)
Percutaneous coronary intervention	19 (9.5)
Family history	49 (24.5)
Smoking	
Current	64 (32.0)
Former	44 (22.0)
Never	92 (46.0)
Self-perceived cardiac symptoms	
Yes	94 (47.0)
No	106 (53.0)
Previous experience of symptoms	
Yes	55 (27.5)
No	145 (72.5)
Mode of hospital transport	
Ambulance	21 (10.5)
Other	179 (89.5)

Table 2 - Description of pain scale and cognitive variables in the study (N=200).

Variable	Range	Mean (SD)	Median (IQR)
Pain scale	1-10	8.3 (1.9)	8 (7-10)
Knowledge	8-24	18.7 (2.5)	19 (17-21)
Attitudes	5-19	10.0 (4.0)	10 (6-13)
Beliefs	17-30	24.2 (2.0)	24 (23-25)

SD: standard deviation, IQR: interquartile range

in the multiple logistic regression analysis (smoking, mode of hospital transport, previous ACS information, hypercholesteremia, self-perceived cardiac symptoms, pain scale, knowledge, and attitudes). Multiple logistic regression analysis showed that patients who had previous information on acute coronary syndrome (OR=0.35, 95% CI 0.1-0.6), those who came to the hospital by ambulance (OR=0.3, 95% CI 0.1-0.8), and those who had increased pain intensity (OR=0.7, 95% CI 0.6-0.9) were less likely to arrive late to the hospital. Patients who had a history of hypercholesteremia (OR=2.3, 95% CI 1.1-4.7, *p*=0.019) were more likely to arrive late to the hospital (Table 6). The total model was significant (*p*=0.003). Nagelkerke R square is 0.584 which shows that 58.4% of the variation in the pre-hospital delay is explained by this logistic model. Hosmer-Lemeshow goodness of fit test indicates that the model fits the data (*p*=0.543).

There was no multicollinearity between the variables in the model as indicated by the correlation matrix analysis.

Discussion. The current study showed that 63% of the patients arrived later than 2 hours to the hospital. This percentage was considered higher than that reported in developed countries (51.4% to 59%) and lower than that reported in developing countries (67.7% to 81%).[12,20-22] The median pre-hospital delay in this study was 3.7 hours. Studies conducted in Saudi Arabia in 2013 reported a median delay time of 6 hours and in 2016 a median delay time of 3 hours.[7,8] In other countries, the median pre-hospital delay time was 2 hours in Turkey,[23] 2 to 5 hours in Sweden,[24,25] and 2.5 to 4 hours in China.[26,27] The mean age of the participants in this study was similar to that in a study in Malaysia.[28] Previous studies found that females were more likely to arrive late compared with males, but our findings failed to find statistically significant differences between males and females.[16,29,30]

In the current study, bivariate analysis showed that current smokers were less likely to arrive late, and current smokers might perceived high susceptibility to

Table 3 - Sociodemographic characteristics associated with pre-hospital delay among patients with acute myocardial infarction (N=200).

Variable	Late arrival >2 hours	Early arrival ≤2 hours	OR (95% CI)	P-value
Age, years				
<50	23 (51.1)	22 (48.9)		0.152
50-65	61 (64.9)	33 (35.1)		
>65	42 (68.9)	19 (31.1)	-	
Medical diagnosis				
ST-segment elevation myocardial infarction	63 (57.3)	47 (42.7)	0.57 (0.31-1.03)	0.064
Non-ST-segment elevation myocardial infarction	63 (70.0)	27 (30.0)	1	
Nationality				
Saudi	102 (63.0)	60 (37.0)	0.99 (0.47-2.06)	0.982
Non-Saudi	24 (63.2)	14 (36.8)	1	
Residential area				
Inside Al Madinah Al Munawarah	86 (62.8)	51 (37.2)	0.97 (0.52-1.80)	0.922
Outside Al Madinah Al Munawarah	40 (63.5)	36 (36.5)	1	
Gender				
Male	104 (62.3)	63 (37.7)	0.82 (0.37-1.81)	0.633
Female	22 (66.7)	11 (33.3)	1	
Marital status				
Married	123 (63.4)	71 (36.6)	1.73 (0.34-8.81)	0.503
Unmarried	3 (50.0)	3 (50.0)	1	
Educational level				
Primary school and below	53 (66.3)	27 (33.8)		0.066
Intermediate or secondary school	53 (67.9)	25 (32.1)		
University or more	20 (47.6)	22(52.4)	-	
Employment status				
Employed	48 (59.3)	33 (40.7)		0.065
Retired	33 (55.9)	26 (44.1)		
Unemployed	45 (75.0)	15 (25.0)	-	
Income (Saudi Riyals)				
<4000	56 (65.9)	29 (34.1)		0.536
4000-8000	32 (65.3)	17 (34.7)		
>8000	38 (57.6)	28 (42.4)	-	
Insurance				
Yes	114 (63.7)	65 (36.3)	1.31 (0.52- 3.28)	0.557
No	12 (57.1)	9 (42.9)	1	
Smoking				
Current	19 (29.7)	45 (70.3)	0.49 (0.23-0.91)	0.049
Former	23 (52.3)	21 (47.7)	1.26 (0.27-2.54)	0.064
Never	32 (34.8)	60 (65.2)	1	
Mode of hospital transport				
Ambulance	9 (42.9)	12 (57.1)	0.39 (0.15- 0.99)	0.043
Other	117 (65.4)	62 (34.6)	1	

Values are presented as numbers and percentages (%). OR: odds ratio, CI: confidence interval

have heart disease compared to non smokers. However, multivariate analysis showed no relationship between smoking and pre-hospital delay. A previous study showed that current smokers were less likely to arrive late.[21]

In this study, only 10% of patients arrived to the hospital by ambulance. Previous studies in Saudi Arabia found that 8% and 19% arrived to the hospital by ambulance.[7,8] We found that patients who did not use an ambulance were more likely to arrive late to the hospital compared with those who arrived by ambulance. This finding reflected that the ambulance use is the fastest mode of hospital transport as usual. A similar finding was reported in previous studies.[8,31]

This study failed to detect a significant association between pre-hospital delay and other sociodemographic

Table 4 - Clinical characteristics associated with pre-hospital delay among patients with acute myocardial infarction (N=200).

Variable	Late arrival >2 hours	Early arrival ≤2 hours	OR (95% CI)	P-value
Medical history				
Coronary artery disease				
Yes	24 (61.5)	15 (38.5)	0.92 (0.45-1.90)	0.833
No	102 (63.4)	59 (36.6)	1	
Previous ACS information				
Yes	39 (50.0)	39 (50.0)	0.40(0.22-0.72)	0.003
No	87 (71.3)	35 (28.7)	1	
Angina				
Yes	40 (67.8)	19 (32.2)	1.34 (0.70-2.56)	0.364
No	86 (61.0)	55 (39.0)	1	
Myocardial infarction				
Yes	35 (70.0)	15 (30.0)	1.51 (0.76-3.01)	0.238
No	91 (60.7)	59 (39.3)	1	
Cardiac surgery				
Yes	24 (77.4)	7 (22.6)	2.25 (0.91-5.52)	0.760
No	102 (60.4)	67 (39.6)	1	
Hypercholesteremia				
Yes	53 (74.6)	18 (25.4)	2.25 (1.19-4.27)	0.012
No	73 (56.6)	56 (43.4)	1	
Hypertension				
Yes	66 (63.5)	38 (36.5)	1.04 (0.58-1.85)	0.888
No	60 (62.5)	36 (37.5)	1	
Diabetes				
Yes	74 (64.3)	41 (35.7)	1.14 (0.64-2.04)	0.646
No	52 (61.2)	33 (38.8)	1	
Obesity				
Yes	30 (55.6)	24 (44.4)	0.65 (0.34-1.23)	0.185
No	96 (65.8)	50 (34.2)	1	
Percutaneous coronary intervention				
Yes	13 (68.4)	6 (31.6)	1.30 (0.47-3.59)	0.608
No	113 (62.4)	68 (37.6)	1	
Family history				
Yes	35 (71.4)	14 (28.6)	1.64 (0.81-3.32)	0.162
No	91 (60.3)	60 (39.7)	1	
Self-perceived cardiac symptoms				
Yes	52 (55.3)	42 (44.7)	0.53 (0.30-0.95)	0.034
No	74 (69.8)	32 (30.2)	1	
Previous experience of symptoms				
Yes	39 (70.9)	16 (29.1)	1.62 (0.83-3.17)	0.154
No	87 (60.0)	58 (40.0)	1	

Values are presented as numbers and percentages (%). Chi-square test was used. ACS: acute coronary syndrome, CI: confidence interval, OR: odds ratio

Table 5 - Main variables of the study associated with pre-hospital delay among patients with acute myocardial infarction (N=200).

Variable	Late arrival >2 hours, mean (SD)	Early arrival ≤2 hours, mean (SD)	Mean difference (95% CI)	P-value
Pain scale	8.0 (2.0)	8.8 (1.5)	-0.8 (-1.3 – (-0.2))	0.004
Knowledge	19.2 (2.2)	18.0 (2.9)	1.19 (0.4–1.9)	0.001
Attitudes	9.2 (3.7)	11.3 (4.2)	-2.0 (-3.2 – (-0.0))	<0.001
Beliefs	24.0 (2.0)	24.5 (1.9)	-0.55 (-1.1–0.0)	0.058

SD: standard deviation, CI: confidence interval. Students' t-test was used.

Table 6 - Multiple logistic regression analysis of factors associated with pre-hospital delay (n=200).

Variables	β	Wald	Adjusted OR (95% CI)	P-value
Previous ACS information				
Yes	-1.0	9.6	0.35 (0.1–0.6)	0.002
No			1	
Hypercholesteremia				
Yes	0.8	5.4	2.3 (1.1–4.7)	0.019
No			1	
Mode of hospital transport				
Ambulance	-1.2	4.9	0.3 (0.1–0.8)	0.026
Other			1	
Pain scale	-0.2	8.8	0.7 (0.6–0.9)	0.003

The followings variables were entered into the multiple logistic regression: smoking, mode of hospital transport, previous acute coronary syndrome (ACS) information, hypercholesteremia, self-perceived cardiac symptoms, pain scale, knowledge, and attitude. CI: confidence interval, OR: odds ratio

factors such as age, educational level, nationality, and residential area. A previous study in Saudi Arabia found that pre-hospital delay was associated with a low educational level and living outside the city.[7]

Our study found a significant association between pre-hospital delay and knowledge and attitudes in the bivariate analysis but not in multivariate analysis. Similar findings were reported by a study in Jordan; however, beliefs were also associated with pre-hospital delay.[18] Another study found that inadequate knowledge was associated with late hospital arrival.[32]

With regard to medical history, this study found that a history of hypercholesteremia and previous information about acute coronary syndrome were significantly associated with pre-hospital delay. A previous study found a significant association between hypercholesteremia and pre-hospital delay.[7] Other previous studies found that patients who had history of hypercholesteremia were less likely to arrive late to the hospital.[28,33]

Patients who perceived the symptoms as cardiac in origin were less likely to arrive late to a hospital.[27,34,35] A similar finding was reported in the current study.

Previous studies found that patients who reported an increased pain intensity were less likely to arrive late to a hospital.[31,34,36] Similarly, the current study found that patients who had higher pain scale scores were less likely to arrive late to the hospital. This might be due to that patients with severe pain perceived their condition more serious.

Study limitations. First, recall bias could not be eliminated. Thus, to reduce the risk of bias, patients were interviewed within 72 hours by trained data collectors. Second, the study was carried out in a one center rather than a multicenter and a non-probability sampling technique was used; there was an inability to produce a representative sample of all AMI patients in the country. Third, factors associated with pre-hospital delay reflected only patients who reached the hospital and were hemodynamically stable. Exclusion of patients who died before reaching the hospital or patients who were hemodynamically unstable could affect the generalizability of the findings. Fourth, emotional factors such as anxiety or feeling worried and embarrassed for troubling others and patient's location distance from hospital were not included.

In conclusion, approximately two-thirds of the patients arrived to the hospital later than 2 hours after the onset of symptoms. Patients who had previous information about acute coronary syndrome, had a history of hypercholesteremia, arrived by an ambulance, and had increased pain intensity were more likely associated with pre-hospital delay. The present study highlights the need for educational programs regarding alarming symptoms of AMI for the public and the benefit of using ambulance system services to reduce delay time. Further interventional and qualitative research, are warranted to explore more factors influencing pre-hospital delay and raising awareness to promote early hospital arrival.

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