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The association between symptom onset characteristics and prehospital delay in women and men with acute coronary syndrome

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Abstract

Background—A decision to delay seeking treatment for symptoms of acute coronary syndrome increases the risk of serious complications, disability, and death.

Aims—The purpose of this study was to determine if there was an association between gradual vs abrupt symptom onset and prehospital delay for patients with acute coronary syndrome and to examine the relationship between activities at symptom onset and gradual vs abrupt symptom onset.

Methods—This was a secondary analysis of a large prospective multi-center study. Altogether, 474 patients presenting to the emergency department with symptoms of acute coronary syndrome were included in the study. Symptom characteristics, activity at symptom onset, and prehospital delay were measured with the ACS Patient Questionnaire.

Results—Median prehospital delay time was four hours. Being uninsured ($\beta=0.120$, $p=0.031$) and having a gradual onset of symptoms ($\beta=0.138$, $p=0.003$) were associated with longer delay. A diagnosis of ST-elevation myocardial infarction ($\beta=-0.205$, $p=0.001$) and arrival by ambulance ($\beta=-0.317$, $p<0.001$) were associated with shorter delay. Delay times were shorter for patients who experienced an abrupt vs gradual symptom onset (2.57 h vs 8 h, $p<0.001$). Among men with an abrupt onset of symptoms and a ST-elevation myocardial infarction diagnosis, 54% reported that symptoms were triggered by exertion ($p=0.046$).

Conclusion—Patients should be counselled that a gradual onset of symptoms for potential acute coronary syndrome is an emergency and that they should call 911. Men with ischemic heart disease or with multiple risk factors should be cautioned that symptom onset following exertion may represent acute coronary syndrome.

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Conflict of interest

The authors declare that there is no conflict of interest.

Keywords

Acute coronary syndrome; prehospital delay; symptoms; symptom onset; sex differences; treatment-seeking

Failure to recognize symptoms of acute coronary syndrome (ACS) and to respond rapidly and appropriately has been implicated in prehospital delay.¹ Total prehospital delay time is defined as the time from symptom onset to arrival in the emergency department (ED). Prehospital delay has three phases: (a) symptom recognition to a decision to seek medical care; (b) the decision to seek care to first medical contact; and (c) first medical contact to hospital arrival (“transportation time”) (Figure 1).² Delay times of more than two hours are still common and continue to pose a threat to the administration of timely and effective treatments.^{3,4} Studies have shown that the time for individuals to recognize, interpret, and make a decision to seek medical attention (individual’s delay time) is the main cause and the major contributor to prehospital delay. Thus, the best option for reducing total ischemic time, and to preserve myocardium, is to reduce the time from symptom onset to first medical contact.^{5,6} Total ischemic time has a critical impact on outcomes in patients with ACS.⁷ The decision to delay seeking treatment considerably increase a person’s risk for serious complications, major disability, and death.⁸ There is little reduction in mortality for reperfusion if it occurs after six hours, and studies demonstrate that every 30 min delay in flow restoration reduces life expectancy by one year.^{9,10}

The sub-categories of ACS include ST-elevation myocardial infarction (STEMI), non-ST-elevation myocardial infarction (NSTEMI), and unstable angina (UA). STEMI presents with abnormal troponin cardiac enzymes. Revascularization, often percutaneous coronary intervention (PCI), is an emergency. For patients with NSTEMI, positive biomarkers, transient ST elevation, ST depression, or new T wave inversions with continuous cardiac chest pain are diagnostic. An invasive strategy, such as PCI, is often selected in addition to medical therapy. Patients with UA, present with normal initial biomarkers and symptoms at rest and medical therapy is recommended.^{11,12}

Despite decades of research focused on identifying factors associated with patient delay and success in reducing door to balloon times, almost 40% of patients delay longer than six hours, the window needed to salvage myocardial tissue,^{13,14} indicating that previous attempts to reduce patient delay have been relatively unsuccessful. One reason might be misinterpretation of symptoms.^{15,16} The timely and accurate identification of symptoms of ACS can be difficult for individuals because such symptoms may be similar to those of other less serious conditions.¹⁷ Individuals may attribute their symptoms to non-cardiac causes, and thus not seek care.¹⁸ This can lead to decision delay, which consumes the largest proportion of prehospital delay time.⁶

Characteristics of symptom onset, such as type and timing of symptoms, can affect behaviors that could negatively influence treatment-seeking behavior and increase prehospital delay.¹⁵ Some studies have shown that women are more likely to experience longer prehospital delay time than men.^{19–21} However, other research has suggested that there are no sex differences in prehospital delay time.^{22,23} Gradual vs abrupt onset of

symptoms has been implicated in care-seeking behaviors. In addition, a variety of triggers have been associated with the onset of an acute ischemic episode and may contribute to an individual's perception of symptoms. Physical activity, behaviors, and emotional upset occurring within 1–2 h of symptom onset have been reported as precursors to ACS.^{24–26} Whether physical exertion or emotions trigger variations in symptom onset is unknown. Differences in pathophysiology or in risk factors may influence the development and outcomes of symptoms during ACS.²⁷

The need to reduce patient prehospital delay times to speed diagnosis and treatment of ACS has driven efforts to increase knowledge of ACS symptoms among the public and health professionals.²⁸ Prior studies have identified a lack of knowledge of ACS symptoms as an important factor in patients' delay in seeking medical care.^{29,30} Additional evidence of how the symptom experience influences care seeking behavior will enable health care providers to target and develop interventions to decrease prehospital delay.³¹ Therefore, the objectives of this study were to: (a) determine if there was an association between gradual vs abrupt onset and prehospital delay time for women and men with ACS; and (b) examine the relationship between activities at symptom onset and gradual vs abrupt symptom onset.

Methods

Design, sample, and setting

This is a secondary data analysis using data from a large prospective, multicenter study conducted in four regions of the USA (Pacific Northwest, West, Southwest, and Midwest).³² Study sites included four academic medical centers and one large regional referral hospital. Enrollment occurred from January 2011–December 2014. Symptoms were assessed within 15 min of admission to the ED. In-depth methods have been reported elsewhere.³³ The sample included 1064 women and men presenting to the ED for symptoms of potential ACS. This secondary data analysis included only patients that went on to be diagnosed with ACS ($n=474$) because this is the population of high-risk patients who may require urgent reperfusion therapies. Inclusion criteria were: (a) ≥ 21 years old, (b) ability to speak and understand English, and (c) arrived by private transportation or emergency medical services (EMS). Exclusion criteria were: (a) exacerbation of heart failure (brain natriuretic peptide >500 pg/ml), (b) transferred from a hemodialysis center, (c) referred for evaluation of a dysrhythmia, and (d) cognitive impairment.³² The study received the approval of Institutional Review Boards at the five data collection sites and the sponsoring institution.

Measures

Symptom characteristics and time from symptom onset to arrival in the ED were assessed with the ACS Patient Information Questionnaire. The questionnaire includes patient-reported information on demographic and symptom variables, including symptom onset and activity at symptom onset. The questionnaire was designed using the standardized reporting guidelines for studies evaluating patients with potential ACS in emergency settings.³⁴ The criteria were established by the Multidisciplinary Standardized Reporting Criteria Task Force and are supported by the Society for Academic Medicine, the American College of Emergency Physicians, the American Heart Association, and the American College of

Cardiology.³⁴ Prehospital delay time was the primary outcome. Patients were asked to recall the time that their symptoms began. The time difference between symptom onset and ED arrival constituted “prehospital delay”, measured in hours and minutes. Activity at symptom onset was explored with an open-ended question: “What were you doing during the 48 hours before your symptoms began?” Patients gave 209 different answers to their activity at symptom onset and answers were categorized into five themes: (a) resting (e.g. reclining, reclining and watching TV); (b) sleeping; (c) sitting (e.g. deskwork, driving, eating, reading); (d) exertion (e.g. running, jogging, climbing stairs, pulling, pushing, shoveling, heavy gardening), and (e) emotional stress (e.g. anger, tension, stress).

Procedures

Eligible patients were approached by the research staff for enrollment after they were considered stable by hospital staff and had been transferred to a private examination room. The study was then explained, and once consent was obtained, the ACS Information Questionnaire was completed by research staff. All data was collected directly from the patient in the ED or catheterization laboratory.

Data analysis

Data were examined for their distributional properties, outliers, and presence of missing data. Participants with missing data for prehospital delay times ($n=45$) or symptom onset ($n=6$) were excluded from the analyses. Descriptive statistics were used to summarize the demographic and clinical characteristics of the sample. Comparison of means was accomplished using independent sample t tests. Categorical variables were analyzed using the chi-square test and were reported as frequencies and percentages. Prehospital delay time was initially analyzed for conformity to the normal distribution assumptions using the Shapiro-Wilk test and a histogram. Because prehospital delay times were not normally distributed (positive skew), delay times are presented as medians and interquartile ranges (IQRs). Data were log-transformed for regression analyses. The nonparametric Mann-Whitney test was used to compare prehospital delay times between two groups of patients; those with abrupt symptom onset and those with gradual symptom onset. Bivariate regression analyses were initially conducted on prehospital delay time and each sociodemographic and clinical variable. In multiple regression analysis, all variables were entered into the regression model simultaneously. Linktest was used to test for model specification of independent variables after each regression model. The results indicated that the regression model specified variables correctly. The omnibus test, which tests the null hypothesis of no difference across groups,³⁵ conducted after predictors for more than two categories which were significant in the regression model was used to examine differences across the group. Chi-square tests were used to compare differences in activity at symptom onset in women and men. All statistical analyses were run with STATA statistical software (Version 14.2, Release12, StataCorp LP, College Station, Texas, USA). Significance was set at $p<0.05$ for all statistical tests.

Results

A total of 474 patients with ACS were included in the study. Demographic and clinical characteristics of patients are shown in Table 1. One hundred thirty-one women (27.65%) and 343 men (72.65%), ranging in age from 29–93 years (mean age 61.68 ± 11.94 years) were enrolled. Women were significantly older than men (64.72 years vs 60.52 years; $p < 0.001$).

Abrupt versus gradual symptom onset

Two hundred sixty-one patients (55.77%) reported abrupt symptom onset, and 207 (44.23%) experienced gradual symptom onset. Of note, 115 (24.57%) patients were diagnosed with STEMI. Of these, 65 (56.52%) experienced abrupt symptom onset, and 50 (43.48%) experienced gradual symptom onset. There were no significant differences in demographic and clinical characteristic between patients with ACS who reported an abrupt versus gradual symptom onset in this cohort (Table 2). Women in both the abrupt symptom onset and gradual symptom onset groups were significantly older than men (64.01 ± 13.22 vs 59.73 ± 11.52 , $p = 0.008$, and 66.08 ± 13.80 vs 61.39 ± 10.73 , $p = 0.013$ respectively; Table 3). In the gradual symptom onset group, men were more likely to have higher education levels than women ($p = 0.02$). For the abrupt symptom onset group, men were more likely to be current smokers compared to women ($p = 0.04$).

Prehospital delay in women and men

The median prehospital delay time for the entire sample was four hours; the IQR was 22.72 h. The median prehospital delay time was 3.47 h (IQR=22.7 h) for women and 4.09 h (IQR=23.7 h) for men ($p = 0.83$). Delay times were significantly shorter in both women and men who experienced abrupt symptom onset (2.57 h, IQR=19 h; 8 h, IQR=46.3; $p < 0.001$). For women who experienced abrupt symptom onset, the median prehospital delay time was 2.4 h (IQR=16 h); for those in the gradual symptom onset group, it was 11.7 h (IQR=45.6 h; $p = 0.023$). Similarly, there was a significant difference between median delay time in men with abrupt symptom onset (2.8 h, IQR=21.5h) compared to gradual symptom onset (7.17 h, IQR=46.65 h; $p < 0.001$). Differences between women and men were not significant (abrupt symptom onset 2.48 h, IQR=16 h vs 2.85 h, IQR=21.5 h, $p = 0.98$; gradual symptom onset 11.76 h, IQR=45.6 vs 7.17 h, IQR=46.5 h, respectively, $p = 0.68$).

Factors influencing prehospital delay time

Demographic, clinical, and symptom onset variables were examined to determine if there were associations with prehospital delay (Table 4). In bivariate analysis, there were no significant differences in prehospital delay time in association with demographic characteristics and clinical history. The final regression model accounted for 26.2% of the variance in delay time in patients with ACS. Not being insured ($\beta = 0.120$, $p = 0.031$) and a gradual symptom onset ($\beta = 0.138$, $p = 0.003$) were associated with longer prehospital delay times; a diagnosis of STEMI ($\beta = -0.205$, $p = 0.001$) and arrival by ambulance ($\beta = -0.317$, $p < 0.001$) were associated with shorter delay.

Activity at symptom onset

Patients with a STEMI diagnosis, who experienced an abrupt onset of symptoms, were more likely to report that symptoms began following exertion (50.79% vs 49.21%) than were those with an NSTEMI (31.06% vs 68.94%) or UA (39.22% vs 60.78%, $p=0.028$) diagnosis (Table 5). Patients with a gradual onset of symptoms were less likely to report that symptoms were triggered by exertion regardless of diagnosis. There was a relationship between the type of infarction and exertion in men but there was no such relationship for women. Among men with an abrupt onset of symptoms and a STEMI diagnosis, 54% reported symptoms preceded by exertion (Table 6). For women with a gradual onset of symptom, sleeping was the most common activity at symptom onset in those with STEMI and for men with a gradual onset of symptoms exertion was the most common activity at symptom onset in those with UA (Table 7).

Discussion

Prolonged prehospital delay time can postpone treatment and can result in poor outcomes for patients with ACS, a potentially life-threatening condition. We found that four variables were associated with prehospital delay. Gradual symptom onset and not having insurance were significantly related to longer prehospital delay time. A STEMI diagnosis and use of an ambulance were significantly related to shorter prehospital delay times. Other key findings were that median delay times for women (3.5 h) and men (4 h) were not significantly different. These delay times however, were still significantly longer than the American Heart Association (AHA) recommendation of <120 min.³⁶ Despite the implementation of specific public policies, these times have not changed in the last decade.³⁷ Importantly, delay times were significantly shorter for both women and men who experienced abrupt symptom onset. Finally, physical exertion was a significant symptom trigger.

There have been contradictory findings for differences in prehospital delay time between women and men. Some studies concluded that women had longer prehospital delay times,³⁸ whereas other studies found that there was no difference between women and men.³⁹ Bruins Slot et al. found that overall prehospital delay was similar in women and men suspected of ACS.² Nguyen et al., in a systematic review of the literature from 1960–2008, found that in the majority of studies, which included patients hospitalized with acute myocardial infarction (AMI), women were more likely to arrive at the hospital later than men.¹⁹ However, the authors included only patients with AMI; in the present study, we also included patients with UA. We also found that patients with STEMI (a true emergency) had shorter prehospital delay times. These patients require emergency reperfusion, and most fell outside the time for optimum intervention.⁴⁰

Our study revealed that patients with gradual symptom onset experienced a greater delay time compared to patients with abrupt symptom onset (8 h vs 2.57 h, $p<0.001$). Our finding is consistent with previous investigations. Prior studies demonstrated that patients who had abrupt and intense symptoms, which are almost immediately recognizable as a potential heart attack, go to the hospital quickly.¹⁵ Mild, diffuse, or vague symptoms that begin gradually are associated with prolonged prehospital delay because patients often attribute their symptoms to non-cardiac causes.⁴¹ Consistent with prior investigations, we found

patients who were not insured had prolonged prehospital delay times compared to patients with private and government insurance. Prior studies indicated that lack of health insurance was associated with delays in seeking emergency care for AMI.⁴² O'Donnell et al.⁴³ found that patients with private insurance were more likely to experience a shorter prehospital delay.

Patients with a STEMI diagnosis and patients who arrived to the ED by ambulance experienced shorter prehospital delay times. Perkins-Porras and colleagues also showed that patients who had STEMI rather than NSTEMI or UA were more likely to experience shorter prehospital delay times.⁴⁴ Similar to our findings, previous studies found that initial contact with EMS reduces prehospital delay time.^{44,45} Unfortunately, only 44.6% of patients in our study called EMS. In addition, EMS transport was used by only 56.3% of STEMI patients. Similar to our study, Mathews et al.⁴⁶ found that patients transported by EMS with STEMI had significantly shorter delays in symptom-onset to arrival time (median 89 min vs 120 min; $p < 0.0001$), compared with self-transported patients. Sixty percent of STEMI patients in the Mathews et al. study used an ambulance.⁴⁶

Finally, physical exertion was the only activity related to symptom onset in patients with ACS, and patients with STEMI were more likely to experience abrupt symptom onset with exertion compared to patients with UA and NSTEMI. Similarly, results from prior studies showed that physical exertion was associated with higher risk of myocardial infarction (MI).⁴⁷ Buckley et al. found that patients with exertion-triggered MI were at higher risk of presenting with an occluded than a non-occluded artery on hospital admission.⁴⁸ We also found that more men than women with STEMI in our sample had symptoms following physical exertion. This finding is consistent with a recent study that men were more likely to experience coronary occlusion with heavy exertion than were women (17% vs 5%). Exertion is known to be associated with rupture of vulnerable atherosclerotic plaques.⁴⁸ Our multi-center and heterogeneous sample of the patients allows for generalization of our findings to other cohorts of the American population.

Limitations

This study had limitations. Patients were asked, "When did symptoms responsible for this admission start?" Some patients could not recall accurately when their symptoms began and thus prehospital delay was abstracted from the medical record. Also, admission to the ED for ACS is stressful and makes recall arduous. Exertion-related cardiac events have been defined as symptoms that begin within 1 hour of physical exertion.⁴⁹ However, there is no general agreement regarding how long before symptom onset an activity can be regarded as a trigger.⁵⁰ Patients in our study were queried about whether they had single or multiple symptoms in the 48 h prior to admission.

Conclusion

Prehospital delay for symptoms of potential ACS remains excessive for women and men despite the identification of barriers to treatment, such as being insured or gradual onset of symptoms. Patients should be counseled that a gradual, as well as abrupt, onset of symptoms for potential ACS is an emergency and they should call 911. Men with ischemic heart

disease or with multiple risk factors should be cautioned that symptom onset following exertion may represent ACS. Patients should be cautioned that a gradual onset of symptoms may signify ACS and that they should seek immediate care.

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Implications for practice

- At-risk individual's and emergency department clinicians should be aware that abrupt onset of symptoms is associated with ST-elevation myocardial infarction and requires emergent reperfusion to preserve myocardium.
- Patients should be counselled that a gradual onset of symptoms for potential acute coronary syndrome (ACS) is an emergency and they should call 911.
- Men with ischemic heart disease or with multiple risk factors should be cautioned that the symptom onset following exertion may represent ACS.
- Prehospital delay for symptoms of potential ACS remains excessive for women and men and is associated with lack of insurance and gradual onset of symptoms.

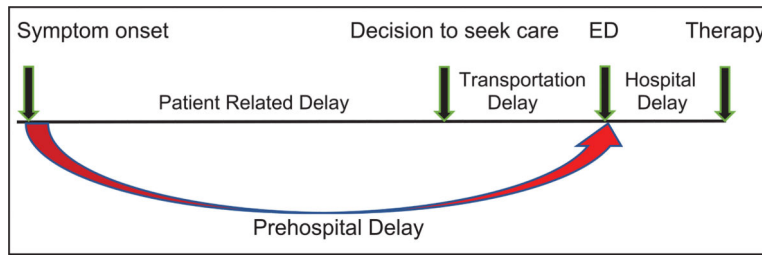


Figure 1. Phases of delay time in patients with acute coronary syndrome (ACS) before reperfusion therapy. ED: emergency department.

Table 1.

Demographic and clinical characteristics by sex (*n*=474).

Characteristics	Total (<i>n</i> =474)	Women (<i>n</i> =131, 27.65%)	Men (<i>n</i> =343, 72.65%)	<i>p</i> Value
Age, mean (SD)	61.68 (11.94)	64.72 (13.32)	60.52 (11.17)	<0.001
Race/ethnicity				0.532
White	325 (69.1)	87 (66.92)	238 (69.79)	
Black	56 (11.9)	20 (15.38)	36 (10.56)	
Hispanic	45 (9.5)	12 (9.23)	33 (9.68)	
Other	45 (9.5)	11 (8.46)	34 (9.97)	
Insurance				0.015
Private	195 (42.12)	56 (43.41)	139 (41.62)	
Govt./other	197 (42.55)	63 (48.84)	134 (40.12)	
Not insured	71 (15.33)	10 (7.75)	61 (18.26)	
Education				0.317
<High school diploma	60 (12.7)	23 (17.56)	37 (10.82)	
High school diploma	112 (23.6)	32 (24.43)	80 (23.39)	
Some college	154 (32.5)	41 (31.30)	113 (33.04)	
College degree/grad work	89 (18.8)	22 (16.79)	67 (19.59)	
Graduate degree	58 (12.2)	13 (9.92)	45 (13.16)	
Income, <i>n</i> (%)				0.874
<\$20,000	121 (25.5)	34 (25.95)	87 (25.36)	
\$20,000–\$49,999	139 (29.3)	39 (29.77)	100 (29.15)	
\$50,000–\$99,999	103 (22.0)	26 (19.85)	77 (22.45)	
≥\$100,000	56 (11.8)	14 (10.69)	42 (12.24)	
Missing	55 (11.6)	18 (13.74)	37 (10.79)	
Marital status, <i>n</i> (%)				0.526
Single/separated/divorced/widowed	202 (42.71)	59 (45.04)	143 (41.81)	
Married/committed relationship	271 (57.29)	72 (54.96)	199 (58.19)	
Recruitment site				0.345
Midwest	55 (11.6)	54 (41.22)	129 (37.61)	
Northwest I	85 (18.0)	16 (12.21)	39 (11.37)	

Characteristics	Total (n=474)	Women (n=131, 27.65%)	Men (n=343, 72.65%)	p Value
Northwest 2	46 (9.7)	22 (16.79)	63 (18.37)	
West	183 (38.6)	7 (5.34)	39 (11.37)	
Southwest	105 (22.2)	32 (24.43)	73 (21.28)	
Obese				0.193
Yes	184 (39.07)	45 (34.35)	139 (40.88)	
No	287 (60.93)	86 (65.65)	201 (59.12)	
Diagnosis				0.291
Unstable angina	105 (22.15)	31 (23.66)	74 (21.57)	
NSTEMI	251 (52.95)	74 (57.49)	177 (52.60)	
STEMI	118 (24.89)	24 (19.85)	92 (26.82)	
Diabetes				0.322
Yes	140 (29.98)	34 (26.56)	106 (31.27)	
No	327 (70.02)	94 (73.44)	233 (68.73)	
Hypertension				0.404
Yes	324 (68.79)	85 (65.89)	239 (69.88)	
No	147 (31.21)	41 (34.11)	103 (30.12)	
Family history heart disease/premature cardiac death				0.255
Yes	214 (46.52)	65 (51.78)	149 (44.88)	
No	246 (53.48)	63 (49.22)	183 (55.12)	
Current smoker				0.118
Yes	114 (24.05)	25 (19.08)	89 (25.95)	
No	360 (75.95)	106 (80.92)	254 (74.05)	
Mode of arrival to the ED				0.319
Self-transport	245 (52.02)	61 (46.92)	184 (53.96)	
Ambulance/paramedic	210 (44.59)	63 (48.46)	147 (43.11)	
Transfer from another facility	16 (3.40)	6 (4.62)	10 (2.93)	

ED: emergency department; Govt.: government; NSTEMI: non-ST elevation myocardial infarction; SD: standard deviation; STEMI: ST-elevation myocardial infarction. Statistically significant values are bolded.

Table 2.

Sample characteristics for abrupt and gradual onset of symptom groups (*n*=468).

Sample characteristics	Abrupt symptom onset (<i>n</i> =261; 55.77%)	Gradual symptom onset (<i>n</i> =207; 44.23%)	<i>p</i> Value
Age, mean (SD)	61.03 (12.19)	62.50 (11.67)	0.18
Race/ethnicity			0.363
White	173 (66.80)	147 (71.36)	
Black	36 (13.90)	19 (9.22)	
Hispanic	23 (8.88)	22 (10.68)	
Other	27 (10.42)	18 (8.74)	
Insurance			0.572
Private	113 (44.14)	79 (39.30)	
Govt./other	104 (40.63)	90 (44.78)	
Not insured	39 (15.23)	32 (15.92)	
Education			0.84
Less than high school diploma	31 (11.88)	29 (14.08)	
High school diploma	59 (22.61)	52 (25.24)	
Some college	90 (34.48)	63 (30.58)	
College degree/graduate work	48 (18.39)	38 (18.45)	
Graduate degree	33 (12.64)	24 (11.65)	
Income			0.127
<\$20,000	61 (26.18)	60 (28.99)	
\$20,000–\$50,000	78 (29.89)	59 (28.50)	
\$50,000–\$100,000	61 (23.37)	41 (19.81)	
\$100,000+	33 (12.64)	23 (11.11)	
Missing	28 (10.73)	24 (11.59)	
Marital status			0.515
Single/separated/Divorced/widowed	109 (41.92)	93 (44.93)	
Married/committed relationship	151 (58.08)	114 (55.07)	
Recruitment site			0.945
Midwest	104 (39.85)	78 (37.68)	
Northwest I	32 (12.26)	23 (11.11)	

Sample characteristics	Abrupt symptom onset (n=261; 55.77%)	Gradual symptom onset (n=207; 44.23%)	p Value
Northwest 2	46 (17.62)	37 (17.87)	
West	23 (8.81)	22 (10.63)	
Southwest	56 (21.46)	47 (22.71)	
Obese			0.68
Yes	100 (38.31)	82 (40.20)	
No	161 (61.69)	122 (59.80)	
Diagnosis			0.91
Unstable angina	55 (21.07)	47 (22.71)	
NSTEMI	141 (54.02)	110 (53.14)	
STEMI	65 (24.90)	50 (24.15)	
Diabetes			0.38
Yes	74 (28.35)	66 (32.04)	
No	187 (71.65)	140 (67.96)	
Hypertension			0.45
Yes	175 (67.83)	147 (71.01)	
No	83 (32.17)	60 (28.99)	
Family history heart disease/premature cardiac death			0.78
Yes	116 (46.03)	96 (47.29)	
No	136 (53.97)	107 (52.71)	
Current smoker			0.22
Yes	68 (26.05)	44 (21.26)	
No	193 (73.95)	163 (78.74)	
Mode of arrival to the ED			0.52
Self-transport	137 (52.69)	106 (51.71)	
Ambulance/paramedic	112 (43.08)	94 (45.85)	
Transfer from another facility	11 (4.23)	5 (2.44)	

ED: emergency department; Govt.: government; NSTEMI: non-ST elevation myocardial infarction; SD: standard deviation; STEMI: ST-elevation myocardial infarction. Statistically significant values are bolded.

Table 3.

Sample characteristics for abrupt and gradual symptom onset groups by sex ($n=468$).

Sample characteristics	Abrupt symptom onset ($n=261, 55.77\%$)		p Value	Gradual symptom onset (207, 44.23%)		p Value
	Women ($n=79, 61.72\%$)	Men ($n=182, 53.53\%$)		Women ($n=49, 38.28\%$)	Men ($n=158, 46.47\%$)	
Age (mean, SD)	64.01 (13.22)	59.73 (11.52)	0.008	66.08 (13.80)	61.39 (10.73)	0.013
Marital status						
Single/separated/divorced/widowed	31 (39.24)	78 (43.09)	0.56	28 (57.14)	65 (41.14)	0.051
Married/committed relationship	48 (60.76)	103 (56.91)	0.98	21 (42.86)	93 (58.86)	0.02
Education						
<High school Diploma	10 (12.66)	21 (11.54)		13 (26.53)	16 (10.19)	
High school diploma	16 (20.25)	43 (23.63)		15 (30.61)	37 (23.57)	
Some college	28 (35.44)	62 (34.07)		12 (24.49)	51 (32.48)	
College degree	15 (18.99)	33 (18.13)		6 (12.24)	32 (20.38)	
Graduate degree	10 (12.66)	23 (12.64)		3 (6.12)	21 (13.38)	
Insurance			0.084			0.112
Private	37 (74.44)	76 (42.70)		17 (35.42)	62 (40.52)	
Govt./other	35 (44.87)	69 (38.76)		27 (56.25)	63 (41.18)	
Not insured	6 (7.69)	33 (18.54)		4 (8.33)	28 (18.30)	
Income			0.94			0.50
<\$20,000	18 (22.78)	43 (23.62)		16 (32.65)	44 (27.85)	
\$20,000–\$50,000	23 (29.11)	55 (30.22)		14 (28.57)	45 (28.48)	
\$50,000–\$100,000	17 (21.52)	44 (24.18)		8 (16.33)	33 (20.89)	
\$100,000+	11 (13.92)	22 (12.09)		3 (6.33)	20 (12.66)	
Missing	10 (12.66)	18 (9.89)		8 (16.33)	16 (10.33)	
Obese			0.53			0.21
Yes	28 (35.44)	72 (39.56)		16 (32.65)	66 (42.58)	
No	51 (64.56)	110 (60.44)		33 (67.35)	89 (57.42)	
Diagnosis			0.32			0.51
Unstable angina	19 (24.05)	36 (19.78)		11 (22.45)	36 (22.78)	
NSTEMI	45 (56.96)	96 (52.75)		29 (59.18)	81 (51.27)	
STEMI	15 (18.99)	50 (27.47)		9 (18.37)	41 (25.95)	

Sample characteristics	Abrupt symptom onset (n=261, 55.77%)		p Value	Gradual symptom onset (207, 44.23%)		p Value
	Women (n=79, 61.72%)	Men (n=182, 53.53%)		Women (n=49, 38.28%)	Men (n=158, 46.47%)	
Diabetes			0.67			0.34
Yes	21 (26.58)	53 (29.12)		13 (26.53)	53 (33.76)	
No	58 (73.42)	129 (70.88)		36 (73.47)	104 (66.24)	
Hypertension			0.6			0.17
Yes	54 (70.13)	121 (66.85)		31 (63.27)	116 (73.42)	
No	23 (29.87)	60 (33.15)		18 (36.73)	42 (26.58)	
Family history heart disease/premature cardiac death			0.32			0.35
Yes	39 (50.65)	77 (44.00)		26 (53.06)	70 (45.45)	
No	38 (49.35)	98 (56.00)		23 (46.94)	84 (54.55)	
Current smoker			0.04			0.57
Yes	14 (17.72)	54 (29.67)		9 (18.37)	35 (22.15)	
No	65 (82.28)	128 (70.33)		40 (81.63)	123 (77.85)	
Mode of arrival to ED			0.23			0.93
Self-transport	36 (45.57)	101 (55.80)		24 (50)	82 (52.23)	
Ambulance/paramedic	38 (48.10)	74 (40.88)		23 (47.92)	71 (45.22)	
Transfer from another facility	5 (6.33)	6 (3.31)		1 (2.08)	4 (2.55)	

ED: emergency department; Govt.: government; NSTEMI: non-ST elevation myocardial infarction; SD: standard deviation; STEMI: ST-elevation myocardial infarction. Statistically significant values are bolded.

Table 4.

Factors influencing prehospital delay time ($n=429$).

Characteristics	n (%)	β	p Value
Age, mean (SD)	61.68 (11.94)	-0.004	0.942
Gender			
Female	131 (27.64)	0.041	0.387
Male	343 (72.36)		
Marital status			
Married/committed relationship	271 (57.29)	0.078	0.112
Single/separated/Divorced/widowed	202 (42.71)		
Insurance			
Private	195 (42.12)	0.003	0.955
Not insured	71 (15.33)	0.120	0.031
Govt./other	197 (42.55)		
Education			
High school diploma	112 (23.68)	0.115	0.100
Some college	154 (32.56)	0.142	0.058
College degree/ graduate work	89 (18.82)	0.034	0.618
Graduate degree	58 (12.26)	0.022	0.745
<High school diploma	60 (12.68)		
Income			
\$20,000-\$50,000	139 (33.17)	0.056	0.458
\$50,000-\$100,000	103 (24.58)	-0.005	0.940
\$100,000+	56 (13.37)	0.011	0.877
<\$20,000	121 (28.88)	-0.0008	0.991
Missing			
Diagnosis			
NSTEMI	251 (23.59)	-0.030	0.618
STEMI	118 (11.09)	-0.205	0.001
Unstable angina	105 (9.87)		
Obese			

Characteristics	n (%)	β	p Value
Yes	184 (39.07)	0.030	0.547
No	287 (60.93)		
Hypercholesterolemia			
Yes	292 (63.07)	0.064	0.189
No	171 (36.93)		
Diabetes			
Yes	142 (30.02)	0.012	0.793
No	331 (69.98)		
Hypertension			
Yes	324 (68.79)	0.070	0.167
No	147 (31.21)		
Family history heart disease/premature cardiac death			
Yes	214 (46.52)	0.081	0.091
No	246 (53.48)		
Current smoker			
Yes	114 (24.05)	-0.015	0.762
No	360 (75.95)		
Mode of arrival to the ED			
Ambulance/paramedic	210 (44.59)	-0.317	<0.001
Transfer from another facility	16 (3.40)	-0.082	0.084
Self-transport	245 (52.02)		
Onset of symptoms			
Gradual	207 (44.23)	0.138	0.003
Abrupt	261 (55.77)		

ED: emergency department; Govt.: government; NSTEMI: non-ST elevation myocardial infarction; SD: standard deviation; STEMI: ST-elevation myocardial infarction. Statistically significant values are bolded.

Table 5.

Activity at symptom onset by symptom onset group and diagnosis ($n=468$).

Activity at symptom onset	UA		Abrupt symptom onset ($n=261, 55.77\%$)		STEMI		p Value	Gradual symptom onset ($n=207, 44.23\%$)		STEMI	p Value
	UA	UA	NSTEMI	STEMI	NSTEMI	STEMI		NSTEMI	STEMI		
Rest							0.21				0.15
Yes	7 (15.91)	24 (22.64)	6 (11.54)	6 (11.54)	6 (15.00)	3 (8.33)		19 (22.62)	3 (8.33)		
No	37 (84.09)	82 (77.36)	46 (88.46)	46 (88.46)	34 (85.00)	33 (91.67)		65 (77.38)	33 (91.67)		
Sleep							0.63				0.18
Yes	7 (13.73)	26 (19.70)	11 (17.46)	11 (17.46)	2 (4.76)	7 (16.28)		8 (8.70)	7 (16.28)		
No	44 (86.27)	106 (80.30)	52 (82.54)	52 (82.54)	40 (95.24)	36 (83.72)		84 (91.30)	36 (83.72)		
Sitting							0.91				0.5
Yes	13 (25.49)	31 (23.48)	14 (22.22)	14 (22.22)	6 (14.29)	12 (27.91)		32 (34.78)	12 (27.91)		
No	38 (74.51)	101 (76.52)	49 (77.78)	49 (77.78)	36 (85.71)	31 (72.09)		60 (65.22)	31 (72.09)		
Exertion							0.028				0.001
Yes	20 (39.22)	41 (31.06)	32 (50.79)	32 (50.79)	27 (64.29)	20 (46.51)		28 (30.43)	20 (46.51)		
No	31 (60.78)	91 (68.94)	31 (49.21)	31 (49.21)	15 (35.71)	23 (53.49)		64 (69.57)	23 (53.49)		
Emotional stress							0.07				0.57
Yes	4 (7.84)	10 (7.58)	0 (0.0)	0 (0.0)	1 (2.38)	1 (2.33)		5 (5.43)	1 (2.33)		
No	47 (92.16)	122 (92.42)	63 (100)	63 (100)	41 (97.62)	42 (97.67)		87 (94.57)	42 (97.67)		

NSTEMI: non-ST elevation myocardial infarction; STEMI: ST-elevation myocardial infarction; UA: unstable angina. Statistically significant values are bolded.

Table 6.

Activity for *abrupt* symptom onset group by sex and diagnosis (*n*=246).

Activity at symptom onset	UA	Women (<i>n</i> =76)		<i>p</i> Value	UA	Men (<i>n</i> =170)		<i>p</i> Value
		NSTEMI	STEMI			NSTEMI	STEMI	
Rest				0.53				0.21
Yes	0 (0.00)	10 (29.41)	2 (20.00)		7 (25.00)	14 (19.44)	4 (9.52)	
No	16 (100)	24 (70.59)	8 (80.00)		21 (75.00)	58 (80.56)	38 (90.48)	
Sleep				0.15				0.68
Yes	1 (5.88)	10 (22.73)	5 (33.33)		6 (17.65)	16 (18.18)	6 (12.50)	
No	16 (94.12)	34 (77.27)	10 (66.67)		28 (82.35)	72 (81.82)	42 (87.50)	
Sitting				0.24				0.81
Yes	6 (35.29)	8 (18.18)	2 (13.33)		7 (20.59)	23 (26.14)	12 (25.00)	
No	11 (64.71)	36 (81.82)	13 (86.67)		27 (79.41)	65 (73.86)	36 (75.00)	
Exertion				0.30				0.046
Yes	8 (47.06)	12 (27.27)	6 (40.00)		12 (35.29)	29 (32.95)	26 (54.17)	
No	9 (52.94)	32 (72.73)	9 (60.00)		22 (64.71)	59 (76.05)	22 (45.83)	
Emotional stress				0.42				0.187
Yes	2 (11.76)	4 (9.09)	0 (0.00)		2 (5.88)	6 (6.82)	0 (0.00)	
No	15 (88.24)	40 (90.91)	15 (100.)		32 (94.12)	82 (93.18)	48 (100)	

NSTEMI: non-ST elevation myocardial infarction; STEMI: ST-elevation myocardial infarction; UA: unstable angina.

Statistically significant values are bolded.

Table 7.

Activity for *gradual* symptom onset group by sex and diagnosis (*n*=177).

Activity at symptom onset	UA	Women (<i>n</i> =43)		<i>p</i> Value	UA	Men (<i>n</i> =134)		<i>p</i> Value
		NSTEMI	STEMI			NSTEMI	STEMI	
Rest				0.18				0.084
Yes	0 (0.00)	7 (26.92)	2 (40.00)		6 (18.75)	12 (20.69)	1 (3.23)	
No	8 (100)	19 (73.08)	3 (60.00)		26 (81.25)	46 (79.31)	30 (96.77)	
Sleep				0.006				0.32
Yes	1 (11.11)	0 (0.00)	3 (37.50)		1 (3.03)	8 (12.12)	4 (11.43)	
No	8 (88.89)	26 (100.0)	5 (62.50)		32 (96.97)	58 (87.88)	31 (88.57)	
Sitting				0.22				0.089
Yes	2 (22.22)	11 (42.31)	1 (12.50)		4 (12.12)	21 (31.82)	11 (31.43)	
No	7 (77.78)	15 (57.69)	7 (87.50)		29 (87.88)	45 (68.18)	24 (68.57)	
Exertion				0.079				0.007
Yes	6 (66.67)	7 (26.92)	2 (25.00)		21 (63.64)	21 (31.82)	18 (51.43)	
No	3 (33.33)	19 (73.08)	6 (75.00)		12 (36.36)	45 (68.18)	17 (48.57)	
Emotional stress				0.716				0.68
Yes	0 (0.00)	1 (3.85)	0 (0.00)		1 (3.03)	4 (6.06)	1 (2.86)	
No	9 (100)	25 (96.15)	8 (100)		32 (96.97)	62 (93.94)	34 (97.14)	

NSTEMI: non-ST elevation myocardial infarction; STEMI: ST-elevation myocardial infarction; UA: unstable angina.

Statistically significant values are bolded.