The Initial Phase of an Acute Coronary Syndrome
Till Emma, Jesper och Magnus
The Initial Phase of an Acute Coronary Syndrome

Symptoms, patients’ response to symptoms and opportunity to reduce time to seek care and to increase ambulance use
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Abstract

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This thesis aims to describe the initial phase of an acute coronary syndrome (ACS) in overall terms from a national perspective and to evaluate the impact of an information campaign designed to inform the public about how to act when suspecting an ACS. A total of 1939 patients at 11 hospitals in Sweden with diagnosed ACS and symptom onset outside hospital completed a questionnaire (I-IV). In Study V, a questionnaire was completed by 116 patients with ACS before the campaign vs. 122 after it. Register data were followed every year to evaluate ambulance use and emergency department (ED) visits.

With regard to symptoms, patients with ST-elevation ACS (STE-ACS) more frequently had associated symptoms and pain with an abrupt onset reaching maximum intensity within minutes. However, fewer than half the patients with STE-ACS had this type of symptom onset. There were more similarities than differences between genders and differences between age groups were minor (I).

Three-quarters of the patients interpreted the symptoms as cardiac in origin. The majority contacted a family member after symptom onset, whereas few called directly for an ambulance. Approaching someone after symptom onset and the belief that the symptoms were cardiac in origin were factors associated with a shorter pre-hospital delay (II).

Half the patients went to hospital by ambulance. Independent factors for ambulance use were knowledge of the importance of quickly seeking medical care and calling for an ambulance when experiencing chest pain, severe symptoms, abrupt onset of pain, STE-ACS, increasing age and distance to hospital of > 5 km. Reasons for not calling for an ambulance were thinking self-transport would be faster or not being ill enough (III). Pain with abrupt onset, STE-ACS, symptoms such as vertigo or near syncope, experiencing the pain as frightening, interpreting the pain as cardiac in origin and knowledge were major factors associated with a short delay between symptom onset and decision to seek medical care, patient decision time (IV).

The information campaign did not result in a reduction in patient decision time, but it appeared to increase ambulance use and the number of patients seeking the ED for acute chest pain (V).

Keywords: Acute coronary syndrome, pre-hospital delay, ambulance use, symptom, decision making.

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Original papers

This thesis is based upon the following original papers, which are referred to in the text by their Roman numerals:


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List of abbreviations

ACS       Acute coronary syndrome
AMI       Acute myocardial infarction
CAD       Coronary artery disease
CI        Confidence interval
CCU       Coronary care unit
CPR       Cardiopulmonary resuscitation
ECG       Electrocardiogram
ED        Emergency department
EMS       Emergency medical service
NSTE-ACS  Non ST-segment elevation acute coronary syndrome
OR        Odds ratio
PCI       Percutaneous coronary intervention
PPCI      Primary percutaneous coronary intervention
RIKS-HIA  Register of Information and Knowledge about Swedish Heart Intensive care Admissions
STE-ACS   ST-segment elevation acute coronary syndrome
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INTRODUCTION

The time between the onset of symptoms of a suspected acute coronary syndrome (ACS) and the start of treatment is crucial for the prognosis. The more time that elapses, the more heart muscle will be damaged. Reperfusion treatment reduces mortality and morbidity and the earlier the treatment is initiated, preferably within the first hour after symptom onset, the better the prognosis. Unfortunately, the time between symptom onset and the start of treatment is far longer. A great deal of work has been done and is being done to reduce the delays from arrival in hospital until the start of treatment. One major obstacle to early treatment, however, is the delay outside hospital. The main cause of this delay is the time it takes for the person to decide to seek medical care. Furthermore, calling the emergency number for an ambulance is advised when experiencing symptoms of ACS, but this is seldom done as the first course of action. People who suffer from a serious, life-threatening condition such as ACS need to act appropriately to obtain the best result from treatment. In the light of this, members of a project group from the Swedish Society of Cardiology initiated this research project.

BACKGROUND

Coronary artery disease

Coronary artery disease (CAD) is a major cause of death and disease worldwide among both women and men. More than half the deaths occur early, within the first two hours after symptom onset, outside hospital, due primarily to a sudden cardiac arrest caused by ventricular fibrillation.

The death rate has declined in western countries and the age-standardised mortality from acute myocardial infarction (AMI) in Sweden has decreased with by about five percent a year on average during the last 10 years. The mortality rate within 28 days because of an AMI was 29 percent in 2010, whereas the corresponding figure among those who were treated in hospital was 13 percent. The same figures are found in other western countries, with a decrease in mortality due to CAD.

In spite of this, the incidence of the disease remains high and, in 2006, CAD caused approximately one in every six deaths in the United States. Today, approximately every 25 seconds, a coronary event occurs. In Sweden, in 2010, there were 940 cases of AMI per 100 000 inhabitants. CAD is strongly related to age in terms of both incidence and mortality. The incidence is fairly similar in both genders, but the first presentation of CAD
occurs approximately 10 years later among women than men. Every year, the incidence decreases slightly in both genders.

**History**

The acute care and treatment of patients with a suspected ACS has changed dramatically. In the early 1960s, prior to the entry of coronary care units (CCU), the mortality in hospital was 25-30% on average, compared with 16% in the mid-1980s. The CCU enabled the continuous monitoring of cardiac rhythm by highly trained nurses with the authority immediately to begin the treatment of arrhythmias and it was equipped with defibrillators, pacemakers and specialised drugs. Thrombolytic therapy, pharmacological reperfusion, was introduced in the 1980s and percutaneous coronary intervention (PCI), mechanical reperfusion, in the 1990s. After the introduction of beta-blockers, anti-thrombotic therapy and reperfusion therapy the in-hospital mortality rate has been reduced still further. In contrast to in-hospital mortality, the mortality rate outside hospital has not changed to the same extent.

From the start, the ambulance service was only a mode of transport to hospital. The transport of the patient should be performed as quickly as possible to the closest hospital’s emergency department (ED), i.e. “scope and run”. In 1966, a mobile CCU was introduced after a study in Belfast had shown that the mean interval between onset of symptoms and arrival at hospital was 12 hours. The ambulance was equipped with a defibrillator, a physician and a nurse and, for the first time, cardiac arrest could be treated successfully. In Sweden, similar mobile CCUs (Ola ambulances) were introduced at the end of 1970s. These ambulances were equipped with health-care providers from the CCU trained in advanced cardiac life support. A reduction in mortality was seen among patients with an AMI who were transported by a mobile CCU. During the 1990s, the ambulance service improved still further and it is now the extended arm of the hospital, where the treatment of the patient begins in the home or in the ambulance, i.e. “stay and play”.

**Acute coronary syndrome**

Acute coronary syndrome is the acute manifestation of CAD and includes AMI and unstable angina pectoris.
Pathogenesis
An ACS is a result of the reduction or cessation of oxygen supply due to an acute disruption of an atherosclerotic plaque in a coronary artery lumen. This leads to the formation of a thrombosis that occludes, total or partially, the coronary artery, followed by ischemia and myocardial necrosis, resulting in a reduction in pump function, ECG changes and symptoms. The exact duration of this critical early period may be modified by several factors, including the presence of functioning collateral coronary arteries and myocardial oxygen demands. When the oxygen supply stops for more than 15-20 minutes, myocardial damage occurs, with the leakage of elements, markers of myocardial injury. These markers, cardiac troponin I or T, can be detected in blood tests. Moreover, the injury to the myocardium is time dependent and, the longer the oxygen supply is limited, the more extensive the necrosis will become, “time is muscle”\(^9\). If the ischemia leads to an irreversible injury, an AMI occurs by definition, whereas if the ischemia not is severe enough to cause myocardial damage it is referred to as unstable angina pectoris.\(^9\)

Clinical aspects
The majority of all ACSs are diagnosed by means of anamnesis, clinical presentation, a 12-leads electrocardiogram (ECG) and biochemical markers. Among patients presenting at the ED for an evaluation of acute chest pain, about 10 to 25 percent have ACS.\(^{11,12}\) There are several differential diagnoses for ACS, where other life-threatening conditions, such as pulmonary embolism or aortic dissection, accounts for a small percentage. The majority are discharged from the ED without a diagnosis or a non-cardiac diagnosis, such as musculoskeletal syndromes, gastrointestinal disorders and psychological disorders.\(^{10,13}\)

ACS is usually classified into categories based on the findings on the initial ECG into ST-segment elevation ACS (STE-ACS) and non-ST-segment elevation ACS (NSTE-ACS).\(^9\) The treatment to restore the flow in the occluded infarct-related artery is based on the ECG findings, where ST-elevation is a criterion for early reperfusion treatment.\(^{14}\) This early treatment is crucial for the outcome and reduces mortality and morbidity.\(^{15}\) The mortality in hospital is higher among patients with STE-ACS than among patients with NSTE-ACS. However, after six months, the mortality rates in both groups are very similar.\(^{16}\)
Symptoms
The symptom that normally is the first manifestation of ACS is chest pain, pressure or chest discomfort, with sudden onset and duration of more than 15 minutes. The symptom from the chest occasionally radiates to the left arm, neck, shoulder, back or epigastrium. However, an ACS sometimes is presented without symptoms from the chest. Common associated symptoms are shortness of breath, weakness, cold sweat, nausea or vomiting. The elderly sometimes experience minor symptoms or less severe symptoms. They less frequently experience arm pain and sweating. It has previously been suggested that patients with a history of diabetes have less severe symptoms, while other have suggested that patients with and without a history of diabetes have similar symptoms.

Gender differences in the presentation of symptoms have been reported with equivocal results. Some have demonstrated that men more frequently present with chest pain, whereas others found no gender differences. Furthermore, data related to other symptoms also conflict, where women more frequently report nausea, vomiting, indigestion, dyspnoea, arm pain, neck and jaw pain, while men more frequently report diaphoresis. Others have, however, not shown any gender differences regarding these symptoms.

Treatment
The primary goals of the early treatment of ACS are to minimise myocardial damage and prevent life-threatening cardiac events. The treatment includes reperfusion therapies, i.e. thrombolysis or primary percutaneous coronary intervention (PPCI), to restore the flow in the occluded infarct-related artery; anti-thrombotic therapy to inhibit platelet activity and coagulation; and anti-ischemic therapy. In patients with STE-ACS, PPCI is the treatment of choice if it can be performed within 90 minutes after the first medical contact. The early treatment of an ACS also includes the control of pain with analgesics, nitrates, beta-blockers, oxygen and treating any complications associated with the disease. The treatment also includes ACE inhibitors and lipid-lowering drugs, although this treatment usually starts somewhat later.

The importance of time between symptom onset and treatment
During the last few decades, we have learned that the time between the onset of symptoms of ACS and the initiation of reperfusion therapy is crucial for the prognosis. The earlier the treatment is initiated, the greater the likelihood that myocardial damage will be limited and myocardial function will be maintained. The benefit of reperfusion therapy is greatest
in the first two to three hours after the onset of symptoms of ACS. This is most probably a consequence of myocardial salvage and the reduction of life-threatening arrhythmias. After this early period, the mortality benefit is reduced and the time to reperfusion therapy becomes less critical. Moreover, reperfusion therapy beginning within the first hour following symptom onset promotes maximum myocardial salvage and has been referred to as "the golden hour" in terms of pharmacological reperfusion. With regard to PPCI, data demonstrate that each 30 minutes of delay to PPCI, is associated with an increase in risk of one-year mortality.

The main components involved in the delay between the onset of symptoms of ACS and the start of treatment can be divided into the following three phases.

Patient decision phase: the time it takes for the patient to recognise the seriousness of the symptoms and decide to seek medical care i.e. time between onset of symptoms and emergency call or decision to seek medical care.

Transportation phase: the time between calling the emergency number and the arrival of the ambulance at the hospital, or, for private transportation, the time between the decision to seek medical care and hospital arrival.

Hospital phase: the time taken for the diagnosis and initiation of treatment in the hospital, i.e. the time between admission to hospital and start of treatment, "door-to-needle" time for patients receiving thrombolysis and "door-to-balloon" time for patients undergoing PPCI.

The patient decision phase and transportation phase together are defined as the pre-hospital phase, the time from the onset of symptoms to hospital arrival.

System delay is the time between first contact with the health care system and the initiation of reperfusion treatment. It is an important contributor to delays of treatment and is associated with mortality in patients with STE-ACS treated with PPCI. However, the main cause of delay until the start of treatment is the patient decision time. This phase accounts for more than three-quarters of the total pre-hospital delay and is a major obstacle to early treatment. The median time from symptom onset to arrival in hospital varies between 2.2 and 6.4 hours in different countries and has remained constant for several years and only 20 percent of patients with symptoms of AMI arrive at the ED within one hour. In the Register of Information and Knowledge about Swedish Heart Intensive care Admissions (RIKS-HIA), the median pre-hospital delay was two hours in 2010 and these figures have remained constant for several years and appear not to have changed during the last decade.
Pre-hospital care

About half the deaths from ACS occur early, within the first two hours, outside hospital, due mainly to a sudden cardiac arrest usually caused by ventricular fibrillation. The chain of survival starts with the patient, family members or bystanders, who must be aware of signs and symptoms of ACS and the importance of early contact with the emergency medical services (EMS). The EMS plays a critical role in the management of an ACS and consists of the emergency dispatch centre and EMS ambulances. The personnel at the emergency dispatch centre have protocols for rapid diagnosis and sending an ambulance.

At the present time, the ambulance is not only a mode of transport but also a place for initial diagnosis including ECG transmission to the hospital, triage and treatment. Both the European and the Swedish guidelines strongly recommend the activation of the EMS by patients who have symptoms consistent with ACS. The utilisation of the EMS leads to the faster receipt of initial reperfusion therapies. If thrombolysis is administered prior to hospital admission, the delay and mortality both decrease. Moreover, the EMS alerts the hospital and enables ED bypass. Decisions relating to treatment and the preparation of a potential PPCI at the local hospital, as well as acute transferral to an interventional centre with PPCI facilities, can be made effectively with a shorter treatment delay. Finally, most ambulances are equipped with defibrillators and paramedics who are trained in basic and advanced cardiac life support, thereby increasing survival if a cardiac arrest occurs. In spite of this, only 50 percent to 60 percent of persons with an AMI choose to initiate care by using the EMS and this figure has not changed much over time.

Factors associated with patient decision time and ambulance use

A number of factors influence the way people act when they suspect an ACS; they include socio-demographic, medical history, cognitive, emotional and social factors. High age, and female gender have been shown to be related to longer delays before seeking medical care. With regard to gender, however, conflicting results with no gender differences are reported. Furthermore, a low education level, low socio-economic status and black race are associated with an increased delay. When it comes to medical history, having a prior AMI does not appear to reduce the delay, but it instead appears to increase it. Patients with a history of angina delay seeking care. Other prior chronic health conditions, such as hypertension, hyperlipidemia and diabetes are also related to an increase in delay.
The decision-making process relating to seeking medical care is complex, where cognitive, emotional and social factors influence delays. Cogni-
tive factors, such as having knowledge, are necessary in order correctly to
label the symptoms and signs of ACS. However, this does not necessarily
lead to a shorter delay. One cognitive factor explaining gender differences
in the time it takes to seek care is believing that ACS is a male disease.
Furthermore, there is sometimes a mismatch between expected and experi-
cenced symptoms. Patients think symptoms, especially chest pain, would be
more severe compared with what they actually experienced. Those with
severe acute symptoms have shorter delays, whereas patients who do not
perceive the symptoms as a serious condition wait longer. However, others have shown that the severity of symptoms is not related to delay.

Unproductive responses like thinking that the pain will disappear or
not recognising the importance of symptoms results in hesitation about
seeking medical care. Not interpreting symptom as being cardiac in
origin or not believing that the symptoms are serious have been
shown to increase the time from symptom onset to seeking medical care. Self-
medication to relieve symptoms is another factor that increases the delay.

When it comes to ambulance use, high age, female gender, a history
of heart disease, severe symptoms and the presence of other people are associated with a greater use of ambulance. Believing that self-transport is faster or the perceptions that the symptoms are not serious enough are responses that lead people not to choose an ambulance.

Educational and information campaigns
Over the past three decades, attempts with community education have
been performed to influence the pre-hospital delay and ambulance use in
ACS with varying success. The interventions, directed at the public,
have focused on symptoms of ACS, calling the emergency number for an
ambulance and available treatments. One successful, extensive campaign
was conducted in Göteborg in the late 1980s. It resulted in a reduction in
the median time of 40 minutes between symptom onset and arrival at
hospital in AMI patients. The improvement could still be seen three
years later. However, ambulance use did not change. Another large inter-
vention conducted in the United States resulted in the opposite findings. An
increase in ambulance use and an association between early reperfusion
therapy and ambulance use was found in intervention communities. The cam-
paign did not, however, influence patient delays. Other attempts with
community interventions had a limited influence on behaviour. One cam-
paign produced a reduction in pre-hospital delay but the delay was meas-
ured during and immediately after the campaign and thereby lacked any
long-term effects. Others have been unable to demonstrate any effect of the campaign. Most of the interventions were carried out over a relatively short period. With regard to ambulance use, it has not been evaluated to the same extent.

Rationale for the thesis

A short delay between the onset of symptoms and the initiation of reperfusion treatment in ACS is crucial for the outcome. Despite this, only a minority of patients suitable for reperfusion treatment receive therapy within one to two hours after the onset of symptoms. Previous attempts aimed at reducing patient delay have had limited success, which raises the question of possible missing information about the onset of an ACS and thereby the communication of an incorrect message. Furthermore, in order to affect the behaviour of patients with symptoms of an ACS, we need to have a clearer understanding of why patients do not respond appropriately. How do patients experience their symptoms and how do they interpret their symptoms in acute ACS? What is the reason that patients often delay so long before contacting medical care? What is the reason that patients often fail to call an ambulance in ACS? This is necessary knowledge in order subsequently be able, if possible, to change the behaviour of persons suffering a suspected ACS.

At the time of the start of the present research project, studies had primarily focused on clinical and demographic factors related to delays in ACS patients, with conflicting results. However, the major obstacle to early treatment is related to the decision-making process of the patient and the impact of social, cognitive and emotional factors had only been examined in few studies. Information about care-seeking behaviour among patients with ACS in relation to age, gender, previous history of CAD, type of ACS and residential area was limited. Moreover, ambulance use in ACS had scarcely been studied and the under-utilisation of the EMS was not entirely understood. There was a need to learn more about the onset of an ACS in overall terms. The purpose was then to use the results and experiences when designing an information campaign about how to act when suspecting an ACS.
AIMS
The overall aims of the present thesis was to describe the initial phase of an ACS in overall terms from a national perspective in total and in various subgroups and to evaluate the impact of an information campaign designed to inform the public about how to act when suspecting an ACS.

These aims have resulted in five papers with the following specific aims:

- To describe characteristics and severity of symptoms and patients’ experience of symptoms in ACS and the relationship to the type of ACS, age, gender and a history of diabetes (I)

- To describe patients’ interpretation of symptoms, thoughts and actions after the onset of symptoms of ACS in total and the relationship to age, gender, a history of CAD (II, III), type of ACS, residential area (II) and distance to hospital (III)

- To describe factors influencing pre-hospital delay (II), ambulance use (III) and the reasons for not choosing an ambulance (III) in ACS

- To describe patient decision time in ACS and various factors associated with patient decision time (IV)

- To evaluate the long-term effects of an information campaign with regard to patient decision time, pre-hospital delay and ambulance use in ACS and the number of patients seeking the emergency department for chest pain (V)
MATERIAL AND METHODS

Design
This thesis comprises five studies using quantitative methods. The first four studies (Papers I–IV) are based on a cross-sectional, observational, multi-centre survey using a descriptive design. A questionnaire and medical records were used to gather information about the initial phase of ACS. Study V is an intervention study with a quasi-experimental design with an historical comparison group and time series. Data were collected through questionnaires, medical records and registers.

Definitions
The definition of ACS in the studies (I–V) included pain or discomfort in the chest of more than 15 minutes, changes on the ECG and/or an increase in at least one biochemical marker (CK-MB, troponin I, or troponin T). The syndrome was divided into STE-ACS (ST-elevation of 2 mm or more in V1–V4 or 1 mm or more in the other ECG leads) and NSTE-ACS (ST-depression of 1 mm or more or T-negativity in any ECG lead and/or an increase in at least one biochemical marker above the upper normal limit).

A history of coronary artery disease (CAD) included AMI, angina pectoris, percutaneous coronary intervention (PCI) and coronary surgery.

The continuation of studies after the first nine years of school was defined as a high educational level.

Setting and participants

Papers I–IV
The study population consisted of patients hospitalised with a diagnosis of ACS at eleven small, medium-sized and large hospitals in different regions of Sweden between April 2001 and February 2003. The hospitals were chosen in order to provide geographical diversity and different hospital sizes, where the smallest hospital serves 40 000 inhabitants and the largest 500 000 inhabitants. In all, these hospitals serve almost a quarter of the Swedish population of nine million people.
The participating hospitals were divided into urban and rural areas. Urban areas included hospitals in cities with a population of more than 125,000 inhabitants. Rural areas included hospitals in towns with 12,000 to 75,000 inhabitants. Both urban and rural areas comprised patients living in the countryside around each city.

The hospitals in urban areas were Sahlgrenska University Hospital in Göteborg, South Hospital in Stockholm, Uppsala University Hospital and Örebro University Hospital. The hospitals in rural areas were Falu Hospital, Kristianstad Central Hospital, Motala Community Hospital, Lidköping Community Hospital, Lycksele Community Hospital, Skellefteå Central Hospital and NU Hospital Organisation, NÄL, in Trollhättan (Fig. 1).

The criteria for inclusion in the study were chest pain or chest discomfort with onset outside hospital and fulfilling the criteria for ACS. Only patients in intensive cardiac care units were included. Patients were excluded if they met any of the following exclusion criteria: hemodynamically unstable, sight- or hearing difficulties, language other than Swedish, previous participation in the study, or declined to participate.

In all, 2,409 patients fulfilled the inclusion criteria and of those 470 (20%) were excluded according to the exclusion criteria. The remaining 1,939 patients participated in the survey and the patient characteristics are given in Table 1. The distribution of the type of ACS was STE-ACS 42% and NSTE-ACS 58%. Of all the patients, 94% had an elevation of some biochemical marker. The corresponding figure was 99% for patients with ST-ACS and 90% for patients with NST-ACS. Forty-two percent of the patients had a high educational level. Slightly more than half (55%) lived in rural areas. Most patients were at home when the symptoms started,
together with somebody (51%) or alone (24%). Only a few patients were at work (7%).

**Paper V**

Patients with ACS who were hospitalised at a university hospital in central Sweden, serving 172,000 inhabitants, were recruited consecutively between April 2001 and February 2003 and between November 2008 and August 2009. The first group consisted of an historical cohort from one centre in the multi-centre study described above and is defined as the before-campaign group. The follow-up started three years after the start of the campaign and this group of patients is defined as the after-campaign group.

**Table 1** Patient demographics in all patients, with a diagnosis of ACS and chest pain at symptom onset, at the participating hospitals during the study period (RIKS-HIA data) and background characteristics of all patients, by gender in the studies I–IV and in the before- and after-campaign group (V)

<table>
<thead>
<tr>
<th></th>
<th>RIKS-HIA (n=5821)</th>
<th>All (I–IV) n=1939</th>
<th>Men (I–IV) n=1421</th>
<th>Women (I–IV) n=480</th>
<th>Before-campaign group (V) n=116</th>
<th>After-campaign group (V) n=122</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (mean(SD))</strong></td>
<td>70 (12)</td>
<td>67 (11)</td>
<td>66 (11)</td>
<td>69 (11)</td>
<td>63 (10)</td>
<td>68 (11)</td>
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<tr>
<td><strong>Female gender (%)</strong></td>
<td>34</td>
<td>25</td>
<td>26</td>
<td>26</td>
<td>30</td>
<td>30</td>
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<td><strong>History of (%)</strong></td>
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<td>Angina pectoris</td>
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<tr>
<td>Myocardial infarction</td>
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<td>Hypertension</td>
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<td>Diabetes mellitus</td>
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<td>Heart failure</td>
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<td>Coronary surgery</td>
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<td>PCI</td>
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<td>Thrombolysis</td>
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<td>Hyperlipidemia</td>
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<tr>
<td>Current smoker (%)</td>
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</table>

The inclusion and exclusion criteria were the same as those described in Papers I–IV. In all, 144 patients fulfilled the inclusion criteria before the campaign and 188 after it. Twenty-eight patients before the campaign and 66 patients after it were excluded according to the exclusion criteria. The patient characteristics are given in Table 1. The percentage of patients with STE-ACS was 55% in the before-campaign group and 35% in the after-campaign group. The difference in distribution is in accordance with data from RIKS-HIA during the corresponding period.\(^{86}\) Forty-eight percent of the patients had a high educational level in the before-campaign group vs. 41% in the after-campaign group.

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MARIE THURESSON *The initial phase of an acute coronary syndrome*
Registry data were collected from three different registers in 2002-2009. The study population varied somewhat in the registers compared with the questionnaire part and were as follows: (1) in RIKS-HIA: patients with a diagnosis of acute myocardial infarction (AMI) or unstable angina pectoris admitted to a CCU, n=2,889 at the intervention hospital (patients transferred from other hospitals were excluded), n=180,934 in the rest of the country; (2) in the Ambulance Mission Register (intervention hospital): transport of priority 1 and 2 in patients with chest pain and chest pain including shortness of breath, n=10,372, and (3) in the patient administration register, Infomedix (intervention hospital): patients seeking the ED because of chest pain, n=32,420.

Data collection

In Papers I–IV, a self-reporting questionnaire comprising questions formulated by the investigators was used. The questionnaire contained 44 questions in nine domains: 1) background factors, 2) symptoms and type of symptom onset, 3) place of symptom onset, 4) behavioural response to symptoms, 5) emotional response to symptoms, 6) cognitive response to symptoms, 7) responses of approached people, 8) patient decision time and 9) mode of transport to hospital. It was possible for the patient to choose numerous defined alternatives. The intensity of the pain/discomfort was evaluated using a numeric rating scale where 0 is free from pain/discomfort and 10 the worst pain/discomfort ever experienced. To describe the character of the pain and experience of symptoms, words were divided into a sensory component and an emotional component.

In Paper V, the questionnaire used after the campaign contained five questions relating to background factors and 12 questions from the previous multi-centre study regarding the interpretation of symptoms, actions after symptom onset, decision time and mode of transport to hospital. It also included questions related to the campaign: have you heard of the campaign; in which way have you heard of the campaign; how much has the campaign influenced you: to realise that the symptoms originated from the heart; in the decision to seek medical help and in the decision to call for an ambulance, with the following answers: not at all, some, quite a lot, a great deal.

The patients completed the questionnaire within three days after admission to hospital, when their condition had stabilised and after informed consent had been obtained. Cardiac nurses responsible for the study performed the inclusion of patients and administered the questionnaire. The nurses were available to answer questions from the patients and to clarify obscurities that might arise in order to ensure accuracy. The patients were
carefully instructed to choose the alternative (or alternatives) that reflected their experience of symptom onset most accurately (I–V).

Data on ECG and type of syndrome were obtained from medical records and prior history of heart disease and risk factors were obtained from patients and medical records. Pre-hospital delay, the time from the onset of symptoms until hospital arrival, was obtained from the patients and medical records. The patients were asked to determine as precisely as possible the time of symptom onset (I–V). Patient decision time was determined in two ways (IV, V): (1) all the patients were asked to estimate the time from symptom onset to the decision to seek medical care, with the following alternatives: less than 15 min, 15-29 min, 30-59 min, 1-2 hours, 2-3 hours, 3-4 hours, and more than 4 hours; (2) among ambulance-transported patients, the time between the onset of symptoms and calling for an ambulance (obtained from the ambulance record) was determined.

Register data were collected every year to follow trends in ambulance use and the number of ED visits (V).

The information campaign
The campaign designed to inform the public about how to act when suspecting an ACS was an assignment from the county council management team. It was conducted in a county in central Sweden, with a population of 280,300 inhabitants. A working group composed of cardiologists, a cardiac care nurse and copywriters from an advertising agency developed the information material and the slogan for the campaign “OM Hjärtinfarkt – symtom och livsviktiga råd”, which means “IF Heart attack – symptoms and life-saving advice”. The results of and experience from the previous multi-centre study were used when designing the content.

The information material consisted of a leaflet with a practical information section that could be removed and put in an easily accessible place, a video disc and posters. The content of the material was informative, not frightening and contained an urgent request not to ignore symptoms and not to hesitate to call for an ambulance. It included what causes an AMI and why early treatment (preferably within 30 minutes after the onset of symptoms) is important; signs of an AMI including the fact that symptoms do not have to be severe; what to do, i.e. call the emergency number for an

Fig2. The front page of the leaflet
ambulance and do not wait until the symptoms disappear; why calling for an ambulance, i.e. earlier start of treatment, is important and the hospital is prepared; and the fact that it is always the right thing to call the emergency number for an ambulance or advice, the emergency operator can help to decide if you are “ill enough” and decide on the need for an ambulance. The message in the campaign was based on the opportunity to identify with a person. Three former patients, two men and one woman who had suffered from ACS, took part in the video, the leaflet (pictures and quotes) and the poster. In the video, they described their experiences and thoughts when they became ill, how they acted and also how they recovered (i.e. healthy). The video also included disease-specific information from a cardiologist.

**Campaign procedure**

The campaign started on 8 November 2005 with a press conference. The message was then spread via TV, radio and printed material in local newspapers (initially on a few occasions) and via direct mail to all county residents on two occasions in 2006. Leaflets were available and posters were put up at all the clinics at hospitals, in primary care and at pharmacies. Campaign material was also sent to private physicians, patient associations, senior citizen associations, high schools and nursing education centres. Lectures were organised for the public on five occasions in 2005-2006. The information was also printed in the 2006/2007 County Council Directory and was available on the internet. The video was shown at pharmacies, at public lectures and was available on the internet.

**Estimation of sample size**

As Papers I-IV are essentially descriptive studies, it is difficult to make statistical estimates of sample size. Comparisons were, however, made between different subgroups and, because of the fairly extensive sample included, it was fully reasonable to make comparisons with high statistical power.

In Study V, the primary outcome measures were patient decision time, pre-hospital delay and ambulance use. Sample size was calculated based on the mean (SD) pre-hospital delay from data in RIKS-HIA. Because delay times were positively skewed, sample size was calculated based on log-transformed data. With the target of a reduction in the mean of 45 minutes, from 184 to 139 min, SD 160 min and using alpha 0.05 and beta 0.20, data on 114 patients in each group were required to detect a significant difference. With regard to ambulance use, the study population
in the questionnaire part was not sufficient to detect a reasonable increase and this variable has therefore been evaluated primarily via register data.

**Statistical analysis**

As delays were positively skewed, patient decision time, time from symptom onset until calling for an ambulance and pre-hospital delay were dichotomised in the analysis (II, IV, V). The cut-off point for delays was the median (II, IV), patient decision time of 60 min and pre-hospital delay of 120 min (V). These cut-offs were chosen according to the median (II, IV) and the relevance to receiving early treatment (V). To evaluate the influence of the campaign on the response to symptoms, the after-campaign group was divided into those who had or had not heard of the campaign (V).

**Descriptive statistics**

The results are presented as the median, mean, standard deviation (SD) and range for continuous variables and percentages for proportions (I–V).

**Univariate statistical analysis**

For comparisons between groups in terms of continuous variables, Pitman’s non-parametric permutation test (I, III) and the Mann Whitney U test were used (V). For comparisons of dichotomous variables between two groups, Fisher’s exact test was used (I, III, V). The likelihood that patients would have a decision time of < 1 h was defined as the odds ratio and 95% confidence interval (IV). When evaluating the influence of the campaign on delays, ambulance use and response to symptoms (V), logistic regression was used to calculate odds ratios (OR) and corresponding 95% confidence intervals (CI).

Ambulance use over time was evaluated using the chi-square test for trend and the chi-square test when comparing the period before with after the campaign, excluding the campaign period.

**Multivariate statistical analysis**

Logistic regression (I–III) and analyses of covariance (I) were used to calculate p-values (I, II) and OR and 95% CI (III) adjusted for the following factors: age, gender, type of ACS, a history of CAD, diabetes, heart failure, hypertension (I–III), residential area (II) and distance to hospital (III).

In Study V, a multiple logistic regression analysis was performed, because of clinically relevant differences in patient characteristics between groups. In this analysis, OR and 95% CI were adjusted: for age and type of ACS when comparing the before-campaign group with the after-campaign group.
group; and for age, gender and a history of CAD with regard to campaign yes vs. no.

A stepwise logistic regression was performed to examine the association between various factors and pre-hospital delay (II) and to examine factors associated with ambulance use (III). Independent predictors of a short decision time (<1 h) for the two definitions used were determined using logistic regression. Only those variables that were significantly associated (p<0.05) with decision time in the univariate analysis were included in the multivariate model (IV). The results are expressed as the OR and 95% CI.

Statistical analyses were performed in SAS 8.0 (SAS Institute Inc., Cary, NC, USA). The significance level was set at 0.01. This level was chosen due to the large number of p-values that were created (I–IV). In Study V, statistical analyses were performed in the Statistical Package for Social Sciences 17.0 (SPSS, Inc) and the significance level was set at 0.05. Two-sided tests were applied (I–V).

### Ethical considerations

The studies were approved by Ethical Review Boards and conform to the principles outlined in the World Medical Association Helsinki Declaration. Both verbal and written informed consent was obtained from each patient. Patient participation was strictly voluntary and the patients were told that confidentiality was guaranteed and that they could withdraw, at any time, without this having any negative impact on their future care (I–V). Answering questions about the onset of an ACS can pose a possible risk of arousing uncomfortable feelings. If such a situation occurred, it was possible for the patients to talk to a nurse or social worker. Participation was assessed in order not to present any other risk to the patient. The analyses were carried out at group level rather than individual level.

Approval was obtained from the ethics committees at each hospital (I–IV) and from the Regional Ethical Review Board in Uppsala, Sweden (V, no. 2008/222).
RESULTS

Symptom presentation in ACS (I)
All the patients had chest pain or chest discomfort, as this was an inclusion criterion. Half the patients reported pain/discomfort in the left arm (52%) and many patients had pain/discomfort in the right arm (32%). Symptoms such as nausea or cold sweat occurred in half the patients (53%) and one-third reported dyspnoea (36%). Tiredness (53%) and a feeling of sickness (40%) were also commonly reported symptoms. Approximately two-thirds experienced the symptoms as unpleasant (69%), worrying (66%) and troublesome (60%) respectively, while almost half the patients experienced their symptoms as frightening (43%) and tiring (46%) respectively. The word pressing, which is usually associated with ACS, was the most common word descriptor to describe the pain (66%), followed by squeezing (45%), grinding (44%) and tearing (41%). The occurrence of various word descriptors in the sensory component differed only marginally or not at all when we considered the type of ACS, gender and age.

Pain appearing suddenly and reaching maximum intensity within minutes (41%) and pain increasing gradually in intensity during hours (32%) were most frequently used to describe the onset of pain. The maximum intensity of pain/discomfort was a median of 7 on the ten-point scale.

Thoughts and actions after onset of symptoms (II, III)
Three-quarters (75%) of the patients interpreted their symptoms as being cardiac in origin. Two thirds (64%) reported that they knew someone who had had an AMI as a reason for suspecting that their symptoms originated from the heart and almost half had obtained information about AMI from newspapers (47%) or radio/TV (45%). Interpreting the symptoms as cardiac in origin (53%) and severe pain (51%) were the main reasons for deciding to seek medical care.

Most of the patients (89%) approached somebody, usually their husband/wife after the onset of symptoms. The people who were approached by the patient recommended the patient to go to hospital (45%) or call the EMS for an ambulance (37%). One in five recommended that the patient should rest (20%). Almost half the approached people actually called the EMS for an ambulance (49%) and a similar percentage took the patient to hospital (46%). In overall terms, it was unusual among the patients to contact an ordinary physician, the medical inquiry office, the outpatient clinic or directly call the EMS for an ambulance or advice (3-4% respectively).
Half the patients took medicine to relieve pain and nitrates were the medicine that was most frequently used. One-third (32%) of the patients hesitated about seeking medical care and most of them (90%) thought the pain would disappear, while almost half (42%) did not think it was serious. The majority (86%) of all patients had heard about the importance of quickly seeking medical care and calling for an ambulance when suffering from persistent chest pain. The most common way of receiving this information was via TV (50%), newspapers (48%), or a friend, neighbour or relative (41%).

Table 2 Adjusted odds ratios for factors independently associated with ambulance use among patients with acute coronary syndrome

<table>
<thead>
<tr>
<th>Knowledge (yes/no)</th>
<th>Adjusted OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have heard of the importance of quickly seeking medical care and calling for an ambulance when experiencing acute chest pain</td>
<td>3.61</td>
<td>2.43-5.45</td>
</tr>
<tr>
<td>Previous history of (yes/no) Heart failure</td>
<td>2.48</td>
<td>1.47-4.26</td>
</tr>
<tr>
<td>Type of symptom onset (yes/no) Abrupt onset of pain reaching maximum intensity within minutes</td>
<td>2.08</td>
<td>1.62-2.69</td>
</tr>
<tr>
<td>Associated symptoms (yes/no) Nausea or cold sweat</td>
<td>2.02</td>
<td>1.54-2.65</td>
</tr>
<tr>
<td>Vertigo or near syncope</td>
<td>1.63</td>
<td>1.21-2.20</td>
</tr>
<tr>
<td>Local factors (yes/no) Distance to hospital &gt; 5 km</td>
<td>2.00</td>
<td>1.55-2.59</td>
</tr>
<tr>
<td>Type of ACS (yes/no) ST-elevation ACS</td>
<td>1.58</td>
<td>1.21-2.06</td>
</tr>
<tr>
<td>Age (years; continuous)</td>
<td>1.03</td>
<td>1.02-1.04</td>
</tr>
<tr>
<td>Word descriptor (yes/no) Grinding</td>
<td>0.62</td>
<td>0.48-0.80</td>
</tr>
</tbody>
</table>

OR, odds ratio. CI, confidence interval. ACS, acute coronary syndrome.

Mode of transport to hospital and factors associated with ambulance use (III)

Half the patients (51%) went to hospital by ambulance. Almost one in three (30%) was given a lift by a friend or a neighbour. Patients transported to hospital by ambulance were older (median age 70 vs. 65 year), more frequently had STE-ACS (48% vs. 35%), a history of AMI (26% vs. 17%) and heart failure (11% vs. 4%). They more frequently reported severe symptoms, interpreted symptoms as cardiac in origin (81% vs. 70%) and had an abrupt onset of pain (54% vs. 33%). There was no clinically relevant difference in pain intensity between those who used an ambulance.
and those who did not. Factors independently associated with ambulance use are listed in Table 2.

Those who did not call for an ambulance thought self-transport would be faster (46%), did not believe they were ill enough (44%), thought it was easier to take a taxi or be driven (36%), did not think it was necessary (31%), did not think of going by ambulance (31%) or were not aware of the importance of going to hospital by ambulance when experiencing chest pain (28%).

The initial phase of ACS in relation to type of ACS (I–IV)

Patients with STE-ACS were a mean of three years younger and had less previous CAD and hyperlipidemia compared with patients with NSTE-ACS. They more frequently had associated symptoms, slightly higher pain/discomfort intensity and more frequently had pain with an abrupt onset reaching maximum intensity within minutes (Table 3). However, this type of symptom onset was only seen in half (49%) the patients with STE-ACS and only one in five (22%) fulfilled all the criteria usually associated with an AMI, i.e. 1) chest pain, 2) pain appearing suddenly and reaching maximum intensity within minutes, 3) pressing or squeezing pain/discomfort, 4) pain intensity of > 5 on the 10-grade scale and 5) pain was accompanied by nausea or cold sweat. The corresponding percentage for patients with NSTE-ACS was 12%. Pain that appeared and disappeared during hours to days was more frequently reported among patients with NSTE-ACS (27% vs. 20%, p<0.0001).

When examining differences between STE-ACS and NSTE-ACS, patients with STE-ACS were more frequently advised to call the EMS for an ambulance (41% vs. 32%, p<0.0001) and the people who were approached actually called the EMS for an ambulance more frequently (55% vs.42%, p<0.0001). Patients with STE-ACS also more frequently reported that the reasons for deciding to seek medical care were severe pain (59% vs. 49%, p=0.0002) and thinking it was a heart attack (55% vs. 42%, p<0.0001). In addition, they less frequently hesitated about seeking medical care (29% vs. 34%, p=0.0004).

The initial phase of ACS in relation to gender (I–IV)

Gender differed in a few respects and the differences in symptoms are shown in Table 3. Regarding actions after the onset of symptoms, women more frequently contacted a child compared with men (23% vs. 6%, p<0.0001). Among these women, 70% were living alone. Women also more frequently reported “did not want to be regarded as an imaginary invalid
or soft” (28% vs. 18%, p=0.003) as a reason for hesitation about seeking medical care. Considering that it was easier to drive oneself as a reason for not calling the emergency number for an ambulance was more common in men (19% vs. 7%, p=0.0002). Moreover, men were more frequently recommended by the people they approached to call for an ambulance compared with women (39% vs. 30%, p=0.005).

Table 3 Symptoms, pain/discomfort intensity and type of symptom onset in relation to type of acute coronary syndrome and gender (%)

<table>
<thead>
<tr>
<th>Symptoms (%)</th>
<th>ST-elevation ACS</th>
<th>Non-ST-elevation ACS</th>
<th>p*</th>
<th>Men</th>
<th>Women</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest pain</td>
<td>82</td>
<td>80</td>
<td>.02</td>
<td>82</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Chest discomfort/pressure</td>
<td>70</td>
<td>74</td>
<td></td>
<td>73</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Pain/discomfort in left arm</td>
<td>53</td>
<td>51</td>
<td></td>
<td>51</td>
<td>56</td>
<td>.02</td>
</tr>
<tr>
<td>right arm</td>
<td>34</td>
<td>30</td>
<td></td>
<td>31</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>neck or jaw</td>
<td>26</td>
<td>28</td>
<td></td>
<td>24</td>
<td>36</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>back</td>
<td>27</td>
<td>25</td>
<td></td>
<td>20</td>
<td>43</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>stomach</td>
<td>14</td>
<td>13</td>
<td></td>
<td>12</td>
<td>16</td>
<td>.03</td>
</tr>
<tr>
<td>Nausea or cold sweat</td>
<td>66</td>
<td>42</td>
<td>&lt;.0001</td>
<td>50</td>
<td>56</td>
<td>.01</td>
</tr>
<tr>
<td>Tiredness/weakness</td>
<td>54</td>
<td>53</td>
<td></td>
<td>51</td>
<td>59</td>
<td>.008</td>
</tr>
<tr>
<td>Feeling of sickness</td>
<td>41</td>
<td>38</td>
<td></td>
<td>38</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>33</td>
<td>38</td>
<td></td>
<td>36</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Anxiety/fear</td>
<td>33</td>
<td>35</td>
<td></td>
<td>32</td>
<td>40</td>
<td>.0008</td>
</tr>
<tr>
<td>Vertigo or near syncope</td>
<td>30</td>
<td>23</td>
<td>.0004</td>
<td>24</td>
<td>30</td>
<td>.02</td>
</tr>
<tr>
<td>Vomiting</td>
<td>18</td>
<td>11</td>
<td>&lt;.0001</td>
<td>11</td>
<td>24</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Maximum intensity of pain/discomfort

| Median (scale 0-10) | 8 | 7 | 7 | 8 |

Type of symptom onset (%)

| Abrupt onset of pain reaching maximum intensity within minutes | 49 | 40 | .001 | 45 | 41 |

* Adjusted p-value, p-value denoted if <0.05

The initial phase of ACS in relation to age (I–IV)

Differences between age groups were minor in terms of symptoms. The younger patients more frequently reported pain/discomfort in the left arm and neck or jaw, while the elderly ones more frequently reported tiredness/weakness and a feeling of sickness. Younger patients reacted more emotionally than elderly ones. With regard to the characteristics of pain, older patients more frequently reported that the pain increased gradually in
intensity over a period of hours and patients aged > 65 years more frequently thought that their back was causing the pain (8% vs. 5%, p=0.009). The elderly patients were more frequently recommended by the people they approached to call for an ambulance (41% vs. 32%, p=0.007) and people who were approached more frequently called the EMS (56% vs. 41%, p<0.0001) or took the patient to hospital (50% vs. 42%, p=0.0002) compared with younger patients. It was more common among younger patients to hesitate about seeking medical care (39% vs. 27%, p<0.0001).

The initial phase of ACS in relation to previous medical history (I–IV)
No difference was found between patients with and without diabetes regarding symptoms and type of symptom onset. Patients with a previous history of CAD more frequently attributed the cause of the symptoms to the heart (88% vs. 68%, p<0.0001) and more frequently took medicine to relieve pain (73% vs. 37%, p<0.0001). Fewer than half the patients with previous CAD (43%) reported that a nurse or some other health-care professional had informed them of the symptoms of AMI and one-third (36%) had been given information by a physician and quoted this as a reason for suspecting that the symptoms originated from the heart.

Patients without a history of CAD more frequently reported “did not think it was serious” (50% vs. 28%, p<0.0001) as a reason for hesitation about seeking medical care and “did not consider myself ill enough” (49% vs. 33%, p=0.0006) as a reason for not calling for an ambulance compared with those with a history of CAD. Furthermore, more patients with prior CAD had knowledge of the importance of quickly seeking medical care and calling for an ambulance (93% vs. 82%, p<0.0001). They reported that they had been given this information by a physician (55%) or nurse (43%). Regarding the mode of transport to hospital, patients with a previous history of CAD used ambulance to a greater extent (58% vs. 46%, p=0.004).

The initial phase of ACS in relation to residential area and distance to hospital (II, III)
Patients living in rural areas were more frequently advised to contact the outpatient clinic (26% vs. 16%, p<0.0001) and were less frequently advised to go to hospital compared with patients living in urban areas (40% vs. 49%, p=0.0006). Patients living in urban areas more frequently hesitated about seeking medical care (36% vs. 29%, p=0.005). They differed from patients living in rural areas by more frequently reporting “had heard about the long waiting times at the emergency department and did not
want to risk waiting for hours” (22% vs. 11%, p=0.0002, of the total that hesitated).

Patients with a distance to hospital of ≤ 5 km less frequently used an ambulance. Among those who did not use an ambulance, there was an association between a distance to hospital of > 5 km and reporting that it was “easier to take a taxi or be driven” and “not wanting to disturb others who could be in greater need of an ambulance” as reasons for not calling for an ambulance.

**Table 4** Factors evaluated and associated with a delay of > 160 minutes (median value) from symptom onset to hospital arrival

<table>
<thead>
<tr>
<th></th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted OR (95% CI)</td>
<td>Adjusted OR (95% CI)*</td>
</tr>
<tr>
<td><strong>Age (years; continuous)</strong></td>
<td>1.009 (1.000 - 1.018)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender (female/male)</strong></td>
<td>1.20 (0.96 - 1.52)</td>
<td></td>
</tr>
<tr>
<td><strong>Previous history (yes/no)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1.11 (0.91- 1.36)</td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>0.98 (0.68 - 1.42)</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.13 (0.86 - 1.51)</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.91 (0.74 - 1.12)</td>
<td></td>
</tr>
<tr>
<td><strong>Type of syndrome (yes/no)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST-elevation ACS</td>
<td>0.53 (0.43 - 0.65)</td>
<td>0.61 (0.48 - 0.77)</td>
</tr>
<tr>
<td>Residential area (rural/urban)</td>
<td>1.17 (0.96 - 1.42)</td>
<td></td>
</tr>
<tr>
<td>Interpretation of pain (yes/no)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The heart</td>
<td>0.48 (0.38 - 0.62)</td>
<td>0.56 (0.40 - 0.77)</td>
</tr>
<tr>
<td><strong>Actions (yes/no)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Took medication to relieve pain</td>
<td>1.84 (1.49 - 2.26)</td>
<td>1.83 (1.44 - 2.31)</td>
</tr>
<tr>
<td>Approached someone after symptom onset</td>
<td>0.46 (0.32 - 0.65)</td>
<td>0.54 (0.36 - 0.80)</td>
</tr>
<tr>
<td><strong>Reasons for decision to seek medical care (yes/no)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The pain was so severe</td>
<td>0.72 (0.59 - 0.88)</td>
<td>0.73 (0.57 - 0.92)</td>
</tr>
<tr>
<td>Thought I was having a heart attack</td>
<td>0.47 (0.38 - 0.58)</td>
<td>0.56 (0.44 - 0.73)</td>
</tr>
<tr>
<td>Did not have much pain but felt very sick</td>
<td>1.40 (1.10 - 1.77)</td>
<td>1.39 (1.05 - 1.83)</td>
</tr>
</tbody>
</table>

OR, odds ratio. CI, confidence interval. * Denoted only if the confidence interval was above or below 1

**Pre-hospital delay and patient decision time in ACS**

**Pre-hospital delay (II)**
The delay from the onset of symptoms until arrival in hospital, pre-hospital delay, was a median of 160 minutes. Interpreting symptoms as cardiac in origin and contacting somebody after the onset of symptoms were factors associated with a shorter pre-hospital delay (<160 minutes), whereas self-medication increased the delay. The presence of STE-ACS and severe pain was also associated with a shorter delay. Patients who reported not having
much pain but feeling very ill as a reason for the decision to seek medical care had an increased delay (Table 4). Gender, age and a history of CAD were not found to be associated with pre-hospital delay.

Table 5 Independent predictors of a short delay (<60 min and <68 min) between onset of symptoms and decision to seek medical care among all patients* and symptoms and calling for an ambulance among ambulance transported patients**

<table>
<thead>
<tr>
<th></th>
<th>All patients</th>
<th></th>
<th>Ambulance transported</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of symptom onset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abrupt onset of pain reaching maximum intensity within minutes</td>
<td>6.94 5.39-8.99</td>
<td>6.69 4.72-9.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous history</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment with thrombolysis</td>
<td>2.22 1.22-4.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have heard of the importance of quickly seeking medical care and calling for an ambulance when suffering from acute chest pain</td>
<td>1.91 1.32-2.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of ACS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST-elevation ACS</td>
<td>1.90 1.47-2.46</td>
<td>1.73 1.21-2.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpretation of pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac in origin</td>
<td>1.75 1.29-2.37</td>
<td>2.16 1.42-3.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word descriptors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional component</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frightening</td>
<td>1.54 1.20-1.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory component</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grinding</td>
<td>0.74 0.58-0.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associated symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertigo or near syncope</td>
<td>1.52 1.12-2.05</td>
<td>1.60 1.12-2.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea or cold sweat</td>
<td>1.40 1.07-1.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain localisation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>0.61 0.46-0.80</td>
<td>0.68 0.47-0.998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of symptom onset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At home</td>
<td>0.56 0.42-0.76</td>
<td>0.54 0.37-0.79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR, odds ratio. CI, confidence interval
*Information missing in 509 patients. **Information missing in 175 patients

Patient decision time (IV)
The distribution of patients according to decision time was as follows: < 15 min 20%, 15-29 min 20%, 30-59 min 13%, 1-2 h 13%, 2-3 h 6%, 3-4 h 4% and > 4 h 24%. Among patients transported by ambulance, the median time between the onset of symptoms and calling for an ambulance was 68 min, 25th and 75th percentile 30 min and 182 min respectively.

Pain appearing suddenly and reaching maximum intensity within minutes, STE-ACS, associated symptoms such as vertigo or near syncope, experiencing the pain as frightening, interpreting the pain as cardiac in origin and having knowledge of the importance of quickly seeking medical care...
were independent factors associated with a short delay. Pain localised in the back and symptoms onset at home when alone were associated with a prolonged delay (Table 5). Independent predictors of delay between the onset of symptoms and calling for an ambulance are listed in Table 5. Age, gender and a history of CAD were not found to be associated with patient decision time in the multivariate analyses.

The information campaign (V)

Patient decision time and pre-hospital delay (questionnaire part)

Table 6 Delays, ambulance use and response to symptoms in patients with acute coronary syndrome in the before-campaign group and after-campaign group

<table>
<thead>
<tr>
<th></th>
<th>Before-campaign group n=116</th>
<th>After-campaign group n=122</th>
<th>OR 95% CI</th>
<th>Adjusted OR 95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient decision time (all patients)</td>
<td></td>
<td></td>
<td>0.74 0.44-1.24</td>
<td>0.84 0.48-1.47</td>
</tr>
<tr>
<td>&lt; 60 min, n (%)</td>
<td>56 (50)</td>
<td>52 (43)</td>
<td>0.9 0.45-1.8</td>
<td>1.11 0.53-2.34</td>
</tr>
<tr>
<td>Symptom to call EMS</td>
<td></td>
<td></td>
<td>0.74 0.42-1.31</td>
<td>0.94 0.51-1.73</td>
</tr>
<tr>
<td>&lt; 60 min, n (%)</td>
<td>29 (48)</td>
<td>31 (46)</td>
<td>0.9 0.45-1.8</td>
<td>1.11 0.53-2.34</td>
</tr>
<tr>
<td>Pre-hospital delay</td>
<td></td>
<td></td>
<td>0.95 0.56-1.59</td>
<td>0.89 0.51-1.57</td>
</tr>
<tr>
<td>&lt; 120 min, n (%)</td>
<td>39 (47)</td>
<td>46 (40)</td>
<td>0.95 0.56-1.59</td>
<td>0.89 0.51-1.57</td>
</tr>
<tr>
<td>Mode of transport, n (%)</td>
<td></td>
<td></td>
<td>1.38 0.7-2.74</td>
<td>1.35 0.66-2.76</td>
</tr>
<tr>
<td>Ambulance</td>
<td></td>
<td></td>
<td>1.38 0.7-2.74</td>
<td>1.35 0.66-2.76</td>
</tr>
<tr>
<td>Interpretation of pain, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac in origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First contact after symptom onset, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member, neighbour, friend</td>
<td>87 (79)</td>
<td>84 (71)</td>
<td>0.63 0.35-1.16</td>
<td>0.59 0.31-1.12</td>
</tr>
<tr>
<td>EMS</td>
<td>8 (7)</td>
<td>15 (13)</td>
<td>1.82 0.74-4.48</td>
<td>2.49 0.93-6.67</td>
</tr>
<tr>
<td>Outpatient clinic, medical inquiry office, ED</td>
<td>11 (10)</td>
<td>18 (15)</td>
<td>1.59 0.71-3.53</td>
<td>1.42 0.62-3.27</td>
</tr>
<tr>
<td>Other</td>
<td>4 (4)</td>
<td>2 (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not hesitate to seek medical care, n (%)</td>
<td>73 (65)</td>
<td>70 (58)</td>
<td>0.75 0.44-1.28</td>
<td>0.75 0.42-1.31</td>
</tr>
</tbody>
</table>

OR, odds ratio. CI, confidence interval
EMS, emergency medical service. ED, emergency department
*OR and 95% CI adjusted for age and type of syndrome

Neither patient decision time, estimated by the patient, nor the time from the onset of symptoms to calling for an ambulance decreased after the campaign (Table 6). The category of median patient decision time, estimated by the patient, was 30-59 minutes in the before-campaign group vs. 1-2 hours in the after-campaign group. The median time between the onset of symptoms and calling for an ambulance was 68 minutes before the campaign vs. 71 minutes after the campaign. In addition, the total pre-hospital delay did not decrease but instead increased. The median pre-
hospital delay was 130 minutes in the before-campaign group compared with 165 minutes in the after-campaign group. When analysing the pre-hospital delay according to the cut-off of 120 minutes, no statistically significant differences were found between the groups (Table 6).

Ambulance use and number of patients with chest pain in the ED
Slightly more than half the patients who completed the questionnaire used the ambulance for transportation to hospital both before and after the campaign. A statistically significant increase in ambulance use was found during the campaign and the following three years after the campaign (registry data). This trend was not found in the rest of the country during the same period (Fig. 3). When comparing the period before the campaign with the period one to three years after the campaign (the campaign period excluded), ambulance use increased by 7.4% in patients with ACS (RIKS-HIA data). Fifty-eight percent used an ambulance before the campaign compared with 63% one to three years after the campaign (p=0.017).

The number of patients with chest pain seeking the ED increased during and after the campaign compared with the period before the campaign (Fig. 4).

Figure 3. Proportion of ambulance use per year

*RIKS-HIA I: the Swedish Register of Cardiac Intensive Care, patients with a diagnosis of acute coronary syndrome (ACS) in intervention hospital (p<0.001)
**RIKS-HIA II: RIKS-HIA, patients with a diagnosis of ACS in the rest of the Country
***Amb.reg: Ambulance Mission Register, patients with chest pain admitted to the emergency department, intervention hospital, (p<0.0001)
Influence of the content of the campaign (questionnaire part)
Patients who had heard of the campaign (n=24, (20%)) were older, were more frequently female and more frequently had a history of AMI, PCI, hyperlipidemia and diabetes compared with those who had not heard of the campaign. The patients had heard of the campaign in the following ways: leaflet (n=16), newspaper (n=7), radio/TV (n=5), posters (n=5), seminars (n=3), the internet (n=1) and the video disc (n=0). The majority reported that the campaign had influenced them in their decision to seek medical care and in their decision to call for an ambulance. They also reported that it had influenced them to suspect that the symptoms originated from the heart. Although the patient decision time and the pre-hospital delay tended to be shorter and ambulance use tended to be higher among patients who had heard of the campaign, no statistically significant associations could be detected.
DISCUSSION

The main findings in this thesis were, firstly, the small percentage of patients with the type of symptoms that are commonly associated with ACS, those with STE-ACS included. We found more similarities than differences in symptoms with regard to gender.

Secondly, many of the patients thought the heart had caused the symptoms, but, despite this, almost half waited more than one hour before deciding to seek medical care. The most common reason for believing that the symptoms originated from the heart was knowing someone who had had an AMI. The majority contacted a family member, whereas only a few directly called the emergency number for an ambulance. Approaching someone after symptom onset and interpreting the symptoms as cardiac in origin was associated with shorter pre-hospital delay.

Thirdly, the proportion of patients who used an ambulance was not very high. Others have reported higher figures. Knowledge, i.e. having heard of the importance of quickly seeking medical care and calling for an ambulance when experiencing chest pain, an abrupt onset of symptoms with more severe symptoms and STE-ACS were factors that increased ambulance use and were also associated with a shorter patient decision time. Furthermore, interpreting pain as cardiac in origin was associated with a shorter decision time but not with ambulance use.

Fourthly, no association was found between age, gender or a history of CAD and pre-hospital delay or patient decision time.

Finally, a relatively small community information campaign designed to inform people about how to act when faced by an ACS did not result in a reduction in patient decision time, but it appeared to increase ambulance use.

Symptom presentation in ACS

We found that symptoms such as vertigo or near syncope, nausea or cold sweat and vomiting were more common among patients with STE-ACS. It therefore seems likely that more extensive myocardial damage is more frequently associated with these symptoms. However, just half the patients with STE-ACS reported that the pain appeared suddenly and reached maximum intensity within minutes and only one in five fulfilled all the criteria usually associated with an AMI. Because patients are unable to differentiate between whether the symptoms are due to STE-ACS or NSTE-ACS, early medical contact is needed in both instances.

A large number of studies have been performed to examine whether there are differences with regard to gender in ACS. The results are, how-
ever, inconsistent to a large extent. Atypical symptoms are common in both genders but slightly more common in women.\textsuperscript{89, 90} This was confirmed by our study with more similarities than differences when comparing women with men. It has, however, previously been suggested that typical symptoms are also the strongest symptom predictors of ACS in women and are as important in women as in men.\textsuperscript{91} One inclusion criterion in the present thesis was pain or discomfort in the chest. Recent research has shown that chest pain is the most frequently presenting symptom in both women and men with AMI.\textsuperscript{89, 92, 93} In two reviews, however, women were significantly less likely to report chest pain or discomfort and had a larger number of diverse symptoms compared with men.\textsuperscript{6, 90} The authors conclude, however somewhat conflicting, that the differences are not large enough to motivate gender-specific messages regarding the symptoms of ACS\textsuperscript{6} and continue to promote chest pain as the main symptom of ACS, but also highlight potential gender differences.\textsuperscript{90}

Furthermore, the presence of a larger number of various symptoms\textsuperscript{92, 93} and observations that women may sometimes experience milder and atypical symptoms or describe them somewhat differently compared with men might lead the physician to misdiagnose. To summarise, based on our and others’ findings, it is important to emphasise in public education and to health-care professionals that an ACS can present in many different ways in both genders, with more similarities than differences.

With regard to age, we found that elderly patients more frequently experienced pain that increased gradually in intensity during hours. Furthermore, the age differences relating to symptoms were minor and the absolute differences were small. It has previously been reported that elderly patients experience less typical symptoms compared with younger patients.\textsuperscript{89, 94} In addition, age may be an important contributor to any gender-based differences in ACS presentation because women with ACS are older than men.\textsuperscript{6} However, further research is needed in this area.

Importantly, symptom experience versus symptom expectation of what a heart attack would be like differs between “typical” and “atypical” symptoms. Few patients expect to experience the atypical symptoms, i.e. atypical pain, radiating pain (arm, jaw, neck or shoulder), shortness of breath, nausea or vomiting, dizziness and sweats while many patients expect typical symptoms, i.e. chest pain. A majority of women and men reported that their symptoms were different from what they expected.\textsuperscript{95-97} This is consistent with and explains why many patients do not interpret the symptoms of ACS as a serious condition. In addition, the media picture of an AMI highlights the fact that the typical symptoms of AMI are chest pain with an
acute onset. This might mislead patients, as a high percentage obviously has other pain characteristics without an acute onset.

**Thoughts and actions after the onset of symptoms**

Three of four patients interpreted their symptoms as cardiac in origin. Lower, similar and higher figures have been reported previously. Despite this observation, the median delay from symptom onset to hospital admission was as long as 160 minutes (including the ambulance staff’s procedure time) and about half waited more than one hour before deciding to seek medical care. This may indicate that the majority of patients are not aware of the significance of the time until the start of treatment. In fact, believing that the heart is causing the symptoms is only one of several factors that influence the decision-making process.

One important finding was that more than half the patients knew someone who had had an AMI and this made them interpret their own symptoms as being cardiac in origin. This finding suggests that identifying oneself with another person helps to recognise the symptoms of an AMI. Information campaigns aimed at reducing patient delay should take this into account.

Most patients contacted somebody, usually their spouse or a child, rather than making the appropriate initial response to their symptoms, i.e. calling the emergency number directly for an ambulance. This kind of behaviour has been reported previously and contrasts strongly to the current recommendations. The finding that the people who were approached by the patient called for an ambulance or took the patient to hospital and encouraged the patients in their decision to seek medical care indicates that there is a need to educate not only the patients but also their family members about the appropriate action in the early phase of a suspected ACS. They can help the patient by taking charge of the situation and are thereby responsible for the decision to seek medical care and call for an ambulance. A theoretical perspective of the illness process is described in the Illness Constellation Model, developed by Morse and Johnson, based on that the illness affects both the person who is sick and the relative. The model consists of four stages where the first two include the initial phase: (1) the stage of uncertainty, struggling to maintain control, (2) the stage of disruption, loss of control, (3) striving to regain self and (4) regaining wellness, sense of control. Thus, to contact somebody after the onset of symptoms make it easier for the patient to abandon control, let someone else take over (stage one and two in the model) and thereby facilitate in the decision to seek medical care. In addition, in the social situation, the patient, family members and lay people experience an
intersection and interaction between social, psychological, cultural and biophysical factors in the decision about when, where and if medical care will be sought.\textsuperscript{102, 103} Furthermore, people appear to act more appropriately to someone else’s chest pain than to their own.\textsuperscript{104}

Responses like thinking that the pain will disappear and thinking it is nothing serious lead to hesitation about seeking medical care. These responses contribute to longer delays and are previously known as common responses when suffering an ACS.\textsuperscript{35, 68, 73, 74} It has been reported that women do not see the symptoms, even when severe, as a potential risk of an AMI. They wait at home thinking the pain will disappear and do not interpret and understand the symptoms as originating from the heart.\textsuperscript{105} This might also apply to males and we did not find any differences between genders with regard to reasons for hesitation. In addition, previous research has examined factors related to care-seeking behaviour, where defence and coping mechanisms play a role.\textsuperscript{106} A previous negative experience of health care is a factor that might affect the care-seeking process negatively.

There were some differences in approached people’s responses to symptoms. Men were more frequently advised to call the emergency number for an ambulance as compared with women. It is important to teach the public that CAD is not only a “male” disease nowadays. It has, however, recently been suggested that knowledge of the symptoms and risk factors of cardiovascular disease is similar or even higher in women compared with men.\textsuperscript{107-109}

It was obvious that patients’ reactions after symptom onset were influenced by the presence of a history of CAD. The observations that patients with previous CAD did not call for an ambulance more frequently than patients without CAD and that the belief that the pain would disappear was similar regardless of a history of CAD was somewhat surprising, however. Pattenden et al. suggested that self-medication could contribute to the perception that the pain would disappear.\textsuperscript{69} Patients were confused because their symptoms were similar to those of angina and the use of nitrates may increase this confusion by “lessening the pain a bit”.

**What factors are crucial for delays in ACS?**

We found that about half the patients with ACS decided to seek medical care within one hour after the onset of symptoms. The strongest factor associated with a short decision time, both when evaluating all patients and when evaluating patients who called for an ambulance, was the type of symptom onset, i.e. when the pain appeared suddenly and reached a maximum within minutes. This information is hardly surprising. It is reasonable to assume that this type of symptom onset will alert and worry
many patients and therefore force them more quickly to dial the emergency number or contact health-care providers by some other means.

Another factor that appeared to help the patients to decide more quickly to alert health-care providers was that they thought that the symptoms originated from the heart. In addition, thinking that one was having a heart attack was one reason for the decision to seek medical care and shortened the pre-hospital delay. This information is in agreement with others.\textsuperscript{106,110} In addition, individuals with symptoms that match their expectations of having an ACS or attribute symptoms as originating from the heart seek care more quickly than those who do not experience the expected symptoms.\textsuperscript{63,95,111,112} The findings that many patients do not experience the type of symptoms that are commonly associated with ACS and thereby do not recognise the symptoms of an ACS contributes to delays in receiving early treatment.

One factor that was strongly associated with a shorter decision time was the presence of STE-ACS. This type of ACS was associated with more distinct symptoms, and it should therefore be expected to be associated with a shorter patient decision time. Associated symptoms such as nausea and cold sweat were also associated with a shorter patient decision time. These symptoms are indicators of a more severe ACS and will probably alert the patients more rapidly to approach health-care providers. Seeking medical care due to severe pain was associated with a shorter pre-hospital delay. The intensity of pain was, however, not associated with patient decision time in the multivariate analysis in accordance with previous findings.\textsuperscript{60} However, there are some difficulties in trying to evaluate the intensity of pain when using figures such as estimations from a numerical rating scale, since there is no correlate in words with the various numbers. So, a value of 7 on the scale might mean different things to different patients. Moreover, factors other than the intensity of pain appear to be more important in relation to the patient decision time.

As mentioned earlier, and in agreement with findings reported by others, family members play an important role in the decision-making process.\textsuperscript{71,99,103,113} Approaching someone after symptom onset was therefore associated with a shorter pre-hospital delay, whereas we found that being alone at home at symptom onset contributed to longer delays. However, others have reported that contacting a relative contributes to longer delays.\textsuperscript{111} Thus, contacting a family member can have both positive and negative influence on pre-hospital delay.\textsuperscript{99,103} Contacting a general practitioner\textsuperscript{98,111} or other health care providers\textsuperscript{114} is also a factor contributing to longer delays. Furthermore, previous research has reported longer delays
among patients treating their symptoms with medication\textsuperscript{35, 73, 75, 111} and this was confirmed by our study.

Many previous studies have shown that women wait longer than men to seek help in the event of acute chest pain.\textsuperscript{57, 115, 116} We found a gender difference in the univariate analysis indicating a longer delay in women. However, when other variables were taken into account in a multivariate analysis, female gender did not appear as an independent predictor of patients’ decision time. This was also reported recently in a Swedish study.\textsuperscript{89}

Many of the factors in our study that were related to the delay were also gender related. Women more frequently suffered a heart attack when at home and alone. Women also more frequently had pain in the back. In addition, women are more likely to have co-morbid conditions such as diabetes, hypertension and heart failure in AMI.\textsuperscript{6} Most previous studies have suggested that increasing age is associated with a prolonged delay.\textsuperscript{56-58, 66, 89, 116} In contrast, we did not find that age was associated with patient decision time or pre-hospital delay. We have no good explanation for this discrepancy between previous research and our own findings, although the relatively young study population could have contributed to our findings. Our data thus suggest that the patients’ reaction pattern is more important than age and gender.

Finally, knowledge about the importance of quickly seeking medical care when suffering from chest pain was a predictor of a shorter patient decision time (although not among those who used ambulance). According to Morse and Johnson, prior knowledge of or experience of CVD are factors that cause the person to abandon control and should therefore reduce the delay.\textsuperscript{101} This highlights the importance of trying to spread the message of how to act appropriately as effectively as possible.

**Which factors are associated with ambulance use in ACS?**

One of the main findings was that only half the patients were transported to hospital by ambulance. This was observed despite the fact that the EMS in Sweden can be reached free of charge by the user, due to the existing state health insurance system. Having knowledge of the importance of calling for an ambulance when suffering from a suspected ACS was strongly associated with increased ambulance use. However, three-quarters of the patients who did not use ambulance also had this knowledge, indicating that they did not interpret their symptoms as being serious enough. This information is important, as it suggests that educational campaigns might have the potential to increase ambulance use, which was supported by our own intervention, despite previous negative experiences.\textsuperscript{80, 117, 118} Furthermore, in the REACT trial, increased ambulance use was found in
intervention communities. In addition, community interventions have previously been shown to increase the general public’s knowledge of heart attack symptoms.

In agreement with previous reports, increasing age was associated with increased ambulance use. Older people have more severe co-morbidity and are therefore more aware of calling for an ambulance, whereas younger persons may be less likely to believe that they have a serious disease. We found no gender differences in ambulance use, which contrasts with previous findings. We have no clear-cut explanation for this observation. The study population is relatively young and it is possible that, if the total spectrum of ages had been covered, we might have seen more women using an ambulance.

The finding that a history of heart failure was associated with increased ambulance use is in agreement with previous studies. It seems reasonable that heart failure is associated with severe symptoms such as dyspnoea. This should alert patients to call for an ambulance. Dyspnoea was also a symptom that was more frequently reported by patients who were transported by ambulance. In the univariate analysis, patients with a prior AMI were found to use an ambulance more frequently. However, prior AMI was not an independent factor associated with ambulance use in the multivariate analysis.

An abrupt onset of pain/discomfort and associated symptoms were associated with increased ambulance use, as was ST-elevation ACS. These results indicate that patients experiencing more severe symptoms, symptoms that match today’s picture of a heart attack, more frequently chose to initiate care by using an ambulance. The more severe the symptoms, the greater the ambulance use reported in several previous studies.

Distance to hospital was associated with ambulance use. The distance to hospital appears to have an impact when it comes to the mode of transport. In agreement with recent published data, patients living close to a hospital did not use the ambulance to the same extent. As reported previously, those who did not call for an ambulance thought self-transport would be faster or did not believe they were ill enough. However, even if self-transport to hospital is faster, more rapid care is obtained when an ambulance is used. This information was highlighted in our information campaign.
Community interventions to affect behaviour when suspecting an ACS

The information campaign did not result in a reduction in patient decision time, but it appeared to increase ambulance use. With regard to ambulance use, the clinical relevance of an increase of 7.4% can be discussed. In the light of the fact that delays to treatment and mortality will most probably be reduced when using an ambulance, it should be interpreted as clinically relevant. In addition, early reperfusion treatment is possible primarily because of direct transfer to the PCI lab, thereby bypassing the ED. This was a relatively small campaign based primarily on written information and, in spite of this, there was an increase in ambulance use over time. This finding of an increase in ambulance use during and after the campaign in the area where the campaign took place and no increase in the rest of the country suggests a campaign effect. However, the proportion of patients who used ambulance in the campaign area was smaller before the intervention compared with the rest of the country. The fact that this kind of room for improvement may explain at least part of the positive results must be considered.

The earlier campaign that was performed in Gothenburg in Sweden did not change the ambulance use, despite a slogan containing the message “heart-pain-call 90 000 (the emergency number at the time)”.

One reason might be the time between the interventions (the Gothenburg campaign was run 25 years ago), with a more permissive attitude today when it comes to calling the emergency number for an ambulance. However, the fact is that our message highlighted the importance of and the reason for calling for an ambulance, which was not highlighted in previous community interventions to a similar extent.

The result of no reduction in patient decision time or pre-hospital delay after the campaign may be due to the relatively small percentage of patients who had actually heard of the campaign. Moreover, the before-campaign group was younger and more frequently had STE-ACS, but, despite statistical adjustment for these factors, no change in delay was found. A recent study observed a 17 minutes reduction of pre-hospital delay after a community information campaign.

There was an increase in the number of patients seeking care for chest pain in the ED, especially the first month after the start of the campaign. A transient increase in ED visits after such an intervention has previously been reported. We found, however, an increase in the number of ED visits even years after the campaign, suggesting an increased awareness of taking chest pain symptoms seriously. The campaign may have contrib-
uted to this finding. Other previous interventions did not result in an increase in the number of ED visits.\textsuperscript{119, 127} There is no good explanation for the deviation in results when comparing ours with others. Methodological aspects may play a role. There are obvious difficulties in the evaluation of the number of admissions to hospital with acute chest pain in a community.

Patients who had heard of the campaign reported that it had influenced them in their decision to seek medical care and call for an ambulance. This group of patients also tended to act more appropriately. Despite the fact that no statistical significance was detected, which could be related to the sample size in the subgroup, the differences in percentages and ORs suggest that the content of the campaign appears to be effective. It needs, however, to be confirmed in a larger study.

Previous educational campaigns have highlighted the fact that the typical symptoms of an AMI is chest pain with acute onset.\textsuperscript{78} This might have misled patients, as a high percentage obviously have other symptom presentations and other pain characteristics. Media information about the symptoms of a heart attack appears to influence the ability to recognise the symptoms of a heart attack. However, a recent information and counselling intervention targeting high-risk patients gave information about symptoms and appropriate actions but still failed to change the pre-hospital delay and ambulance use,\textsuperscript{127}

**How can we teach people to act appropriately in the initial phase of an ACS?**

The achievement of appropriate actions among people suffering a suspected ACS is a major challenge. Awareness of AMI symptoms and recognising the need to call for an ambulance have been demonstrated to be low.\textsuperscript{107, 108} It is important to inform people about the various symptoms of ACS, which gives a new, less dramatic picture of a heart attack. It seems that it is not enough to have knowledge of typical ACS symptoms and to interpret them as being cardiac in origin in order to make the decision to seek medical care quickly. The general public and people with a known risk of ACS therefore need to be informed that patients who suffer from ACS are frequently affected by unproductive thoughts, feelings and actions at the onset of symptoms. The complex care-seeking process, including cognitive, emotional and social factors, has to be considered in any attempts to induce the appropriate actions in ACS.

Highlighting the time factor, the importance of ambulance use and its influence on outcome is paramount. Moreover, using an ambulance in ACS
has to be given legitimacy and people need to be aware that the ambulance is an extended part of hospital care, with the facilities to start the treatment and directly transport the patient to the appropriate level, thereby often bypassing the ED. This is an important message and it also applies to people living close to a hospital. Furthermore, information about the treatment that can be provided and the negative consequences of delays in seeking medical care for symptoms of an ACS needs to be communicated. The way in which the general public is made aware of the seriousness of an AMI and how clearly this should be communicated is, however, unclear. One question is whether or not information campaigns should scare the public. It is possible that scaring the public is counter-productive and contributes to defensive reactions. However, experiences that strong negative information may, on the other hand, have the desired effect on behaviour as long as the individuals believe they can protect themselves have been reported.  

Public information

It could be argued that there is little evidence that community interventions change patients' perceptions of symptoms and actions in ACS. However, the various types of onset of symptoms and the complex care-seeking process have previously not been fully communicated. Furthermore, limiting the educational efforts to persons at high risk of the future development of ACS will only reach a part of our target group. Family members play an important role in the decision to seek medical care. Finally, in order to reach patients with first-time ACS and potential bystanders, the information must be directed at the general public.

Furthermore, efforts to influence patients' behaviour at the onset of ACS need to be continuous, preferably through the media, i.e. TV, newspapers. It has previously been reported that these channels are the most frequent means by which patients have received information about the importance of rapid care-seeking and calling for an ambulance when experiencing persistent chest pain. However, this means of communication is relatively expensive and requires support from the public services.

One concern when educating the general public is that it may contribute to an inappropriate increase in ambulance use and ED visits in patients worrying about suffering from AMI although their symptoms were harmless. In a recent study, however, the intervention did not increase anxiety levels but increased the sense of perceived control in cardiac patients. Moreover, individualised counselling is not possible. Naturally, educating the general public does not exclude patients at high risk receiving individualised information in which health-care professionals can prepare people at
known risk of CAD about the symptoms and appropriate actions in the event of suspected ACS.

**The health service**

Because survival after an ACS may be directly related to the individual’s decision to seek medical care for symptoms, it is regrettable that healthcare providers appear to have been unsuccessful in informing the people at risk of ACS and the public of the appropriate response to ACS symptoms. We found that patients with a history of CAD had more frequently been informed about AMI symptoms by someone who had had an AMI rather than by healthcare professionals. In addition, a previous history of MI did not predict ambulance use or a short delay. This indicates that the medical service has been unsuccessful with its information. One reason could be a wrong message. Another explanation could be that healthcare professionals give too much information at the same time and patients are therefore unable to assimilate the information. To the best of my knowledge, further research is needed in this area.

Healthcare professionals need to be aware of the opportunity to inform people and patients at high risk of CAD about the appropriate action in the early phase of a suspected ACS. In order to do this, it is also necessary to educate healthcare professionals. They must be aware that ACS can present in many different ways in both genders, with more similarities than differences. The findings relating to differences in subgroups, such as gender, should be borne in mind but used with caution in the meeting with the patient, as every person is an individual and varies a great deal from one case to another. Information about the treatment that can be provided and the negative consequences of delay in seeking medical care for symptoms of an ACS also needs to be communicated.

Furthermore, healthcare professionals have the potential and can prepare patients and their families to avoid unproductive responses by informing them about these kinds of responses to symptoms. Furthermore, to avoid hesitation among patients with CAD when it comes to seeking medical care, the instructions must be very clear; if nitrates have no total effect within 15 minutes, call for an ambulance. Moreover, a previous negative experience of health care might contribute to delays in seeking medical care. It is therefore important to make medical resources user friendly.

**Discussion of methods**

Quantitative methods were used in all five studies. The purpose was to describe the initial phase of ACS in overall terms and in relation to various subgroups. When an approach of this kind was used, quantitative methods
appeared to be appropriate. We therefore used the knowledge of the topic at the time when designing the questionnaire (I–IV).

The selection of hospitals was made to cover different areas of the country (I–IV). We chose the hospitals at which we had colleagues with an interest in the problems under investigation. One alternative to convenience sampling would have been a random selection of all the hospitals in Sweden, with the strength of avoiding possible selection bias. However, the participating hospitals were located in different areas of Sweden and there was a fairly similar distribution of patients living in rural and urban areas. With regard to the representativeness of the study population, we found that all patients with a diagnosis of ACS admitted to a CCU for chest pain in the participating hospitals during the time of the survey were three years older and included more women when compared with the study cohort (Table I). The study cohort covered approximately 41% of all eligible patients in the participating hospitals during the corresponding period. With regard to residential area, the distribution of all eligible patients with a diagnosis of ACS, admitted to a CCU for chest pain at the participating hospitals during the time of the survey, we found that somewhat more patients lived in urban areas (53% vs. 47% in rural areas) compared with the study cohort (data from RIKS-HIA). Furthermore, an analysis of the excluded patients at one hospital was performed and it demonstrated that the excluded cohort was eight years older on average and included more females compared with the total sample in the same hospital.

The use of a self-administered questionnaire with predefined response options poses some methodological considerations. The participants are forced to give simple answers to sometimes complex questions. Moreover, since there are limited numbers of possible answers, which are based on the designer’s perspective and experiences, it also fails to capture the unexpected. However, in the questionnaire used in the present thesis, it was possible in each question to choose the response alternative “other”, with an opportunity for the patient to use his/her own words in the answer, but this has not been analysed.

The questionnaire was evaluated for content and face validity by experienced cardiologists, cardiac-care nurses and a behavioural scientist and for face validity by patients with ACS. Many of the questions in the questionnaire had previously been used in a smaller study in Gothenburg. The questionnaires might have needed more testing with regard to validity. However, further testing with regard to validity was not performed. A suitable test of reliability was not performed, since the instrument used does not measure a single concept and testing internal consistency would not be appropriate.
The patients completed the questionnaire retrospectively, making recall bias and inaccuracy possible (I–V). We did not record the exact day after hospital admission on which the questionnaire was given to the patients. However, the routine was to give it within three days. It remains unknown whether symptoms are remembered differently based on the experience embedded in diagnosis and treatment (I–V).

Since a cross-sectional design was used in Study I-IV, conclusions regarding relationships between variables and outcome should be interpreted with some caution. Multivariate analyses were therefore performed to adjust for potential confounders. Information was missing for all the evaluated variables, but the percentage of missing information was generally low. Because of a large number of statistical tests, a higher statistical significance level was used (<0.01). No other method of correction was used and this can be discussed. However, the risk of type 2 errors, failing to detect differences or associations when they really exist, increases when avoiding mass significance using the Bonferroni correction, for example.

The strengths of Studies I–IV are that they are all based on a large, relatively representative sample of patients hospitalised with ACS and the fact that a heterogeneous group of patients from different geographical areas in Sweden were evaluated. There are, however, some limitations. Firstly, the patients who completed the questionnaire were selected on the basis of inclusion and exclusion criteria. The findings are representative of the population who survived the initial phase, as patients who died of an ACS before reaching the CCU were not included. The study population was younger and included more males than in RIKS-HIA. This was expected, as patients who were not in a clinical condition to answer the questionnaire were mostly elderly. In Sweden, there are patients with ACS who are admitted to wards other than the CCU or the equivalent. They are mostly elderly. We are therefore unable to generalise our data to apply to an elderly population with ACS. Furthermore, the possibility that aspects of co-morbidity could have influenced the results cannot be excluded. In the statistical analyses, we therefore adjusted not only for the type of ACS, gender, age, a history of diabetes and CAD but also for other cardiovascular diseases (I–III). Secondly, only patients with chest pain or chest discomfort were included. Thirdly, we have not examined the symptoms of ACS in relation to other factors of possible relevance such as race, culture and socio-economic status. Fourthly, the inability to distinguish the chief complaint that led the patient to seek medical care from other associated symptoms. Fifthly, the questionnaire was in Swedish, which limited participation to patients who understood the Swedish language. Finally, not all the patients fulfilling the inclusion criteria at all the participating hospitals...
were asked to participate, which introduces the possibility of selection bias. This was caused by logistical difficulties (such as study nurse on vacation, overloaded personnel etc.). These logistical difficulties could hardly be regarded as system errors and the risk of selection bias is therefore less obvious. These limitations may have biased our results. In spite of this, the findings can be generalised to apply to the majority of the population of patients with ACS, with the exception of patients without chest pain/discomfort at symptom onset, the elderly (age >80 years) and patients with multiple diseases.

In Study IV, we did not include two aspects of the inquiry in the analysis, i.e. behavioural response and the response of approached people. This was done in order to limit the number of variables included in the analyses and to avoid overly complicated analyses. However, in Study II, we performed an analysis of the variables when relating to pre-hospital delay.

Furthermore, the time from symptom onset to calling for an ambulance and the time from symptom onset to the decision to seek help may not be exactly the same. The measurements of patient decision time should therefore not be expected a priori to produce exactly the same results. The time of a call is a hard end point, as we have information on the time of calls received by the emergency dispatch centre, but decision-making in the absence of calling for help can be regarded as soft, as it is based on the patients’ memory and therefore creates a risk of recall bias. In addition, the time of decision to seek medical care is not equal to time of actual departure to hospital. The decision to call for an ambulance may also define a group with more severe symptoms.

Furthermore, a large proportion of patients who suffer from ACS have symptoms that start with brief periods of pain or discomfort before the onset of pain or discomfort that is continuous and more severe or at least more obtrusive. In Study IV and V, the time of onset of symptoms was defined as the start of continuous or severe symptoms. These problems, in combination with the risk of recall bias, introduce problems in scientific evaluations of patient delay. Finally, operational definitions of delay time to distinguish between delayers and non-delayers vary across research studies. This pose a problem as the different cut-off times for the definition of delay time may lead to inconsistent results.\footnote{131}

In Study V a quasi-experimental design was applied. One major methodological concern is the difficulty associated with drawing conclusions because of the non-randomised study design. The external validity is threatened because it is difficult to draw conclusions about possible mechanisms behind an eventual association between the intervention and various outcome measurements. Factors other than the intervention could
account for observed differences in outcome. However, with regard to the increase in ambulance use, the time series design and the fact that the increase was not found in the rest of the country during the same period indicate a campaign effect. The strength of using a quasi-experimental design is that it is practical, describes real-life circumstances/patients and is likely to be acceptable to a broader group of patients, because of the non-random assignment. The fact that there was quite a long period between the time of measurement in the pre-campaign group and the intervention is a limitation. However, since the behaviour after symptom onset among patients with ACS appears not to have changed over the past few decades, this has probably not influenced the results.

Patients without symptoms from the chest were not included in the questionnaire part. This may have influenced the results, as, in the information material, we highlighted the fact that symptoms do not have to be severe, and that ACS sometimes occurs without chest symptoms. The selection of patients was designed to be consecutive. However, in the historical cohort, this was not possible due to overloaded personnel, which explains the longer period of inclusion than was originally planned. The amount of missing information was low in overall terms. The internal response rate was 96-100%, with the exception of smoking where the response rate was somewhat lower.
CONCLUSIONS

With regard to the symptoms of ACS, patients with STE-ACS differed from those without in a number of aspects; there were more similarities than differences between genders; differences in age were of minor importance and there were no differences between patients with and without a history of diabetes. The most striking finding was the low proportion of patients with the type of symptoms that are commonly associated with ACS, i.e. severe chest pain with abrupt onset reaching maximum intensity within minutes.

The majority of the patients thought the heart had caused the symptoms, but, despite this, only a few called the EMS for an ambulance. Approaching someone after symptom onset and the belief that the symptoms were cardiac in origin were factors associated with shorter pre-hospital delay. Experiencing severe pain was a reason for deciding to seek medical care and also resulted in a shorter delay, whereas not having much pain but feeling very sick and taking medicine to relieve pain resulted in the opposite. The reaction pattern was influenced to some extent by gender, age, history of CAD and type of ACS but to lesser extent by residential area.

Furthermore, the EMS is still under-utilised by patients with ACS in Sweden. Symptoms, patient characteristics, ACS characteristics, perceptions and knowledge and distance to hospital were all associated with ambulance use. Reasons not to call the emergency number for an ambulance were thinking self-transport would be faster or not being ill enough. The fact that knowledge increases ambulance use and the need for behavioural change pose a challenge for health-care providers. A number of factors, including the type of ACS, the type and localisation of symptoms, the place where symptoms occurred, patients’ interpretation of symptoms and knowledge, were all associated with patients’ decision time to seek medical care for suspected ACS. No association was found between age, gender or a history of CAD and pre-hospital delay or patient decision time.

A relatively small community information campaign designed to inform people about how to act when faced by a suspected ACS did not result in a reduction in patient decision time, but it appeared to increase ambulance use in ACS and the number of patients seeking the ED for acute chest pain, measured three years after the start of the campaign.

Clinical implications

To seek medical care promptly, people need to be aware of the symptoms of ACS, know the action to take and understand why this action should be taken. People in general and persons at high risk of CAD in particular need
to be informed of the consequences of delays in seeking medical care following the symptoms of an ACS. Based on available evidence, the message should target women and men equally. The inclusion of family members in education programmes addresses an important environmental factor that can stimulate the appropriate action in response to ACS symptoms. The fact that knowledge appears to increase ambulance use and is a factor that reduces the time between onset of symptoms and the decision to seek medical care and the need for behavioural change pose a challenge for health-care professionals. The results in the present thesis should be considered when planning educational and information programmes.

Furthermore, the content of the information material seems to have contributed to a more appropriate action after symptom onset among patients with ACS who actually had heard of the campaign. The information material could therefore be used as a complement in education and counselling situations, as well as in community information.

**Future research**

Future research should focus on developing methods to influence the patient decision time and ambulance use and to evaluate the results thereof.

To date, the results of community interventions conflict and there is a need once and for all to establish the influence of community interventions on patients’ behaviour in ACS. Preferably, a large-scale, prospective study should be carried out. Apart from patient decision time and ambulance use, mortality and morbidity should be measured, as well as cost effectiveness.
SVENSK SAMMANFATTNING
(Summary in Swedish)

Akut koronart syndrom (AKS), vilket inkluderar akut hjärtinfarkt och instabil kranškarlsjukdom, är en vanlig dödsorsak bland både kvinnor och män i västvärlden. Initiering av reperfusionsbehandling, trombolys (propupplösande behandling) eller PCI (ballongvidgning), är avgörande för utgången och minskar både död och sjuklighet. Ju tidigare behandlingen påbörjas, helst inom den första timmen efter debut av symtom, desto bättre är prognosen. Trots detta får endast en minoritet reperfusionsbehandling inom en till två timmar efter symtomdebut. Ett avgörande hinder för tidig start av behandling är patientens beslutstid, tiden mellan symtomdebut och beslut att söka sjukvård. Personer som insjuknar i AKS dröjer ofta med att söka sjukvård. Denna fördröjning står för mer än tre fjärrdedelar av den totala fördröjningen innan ankomst till sjukhus (pre-hospital fördröjning), och har rapporterats vara mellan 2,2 och 6,4 timmar och oförändrad under flera år.

Ett annat problem är att endast 50 till 60 procent av personer som insjuknar i AKS använder ambulans till sjukhus. Ambulansen är idag sjukhusets förlängda arm med bl a kompetens att ge avancerad hjärt-lungräddning, sända EKG till sjukhuset och påbörja behandling. Dessutom förvaras sjukhuset som kan förbereda för eventuell direkttransport till röntgen för PCI. På detta sätt minskas tiden till behandlingsstart. Tidigare försök att med informationskampanjer korta den pre-hospitala fördröjningen och öka användningen av ambulans vid AKS har haft begränsad framgång. För att om möjligt kunna påverka personers agerande vid tecken på AKS är det viktigt att öka kunskapen om insjuknandet i AKS.

användning och antal personer som söker för bröstsmärta på akutmottagningen.


Patienters tankar och agerande efter symtomdebut, totalt sett och i relation till kön, ålder, tidigare kranskärlssjukdom, typ av A KS, bostadsområde (tätort/landsort), samt faktorer associerade med pre-hospital fördröjning undersöcktes i studie II. Tre fjärdedelar av patienterna trodde att symtomen orsakades av hjärtat och den vanligaste anledningen till det var att man kände någon som hade haft en akut hjärtinfarkt. De flesta kontaktade en familjemedlem, medan endast tre procent direkt ringde 112 för ambulans. De starkaste skälen till beslut att söka sjukvård var att tolka symtom som hjärtorsakade och svår smärta. Att kontakta någon efter symtomdebut och tro att symtomen kom från hjärtat var faktorer som var associerade med en kortare pre-hospital fördröjning, medan att själv medicinera för att lindra smärtan resulterade i längre fördröjning. Reaktionsmönstret påverkades till viss del av kön, ålder, tidigare kranskärlssjukdom och typ av ACS.

I studie III var syftet att beskriva faktorer som påverkar användning av ambulans vid insjuknande i ACS samt val av transportsätt till sjukhus och skäl för att inte ringa efter ambulans i förhållande till kön, ålder, tidigare kranskärlssjukdom och avstånd till sjukhuset. Resultatet visade att endast hälften av patienterna åkte ambulans till sjukhus. Oberoende faktorer associerade med ökad ambulansanvändning var kunskap om Vikten av att snabbt söka medicinsk vård och ringa 112 vid ihållande bröstsmärta, ett plötsligt insjuknande, illamående eller kallsvett, yrsel eller nära svimning, STE-ACS, hög ålder, tidigare anamnes på hjärtsvikt och ett avstånd till sjukhus över 5 km. Orsaker till att inte ringa 112 efter ambulans var att
man trodde egen transport skulle gå snabbare eller inte trodde att man var tillräckligt sjuk.

De viktigaste faktorerna som var associerade med en kort tid mellan symtomdebut och beslut att söka sjukvård beskrivs i studie IV. Resultatet visade att ett plötsligt insjuknande med smärta som nådde ett maximum inom några minuter, ha kunskap om betydelsen av att snabbt söka medicinsk vård vid tecken på AKS, tolka att symtomen var hjärtorsakade, STE-AKS, associerade symtom som yrsel eller nära svimning och att uppleva symtomen skrämmande var oberoende faktorer associerade med en kort tid, mindre än en timma, från symtomdebut till beslut att söka vård. Smärta som var lokalisering till ryggen och att vara ensam hemma vid insjuknandet var faktorer som ledde till en längre tid till beslut att söka sjukvård. Varken ålder, kön eller tidigare hjärtinfarkt visade sig vara en oberoende faktor för kort fördjupning.

Resultat och erfarenheter från studie I-IV användes sedan vid planering och utformande av kampanjen ”OM Hjärtinfarkt - symtom och livsviktiga råd”. Kampanjen genomfördes i Örebro län och målsättningen var att minska patientfördjupningen och öka ambulansutnyttjandet hos såväl män som kvinnor som insjuknar i misstänkt hjärtinfarkt. De långsiktiga effekterna av kampanjen utvärderades i studie V avseende tid mellan symtomdebut och beslut att söka sjukvård, pre-hospital fördjupning och ambulansanvändning vid AKS samt antal patienter som söker på akutmottagningen för bröstsmärtor. Varken patientens beslutstid, eller pre-hospital fördjupning minskade efter kampanjen. Däremot verkade det som ambulans användningen (statistiskt signifikant) och antalet som sökte på akutmottagningen för bröstsmärtor. Varken patientens beslutstid, eller pre-hospital fördjupning minskade efter kampanjen. Däremot verkade det som ambulans användningen (statistiskt signifikant) och antalet som sökte på akutmottagningen för bröstsmärtor ökade. Av dem som besvarade enkäten efter kampanjen var det 20 procent som faktiskt hade hört talas om den och tenderade att agera mer korrekt. Majorityen rapporterade att kampanjen hade påverkat dem i deras beslut att söka vård och i beslut om att ringa 112 efter en ambulans. De uppgav också att kampanjen hade påverkat dem att misstänka att symptomen kom från hjärtat. Även om tiden till att söka sjukvård och pre-hospital fördjupning tenderade att vara kortare och ambulans användningen högre, kunde inga statistiskt signifikanta samband påvisas.

Resultaten av dessa studier kan ligga till grund för planering av innehåll och vad som bör förmedlas vid utbildning av patienter, anhöriga och allmänhet för att minska patientfördjupning och öka ambulansutnyttjandet hos personer som insjuknar i AKS.
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