

# Predictive factors for myocardial infarction in pre-hospital emergency care

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## Research article

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# Abstract

**Background:** Identifying predictive factors based on procedures carried out by emergency medical teams may speed up the diagnosis of AMI. By shortening the time between the onset of the pain and the initiation of coronary reperfusion, patient prognosis can be improved

**Methods:** The study was conducted on residents of the Bielsko-Biała district, served by state ambulance service Medical Response Teams (MRT). The patients were assigned to the following groups: Group A (n = 338) - patients with chest pain in whom infarction with elevation of the ST segment (ST-ACS) was diagnosed on the basis of an ECG, Group B (n=300) - patients with chest pain in whom an infarction was not diagnosed. A factor structural test for the studied parameters was used to determine their significance. An odds ratio (OR) was established for statistically significant parameters, and multi-dimensional logistic regression analysis was conducted. The significance of the odds ratios (OR) was estimated for individual risk factors based on 95% confidence intervals (CI).

**Results:** It can be stated with 95% probability that the significant parameters: Male (p=0.00001), Age 51-70(p=0.00307), Breathing rate less than 12/min(p=0.02711), Pulse below 60 min (p=0.00165), Edemas (p=0.00075), Moist skin(p<0.01), Sinus rhythm (p=0.00004), Additional ventricular beats(p=0.00133) increase the risk of myocardial infarction.

**Conclusion:** Identifying the predictors of myocardial infarction specific to pre-hospital emergency care is essential for improving the detection of AMI and shortening the time between calls to the MRT and the initiation of coronary reperfusion.

## Background

Severe chest pain is a symptom that prompts patients to contact the Emergency Medical Services (EMS). The etiology of such pain is varied, but it can be one of the first symptoms indicating an ongoing acute myocardial infarction (AMI). Examination of a patient in pre-hospital care is based on various algorithms but they all focus on a quick assessment of the basic parameters. The main determinant of emergency procedures is time. Knowledge of specific symptoms and characteristic parameters is very important in proper diagnosis and shortening the time to implement appropriate treatment. Identifying predictive factors based on procedures carried out by emergency medical teams may speed up the diagnosis of AMI. By shortening the time between the onset of the pain and the initiation of coronary reperfusion, patient prognosis can be improved [1–6].

## Methods

The study was conducted on residents of the Bielsko-Biała district, served by state ambulance service Medical Response Teams (MRT). The study was conducted in the years 2016-2018. The study group comprised 638 patients. The patients were assigned to the following groups: Group A (n = 338) - patients

with chest pain in whom infarction with elevation of the ST segment (ST-ACS) was diagnosed on the basis of an ECG, Group B (n=300) - patients with chest pain in whom an infarction was not diagnosed.

Table 1.

The subject of the research was patient health data entered directly by members of MRTs into the compulsory Polish Medical Emergency Record Card after physical examination of patients. In total, 46 physical examination parameters were used for statistical analysis, as well as age, gender and a 12-lead ECG result. A factor structural test for the studied parameters was used to determine their significance. An odds ratio (OR) was established for statistically significant parameters, and multi-dimensional logistic regression analysis was conducted. The significance of the odds ratios (OR) was estimated for individual risk factors based on 95% confidence intervals (CI). If the lower limit of the confidence interval was higher than 1, the odds ratio for a given factor was accepted to be significant at  $p < 0.05$ . Statistical analysis was conducted using the STATISTICA software package, license no. JPZP602D415110AR-9.

## Results

After a factor structural test was conducted on the 46 parameters studied, 9 statistically significant parameters were selected. The level of significance was set at  $p < 0.05$ .

Table 2.

The subsequent stage of the statistical analysis consisted of conducting multi-dimensional logistic regression analysis on the statistically significant parameters (Table III). For each of these parameters, the odds ratio (OR) was then calculated, as well as the confidence interval at the assumed level of 95%.

Table 3.

It can be stated with 95% probability that the chances of a myocardial infarction occurring in a patient displaying the significant parameters selected as a result of statistical analysis is greater by the factor OR value for a given parameter.

## Discussion

Scientific research conducted over the years into predictive factors for AMI have shown that age and gender are two of the main predictors [7-10]. In their study into demographic risk factors related to the occurrence of myocardial infarction, Duan et al. [7] showed that myocardial infarction is more prevalent

among men than women, and that this risk increases considerably above the age of 50. Alhabib et al. showed in their study of 5055 hospitalized patients that 77.42% of the entire group were men with STEMI, and that their average age was 55.4 years old. Similar results have been shown by other authors [8,9]. Our research confirmed that 68.64% of patients with ST-ACS diagnosed by MRT paramedics were men. The 'age' predictive parameter value confirmed the fact that 57.69% of the study group with diagnosed ST-ACS were between the ages of 51 and 70. When logistic regression analysis was applied, this confirmed the statistical significance of parameters such as: male ( $p=0.000001$ ) and age group between 51 and 70 years old ( $p=0.00307$ ). The OR odds ratio value calculated for each of the listed risk factors shows that the probability of ST-ACS in men reporting chest pain is 2,571 (CI 95%) times higher than for women. The probability of ST-ACS is 1.667 (CI 95%) times higher among patients in the age group between 51 and 70 years old than in other age groups. Scientific studies show that an increased breathing rate in patients following a myocardial infarction directly correlates with mortality. According to Barthel et al. [11], an increase of 4 breaths per minute doubles the risk of death. Hasdai et al. [12] showed that cold, moist skin in patients with AMI complicated by cardiogenic shock increases the risk of death by 1.68 (CI 95%) in comparison to patients in whom such symptoms were not present. Parodi et al. [13] studied the dependencies between heart rate and mortality caused by AMI. Their results showed that at a heart rate of over 80 beats per minute, the odds ratio of death occurring is 2.179 (CI 95%) higher. Every increase in heart rate of 5 beats per minute caused a rise in the odds ratio of death occurring by 1.321 (CI 95%). In our research, the odds ratios were calculated for statistically significant parameters considered to be predictors of AMI: breathing rate below 12/min OR=1.928 (CI 95%), heart rate below 60/min OR=3.370 (CI 95%), moist skin OR= 6.077 (CI 95%). The odds ratios (OR) were calculated for the following, which are also considered to be AMI predictors: GCS 9-12 points OR=3.442 (CI 95%) and swelling OR=3.572 (CI 95%). Kiani et al. [10] analyzed risk factors for patients with myocardial infarction treated in hospital. They demonstrated a statistically significant dependency for sinus rhythm, atrial fibrillation, ventricular tachycardia atrioventricular blocks. As a result of their research, Ahmadi et al. [14] included right His bundle branch block and ventricular tachycardia in the group of myocardial infarction risk factors. Our research into 12-lead ECG results found sinus rhythm OR=2.860 (CI 95%) and additional ventricular beats OR= 9.120 (CI 95%) to be significant predictors of myocardial infarction. Using analysis of parameters obtained by MRT paramedics, the research enabled us to identify which of these can be considered to be predictors of AMI. In the literature, there are few reports into analysis of material in the documentation of patients who have undergone pre-hospital treatment. Further clinical studies on the emergency medical services are required in order to identify the importance of this information as a predictor.

## Limitations

The limitation of the study is the number of patients included in the analysis, diagnostic limitations of pre-hospital management and conducting the examination only in the group of patients with ST segment elevation myocardial infarction. It is necessary to extend the study to a larger population and implement parameter analysis in a group of patients with NSTEMI

## Conclusions

Identification of predictors of myocardial infarction specific to pre-hospital emergency care is useful for improving AMI detection. The study parameters described identify patients at particular risk of developing acute myocardial infarction.

## Abbreviations

Emergency Medical Services (EMS)

Acute Myocardial Infarction (AMI)

Electrocardiogram – ECG

Odds Ratio (OR)

Confidence Intervals (CI)

ST elevation myocardial infarction - ST-ACS

Medical Response Team – MRT

## Declarations

### Ethics approval and consent to participate

The research project received the approval of the Bioethics Committee in Bielsko-Biała.

Bioethics Committee of Medical Chamber 43-300 Bielsko-Biała, 28 Krasińskiego St.

Number 2014/03/13/2

### Consent for publication

Not applicable.

### Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### Competing Interests

The authors declare that they have no competing interests.

## Authors' contributions

*All authors have read and approved the manuscript*

TI, MK, MM, conceived the study, designed the trial, RB,MC,WW,MR, supervised the data collection TI, MM, provided statistical advice on study design and analyzed the data, TI drafted the manuscript, and all authors contributed substantially to its revision

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## Tables

Table 1. Demographic breakdown of the study group

Total Group n = 638	Gender		Age		
	F	M	20 - 50 years old	50-70 years old	Over 70 years old
Group A n = 338	106 31.36%	232 68.64%	34 10.06%	195 57.69%	109 32.25%
Group B n = 300	165 55.00%	135 45.00%	44 14.67%	132 44.00%	124 41.33%

Table 2. Analyzed parameters.

Analyzed parameters	Percentage (%)		p
	Gr A n = 338	Gr B n=300	
Male	68.64%	45.00%	0.00000
Age 51-70	57.69%	44.00%	0.00055
GCS 9-12	13.31%	3.00%	0.00001
Breathing rate less than 12/min	14.50%	7.00%	0.00249
Pulse below 60 min	10.36%	3.33%	0.00055
Edema	15.09%	3.33%	0.00001
Moist skin	29.88%	6.00%	0.00001
Sinus rhythm	89.05%	80.00%	0.00148
Additional ventricular beats	3.55%	1.00%	0.03384

Table3. Odds ratios (OR) for significant parameters.

Analyzed parameters	p	OR	-95%CI	+95%CI
Male	0.00001	2.571	1.8353	3.6006
Age 51-70	0.00307	1.667	1.1879	2.3403
Breathing rate less than 12/min	0.02711	1.928	1.0759	3.4558
Pulse below 60 min	0.00165	3.370	1.5788	7.1924
Edema	0.00075	3.572	1.7011	7.5009
Moist skin	< 0.00001	6.077	3.5213	10.4861
Sinus rhythm	0.00004	2.860	1.7331	4.7180
Additional ventricular beats	0.00133	9.120	2.3588	35.2609

For the significant diagnostic factors, the lower confidence interval limit is greater than 1 (-95%CI > 1)