**Factors associated with emergency services use by patients with recurrent myocardial infarction. From the MONICA/KORA Myocardial Infarction Registry.**

Inge Kirchberger, PhDa,b, Ute Amann, PhDa,b, Margit Heier, MDa,b, Christian Thilo, MDc, Annette Peters, PhDb, Christa Meisinger, MDa,b

a Central Hospital of Augsburg, MONICA/KORA Myocardial Infarction Registry, Augsburg, Germany

b Helmholtz Zentrum München, German Research Center for Environmental Health (GmbH), Institute of Epidemiology II, Neuherberg, Germany

c CentralHospital of Augsburg, Department of Internal Medicine I – Cardiology, Augsburg, Germany

**Corresponding author:**

Dr. Inge Kirchberger

MONICA/KORA Myocardial Infarction Registry

Central Hospital of Augsburg

Stenglinstr. 2

D-86156 Augsburg, Germany

Phone: +49-821-400 4176

Fax: +49-821-400 2838

eMail Inge.Kirchberger@helmholtz-muenchen.de

**Acknowledgements**

The KORA research platform and the MONICA Augsburg studies were initiated and financed by the Helmholtz Zentrum München, German Research Center for Environmental Health, which is funded by the German Federal Ministry of Education, Science, Research and Technology and by the State of Bavaria. Since the year 2000 the myocardial infarction data collection is co-financed by the German Federal Ministry of Health to provide population-based myocardial infarction morbidity data for the official German Health Report (see [www.gbe-bund.de](http://www.gbe-bund.de)). Steering partners of the MONICA/KORA Infarction Registry, Augsburg, are the KORA research platform, Helmholtz Zentrum München and the I. Medizinische Klinik, Herzzentrum Augsburg-Schwaben, Klinikum Augsburg.

We thank all members of the Helmholtz Zentrum München, Institute of Epidemiology II and the field staff in Augsburg who were involved in the planning and conduct of the study. We wish to thank the local health departments and the private physicians of the study area as well as the clinicians of the involved hospitals for their support. Finally, we express our appreciation to all study participants.

**ABSTRACT**

**Background**

Although emergency medical services (EMS) use is the recommended mode of transport in case of acute coronary symptoms, many people fail to use this service.

**Objective**

 The objective of this study was to determine factors associated with EMS use in a population-based sample of German patients with recurrent acute myocardial infarction (AMI).

**Methods**

The sample consisted of 998 persons with a first and recurrent acute myocardial infarction, recruited 1985-2011. Logistic regression modelling adjusted for sociodemographic, situational, and clinical variables, prior diseases, and presenting AMI symptoms was applied.

**Results**

EMS was used by 48.8% of the patients at first, and 62.6% at recurrent AMI, respectively. In first AMI, higher age, history of hyperlipidaemia, ST-segment elevation AMI (STEMI), >4 presenting symptoms, symptom onset in daytime, and later year of AMI were significantly related with EMS use.Pain in the upper abdomen and pain between the shoulder blades were significantly less common in EMS users. In recurrent AMI, EMS use at first AMI, presence of any other symptom except chest pain, STEMI, and later year of AMI were significantly related with EMS use. Significant predictors of EMS use in recurrent AMI in patients who failed to use EMS at first AMI were: unmarried, experience of any symptom except chest symptoms at reinfarction, bundle branch block (first AMI), any in-hospital complication (first AMI), longer duration between first and recurrent AMI, and later year of reinfarction.

**Conclusions**

Patients with AMI and their significant others may profit by education about the benefits of EMS use.

**Keywords:** myocardial infarction; emergency medical services; reinfarction; **BACKGROUND**

Early diagnosis and timely administration of reperfusion treatment can significantly improve survival and morbidity in patients with acute myocardial infarction (AMI), particularly in persons with ST-segment elevation myocardial infarction (STEMI).1-3 In order to minimize treatment delays, patients with unresolved acute coronary symptoms are advised to call an ambulance immediately.

The use of emergency medical services (EMS) reduces pre-hospital and in-hospital delay times by fast transportation to an interventional centre, effective preparation of hospital admission and access to reperfusion therapy.4-9 Moreover, EMS provide emergency medication and defibrillation and may therefore improve survival.10 However, previous studies have shown that individuals often are reluctant to use EMS.11-13 Studies consistently reported that only approximately one half of the patients with AMI used ambulance transport.5,14-19

In the German emergency system, people shall contact the rescue coordination center by telephone and describe their symptoms. Based on the provided information, the rescue coordination center staff decides whether an ambulance with paramedic staff will be dispatched or whether the ambulance will be accompanied by an emergency physician. Generally, if people report suspected AMI symptoms, an ambulance with emergency physician will be sent. However, a certain amount of persons experiencing AMI symptoms, visit their general practitioners first, and were subsequently transferred to hospital by a physician-guided ambulance transport.6

Several studies have determined predictors of EMS use and found that demographic factors, AMI type, risk factors and comorbidities, situational factors (e.g. symptom onset on the weekend, place of AMI event, distance to hospital), and presenting symptoms are related with EMS use.5,14- 24 However, the results are inconsistent and vary considerably depending on study type, sample size, covariables, and country of origin. For instance, patients with recurrent AMI were found to be significantly more likely to use EMS than persons with first AMI in some trials5,9,18, but not in a number of other studies.14,16,17,20,21,25 No previous study has determined predictors of EMS use in patients with reinfarction taking into account characteristics of the first infarction. So far it is unknown, why patients with reinfarction refrain from calling EMS, in spite of their experiences from the first infarction.

**OBJECTIVE**

The objective of this study was to examine EMS use in a population-based sample of patients with recurrent infarction from the German MONICA/KORA Myocardial Infarction Registry. Specific aims are to determine sociodemographic (i.e. age, sex, marital status, education, migration background), clinical (i.e. risk factors, prior diseases, presenting symptoms, AMI type, AMI treatment) and situational factors (i.e. time and place of AMI event) associated with EMS use in the first and the recurrent infarction taking into account the characteristics of the first infarction, and to identify factors associated with EMS use at reinfarction in patients who failed to use EMS at first AMI.

**METHODS**

This study is based on data from the population-based Augsburg Myocardial Infarction Registry which was implemented in 1984 as part of the WHO-MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) project.After the termination of MONICA in 1995, the registry became part of the framework of KORA (Cooperative Health Research in the Region of Augsburg). Since 1984, all cases of coronary deaths and non-fatal AMI of the 25-74 year old study population in the city of Augsburg and the two adjacent counties (about 600,000 inhabitants) have been continuously registered. Data sources for hospitalized patients include 8 hospitals within the study region and 2 hospitals in the adjacent areas. Methods of case finding, diagnostic classification of events, and data quality control have been described elsewhere.26,27

**Sample**

In the present analysis, registered patients who had a first and a recurrent AMI between 1 January 1985 and 31 December 2011 and survived longer than 24 hours were included. From 1,285 persons, we excluded 118 persons who had first and/or recurrent AMI in the hospital, 21 persons with mode of admission other than EMS use, self-admission or referral by practice-based physician and 178 individuals with missing information on mode of admission for first and/or recurrent infarction. Finally, the present analyses comprised 998 persons (766 males and 232 females) with recurrent infarction aged 25 to 74 years at the time of first AMI.

**Data collection**

Data were collected by personal interview and/or chart review. Information on EMS use (ambulance transportation accompanied by emergency physician versus other modes of transportation) was extracted from the medical records. In addition, the following potential confounding variables were extracted: AMI type (STEMI, non-ST-segment elevation myocardial infarction (NSTEMI), bundle branch block), revascularization therapy (thrombolysis, percutaneous coronary intervention, coronary artery bypass surgery), number of days at the intensive care unit and total number of days in hospital. Body mass index (BMI) was determined by assessment of height and weight during the hospital stay. Obesity (yes/no) was defined as BMI ≥30 kg/m2. A summary variable was built indicating the presence of any of the following in-hospital complications: pulmonary oedema, cardiac arrest, cardiogenic shock, ventricular tachycardia and bradycardia.

Interviews were performed by trained study nurses using a standardized questionnaire after the patients have been transferred from the intensive care unit. The patients were asked for two situational factors, namely the place/location when AMI symptoms came up (at home, at work, at the nursing home, at hospital, at a different place) and for the exact time of symptom onset. Variables were created classifying symptom onset into “day (6 am - 5 pm), night (6 pm - 5 am), unknown” and “workdays or weekend” and place of AMI event into “at home or not at home”. The initial question about AMI symptoms was related to the presence of chest pain, or feelings of pressure or tightness. Subsequently, the patients were asked whether they have experienced any other symptoms and complaints. If they agreed, they were queried on the occurrence of ten additional symptoms. For each symptom, a mismatch was defined if a symptom occurred at the first AMI but did not reappear at the second AMI or if a symptom was not present at the first AMI but was reported at the second AMI. A summary variable reflects the amount of mismatching symptoms across all 11 symptoms. Patients were asked whether they are married (yes/no), currently live alone (yes/no), they have ever smoked or have stopped smoking (current smoker/ex-smoker/never smoked) and whether they were diagnosed as having high blood pressure, high blood lipids or blood glucose prior to the AMI event. Self-reported history of angina pectoris, hypertension, hyperlipidaemia or diabetes (yes/no) was only considered if the chart review confirmed these diseases. Moreover, patients were asked for their nationality and whether both parents were Germans. In case the patient or any parent did not have German nationality, a migration background (yes/no) was noted. Education was requested using four different response options reflecting the national educational system. The variable was dichotomized into lower level (9 years of school education) and higher level school education (more than 9 years).

The study was approved by the Ethics Committee of the Bavarian Medical Association. All participants gave written informed consent before being enrolled in the study.

**Data analysis**

The relationship between EMS use and potential associated variables (all variables displayed in Table 1 (first AMI) and Table 2 (recurrent AMI) was examined using multivariate logistic regression modelling with backward variable elimination. Two separate models were established for the dependent variable EMS use (yes/no) at first infarction and at recurrent infarction. The third model examined EMS use (yes/no) at recurrent infarction in a subgroup of patients (n=511), who did not use EMS at first infarction. In all models, an association p<0.20 of independent variables with EMS use in the bivariate analysis was used as the criterion for entry in the multivariate model. The significance levels of the bivariate analyses were not corrected for multiple comparisons. In addition, the interaction of age and sex was entered into the model. The final models only include variables which significantly (p<0.05) contribute to the model. Age and sex were forced to stay in the models. Multicollinearity among the independent variables was examined by assessing Variance Inflation Factors (VIF) in the full models.28

**RESULTS**

The sample consisted of 998 patients (76.8% men) with a mean age of 57.8 years at first and 63.5 years at second infarction, respectively. Further characteristics of the sample are displayed in Table 1 and 2.

EMS was used by 48.8% of the patients at first AMI and 62.6% at recurrent AMI, respectively. Most of the patients (73.1%) who used EMS at first infarction repeated their behavior at recurrent infarction. From those who have not used EMS transportation at first infarction (51.2%, n=511), 52.6% used EMS transportation at the recurrent AMI.

 In general, the frequency of EMS use was clearly associated with the year of AMI onset. In the years 1985-1994 30.9% used EMS, whereas in 1995-2004 this number increased to 66.4%, and in 2005-2011 55.2% of the patients have used EMS for their first AMI.

**Factors associated with EMS use in first AMI**

The parsimonious, multivariable logistic model showed that older patients were significantly more likely to use EMS than younger ones, as were patients with a history of hyperlipidaemia, with STEMI compared with NSTEMI, with >4 presenting symptoms, symptom onset in daytime, and later year of AMI (in relation to the study period from 1985 to 2008) (see Table 3). In contrast, the presence of pain in the upper abdomen, pain between the shoulder blades, or unknown symptom onset was significantly less common in EMS users in the multivariable regression model.

**Factors associated with EMS use in recurrent AMI**

In the multivariable logistic regression model, EMS use at first AMI was the most important predictor (Odds ratio (OR) 2.13, 95% confidence interval (CI) 1.61–2.81, p<0.0001) of EMS use at recurrent infarction (see Table 4). In addition, the presence of any other symptom except chest symptoms, STEMI and later year of AMI were significantly related with EMS use in recurrent infarction.

Among those patients, who did not use EMS at first infarction (n=511), the experience of any symptom at recurrent AMI except chest symptoms emerged as the most important predictor of EMS use (OR 3.60, 95% CI 1.62 – 8.00, p=0.0017) in the multivariable logistic regression model (see Table 4). Furthermore, unmarried patients, patients with bundle branch block or any in-hospital complications at first infarction were significantly more likely to use EMS in recurrent infarction. Finally, a longer duration between first and recurrent AMI was associated with a greater likelihood to use EMS.

No significant interaction effects were found in the logistic regression analyses. VIF were below 2.5 indicating no relevant multicollinearity among the covariables.28

**DISCUSSION**

In our study sample consisting of 998 patients with reinfarction, we demonstrated that EMS use was significantly more common in recurrent AMI than in first AMI. EMS use has risen considerably between 1985 and 2011. This finding is consistent with data from the USA.8 Irrespective of the year of AMI onset, we detected a number of factors which were independently associated with EMS use.

In terms of sociodemographic factors, several previous studies on predictors of EMS use have reported that elderly patients used EMS significantly more often than the younger.5,16,18,20,25 In contrast, other studies did not find any relation between EMS use and age.9,17,21,22 In our study, we showed that age was independently associated with EMS use in first AMI, but not in recurrent infarction. Young persons may have a reduced awareness of being at risk of an AMI and a limited knowledge of AMI symptoms which both can lead to a lower likelihood of EMS use at first infarction. When having a reinfarction, however, the younger patients are aware of their risk and are more able to correctly interpret the experienced symptoms.

Moreover, we failed to confirm the results from some other studies that women5,18,20,25 or men17 are more likely to call EMS.

Situational factors, such as the time of symptom onset (daytime/night, workdays/weekend) or the place (at home/not at home) did not emerge as notably relevant factors associated with EMS use in the present study. Only at first infarction, patients with symptom onset in daytime had a two-fold likelihood to use EMS transportation compared with patients with symptom onset at night. Similar results were reported by Goldberg et al.20 and Mathews et al.18 for large samples of AMI patients in the USA. Contrary to our results, Kerr et al.14 found that EMS use was more common in 105 Australian AMI patients with symptom onset at home compared with other locations.

Patients with STEMI were significantly more likely of being transported by EMS compared with patients with NSTEMI in all studies that considered AMI type in mixed samples16,20,22, as well as in the present study.

In concordance with previous studies, our results support the role of AMI symptoms in the process of deciding to seek help. Previous studies reported that patients with a sudden onset of symptoms/pain16,17, continuous symptoms17, unbearable symptoms22 and patients who attributed their symptoms to the heart17 had a greater likelihood to call EMS. Specifically chest pain14,20, nausea16,22, cold sweat16, vertigo/dizziness16,17, and near syncope16 were associated with more common EMS use, whereas abdominal pain9,19, cramping pain22 and arm/shoulder pain19 were less common in EMS users.

The results from the present study showed that EMS users with first AMI had a significantly higher number of symptoms than non-users and the occurrence of abdominal pain and pain between the shoulder blades was related with a lower likelihood to use EMS. In reinfarction, the presence of any other symptoms except chest symptoms was the second strongest factor predicting EMS use and the strongest predictor in the model restricted to patients who did not use EMS at first AMI. These results highlight the relevance of symptoms which occur in addition to chest pain. One may hypothesize that specifically in patients who experience only mild chest pain, accompanying symptoms such as dyspnea or diaphoresis are decisive factors for calling EMS.

 Since previous studies found a considerable mismatch between the symptom scope of first and recurrent infarction29 and rose the question whether symptom mismatch may have an influence on the decision to seek help12, we included the number of mismatching symptoms in our analyses. However, it failed to show a significant independent effect on EMS use.

The role of AMI risk factors such as diabetes, hypertension and hyperlipidemia prior to first AMI in the decision process to call EMS is not clear so far. It has been discussed that the presence of risk factors might be associated with more awareness of being at risk of an AMI and better knowledge of possible AMI symptoms, which may increase EMS use11. However, the results of available studies are conflicting.14,16,18-22 In our study, only hyperlipidemia emerged as a factor related to a significantly higher likelihood of EMS use in first AMI. This finding confirms the results from Mathews et al.18, but is in contrast to Scherer et al.21 and Kerr et al.14

An interesting objective of the present study pertains to the question whether patients who did not use EMS in first AMI have learned from their experiences resulting in EMS use in reinfarction. Despite a significant increase of the proportion of EMS users at reinfarction, our results showed that only one half of the patients positively changed their behavior. Our findings suggest that their behavior change may be driven by an overall more severe first AMI, as indicated by the 1.7-fold likelihood of patients which had an in-hospital complication at the first AMI to call EMS compared with their counterparts. Interestingly, married individuals were less likely to positively change their help seeking behavior. This finding may reflect the fact that cohabiting patients have more transport options.23 Both results may have implications for post-AMI patient education. The benefits of EMS transport should be explained to all patients, particularly to patients with uncomplicated first AMI. Moreover, it seems essential to include the patients’ significant others since studies have indicated that often the decision to call EMS was made by family or friends.17,30

To our knowledge, this is the first study which explores factors associated with EMS use in the same patients with first and recurrent AMI based on a population-based sample. The strengths of this study are the large sample of patients consecutively hospitalized with validated first and second AMI, the inclusion of patients in a defined area and according to defined criteria, the comprehensive collection of data on socio-demographic characteristics, risk factors, prior diseases, in-hospital treatment, and the standardized patient-reported assessment of symptoms soon after the AMI during 26 years. A wide range of possible covariables have been analysed; some of them (e.g. symptom mismatch) have not yet been considered in previous studies.

Limitations of the study include the restriction to patients younger than 75 years at the first AMI. Patients who died within 24 hours after admission or before the interview could not be included. Since patients who had a STEMI at first or reinfarction are commonly more likely to die within the first day after the AMI event, they might have been more likely to be excluded than patients with NSTEMI. Between 1985 and 2011, definition and treatment of AMI changed considerably and we cannot exclude that these circumstances have affected the results of our study in any way, despite the adjustment for the event year in the statistical analyses. Furthermore, we do not know the number of patients who visited their general practitioner first and then used EMS transportation to hospital. The assessment of symptoms did not include information about the severity and quality of symptoms, the distress associated with them, and the chief symptom if more than one symptom occurred. Finally, although a number of factors were investigated, we were not able to consider the geographic distance to the hospital, which may also affect the decision to call EMS.

**CONCLUSIONS**

In conclusion, our study has demonstrated that the experience of typical or atypical symptoms may considerably influence the decision to use EMS in first and recurrent infarction. Patients who initially used EMS transportation were likely to choose this option again at the recurrent infarction. Those who failed at both times may have had a less severe first AMI and may have relied on the unfavourable advice given by their spouses. These findings give rise to concern about the patients’ and spouses’ lack of knowledge of the symptoms associated with an AMI and the benefits of EMS use. The study results can be beneficial for clinicians and nurses involved in post-AMI care as well as individuals with AMI. It is essential that patients post-AMI and their significant others repeatedly receive individualized information about the potential benefits of EMS use if symptoms are arising once again. Since EMS use can reduce prehospital death and speed up early access to recanalization treatment, the benefit for the patients may be significant.

**REFERENCES**

1. Steg PG, James SK, Atar D, et al. [ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation.](http://www.ncbi.nlm.nih.gov/pubmed/22922416) *Eur Heart J* 2012; 33: 2569-2619.

2. Nallamothu B, Fox KA, Kennelly BM, et al. Relationship of treatment delays and mortality in patients undergoing fibrinolysis and primary percutaneous coronary intervention. The Global Registry of Acute Coronary Events. *Heart* 2007; 93: 1552-1555.

3. Postma S, Dambrink JH, Gosselink AT, et al. The influence of system delay on 30-day and onlong-term mortality in patients with anterior versus non-anterior ST-segment elevation myocardial infarction: a cohort study. *Open Heart* 2015 Apr10;2(1):e000201.

4. Postma S, Dambrink JH, de Boer MJ, et al. Prehospital triage in the ambulance reduces infarct size and improves clinical outcome. *Am Heart J* 2011; 161: 276-282.

5. Canto JG, Zalenski RJ, Ornato JP, et al. Use of emergency medical services in acute myocardial infarction and subsequent quality of care: observations from the National Registry of Myocardial Infarction 2. *Circulation* 2002; 106: 3018-3023.

6. Thilo C, Blüthgen A and von Scheidt W. Efficacy and limitations of a STEMI network: 3 years of experience within the myocardial infarction network of the region of Augsburg - HERA. *Clin Res Cardiol* 2013; 102: 905-914.

7. [Choi SW](http://www.ncbi.nlm.nih.gov/pubmed/?term=Choi%20SW%5BAuthor%5D&cauthor=true&cauthor_uid=26727340), [Shin SD](http://www.ncbi.nlm.nih.gov/pubmed/?term=Shin%20SD%5BAuthor%5D&cauthor=true&cauthor_uid=26727340), [Ro YS](http://www.ncbi.nlm.nih.gov/pubmed/?term=Ro%20YS%5BAuthor%5D&cauthor=true&cauthor_uid=26727340), et al. Effect of Emergency Medical Service Use and Inter-hospital Transfer on Time to Percutaneous Coronary Intervention in Patients with ST Elevation Myocardial Infarction: A Multicenter Observational Study. [*Prehosp Emerg Care*](http://www.ncbi.nlm.nih.gov/pubmed/26727340)2016; 20: 66-75.

8. [Fujii T](http://www.ncbi.nlm.nih.gov/pubmed/?term=Fujii%20T%5BAuthor%5D&cauthor=true&cauthor_uid=24397992), [Masuda N](http://www.ncbi.nlm.nih.gov/pubmed/?term=Masuda%20N%5BAuthor%5D&cauthor=true&cauthor_uid=24397992), [Suzuki T](http://www.ncbi.nlm.nih.gov/pubmed/?term=Suzuki%20T%5BAuthor%5D&cauthor=true&cauthor_uid=24397992), et al. Impact of transport pathways on the time from symptom onset of ST-segment elevation myocardial infarction to door of coronary intervention facility. [*J Cardiol*](http://www.ncbi.nlm.nih.gov/pubmed/24397992)2014; 64: 11-8.

9. Thylén I, Ericsson M, Hellström Ängerud K, et al. First medical contact in patients with STEMI and its impact on time to diagnosis; an explorative cross-sectional study. *BMJ Open* 2015; 5: e007059.

10. Tubaro M, Danchin N, Goldstein P, et al. Pre-hospital treatment of STEMI patients. A scientific statement of the Working Group Acute Cardiac Care of the European Society of Cardiology. *Acute Card Care* 2011; 13: 56-67.

11. Lozzi L, Carstensen S, Rasmussen H, et al. Why do acute myocardial infarction patients not call an ambulance? An interview with patients presenting to hospital with acute myocardial infarction symptoms. *Intern Med J* 2005; 35: 668-671.

12. Pattenden J, Watt I, Lewin RJ, et al. [Decision making processes in people with symptoms of acute myocardial infarction: qualitative study.](http://www.ncbi.nlm.nih.gov/pubmed/11976241) *BMJ* 2002; 324: 1006-1009.

13. [Thuresson M](http://www.ncbi.nlm.nih.gov/pubmed/?term=Thuresson%20M%5BAuthor%5D&cauthor=true&cauthor_uid=18005801), [Jarlöv MB](http://www.ncbi.nlm.nih.gov/pubmed/?term=Jarl%C3%B6v%20MB%5BAuthor%5D&cauthor=true&cauthor_uid=18005801), [Lindahl B](http://www.ncbi.nlm.nih.gov/pubmed/?term=Lindahl%20B%5BAuthor%5D&cauthor=true&cauthor_uid=18005801), et al. Thoughts, actions, and factors associated with prehospital delay in patients with acute coronary syndrome. [*Heart Lung*](http://www.ncbi.nlm.nih.gov/pubmed/18005801) 2007; 36: 398-409.

14. Kerr D, Holden D, Smith J, et al. Predictors of ambulance use in patients with acute myocardial infarction in Australia. *Emerg Med J* 2006; 23: 948-952.

15. Boothroyd LJ, Lambert LJ, Segal E, et al. Comparison of outcomes of ambulance users and nonusers in ST elevation myocardial infarction. *Am J Cardiol* 2014; 114: 1289-1294.

16. Thuresson M, Jarlöv MB, Lindahl B, et al. Factors that influence the use of ambulance in acute coronary syndrome. *Am Heart J* 2008; 156: 170-176.

17. Mooney M, O'Brien F, McKee G, et al. Ambulance use in acute coronary syndrome in Ireland: a cross-sectional study. *Eur J Cardiovasc Nurs* 2015 Mar 24. pii: 1474515115579134. [Epub ahead of print]

18. Mathews R, Peterson ED, Li S, et al. Use of emergency medical service transport among patients with ST-segment-elevation myocardial infarction: findings from the National Cardiovascular Data Registry Acute Coronary Treatment Intervention Outcomes Network Registry-Get With The Guidelines. *Circulation* 2011; 124: 154-163.

19. Tataris K, Kivlehan S, and Govindarajan P. National trends in the utilization of emergency medical services for acute myocardial infarction and stroke. *West J Emerg Med* 2014; 15: 744-748.

20. Goldberg RJ, Lamusta J, Darling C, et al. Community trends in the use and characteristics of persons with acute myocardial infarction who are transported by emergency medical services. *Heart Lung* 2012; 41: 323-331.

21. Scherer TM, Russ S, Jenkins CA, et al. Predictors of ambulance transport in patients with ST-elevation myocardial infarction. *Prehosp Disaster Med* 2012; 27: 226-230.

22. Johansson I, Strömberg A, and Swahn E. Ambulance use in patients with acute myocardial infarction. *J Cardiovasc Nurs* 2004; 19: 5-12.

23. Brown AL, Mann NC, Daya M, et al. Demographic, belief, and situational factors influencing the decision to utilize emergency medical services among chest pain patients. Rapid Early Action for Coronary Treatment (REACT) study. *Circulation* 2000; 102: 173-178.

24. McGinn AP, Rosamond WD, Goff DC Jr, et al. Trends in prehospital delay time and use of emergency medical services for acute myocardial infarction: experience in 4 US communities from 1987-2000. *Am Heart J* 2005; 150(3): 392-400.

24. Demirkan B, Ege MR, Doğan P, et al. Factors influencing the use of ambulance among patients with acute coronary syndrome: results of two centers in Turkey. *Anadolu Kardiyol Derg* 2013; 13: 516-522.

26. Meisinger C, Hörmann A, Heier M, et al. Admission blood glucose and adverse outcomes in non-diabetic patients with myocardial infarction in the reperfusion era. *Int J Cardiol* 2006; 113: 229–235.

27. Kuch B, Heier M, von Scheidt W, et al. 20-year-trends in clinical characteristics, therapy and short-term prognosis in acute myocardial infarction according to presenting electrocardiogram – results of the MONICA/KORA Augsburg Myocardial Infarction Registry (1985–2004). *Am J Cardiol* 2007; 100: 1056–1060.

28. Allison PD: When Can You Safely Ignore Multicollinearity? [accessed February, 2015] Available at: http://www.statisticalhorizons.com/multicollinearity.

29. Kirchberger I, Heier M, Golüke H, et al. Mismatch of presenting symptoms at first and recurrent acute myocardial infarction. From the MONICA/KORA Myocardial Infarction Registry. *Eur J Prev Cardiol* 2015 May 20. pii: 2047487315588071. [Epub ahead of print]

30. Ingarfield SL, Jacobs IG, Jelinek GA, et al. Patient delay and use of ambulance by patients with chest pain. *Emerg Med Australas* 2005; 17: 218-223.

**What’s new?**

* The experience of typical or atypical symptoms considerably influences the decision to use EMS in first and recurrent infarction.
* Symptoms which occur in addition to typical chest pain seem to intensify the need to use EMS.
* Patients who initially used EMS transportation were likely to choose this option again at the recurrent infarction.
* Those who failed at both times may have had a less severe first AMI and may have relied on the unfavourable advice given by their spouses. These findings highlight the need for continuous education of patients and significant others on AMI symptoms and the benefits of EMS use.

Table 1: Sample characteristics stratified by emergency services (EMS) use at first acute myocardial infarction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable |  | n | EMS use (n=487)n (%) | No EMS use (n=511)n (%) | p-value |
| **Sociodemographic characteristics** |
| Sex | Men | 766 | 374 (76.80) | 392 (76.71) | 0.9748 |
|  | Women | 232 | 113 (23.20) | 119 (23.29) |  |
| Age (years) | <55 | 348 | 159 (32.65) | 189 (36.99) | 0.0326 |
|  | 55-64 | 378 | 177 (36.34) | 201 (39.33) |  |
|  | ≥65 | 272 | 151 (31.01) | 121 (23.68) |  |
| Married |  | 749 | 366 (75.15) | 382 (74.76) | 0.7772 |
| Living alone  |  | 123 | 63 (12.94) | 60 (11.74) | 0.6142 |
| Education | ≤9 years | 682 | 329 (67.56) | 353 (69.08) | 0.9034 |
|  | >9 years | 197 | 96 (19.71) | 101 (19.77) |  |
| Migration background  |  | 107 | 61 (12.53) | 46 (9.00) | 0.8074 |
|  |  |  |  |  |  |
| **Prior diseases and risk factors** |
| Angina pectoris  |  | 211 | 89 (18.28) | 122 (23.87) | 0.0268 |
| Hypertension  |  | 639 | 321 (65.91) | 318 (62.23) | 0.2564 |
| Hyperlipidemia  |  | 646 | 336 (68.99) | 310 (60.67) | 0.0058 |
| Stroke  |  | 50 | 26 (5.34) | 24 (4.50) | 0.5563 |
| Diabetes |  | 269 | 152 (31.21) | 117 (22.90) | 0.0031 |
| Smoking | Current smoker | 438 | 214 (43.94) | 224 (43.84) | 0.6184 |
|  | Ex-smoker | 235 | 121 (24.85) | 114 (22.31) |  |
|  | Never smoker | 284 | 134 (27.52) | 150 (29.35) |  |
| Obesity (BMI≥30 kg/m2) |  | 162 | 84 (17.25) | 78 (15.26) | 0.3955 |
| Family history of AMI |  | 174 | 93 (19.10) | 81 (15.85) | 0.2747 |
|  |  |  |  |  |  |
| **Presenting symptoms** |  |  |  |  |  |
| Chest symptoms |  | 962 | 471 (96.71) | 491 (96.09) | 0.5946 |
| Any other symptoms |  | 932 | 460 (94.56) | 472 (92.37) | 0.4407 |
| Pain left extremity |  | 546 | 271 (55.65) | 275 (53.82) | 0.6546 |
| Pain right extremity |  | 292 | 128 (26.28) | 164 (32.09) | 0.0292 |
| Pain throat/jaw |  | 289 | 139 (28.54) | 150 (29.35) | 0.6442 |
| Pain upper abdomen |  | 96 | 32 (6.57) | 64 (12.52) | 0.0010 |
| Pain shoulder blade |  | 248 | 112 (23.00) | 136 (26.61) | 0.1376 |
| Vomiting |  | 145 | 68 (13.69) | 77 (15.07) | 0.5763 |
| Nausea |  | 352 | 185 (37.99) | 167 (32.68) | 0.1105 |
| Dyspnea |  | 450 | 239 (49.08) | 211 (43.33) | 0.0196 |
| Diaphoresis |  | 539 | 284 (58.32) | 255 (52.36) | 0.0133 |
| Fear of death |  | 304 | 165 (33.88) | 139 (27.20) | 0.0346 |
| Number of symptoms | ≤4 | 571 | 265 (54.41) | 306 (59.88) | 0.081 |
|  | >4 | 427 | 222 (45.59) | 205 (40.12) |  |
|  |  |  |  |  |  |
| **Situational factors** |  |  |  |  |  |
| AMI at home |  | 663 | 350 (71.87) | 313 (61.25) | 0.4806 |
| Symptom onset  | Workday | 700 | 347 (71.25)  | 353 (69.08) | 0.8078 |
|  | Weekend | 269 | 131 (26.90) | 138 (27.01) |  |
|  | Daytime | 462 | 226 (44.97) | 236 (46.18) | 0.0388 |
|  | Night | 391 | 219 (46.41) | 172 (33.66) |  |
|  | Unknown | 145 | 42 (8.62) | 103 (20.16) |  |
|  |
| **AMI characteristics/treatment** |
| Revascularization therapy | Thrombolysis | 174 | 98 (20.12) | 76 (14.87) | <0.0001 |
|  | PCI | 269 | 194 (39.84) | 75 (14.68) |  |
|  | CABG | 54 | 26 (5.34) | 28 (5.48) |  |
|  | None | 346 | 109 (22.38) | 237 (46.38) |  |
| AMI type | STEMI | 441 | 246 (50.51) | 195 (38.16) | 0.0004 |
|  | NSTEMI | 448 | 192 (39.43) | 265 (51.86) |  |
|  | Bundle branch block | 49 | 27 (5.54) | 22 (4.31) |  |
| Any in-hospital complication |  | 208 | 110 (22.59) | 98 (19.18) | 0.1903 |
| Days at intensive care unit | ≤3 | 603 | 315 (64.68) | 288 (56.36) | 0.0072 |
|  | >3 | 395 | 172 (35.32) | 223 (43.34) |  |
| Days in hospital  | ≤16 | 522 | 283 (58.11) | 239 (46.77) | 0.0003 |
|  | >16 | 476 | 204 (41.89) | 272 (53.23) |  |
| Year of AMI | 1985-1994 | 450 | 139 (28.54) | 311 (60.86) | <0.0001 |
|  | 1995-2004 | 405 | 269 (55.24) | 136 (26.61) |  |
|  | 2005-2011 | 143 | 79 (16.22) | 64 (12.52) |  |

EMS=emergency services; BMI=Body mass index; AMI=Acute myocardial infarction; PCI=Percutanous coronary intervention; CABG=Coronary artery bypass grafting; STEMI=ST-segment elevation myocardial infarction; NSTEMI=Non ST-segment elevation myocardial infarction

Table 2: Sample characteristics stratified by emergency services (EMS) use at recurrent acute myocardial infarction

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable |  | n | EMS use (n=625)n (%) | No EMS use (n=373)n (%) | p-value |
| **Sociodemographic characteristics** |
| Sex | Men | 766 | 478 (76.48) | 288 (77.21) | 0.7912 |
|  | Women | 232 | 147 (23.52) | 85 (22.79) |  |
| Age (years) | <55 | 177 | 107 (17.12) | 70 (18.77) | 0.1866 |
|  | 55-64 | 297 | 176 (28.16) | 121 (32.44) |  |
|  | ≥65 | 524 | 342 (54.72) | 182 (48.79) |  |
| Married |  | 749 | 458 (76.97) | 291 (83.14) |  0.0239 |
| Living alone  |  | 123 | 88 (14.79) | 35 (10.00) |  0.0346 |
| Education | ≤9 years | 682 | 429 (78.00) | 253 (76.90) | 0.7050 |
|  | >9 years | 197 | 121 (22.00) | 76 (23.10) |  |
| Migration background  |  | 107 | 65 (15.93) | 42 (18.83) | 0.3530 |
|  |  |  |  |  |  |
| **Prior diseases and risk factors** |
| Angina pectoris  |  | 211 | 136 (21.94) | 75 (20.11) | 0.4952 |
| Hypertension  |  | 639 | 409 (65.76) | 230 (61.83) | 0.2111 |
| Hyperlipidemia  |  | 646 | 413 (67.82) | 233 (64.19) | 0.2464 |
| Stroke  |  | 50 | 33 (5.58) | 17 (4.70) | 0.5509 |
| Diabetes |  | 269 | 171 (27.36) | 98 (26.27) | 0.7082 |
| Smoking | Current smoker | 438 | 293 (48.67) | 145 (40.85) | 0.0627 |
|  | Ex-smoker | 235 | 139 (23.09) | 96 (27.04) |  |
|  | Never smoker | 284 | 170 (28.24) | 114 (32.11) |  |
| Obesity (BMI≥30 kg/m2) |  | 162 | 113 (18.08) | 49 (13.14) | 0.0405 |
| Family history of AMI |  | 174 | 105 (24.08) | 69 (25.94) | 0.5803 |
|  |  |  |  |  |  |
| **Presenting symptoms** |  |  |  |  |  |
| Chest symptoms |  | 923 | 582 (94.02) | 341 (91.91) | 0.201 |
| Any other symptoms |  | 917 | 586 (94.21) | 331 (89.46) | 0.0062 |
| Pain left extremity |  | 506 | 308 (49.44) | 178 (48.24) | 0.7149 |
| Pain right extremity |  | 260 | 163 (26.16) | 97 (26.22) | 0.9855 |
| Pain throat/jaw |  | 256 | 165 (26.48) | 91 (24.73) | 0.5416 |
| Pain upper abdomen |  | 88 | 45 (7.22) | 43 (11.72) | 0.0164 |
| Pain shoulder blade |  | 229 | 150 (24.08) | 79 (34.50) | 0.3464 |
| Vomiting |  | 89 | 54 (8.67) | 35 (39.33) | 0.6633 |
| Nausea |  | 277 | 182 (29.21) | 95 (25.68) | 0.2294 |
| Dyspnea |  | 478 | 311 (49.92) | 167 (45.14) | 0.1446 |
| Diaphoresis |  | 451 | 310 (49.76)  | 141 (38.21) | 0.0004 |
| Fear of death |  | 238 | 162 (26.00) | 76 (20.60) | 0.0539 |
| Number of symptoms | ≤4 | 668 | 405 (64.80) | 263 (70.51) | 0.0636 |
|  | >4 | 330 | 220 (35.20) | 110 (29.49) |  |
| Number of mismatching symptoms | ≤3 | 621 | 399 (63.84) | 222 (59.52) | 0.1730 |
|  | >3 | 377 | 226 (36.16) | 151 (40.48) |  |
|  |  |  |  |  |  |
| **Situational factors** |  |  |  |  |  |
| AMI at home |  | 686 | 456 (86.36) | 230 (79.31) | 0.0087 |
| Symptom onset  | Workday | 704 | 432 (70.59) | 272 (76.19) | 0.0591 |
|  | Weekend | 265 | 180 (29.41) | 85 (23.81) |  |
|  | Daytime | 426 | 295 (47.20) | 131 (35.12) | 0.0538 |
|  | Night | 427 | 269 (43.04) | 158 (42.36) |  |
|  | Unknown | 145 | 61 (9.76) | 84 (22.52) |  |
|  |  |  |  |  |  |
| **AMI characteristics/treatment** |
| Revascularization therapy | Thrombolysis | 174 | 108 (20.26) | 66 (21.29) | 0.0583 |
|  | PCI | 269 | 179 (33.58) | 90 (29.03) |  |
|  | CABG | 54 | 41 (7.69) | 13 (4.19) |  |
|  | None | 346 | 205 (38.46) | 141 (40.75) |  |
| AMI type | STEMI | 319 | 219 (35.96) | 100 (28.17) | 0.0179 |
|  | NSTEMI | 557 | 331 (54.35) | 226 (63.66) |  |
|  | Bundle branch block | 88 | 59 (9.69) | 29 (8.17) |  |
| Any in-hospital complication |  | 208 | 138 (22.12) | 70 (18.77) | 0.208 |
| Days at intensive care unit | ≤3 | 603 | 375 (60.00) | 228 (61.13) | 0.7249 |
|  | >3 | 395 | 250 (40.00) | 145 (38.87) |  |
| Days in hospital  | ≤16 | 522 | 333 (53.28) | 189 (50.67) | 0.4245 |
|  | >16 | 476 | 292 (46.72) | 184 (49.33) |  |
| Year of AMI | 1985-1994 | 198 | 83 (13.28) | 115 (30.83) | <0.0001 |
|  | 1995-2004 | 364 | 246 (39.36) | 118 (31.64) |  |
|  | 2005-2011 | 436 | 296 (47.36) | 140 (37.53) |  |
| Time between first and reinfarction  | ≤4.35 years | 502 | 293 (46.88) | 209 (56.03) |  0.0051 |
|  | >4.35 years | 496 | 332 (53.12) | 164 (43.97) |  |

EMS=emergency services; BMI=Body mass index; AMI=Acute myocardial infarction; PCI=Percutanous coronary intervention; CABG=Coronary artery bypass grafting; STEMI=ST-segment elevation myocardial infarction; NSTEMI=Non ST-segment elevation myocardial infarction

Table 3: Independent, significant (p<0.05) factors associated with emergency services (EMS) use at first acute myocardial infarction in 998 patients with reinfarction

|  |  |  |
| --- | --- | --- |
|  | OR [95% CI]1 | p-value |
| Age (per year) | 1.02 [1.02-1.03] | 0.0249 |
| History of hyperlipidemia | 1.38 [1.03-1.86] | 0.0339 |
| Year of first AMI | 1.10 [1.08-1.12] | <.0001 |
| Symptom onset in daytime | 2.00 [1.26-3.17] | 0.0031 |
| Unknown symptom onset | 0.36 [0.23-0.57] | <.0001 |
| More than 4 symptoms | 1.58 [1.15-2.19] | 0.0052 |
| Pain between shoulder blades | 0.61 [0.42-0.88] | 0.0074 |
| Pain in upper abdomen | 0.35 [0.21-0.59] | <.0001 |
| ST-segment elevation myocardial infarction at first AMI2 | 1.86 [1.38-2.51] | <.0001 |

1 Adjusted for sex and all other variables presented in this table

2 Reference: Non ST-segment elevation myocardial infarction (NSTEMI)

AMI=acute myocardial infarction; OR=odds ratio; CI=confidence interval

Table 4: Independent, significant (p<0.05) factors associated with emergency services (EMS) use at recurrent myocardial infarction in 998 patients

|  |  |  |
| --- | --- | --- |
|  | OR [95% CI]1 | p-value |
| EMS use at first AMI | 2.13 [1.61- 2.81] | <.0001 |
| Year of recurrent AMI | 1.05 [1.03-1.07] | <.0001 |
| Any other symptoms except chest symptoms | 1.87 [1.14- 3.07] | 0.0136 |
| ST-segment elevation myocardial infarction at recurrent AMI2 | 1.70 [1.25- 2.31] | 0.0008 |

1 Adjusted for age, sex and all other variables presented in this table

2 Reference: Non ST-segment elevation myocardial infarction (NSTEMI)

AMI=acute myocardial infarction; OR=odds ratio; CI=confidence interval

Table 5: Independent, significant (p<0.05) factors associated with emergency services (EMS) use in 511 patients with reinfarction who did not use EMS transport at first myocardial infarction.

|  |  |  |
| --- | --- | --- |
|  | OR [95% CI]1 | p-value |
| Married | 0.55 [0.33-0.92] | 0.0224 |
| Any other symptoms except chest symptoms | 3.60 [1.62-8.00] | 0.0017 |
| Year of reinfarction | 1.04 [1.01- 1.07] | 0.0110 |
| Time between first and reinfarction (per year) | 1.04 [1.01- 1.09] | 0.0343 |
| Bundle branch block at first AMI2 | 3.66 [1.30-10.32] | 0.0141 |
|  Any in-hospital complication | 1.72 [1.05- 2.83] | 0.0319 |

1 Adjusted for age, sex and all other variables presented in this table

2 Reference: Non ST-segment elevation myocardial infarction (NSTEMI)

AMI=acute myocardial infarction; OR=odds ratio; CI=confidence interval