

# The second myocardial infarction

A known but different experience

Ulrica Strömbäck

Nursing



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Ulrica Strömbäck

Luleå University of Technology  
Department of Health Science  
Division of Medical Science

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*“The second time, I knew for sure that it was a myocardial infarction, I knew it was serious. It was not at all the same pain as the first time. I am surprised that I knew it was a new myocardial infarction, but I knew it.” (Person afflicted by a second MI)*



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## **The second myocardial infarction:**

### **A known but different experience**

Ulrica Strömbäck, Division of Medical Science, Department of Health Science,  
Luleå University of Technology, Sweden

## **Abstract**

The overall aim of this thesis was to explore the second myocardial infarction (MI) and describe experiences of the second myocardial infarction from the perspectives of patients and personnel in cardiac rehabilitation (CR).

This thesis includes four studies. Studies using quantitative method (I, II) and qualitative method (III, IV) were performed. Studies I and II were retrospective cohort studies based on data from the Northern Sweden's MONICA myocardial infarction registry. A paired design was used. Study I included 1017 participants, and the corresponding figure for Study II was 820 participants. The participants had at least two MI events recorded in the MONICA MI registry from 1990 – 2009 (I) and 1986 – 2009 (II). The two MI events studied were the first and second events. Study III included eight patients who suffered two MIs. The data were collected through interviews about the experience of suffering a second MI. In Study IV, personnel working with CR were interviewed about the experience of working with patients suffering from a second MI and data from study III were used for describing the patients expressed needs during CR. Data were analysed by descriptive and analytic statistics (I, II) and by qualitative content analysis (III, IV).

Both men and women had higher risk factor burdens when suffering the second MI compared when they suffered the first MI. Women had a higher risk factor burden at both first and second MI compared with men. Women also suffered the second MI with a shorter time interval than men did (I). The most common symptom reported in men and women at both MI events were typical symptoms. In men, 10.6 % reported different types of symptoms at first and second MI, and the corresponding figure for women was 16.2 % (II). The number of patients with a prehospital delay < 2 hours increased at the second MI. Furthermore, the results showed that patients with a prehospital delay  $\geq$  2 hours at the first MI were more likely to have a prehospital delay  $\geq$  2 hours at the second MI (II). Suffering a second MI is a known but different event compared to the first MI, it makes afflicted people realise the seriousness and the importance of making lifestyle changes (III). People express they are more affected after having the second MI, both physically and psychologically (III). In the analysis of congruence between the needs patients expressed linked to CR and personnel's description of how they worked, a theme emerged: "Be seen as a unique person"

(IV). The patients expressed a need of customised care, and the personnel described that it was important for them to individualise the care given to these patients.

Suffering a second MI is experienced as a different and more serious event than the first one. The patients had gained valuable knowledge due to their previous experience and the second MI was a wake-up call for life style changes. A majority of the patients had typical symptoms at both MI events and an increased number of patients had a prehospital delay < 2 hours at the second MI. We suggest that the personnel in CR pay attention to first-time MI patients' illness representation to enhance the patient's awareness of the seriousness of the illness and the fact that they suffer from a chronic illness. The care given after an MI, including cardiac rehabilitation should be person-centred to involve the patient as an active participator in the care and where the patient's resources and needs are in focus.

Keywords: cardiac rehabilitation; experience; illness representation; nursing; prehospital delay; risk factors; second myocardial infarction; typical and atypical symptoms

## Abbreviations

CHD	Coronary heart disease
CI	Confidence interval
CR	Cardiac rehabilitation
CSM	Common sense model (of self-regulation and illness representation)
CVD	Cardiovascular disease
ECG	Electrocardiogram
FMC	First medical contact
MI	Myocardial infarction
MONICA	Multinational monitoring of trends and determinants in cardiovascular disease
NSTEMI	Non-ST elevation myocardial infarction
OR	Odds ratio
PCI	Percutaneous coronary intervention
RN	Registered nurse.
STEMI	ST elevation myocardial infarction
WHO	World Health Organisation



## List of original papers

This thesis is based on the following papers, which will be referred to in the text by their roman numerals.

- I. Strömbäck, U., Vikman, I., Lundblad, D., Lundqvist, R., & Engström, Å. (2017). The second myocardial infarction: Higher risk factor burden and earlier second myocardial infarction in women compared with men. The Northern Sweden MONICA Study. *European Journal of Cardiovascular Nursing*, 16(5), 418-424.
- II. Strömbäck, U., Engström, Å., Lundqvist, R., Lundblad, D., & Vikman, I. (2018). The second myocardial infarction: Is there any difference in symptoms and prehospital delay compared to the first myocardial infarction? *European Journal of Cardiovascular Nursing*, 17(7), 652-659.
- III. Strömbäck, U., Engström, Å., & Wälivaara, B-M. Realising the seriousness- people's experience of suffering a second myocardial infarction: A qualitative study.  
Submitted May 2018, resubmitted September 2018
- IV. Strömbäck, U., Wälivaara, B-M., Vikman, I., Lundblad D., & Engström, Å. Patients' expressed needs during cardiac rehabilitation after suffering a second myocardial infarction in comparison to personnel's descriptions of how they work with these patients.  
Submitted October 2018



## **Introduction**

During my 20 years as a registered nurse (RN), mainly as a critical care nurse working in an intensive care unit, I have always had an interest in people with cardiovascular illness and have witnessed a major development in the care of patients suffering myocardial infarctions (MIs). When I became a doctoral student, I had the opportunity to work with data from the Northern Sweden MONICA myocardial infarction registry, focusing on the phenomena of suffering a second MI. I also interviewed people about their experience of a second MI and personnel working in cardiac rehabilitation (CR). By combining two quantitative studies with two qualitative studies, the ambition with this doctoral thesis is to create an enhanced understanding of this research field.

## **Background**

This doctoral thesis was written in the area of nursing. In nursing, the central focus is the person and the person's needs. Supporting the person in daily life with the purpose to promote health, preserve health, regain health and alleviate human suffering and safeguard life are the goals for nursing (Meleis, 2011).

Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups, and communities, sick or well, and in all settings. Nursing includes the promotion of health, prevention of illness, and care of ill, disabled and dying people. Advocacy, promotion of a safe environment, research, participation in shaping health policy and in patient and health systems management, and education are also key nursing roles. (International Council of Nurses, 2012).

People afflicted by MI are living with a chronic disease, and nursing for these people includes promoting health, preventing disease and recurrent MIs and regaining health. Nursing includes acute care as well as care when the person is deteriorating and when the person is dying. Nursing research is needed to gain

knowledge about the possibilities for preventing MIs, caring for people having an MI and in CR. Nursing encompasses support for close relatives of people dying from MI.

### **Living with myocardial infarction**

Cardiovascular disease (CVD) is a chronic condition, and MI is one of the most severe presentations of CVD. The onset of an MI is often sudden and unexpected and can imply a change from wellness to illness. In the phase of early recovery after an MI, the threat to the affected person's life (Kristofferzon, Löfmark & Carlsson, 2007) and survival is in focus (Condon & McCarthy, 2006). Feelings of life being disrupted, a loss of independence and powerlessness (Kerr & Fothergill-Bourbonnais, 2002) as well as feelings of helplessness and shame are described (Jensen & Petersson, 2003). Expressions of guilt and self-reproach due to the lifestyle they had before suffering an MI are common (Jensen & Petersson, 2003). Chronic illness often has a slow onset, and it can be difficult for afflicted people to know the starting point of the illness. However, for people suffering from MI, this can be different, the onset is often an acute event, unexpected and sudden. After admission to hospital, treatment of the MI is prompt, and the patient can experience being cured afterwards.

Nevertheless, MI is a chronic disease and persists over a lifetime, and the changes it implies are an ongoing process. Each chronic illness has its characteristics due to its underpinning pathophysiology. Wagner et al. (2001) identified some commonalities that can be seen as a set of challenges living with chronic conditions: 'dealing with symptoms, disabilities, emotional impacts, complex medication regimens, difficult lifestyle adjustments and obtaining helpful medical care'. People living with a chronic illness have to manage all the mentioned set of challenges (Corbin & Strauss, 1991). After an MI, most people are advised to make lifestyle changes, e.g. eat healthier food, exercise more and stop smoking.

Their concerns about not knowing if/how the MI would affect their ordinary life can be significant (Kristofferzon et al., 2007), and descriptions that afflicted people experience psychological consequences as anxiety and fear of having another MI are common (Kristofferzon et al., 2007; Svedlund & Danielson, 2004). For the person, the greatest impact of the disease lies in the effect it has on their ability to continue with a 'normal' daily life, and this will necessarily be their focus of interest (Paterson, 2001).

### **Myocardial infarction and its symptoms**

The pathological definition of MI is myocardial cell death due to prolonged myocardial ischemia (Alpert, 2018). An atherosclerotic plaque rupture characterises an MI and can result in an intraluminal thrombus in the coronary arteries leading to partial or total occlusion of the coronary artery. This causes decreased myocardial blood flow and subsequent necrosis of myocardial tissue. Necrosis of the myocardium may also occur due to an imbalance between myocardial oxygen supply and demand, for example, due to spasm in the coronary arteries (Roffi et al., 2016). The initial step of an MI is symptoms caused by myocardial ischemia (Alpert, 2018).

Chest pain is the most common symptom in patients, both men and women, with suspected MI. Chest pain typical for MI is characterized by pressure and/or heaviness retrosternal, it can be radiating in both arms but most frequent in the left arm and in the neck and jaw. The proportion of patients with chest pain when suffering an MI is estimated to 82 % to 91.5 % (Ängerud, Brulin, Näslund & Eliasson, 2012; Arslanian-Engoren et al., 2006). The pain can be intermittent or persistent, and MI should be suspected if the pain lasts  $\geq 20$  minutes. There are also less typical symptoms, atypical symptoms, presentation as epigastric pain, symptoms similar to indigestion and isolated dyspnoea (Roffi et al., 2016). Patients with MI often describe more than one symptom (Horne, James, Petrie,

Weinman & Vincent, 2000), and this can lead to difficulties in interpreting the symptoms (Kirchberger, Heier, Wende, von Scheidt & Meisinger, 2012).

Although chest pain is the most common MI symptom for men and women, (Berg, Björck, Dudas, Lappas & Rosengren, 2009; Isaksson, Holmgren, Lundblad, Brulin & Eliasson, 2008), a systematic literature review Coventry, Finn and Bremner (2011) shows that women are more likely than men to present with atypical symptoms such as fatigue, neck pain, syncope, nausea, right arm pain, and dizziness.

When an MI occurs more than 28 days after an MI, it is defined as a recurrent MI (Mendis et al., 2011). Data regarding the prevalence of recurrent MI has been estimated to be 11% - 12.7%. (Fox et al., 2010; Smolina, Wright, Rayner & Goldacre, 2012) and (Jernberg et al., 2015) found that 18.3 % of people suffering an MI had a new CVD event (stroke, MI or cardiovascular death) within the first year. People suffering from a second MI have a worse prognosis than after the first MI, with increased short- and long-term mortality (Gerber, Weston, Jiang & Roger, 2015). They are older, have more pronounced arteriosclerosis and less often receive the recommended therapy than do patients without a previous MI (Rasoul et al., 2011).

## **Diagnosis and treatment**

A combination of criteria is required to diagnose MI. Laboratory data, i.e. rise and/or fall in levels of biomarkers of myocardial necrosis should be detected with at least one of the following: changes in electrocardiogram (ECG), findings from imaging techniques, and clinical findings, i.e. the patient's history and symptoms (Alpert, 2018). According to ECG findings, MI is categorised as ST-elevation MI (STEMI) or non-ST-elevation MI (NSTEMI). Treatment of MI aims to re-establish blood flow through the coronary arteries and should be done as soon as possible. It is evident that early reperfusion of the occluded coronary artery limits

the size of the MI (Kloner, Dai, Hale & Shi, 2016). Late reperfusion is expected to result in more damage to the myocardium and is found to have a higher mortality rate than early reperfusion (De Luca, Suryapranata, Ottervanger & Antman, 2004). In patients with STEMI, the recommended reperfusion therapy is primary percutaneous coronary intervention (PCI) (Ibanez et al., 2017). If PCI cannot be performed within the recommended timeframe, then fibrinolysis is the recommended treatment (Ibanez et al., 2017). The goal for the time from STEMI diagnosis to treatment by PCI is  $\leq 120$  minutes (Ibanez et al., 2017; O'Gara et al., 2013).

MI is the leading cause of morbidity and mortality in the world. However, over the last decades, the outcome for patients suffering from MIs has improved significantly (Reed, Rossi & Cannon, 2017). This is mainly attributable to early reperfusion (Keeley, Boura & Grines, 2003) and developments in pharmacological and preventive strategies (Nichols, Townsend, Scarborough & Rayner, 2014; O'Gara et al., 2013).

### **Prehospital delay**

Diagnosis and treatment of MI starts from the patient's first medical contact (FMC). According to the European Society of Cardiology, the definition of FMC is the point when the patient is assessed by skilled medical personnel. This can be in the prehospital setting or upon arrival at the hospital or health care centre (Ibanez et al., 2017). In patients diagnosed with STEMI, (De Luca, Suryapranata, Ottervanger & Antman, 2004) found that for each 30-minute delay in reperfusion, the risk of one-year mortality increased by 7.5 %. Therefore it is crucial to shorten patients' total ischemic time. The time from onset of symptoms to the start of the treatment is important and should be as short as possible to improve the prognosis. Despite the importance of early medical care when having symptoms of MI, many MI patients have a long prehospital delay.

Prehospital delay in patients having an MI is a well-studied problem, and few of the interventions aimed to reduce prehospital delay have been successful.

(Mooney et al., 2012) found that only two out of eight studied interventions resulted in a significant decrease in prehospital delay time. The prehospital delay time can be divided into three phases; the time from symptom onset until the patient decides to seek medical care (patient decisions time), the time that elapses from the decision to seek medical care to FMC and the time from FMC to hospital arrival. The time interval that contributes to most of the prehospital delay is the patient's decision time (Beig et al., 2017; Moser et al., 2006).

### **Risk factors for myocardial infarction**

Several risk factors contribute to development of MI. Some of them, such as heredity, gender and age, are not modifiable. However, modifiable risk factors highlighted as especially important are smoking, unhealthy diets, physical inactivity, obesity, hypertension, abnormal lipids, diabetes and psychosocial factors (Piepoli et al., 2016; Yusuf et al., 2004). Unhealthy lifestyle contributes to developing CVD, and the benefits of decreasing modifiable risk factors are great (Kuulasmaa et al., 2000). This is not only important in persons with identified risk factors but also in the general population (Yusuf et al., 2004). The reduction in CVD seen in the last decades can to a great extent be attributed to population-based changes in risk factor levels, i.e. reduction in cholesterol, blood pressure and smoking (Piepoli et al., 2016). Current smoking and abnormal levels of lipids are the two strongest risk factors for acute MI, followed by diabetes, hypertension and psychosocial factors (Yusuf et al., 2004). To promote healthy lifestyle behaviour, prevention should take place at the general population level as well as for those at risk of CVD, including patients already recognised with CVD (Cooney et al., 2009). It has been estimated that at least 80 % of CVDs could be prevented by the elimination of health risk behaviours (Liu et al., 2012).

## **Secondary prevention and rehabilitation for MI patients**

Secondary prevention programmes are essential for patients recovering from an MI. After the acute phase, the long-term treatment of CVD through cardiac rehabilitation (CR) begins (Piepoli & Giannuzzi, 2015). Cardiovascular disease is a chronic illness for which medical treatment is life-long. Cardiac rehabilitation aims to address the underlying causes of CVD and improve physical and mental health after MI and encourage a healthy lifestyle which slows the progression of heart disease. Cardiac rehabilitation is a coordinated and structured program designed to remove or reduce the underlying causes of CVD (Piepoli et al., 2016).

Even though there are national (Socialstyrelsen, 2018) and international guidelines on cardiovascular disease prevention with therapeutic targets defined (Piepoli et al., 2016), it can be difficult to reach these targets. A cross-sectional study, EUROASPIRE IV (Kotseva et al., 2016), carried out in 24 European countries found that most patients with CVD failed to achieve the lifestyle, risk factors and therapeutic goals set by the Joint European Societies (Piepoli et al., 2016).

## **The common sense model of illness representation**

To understand people's response to health threats, (Leventhal, Meyer & Nerenz, 1980) developed a self-regulatory model of health and illness behaviour: the common sense model (CSM). This theoretical framework explains the process of interpreting and coping with health threats. When an individual experiences some kind of health threat, an interpretation starts and the individual is seeking for a reasonable explanation. The common sense model assumes that people's own definition and representation of an illness threat strongly influence their health and illness behaviour (Diefenbach & Leventhal, 1996). The individual is seen as a problem solver dealing with the perceived reality of the health threat and the

emotional reactions provoked by the health threat. This is described as two parallel processes (Diefenbach & Leventhal, 1996). Illness representation is central in their model of self-regulation. There are five dimensions of illness representation: identity, cause, timeline, consequences, and controllability. This will be covered further in the discussion of the main results.

## **Rationale**

During planning for this thesis, the literature review showed that qualitative research in this area has focused mainly on the experience and meaning of suffering from one MI, both from a short-time and long-time perspective. Many of the studies focus on how life is changed after an MI. Feelings of fear and uncertainty regarding if or when they will suffer a second MI are frequently described. This is a special situation when having a first one and fear for suffering a second one, but at the same time thinking it might, and hopefully not, happen. The literature review shows that the second MI event is sparsely described. In order to study the second MI from different perspectives we included both quantitative and qualitative studies in the thesis. Using different approaches provides an opportunity to present a more complete picture of the area studied. To explore and describe the second MI, the studies were conducted solely with people afflicted by two MIs. By studying the experience of the second MI, we can expand the knowledge and understanding of what it means for the person to be afflicted by a second MI, how it affects the life and how to meet the afflicted persons' needs and give the best care. To work with lifestyle changes is not a new issue, but something that needs to be further studied and discussed.

## Overall aim

The overall aim of this thesis was to explore the second myocardial infarction and describe experiences of the second myocardial infarction from the perspectives of patients and personnel in cardiac rehabilitation.

Specific aims for the papers:

- I. The aim was to compare risk factors for MI, i.e. diabetes, hypertension and smoking, for the first and second MI events in men and women affected by two MIs and to analyse the time intervals between first and second MIs.
- II. The hypotheses were: (1) Patients, men and women, with two MIs report different types of symptoms at first and second MI event; (2) In patients, men and women, with two MIs, there is a difference in prehospital delay at the two MI events. An additional aim was to identify factors associated with a prehospital delay of  $\geq 2$  hours at the second MI.
- III. The aim was to describe people's experiences of suffering a second MI.
- IV. The aim of this study was to describe patients' expressed needs during CR after suffering a second MI in comparison to personnel's descriptions of how they work with these patients.

## Method

When I planned for this thesis in nursing, I found it important to study the second MI from different perspectives to obtain the most comprehensive picture possible. Therefore, a combination of quantitative and qualitative studies is included. The use of different approaches in nursing research gives the opportunity to present a more complete picture of the area studied and might lead to findings that are more comprehensive (Maggs-Rapport, 2000). An overview of the studies is presented in Table 1.

**Table 1.** Overview of design, participants and analysis in Studies I-IV

Study	Design/Method	Participants	Data sources	Analysis
I	Retrospective cohort study	n = 1017 775 men 242 women	The Northern Sweden MONICA myocardial infarction registry	Descriptive and analytic statistics
II	Retrospective cohort study	n = 820 641 men 179 women	The Northern Sweden MONICA myocardial infarction registry	Descriptive and analytic statistics
III	Descriptive qualitative study	n = 8 6 men 2 women	Interviews	Qualitative content analysis
IV	Descriptive qualitative study	Patients: n = 8 6 men 2 women Personnel: n = 11 1 man 10 women	Interviews	Qualitative content analysis

## **Settings**

This research took place in the two northernmost counties in Sweden, Norrbotten and Västerbotten study. The counties are sparsely populated, with approximately 519 000 inhabitants in 153 400 square kilometres. The majority of inhabitants live in cities.

## **MONICA project**

In the year 1982, the World Health Organisation (WHO) initiated an international collaborative study called the Multinational Monitoring of Trends and Determinants in Cardiovascular disease (MONICA) project. The purpose of the project was to measure trends and determinants of cardiovascular disease. Protocols, procedures and quality-assurance methods were developed for collecting a standard set of data on trends in CVD mortality, non-fatal acute MI, coronary care, and major coronary risk factors in defined populations for men and women aged 25 – 64 years (WHO MONICA Project, 1988). In January 1984, Norrbotten and Västerbotten jointly participated in the project; event registration started in January 1985. The WHO MONICA MI registry project ended in 1995, but as a local project in Norrbotten and Västerbotten, the registration proceeded and was ongoing until 2009. The Northern Sweden MONICA project was a population-based project (Stegmayr, Lundberg & Asplund, 2003). In the beginning, patients aged 25–64 years were included in the register and from the year 2000, patients aged 65–74 year were also included. The registrations of MI events were based on medical records, hospital discharge registers, and death certificates. The MI events are registered and validated according to the MONICA manual, and strict uniform WHO MONICA criteria were used. At the beginning of the registration period, MI diagnoses were based on typical symptoms, cardiac biomarkers as transaminases and ECG findings. In the late 1990s, troponins were introduced to the diagnosis of MIs. This means

that a new MI definition was introduced and the definition of MI differs to some extent before and after the year 2000. Troponins are more sensitive than the biomarkers previously used, and since 2000, troponins have been the biomarker used by all hospitals in Northern Sweden (Lundblad, Holmgren, Jansson, Naslund & Eliasson, 2008). In the MONICA registry, MI diagnoses have been based on typical symptoms and cardiac biomarkers since year 2000, although ECG findings have been used to confirm diagnoses if only one of the two parameters noted above was positive.

During 1985 – 2009, a total of 15 279 patients, - 11 583 (75.8 %) men and 3 696 (24.2%) women –were included in the MONICA MI registry. Of these patients, 1 423 (9.3%) had two or more MI events registered. For men, this number was 1 116 (9.6%) and for women 307 (8.3 %). An event was registered as the patient's first MI if the patient's history was free of previously diagnosed MI. In this registry, a recurrent MI referred to situations in which a new MI event occurred at least 28 days after the first MI, as according to the WHO definition (Mendis et al., 2011; Stegmayr et al., 2003).

## **Participants**

### **Sampling studies I and II**

In Studies I and II, are patients with a first and second MI event registered in the MONICA MI registry. Initially, patients aged 25–64 years were included in the register and from the year 2000, patients aged 65–74 years were also included.

### ***Study I***

In Study I, 1 017 patients, 775 men and 242 women, with at least two MI events registered in the MONICA MI registry during the period 1990 – 2009 were

included. The two MI events analysed were the patient’s first and second MI. Mean age of men and women at the two MI events are shown in Table 2.

**Table 2.** Age of men and women at MI 1 and MI 2

	MI 1		MI 2	
	Men n (%)	Women n (%)	Men n (%)	Women n (%)
	775 (76.2)	242 (23.8)	775 (76.2)	242 (23.8)
Age (years) mean ±SD	55.8 ±8.4	61.3±8.3	60.9±8.3	64.3±7.6

### *Study II*

In study II, 820 patients – 641 men (78.2%) and 179 women (21.8%) – with a first and a second MI were included in the analysis. Mean age of men and women are shown in Table 3.

A total of 1 423 patients with two MI events were registered in MONICA MI register during the period 1985 - 2009. Of these, 603 patients (42, 4 %) were excluded due to incomplete data, (data coded as “insufficient data” or “not known”) for the outcome variables “types of symptom” and “time from onset of symptom to medical contact”. In the excluded patients, the mean age at first and second MI was slightly lower in men and slightly higher in women. The proportion of men and women was similar to the Study sample.

**Table 3.** Age of men and women at MI 1 and MI 2

	MI 1		MI 2	
	Men n (%)	Women n (%)	Men n (%)	Women n (%)
	641 (78.2)	179 (21.8)	641 (78.2)	242 (21.8)
Age (years) mean ±SD	55.9 ±8.2	59.0±8.5	60.6±8.3	62.9±7.6

## Sampling studies III and IV

The participants in Studies III and IV were chosen by purposive sampling. Purposive sampling was chosen to recruit participants who could contribute to the study in the best possible manner (Polit & Beck, 2016). In these studies, patients with the experience of suffering a second MI were included. The patients participated in a CR program with follow-up visits at the hospital during the first year after discharge from hospital. The RN recruited them during their follow-up visit. The sampling of personnel was also purposive. I searched for heterogeneity by sampling different professions that meet MI patients at follow-up visits (RNs, physiotherapists and cardiologists), and for homogeneity to recruit personnel in the context of CR.

### *Study III*

The recruitment took place from hospitals in Northern Sweden. Participants who met the inclusions criteria (having a second MI) were asked to be involved by RNs during the follow-up visit two to three weeks after discharge from hospital. Those who met inclusion criteria were asked if they were interested in participating in the study and received oral and written information about the aim of the study. Eight persons, six men and two women, agreed to participate in the study. They sent their written consent to me. Seven participants were living with their partner, and one lived alone. Three of them worked, and five were retired. The data collection took place one month to 4.5 months after the participants suffered their second MI. The period between the two MI events ranged from 10 months to 15 years. An overview of participants in Study III is shown in Table 4.

**Table 4.** Overview of participants: Study III

<b>Characteristics</b>	<b>n = 8</b>
Age years, median (range)	58.5 (49 – 79)
Male/female, n	6/2
Time between first and second MI, n	
< 1 year	1
1 – 3 years	5
> 5 years	2

### *Study IV*

The patients in Study III (Table 4) and personnel (RNs, physiotherapists and cardiologists) participated in Study IV. For inclusions criteria and recruitment of patients' see the section describing participants in study III. Personnel were recruited from hospitals in Northern Sweden. Thirteen of the eligible personnel were sent written information about the study aim with a request for participation, and eleven of them agreed to attend in the study. They sent their written consent to me. An overview of the personnel that participated are shown in Table 5.

**Table 5.** Overview participants Study IV

<b>Characteristics</b>	<b>n = 11</b>
Age years, median (range)	53
Male/female, n	1/10
Physiotherapist, n	4
Nurse, n	4
Cardiologist, n	3
Years in occupation	
> 10, n	11
Years in CR	
< 5	3
5 -10	2
> 10	6

## Data collection

### Studies I and II

In Studies I and II, data were collected from the MONICA MI registry. The registrations are based on medical records. Variables used in the analysis in Study I were age, sex, hypertension, diabetes, and smoking at first and second MI event. Furthermore, months between the two MI events were calculated. In Study II, variables used in the analysis were age, sex, MI symptoms, time between onset of symptoms and medical presence at the first and second MI, diabetes at second MI, months between first and second MI. Symptoms of coronary events were categorised as follows according to the MONICA MI registry:

1. Typical symptom: chest pain was present and characterized by duration of more than 20 minutes. Synonyms for pain, including pressure, discomfort and ache, were also acceptable.
2. Atypical symptoms (involving one or more of the following conditions): atypical pain, recorded if pain was intermittent or lasted for less than 20 minutes; atypical pain at an unusual site, e.g. upper abdomen, arms, jaw, or neck.
3. Other symptoms referred to those described well but that did not meet any criteria for typical or atypical symptoms, e.g. nausea and dyspnoea.
4. No symptoms.

The categories of atypical symptoms (2), other symptoms (3), and no symptoms (4) were merged into atypical symptoms, meaning that two variables of symptoms emerged: typical and atypical symptoms. The variable time from onset of symptoms to medical presence was according to MONICA MI registry defined as the time when skilled medical care became available for the patient in the form of paramedics, medical care staff, or medical practitioners. For the remainder of this thesis time from onset of symptoms to medical presence is

referred to as prehospital delay. This means that the prehospital delay could end in the ambulance, the health care centre or at arrival at the hospital. This variable was originally coded into seven categories. In this study, we merged these into four categories: prehospital delay 1) < 1 hour, 2) 1 hour to 1 hour and 59 minutes, 3) 2 hours to 3 hours and 59 minutes and 4)  $\geq$  4 hours.

In the multiple logistic regression analysis, there are two categories for prehospital delay: < 2 hours and  $\geq$  2 hours.

### Study III

Individual, semi-structured qualitative interviews were used to collect data. Semi-structured interviews are recommended when a specific topic is to be covered (Polit & Beck, 2016). As the aim of the study was to describe people's experiences when having a second MI, the interviews were conducted to gain descriptions and knowledge about how participants experienced suffering a second MI. After receiving written consent, I phoned the participants and asked them to choose a time and place for the interviews. Seven of the interviews were conducted face-to-face, and one interview was done by telephone due to the long distance involved. Six of the interviews took place in the participants' homes, and two interviews took place at the interviewer's place of work. The interviews took place in undisturbed rooms. During the interviews, an interview guide covering topics about the experience of suffering a second MI was used. The interview guide contained questions to be covered and was prepared to ensure that the same area was covered with each participant (Patton, 2015). The questions were formulated to give participants an opportunity to give a deep description of their experience (Polit & Beck, 2016). The first interview can be seen as a pilot interview and was conducted by my main supervisor and me and was included in the study as it was judged to be of good quality with rich descriptions of the experience of suffering a second MI. The following interviews

were conducted by me. Before the interview started, I gave a brief introduction about the interview, the purpose and the use of the recorder. Participants were ensured that their participation was voluntary, that they could withdraw from the study at any time, and they were guaranteed confidentiality and an anonymous presentation of the findings. I asked if the participants had any questions before the interview began. I recorded background information as age, time for their first and second MI, marital status, and occupation. The participants were encouraged to talk freely about their experience of the second MI. The first question was; Would you please describe your experience of suffering a second MI? Follow-up questions were asked to develop or clarify the narratives and included, What did you think then? Can you tell me more about..., Can you give me any examples? The last question was, Is there anything more you want to tell me?. The purpose was to give participants an opportunity to tell me if they had questions or wanted to add explanations they might have thought of during the interview. The interviews lasted between 44 and 92 minutes and were conducted between December 2014 and October 2017. The interviews were audio recorded and transcribed verbatim by me.

## Study IV

Data collection with patients suffering from a second MI is described in the section above, Study III. Interviews were also conducted with personnel; RNs, physiotherapists and cardiologists working with CR in patients afflicted by MI. After receiving written consent, I phoned participants and asked them to choose a time and place for the interview. We let the participants choose between individual, dyads or group interviews, due to the aim of studying personnel's, i.e. the teams', descriptions.

Data were collected by six individual interviews, one focus group interview with three participants and one dyadic interview. The interviews took place at the

participants' workplaces in an undisturbed room. The participants in the focus group interview were three RNs from the same workplace with different amounts of experience of working with CR. According to Morgan (1997), interactions in the focus group may benefit when participants have similar work experience, and this could contribute to the richness of the discussion data (Morgan, 1997). The focus group interview was conducted by my main supervisor and me. I acted as a moderator and guided participants through the topics and encouraged them to interact. My main supervisor's role was to ask follow-up questions when necessary (Morgan, 1997). The dyadic interview and the individual interviews were conducted by me. The participants in the dyadic interview were from the same workplace and profession. Although the data collection with the personnel in CR in Study IV was carried out in different interview formats, all participants had the opportunity to respond in their own words and express their personal perspectives. The different types of interviews gave a rich description of the research question. An interview guide covering topics about the experience of working with patients suffering from a second MI was used. All interviews were conducted face-to-face. The interviews took place between March 2018 and August 2018. Before the interviews started, I informed the participants about the aim of the interview and use of the recorder. Participants were ensured that their participation was voluntary, that they could withdraw from the study at any time and they were guaranteed confidentiality and an anonymous presentation of the findings. I asked if the participants had any questions before the interview began. I recorded background information such as age, years in the profession and specific years in CR. The informants were asked to narrate their experience of working in CR with patients afflicted by two MIs. The main question was: Can you describe your work with patients affected by a second MI?. Follow-up questions were asked to develop or clarify the narratives. The interviews lasted between 39 and 79 minutes and were audio recorded and transcribed verbatim.

## Data analysis

### Studies I and II

Descriptive and analytic statistics were used (I-II). Data were presented as proportions, means, median and p-values. Comparisons between groups, men and women, were analysed using Chi-square test for categorical data (I-II), Mann-Whitney U test for non-parametric data (I), and Student's t-test for continuous data (I). McNemar's test was used to compare the paired groups for categorical data (I-II). When presenting time intervals between first and second MIs (I), the median time is used due to the skewed distribution. Differences were considered significant if  $p < 0.05$  (I-II).

In Study II, multiple logistic regression was used to estimate the association between the prehospital delay of  $\geq 2$  hours at the second MI and age, sex, diabetes at second MI, type of symptoms at second MI, months between first and second MI and prehospital delay at first MI. Results are presented as odds ratios (OR) with 95 % confidence intervals (CI). Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), version 23.0 (I-II).

### Study III

The transcribed interviews were analysed using qualitative content analysis (Graneheim & Lundman, 2004). Qualitative content analysis comprises descriptions as are close to the text, i.e. the manifest content, and also enables interpretations of the underlying meaning, the latent content. Despite manifest, close to the text, or latent, distant from the text, interpretation, there is closeness to the participants' lived experience (Graneheim & Lundman, 2004). The analysis was performed systematically. To gain a sense of the material as a whole, the transcribed interviews were read through by the authors several times with the

aim in mind. First, meaning units in the interview text containing the participants' description of their experience of suffering a second MI were extracted. Meaning units are words, sentences, or paragraphs as related through their content or context. The meaning units were then condensed and coded. Codes are the foundation for emerging categories. The codes were compared by similarities and differences and sorted into categories based on similarities, an expression of the manifest content of the text (Graneheim & Lundman, 2004; Graneheim, Lindgren & Lundman, 2017). An interpretation of the underlying meaning in these four categories was formulated into one theme. According to Graneheim and Lundman (2004), a theme can be described as the expression of latent content of the text, while a category can be described as the expression of the manifest content. All authors in Study III took part in the process of analysing the text.

## Study IV

A somewhat different approach was used in Study IV compared with Study III. The original aim with Study IV was to describe the personnel's experience of working with patients suffering a second MI. Before the analysis of the data began, we found it to be more of an interest to find out if there was congruence in the patients' expressed needs linked to CR and the personnel's experience of how they work with these patients. The reason for the change was that more knowledge about patients' expressed needs related to CR implies that care given to these patients can be developed to meet these patients' needs. The transcribed interviews were analysed using quality content analysis (Graneheim & Lundman, 2004). First, the interviews were read through several times by me and my supervisors to gain a sense of the material.

The analysis process started with specific questions. The first question was: What needs did patients express during the CR phase? We interpreted patients'

descriptions of what they needed and wanted during the CR as their expressed needs. Meaning units in the interviews as described the patients' expressed needs were extracted, condensed, coded, and sorted in categories; this resulted in five categories. In interviews with patients, they spontaneously expressed their needs linked to their experience of CR, which is the part of the patient interviews analysed in this study. The next question was: Is there congruence between the patients' expressed needs and staff's description of their work? In the next step of the analysis, the categories that emerged from the patient's expressions were used as a grid. Meaning units containing text that described staff's work in CR that was in congruence with patients' expressed needs were extracted, condensed, coded, and sorted in the relevant category.

## **Ethical considerations**

This thesis confirms the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2013).

## **Studies I and II**

The MONICA project was approved by the Regional Ethics Review Board, Umeå University (DNR 09-041M). Additional approval was obtained for Study II (DNR 2017-204-32M). Before being recorded in the MONICA MI registry, patients received a personal letter explaining the purpose of the registry. If they did not want to give consent to their personal data being recorded with identifying information, they were requested to contact the MONICA secretariat. When patients declined registration with identifying data, their data were recorded without personal identification. Until year 1999, 0.4 % of patients declined registration with personal identification (Stegmayr et al., 2003).

## **Studies III and IV**

Study III was approved by the Regional Ethics Review Board, Umeå University (DNR 2014/131-31) for conducting interviews with patients suffering two MIs. The heads of the medical departments at hospitals in Northern Sweden were contacted and gave their permission for us to recruit participants. All participants received oral and written information about the purpose of the study and the ability to approve or decline participation voluntarily. The information included contact information for me and my main supervisor. This was to obtain informed consent from participants. All participants provided prior written consent for inclusion. The participants were guaranteed confidentiality, i.e. none of the information they provided should be reported in a manner that could identify them or be accessible to anyone other than me and my supervisors (Polit & Beck, 2016). They were also guaranteed an anonymous presentation of the findings. Before the interviews were conducted, I once again informed participants of the purpose of the study and their rights to withdraw from participation without any reason for the withdrawal. During the interviews, I attempted active listening and showed interest and respect for what the participants told me.

# Results

## Study I

This study aimed to compare risk factors for MI; diabetes, hypertension and smoking, for the first and second MI event in men and women affected by two MIs. An additional aim was to analyse the time interval between first and second MI. By the time of the second MI, an increased number of men and women showed to be afflicted by diabetes and hypertension compared by the first MI. The numbers of patients who were smokers had declined at second MI (Table 6). The result showed a higher risk factor burden among women compared to men regardless MI event.

Regarding time interval between the two MI events, within 29 months of their first MI, 50 % of the patients suffered their second MI. For women, the median time interval between first and second MI was 16 months and for men 33 months ( $p < 0.001$ ), respectively. During the 12 months after the first MI event, 44% of the women and 34% of the men suffered their second MI.

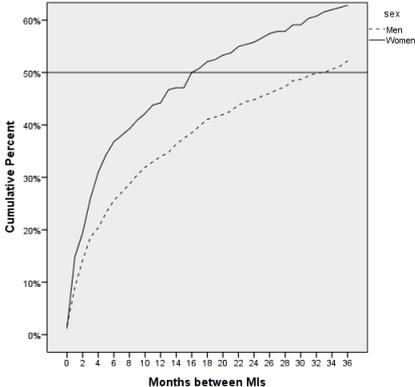


Figure 1. Number of months between first and second MI for men and women

**Table 6.** Risk factors at first and second MI for men and women

Risk factor	First MI		Second MI		P-value men and women	P-value men and women second MI	P-value men first and second MI	P-value women first and second MI
	Men n (%)	Women n (%)	Men n (%)	Women n (%)				
Diabetes	156 (20.1)	81 (33.5)	215 (27.7)	89 (36.8)	= 0.014	= 0.014	< 0.001	= 0.096
Hypertension	316 (40.8)	140 (57.9)	384 (49.5)	155 (64%)	< 0.001	< 0.001	< 0.001	= 0.017
Smoking	290 (37.4)	107 (44.2)	151 (19.5)	59 (24.4)	= 0.010	= 0.162	< 0.001	< 0.001

Abbreviation: MI, myocardial infarction

## Study II

This study's hypothesis was: a) patients, men and women, with two MIs report different types of symptoms at first and second MI event, b) in patients with two MIs, there is a difference in prehospital delay at the two MI events. An additional aim was to identify factors associated with a prehospital delay of  $\geq 2$  hours at the second MI.

Typical symptoms, according to the MONICA criteria, i.e. chest pain lasting for 20 minutes or more, was the most frequently reported symptom in men and women at first and second MI event (Table 7). The prevalence of patients who did not report the same types of symptoms at both MI events was 10.6% of the men and 16.2% of the women.

Nineteen percent of the patients had a prehospital delay time of  $< 1$  hour at the first MI; for the second MI, this was 23.5%. The prevalence of a prehospital delay of  $\geq 4$  hours for the first MI and the second MI was 37.4% and 32.3%, respectively. A majority of the patients had a prehospital delay  $\geq 2$  hours at both MI events (Table 8).

In univariate and multivariate logistic regression, prehospital delay of  $\geq 2$  hours at first MI was associated with a prehospital delay of  $\geq 2$  hours at second MI (OR 1.55) and patients presenting with atypical symptoms at the second MI had lower risk for prehospital delay time of  $\geq 2$  hours at the second MI (OR 0.51) (Table 9).

**Table 7.** Type of symptoms at first and second MI for men and women

Symptom	First MI				Second MI						
	Men n (%)	Women n (%)	Total n (%)	P-value first MI men and women	Men n (%)	Women n (%)	Total n (%)	P-value second MI men and women	P-value first and second MI total	P-value first and second MI men	P-value first and second MI women
Typical n (%)	599 (93.4)	170 (95.0)	769 (93.8)		595 (92.8)	155 (86.6)	750 (91.5)				
Atypical	42 (6.6)	9 (5.0)	51 (6.2)		46 (7.2)	24 (13.4)	70 (8.5)	< 0.05	ns	ns	< 0.05

Abbreviations: ns, not significant; MI, myocardial infarction

**Table 8.** Prehospital delay for first and second MI in men and women

Prehospital delay	First MI			Second MI			P-value men and second MI	P-value first and second MI	P-value men first MI second MI	P-value women first MI second MI
	Men n (%)	Women n (%)	Total n (%)	Men n (%)	Women n (%)	Total n (%)				
< 1 hour n (%)	116 (18.1)	40 (22.3)	156 (19.0)	147 (22.9)	46 (25.7)	193 (23.5)				
60 min – 119 minutes n (%)	142 (22.2)	28 (15.6)	170 (20.7)	154 (24.0)	36 (20.1)	190 (23.2)				
2 hours – 3 h 59 minutes	144 (22.5)	43 (24.0)	187 (22.8)	132 (20.6)	40 (22.3)	172 (21.0)				
≥ 4 hours	239 (37.3)	68 (38.0)	307 (37.4)	208 (32.4)	57 (31.8)	265 (32.3)	0.225	0.659	0.018	0.034
										0.718

Abbreviation: MI, myocardial infarction

**Table 9.** Univariate and multivariate logistic regression of factors associated with a prehospital delay of  $\geq 2$  hours at second MI

	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-value	OR	95 % CI	p-value
Sex						
Men						
Women	1.08	0.75-1.46	0.786	1.11	0.78-1.58	0.556
Age second MI	1.01	0.99-1.03	0.132	1.01	0.99-1.03	0.226
Prehospital delay $\geq 2$ h first MI						
No						
Yes	1.55	1.20-2.11	0.001	1.55	1.16-2.07	0.003
Symptoms second MI						
Typical						
Atypical	0.43	0.26-0.71	0.001	0.51	0.30-0.86	0.013
Diabetes second MI						
No						
Yes	1.30	0.95-1.79	0.098	1.31	0.94-1.83	0.109
Months between first MI and second MI	1.00	0.99-1.00	0.980	1.00	0.99-1.00	0.706

Abbreviations: MI, myocardial infarction; h, hours; OR, odds ratio; CI, confidence interval

### Study III

This study aimed to describe people’s experiences of suffering a second MI. The analysis resulted in four categories; one theme emerged: realising the seriousness (Table 10).

**Table 10.** Overview of the theme and categories

Theme	Categories
Realising the seriousness	Knowledge from previous experience A wake-up call for lifestyle changes The future becomes unpredictable Trying to find balance in life

The second MI was described as a different experience than the first one. When the participants had their second MI, they expressed that they had gained valuable knowledge from their previous experience. Although they experienced different symptoms compared to the first MI, they knew they were having a second MI. They better understood they had suffered an MI, and that contributed to a shorter prehospital delay. Participants said that after suffering the first MI, they wanted to know how to act if they had a second MI. They read about symptoms to expect and how to act if they had heart-related symptoms.

A wake-up call for lifestyle changes indicates that participants became keenly aware of the need to implement a healthier lifestyle. It was important for participants to try to avoid a third MI by, e.g. cessation of smoking, eating healthier food and becoming more physically active. Participants said it had been hard to adopt a healthier lifestyle after the first MI, but after having the second MI, it seemed to be necessary to follow the medical advice. Participants sought a reason for why they were affected by a second MI. Information about the risk of having another MI was something that some participants did not receive after their first MI, and they would have appreciated that kind of information.

The participants experienced the second MI as a different and more serious event than the first. Feelings of uncertainty were manifest due to their anxiety about suffering a third MI, and those thoughts were frightening. They found it hard to have any specific plans for the future. The risk of suffering or possibly dying due to another MI became more tangible after their second one. The period of recovery was experienced as longer than after the first MI. It could be hard to find the energy to do anything; emotions of fear, anxiety and hopelessness were described. There were also participants who were not worried about suffering a third MI; they felt confident about the treatment they received and felt that secondary prevention would protect them.

Trying to find balance in life describes expressions of differences in participants' lives. It was exemplified by decreases of participants' physical capabilities; they did not manage to be as physically active as before the second MI. This led, for example, to their avoidance of activities where they risked overstraining themselves. Even if participants did not have heart-related symptoms, they said they were resting after activities, and this was something they did not do after the first MI. Participants needed someone to talk to about their situation; it was of importance that it was a person with whom they could be confident. It was less important who that person was. Having the support of relatives was appreciated, but for some participant, that was a balancing act because they did not want to worry their relatives by telling them how they felt after the second MI.

*“After the second MI, the reality comes crawling...” (Patient 4)*

## **Study IV**

This study aimed to describe patients' expressed needs during CR after suffering a second MI in comparison to health care professionals' descriptions of how they work with these patients. The questions to be answered were a) What needs did patients express during the CR phase? From this question, the analysis resulted in

five categories (Table 11) that were used as a grid when the next question was answered: b) Is there any congruence between patients' expressed needs and staff's description of their work?

**Table 11.** Overview categories (n = 5)

Categories
Customised care
Feeling trust in the care given
Feedback: How am I doing?
Follow-up regarding medications
Knowing about myocardial infarction and how to act if/when it happens again

Patients expressed a need for individualized care; they wanted the CR to be customised to their condition and prognosis. Personnel described the importance of the care being individualised, although they had guidelines to follow. It was crucial for them to see the individual and discover what was important for each patient. However, patients did not perceive the congruence between their needs and the staff's intentions.

The category of customized care describes the patients' expression of their need to know what was important for them and their need to discuss their condition. They wanted a plan for their CR based on their condition. The group-based CR was experienced as too general.

The personnel said they try to adapt what is important for each unique patient despite having guidelines to follow. Cardiac rehabilitation cannot be the same for all patients. The starting point is to see the specific person with his/her risk factors. The staff expressed that all patients have different needs, and they intended to give them the tools to handle the change in their lifestyles. One problem was that they did not have enough time for patients who needed more attention. Staff felt they could establish good contact with patients because they

meet them a couple of times, which makes the patients feel confident about them.

The group training patients were offered was individual, each patient is assessed by staff and receives advice on how to exercise according to their conditions.

Feeling trust in the care given concerned how patients wanted to have follow-up visits for as long as possible; they felt trust with the care given at the hospital.

This was especially important after suffering the second MI.

Sometimes, patients were called for more specialist visits than the routine. This was exemplified by situations when personnel perceived that patients did not understand that they suffered from a chronic disease, when patients were young, at high risk of recurrent disease and patients with advanced heart disease. Further, the staff noticed that a few months after the MI, patients often had a reduction of risk factors. However, when they met the patient for the last time, around 9 – 12 months after the MI, the risk factors were worse.

The patients expressed a need for feedback regarding how they were managed their lifestyle changes. If they knew someone was supposed to check them later, they thought it would help them get started with the lifestyle changes they were advised to do. The personnel stated that, patients received confirmation of how they were managing the lifestyle changes based on responses to blood samples and blood pressure controls. The patients were offered to participate in an individual test of their cardiorespiratory condition with a re-assessment about three months later. The staff said it gives patients confirmation if they are on the right track.

Follow-up regarding medications referred to patients experiencing that there was no dialogue regarding the medication they were prescribed. As a result of side effects from the medication, they experienced a decrease in quality of life. This was a problem patients experienced as that the health care staff did not take

seriously enough. The personnel said that medicines were always prescribed individually. The care is always from the patient's perspective; it is individual. Patients were asked to contact the RN if they had side effects from the drugs or had questions regarding the medication.

Knowing about MI contains expressions of patients' need for information about how to act if/when they were affected by another MI. They also sought a cause for why they suffered a second MI. This was especially explicit in patients who said they had made the lifestyle changes they were advised to make.

The personnel said that during the heart school, patients were informed what to do when/if they were affected again, the importance of seeking medical care quick and about the symptoms of MI that may vary. In the personnel's opinions, the most important information for a patient suffering from MI to know is that MI is a chronic disease and that one is not cured after having undergone a PCI.

*"...it is not an ingrown toenail I have suffered; it is myocardial infarctions. You want to meet someone that is knowledgeable". (Patient 6)*

*"Some patients ask, "Why has it happened again? I have made lifestyle changes". I try to make them not blame themselves". (RN 3)*

## **Discussion**

The overall aim of this thesis was to explore the second myocardial infarction and describe experiences of the second myocardial infarction from the perspectives of patients and personnel in cardiac rehabilitation.

People suffering a second MI describe it as a different and more serious event than the first MI (III). Despite experiencing the second MI as a different event, there are similarities between the two (I-III). There was a shared opinion from

patients and personnel (IV) that individual care is essential. However, despite this shared opinion, the patients did not perceive their care as individual. These findings will be discussed within the framework of CSM illness representation and person-centred care.

During the first year after the first MI, 44 % of the women and 34 % of the men suffered their second MI. There was a significantly shorter time interval for the women compared to the men (I). When discussing these findings in relation to previous research, it is important to keep in mind the limitations described in the methodological considerations. However, previous research indicates that the risk of suffering a second MI is highest during the first few years after a first MI. Results from a study conducted with data from the Swedish national myocardial infarction registry showed that the proportion of patients suffering a recurrent MI was highest during the first two years after the index event. The time interval for a recurrent MI was shorter in women than in men, with a median interval of 13.9 months and 19.9 months, respectively. The study covered 30 years' follow-up and included patients aged  $\leq 84$  years (Gulliksson, Wedel, Koster & Svardsudd, 2009).

There is an ongoing debate regarding whether outcomes are poorer in women, with previous research indicating that a poorer outcome is related to more comorbidities among women who suffer an MI (Ladwig et al., 2016). Risk factors shown to be associated with the higher incidence of MI in women than men are hypertension, diabetes, intake of alcohol and physical inactivity. Diabetes and hypertension in younger women are more strongly associated with MI than in women aged  $> 60$  years (Anand et al., 2008). The results of Study I showed a higher risk factor burden and a shorter time interval between the MIs for women, supporting previous findings.

By the time of the second MI, more men and women were diagnosed with diabetes and hypertension compared to the first MI (I), as might be explained by

the increase in prevalence of MIs with age (Hales, Carroll, Simon, Kuo & Ogden, 2017).

The Common Sense Model (CSM) of Self-Regulation is a theoretical framework for understanding illness self-management (Leventhal et al., 1980). The model describes how cognitive factors influence illness-coping behaviours and outcomes. Illness representation is central in the CSM and is guided by three sources of information: information from previous cultural knowledge and social communication of the illness, information from the external social environment (e.g., significant others or healthcare personnel) and information based on past experiences with the illness (Leventhal et al., 1980). There are five dimensions of illness representation: *identity, timeline, cause, consequences and controllability* (Diefenbach & Leventhal, 1996). The results will be discussed and explained using the theory of illness representations.

### *Identity*

Identity refers to a person's beliefs about the illness and his or her knowledge about its symptoms (Diefenbach & Leventhal, 1996). The typical symptom (i.e., chest pain lasting for 20 minutes or more) was the most frequently reported type of symptom at both the first and second MI (II). Among women, atypical symptoms increased in the second MI. In men, 10.6 % reported different types of symptoms, and the corresponding number for women was 16.2 %. Since the use of more sensitive biochemical markers indicates an increased number of NSTEMI diagnoses (Reed et al., 2017) during the study period (II), it might explain the increased number of women reporting atypical symptoms at the second MI. Canto et al. (2012) found that MI without chest pain/discomfort (i.e., atypical symptoms) occurred more often in patients with NSTEMI. The patients were more frequently older women with a history of diabetes (Canto et al., 2012). During the study period for Study II, there has been progress in cardiac care, including improvements in treatment as well as in primary and

secondary prevention. This might have contributed to a change in the nature of the symptom presentation, but this remains a speculation.

A majority of the patients in Study III experienced different types of symptoms at the second MI, and most of them said that the symptoms at the second MI had a more serious onset. Patients stated that although they had different types of symptoms, they knew, due to their previous experience, that they had suffered a second MI (III). This may explain the shorter prehospital delay time when patients suffered their second MI (II), as an increased number of patients had a prehospital delay < 2 hours. This strengthens the assumption that symptom recognition is the first of several important factors to impact prehospital delay (Pattenden, Watt, Lewin & Stanford, 2002). If the affected person experiences the symptoms as serious, if the symptom is hard to control and if the person is unable to continue his or her current activity, then it is likely that the affected person will seek medical care (Cameron, Leventhal & Leventhal, 1993). In this case, patients could relate to their previous experience and had gained knowledge regarding the importance of seeking medical care promptly. As a result, they found it as easier to identify the condition as serious (III).

Even though the results in Study II and Study III indicate that the prehospital delay was shorter at the second MI compared to the first MI, about one third of the patients had a prehospital delay > 4 hours at the second MI (II), which is a considerable prehospital delay. Few of the interventions aimed to reduce prehospital delay have been successful. (Mooney et al., 2012) found that only two out of eight studied interventions resulted in a significant decrease in prehospital delay time. The time interval that contributes the most to prehospital delay is the patient's decision time (Beig et al., 2017; Moser et al., 2006). Results from a recent review showed that the most common factors associated with prehospital delay were old age, female gender, chronic diseases and previous MI (Wechkunanukul, Grantham & Clark, 2017). The research regarding whether

previous MI contributes to longer prehospital delay has been contradictory, as some studies have found shorter previous delay (Goldberg et al., 2009; Ottesen, Dixen, Torp-Pedersen & Køber, 2004; Peng et al., 2014).

In the current study, patients with a prehospital delay of  $\geq 2$  hours at the first MI were more likely to have a prehospital delay of  $\geq 2$  hours at the second MI (II). Shortening prehospital delay is important for minimising myocardial damage (Kloner et al., 2016); it is even more critical given the worse prognosis for patients with a recurrent MI. Memories are considered an important part of illness representation, since they reflect patients' past experiences of an event, including emotional responses associated with the illness. Due to patients' previous knowledge and their emotional and behavioural experiences, one would expect enhanced responsiveness to recurrent MI symptoms (Roe et al., 2012). Therefore, it is significant for personnel in CR to give information on a personal level based on the patient's previous experience (III, IV). Such a practice might be a way of reducing prehospital delay.

### *Timeline*

Timeline describes the affected person's beliefs about the progression of the illness. For example, does the person believe the illness is a chronic condition, or an acute condition that soon can be cured (Diefenbach & Leventhal, 1996). The personnel in Study IV consistently expressed how critical it is for patients suffering an MI to know that it is a chronic illness requiring lifelong efforts to reduce the risk of a second MI. During follow-up visits with RNs, physiotherapists and cardiologists, medical personnel have opportunities to talk with patients about the risk of suffering a second MI and to get an idea of how the patients estimate their risk for recurrence. The role of medical staff in these cases can be understood as a balancing act between encouraging patients not to be restricted by the illness while at the same time making them aware of necessary lifestyle changes and the risk of recurrence. Wiles and Kinmonth (2001)

warn of the tension between reassuring patients and providing realistic information about the uncertainty of the outcome.

### *Cause*

Cause refers to the affected person's beliefs about what factors contribute to the illness (Diefenbach & Leventhal, 1996). Regarding the third risk factor investigated (I), smoking, the number of smokers decreased between the first and second MI for both genders. Still, one-fifth of the men and one-fourth of the women continued smoking after having their first MI (I). In Study III, patients who continued smoking after the first MI had quit smoking after having their second MI and were convinced that smoking caused the second MI. This can relate not only to the dimension of *cause* (they thought they suffered the second MI because they continued to smoke) but also to the dimension of *controllability* (they thought they could control the illness by ceasing to smoke).

### *Controllability*

Controllability involves the affected person's perception of how possible it is to cure the illness and to what degree a cure depends on the person versus professional intervention (Diefenbach & Leventhal, 1996). The results in Study III showed that the second MI was a wake-up call for lifestyle changes. The second MI seemed to motivate the patients (III) to evaluate their lifestyles, and it was important for them to do what they could to avoid a third MI. This indicates that their illness representation shifted after the second MI. Previous research shows that patients' illness perceptions are related to what degree they perceive the risk of suffering a recurrent MI (Broadbent et al., 2006). Some participants did not have any thoughts about suffering a second MI. However, after the second MI occurred, the risk of a third MI became more of a reality (III). People act to avoid health threats, and they are more likely to act to avoid the threat if they perceive the threat as strong (Leventhal, 1970). This result indicates that the

patients (III) perceived the second MI as a stronger health threat than the first, which resulted in the wake-up call for lifestyle changes.

### *Consequences*

Consequences refers to a person's beliefs regarding what impact the illness will have on everyday life (Diefenbach & Leventhal, 1996). The second MI was experienced as a more serious event than the first one, and the consequences had a greater impact on daily life (III). They felt physically and psychologically restricted to a greater extent than they did after the first MI. Petrie, Buckley, Weinman and Sharpe (1996) found that patients' illness perceptions associated with MI were contributing factors to recovery. They found that patients who believed that their illness could be cured or controlled thought that recovery would be shorter and less serious compared with patients who believed that their illness could not be controlled. According to CSM, illness representation is also influenced by individuals' perceived risk of being afflicted with a disease. In Study III, some patients did not have any thoughts about the risk of having a second MI. This perception changed after the second MI; the risk of a third MI became more of a reality for them.

Patients expressed their desire for care to be customised; they wanted to know what was important for them based on their condition (IV). This aligned with the personnel's view: despite guidelines that they had to follow, it was important for them that the care was given from the patient's perspective. Adhering to guidelines is described as a balancing act between individual needs and collectively directed care (Suhonen, Välimäki & Leino-Kilpi, 2002). Van Servellen and McCloskey (1988) highlighted the unique characteristics of patients' responses to standardised treatment, the right of patients to have their individuality protected and the importance of focused care on individual patients' needs.

Study IV focused on patients' expressed needs. According to Fagerstrom, Eriksson and Bergbom Engberg (1998), caring needs are those expressed by the patient as suffering, though they are also related to the experience of well-being. Personnel's awareness and knowledge regarding patients' needs and wants, as well as the importance of their encounters, helps in understanding the message patients convey concerning the need for caring. Fagerström, Eriksson and Engberg (1999) highlight the difficulties in "measuring" patients' caring needs. They explain that caring needs may contain the patient's problems, needs and desires. Person-centred care is about the person's individuality, subjectivity, rights and preferences, acknowledging the person's needs and competence (Leplege et al., 2007). In a person-centred perspective, medical staff must keep in mind that the patient's unexpressed needs also require attention.

Person-centred care is a concept used in healthcare in general and in nursing in particular (McCormack & McCance, 2006). In person-centred care, the patient's resources are in focus instead of just the illness and limitations caused by the illness. The purpose is to involve the patient as an active participant in care and treatment. Central to person-centred care is the patient's view of the condition and his or her life situation (Ekman et al., 2011). The starting point is a narrative combined with medical test results (Wallström & Ekman, 2018). The narrative enhances the understanding of the patient's view of the situation and leads to shared agreement on how care will proceed (Wallström & Ekman, 2018). By combining the theory of illness representation with a person-centred care it might be possible to offer care that is in line with needs and resources expressed by people who have suffered a second MI.

## Methodological considerations

### Studies I and II

A limitation in the MONICA registry is the somewhat old data and the age limit chosen in the WHO MONICA project. In the beginning, patients aged 25–64 years were included in the register, and from the year 2000, patients aged 65–74 year were also included. The results regarding women have to be interpreted with caution, and it may affect external validity. In most Western societies, women are on average seven to ten years older than men when developing CHD (Ladwig et al., 2016). Hence, women with an MI under 65 years of age are supposed to have comorbidities to a greater extent than men, indicating selection bias. The results in Study I also show a higher risk factor burden for women, supporting this.

In study I and II those who had their first MI close to the upper age limit might not be included since their second MI then could occur too late to be registered. This might give an imbalance in favour to two MIs occurring in earlier age in both age groups. Since both MIs should occur within a certain time span the same argument could be used for MIs occurring late in the time span leading to same type of imbalance.

During the study period for the MONICA registry, there has been progress in cardiac care, improvements in treatment as well as in primary and secondary prevention in CHD. More sensitive biochemical markers have increased the number of NSTEMI diagnoses, but the total number of MIs has decreased, most significantly for men. Risk factor burden in the population (Eriksson et al., 2011) and mortality rates have also decreased (Lundblad et al., 2008). This may mean that the MI population differs when early and late MIs are compared.

Registration in the MONICA MI registry was based on medical records. As data from medical records are based on many physicians collecting data (e.g. MI

symptoms), there is a risk that their different experiences influence the way of asking patients about their symptoms. If the registry had been based on standardized questionnaires, it probably would have decreased the risk of bias. A limitation is that data is missing for 42 % of eligible patients recorded (II) for the type of the variable of symptoms and time from onset of symptoms to FMC. These patients were excluded from Study II. A review paper by Davis (2015) showed that the percentage of missing data when abstracted from medical records varied 14 % - 40 %. The analysis of patients excluded because of missing data showed similar age and gender proportions as the study sample; this might indicate that there is not a systematic error. Missing data is almost always a problem, but less so if data are lost due to causes which do not introduce any bias. We see no reason to believe that the reasons behind missing data in the MONICA registers would be of any other kind.

One strength is the internal and external quality control that ensures the reliability of the data. A central quality assurance program performed in the MONICA Data Centre in Helsinki stated that the data from the Northern Sweden MONICA project held a good quality score (Eriksson, Stegmayr & Lundberg, 2003).

### **Studies III and IV**

The rigour of the research, in other words, its validity and reliability, is as essential to qualitative research as it is to quantitative research. There are different opinions about which concepts should be used when describing this within qualitative studies. For assessing trustworthiness in our qualitative studies (III, IV), we used the four criteria originally formulated by (Lincoln & Guba, 1985): credibility, dependability, confirmability, and transferability. Graneheim and Lundman (2004), as used as analysis method in Study III and IV, discuss foremost the criteria credibility, dependability and transferability when using qualitative

content analysis and Granheim et al. (2017) add confirmability when discussing trustworthiness; these articles will be further used when discussing this issue.

To achieve credibility, it is necessary to find participants who have experiences in accordance with the aim of the study and want and can tell about it. To strengthen dependability, we used an interview guide to ensure that the questions covered the same area for all participants. Selecting the most appropriate method for data collection and the number of participants is another issue that needs attention to establish credibility (Graneheim & Lundman, 2004; Graneheim et al., 2017). In Study II, we found it most appropriate to use individual semi-structured interviews. as the topic might be sensitive and not appropriate to be discussed in a group. In Study IV, we let the participants choose between individual, dyads or group interviews. Because the aim was to study personnel's descriptions, we found it could be an advantage to have more than one person to interview in each session, as they could discuss their experiences together. This was, unfortunately, impossible to perform in all interviews due to the participants' schedules. In Study III, eight persons who suffered a second MI participated, and in Study IV those eight persons along with four RNs, four physiotherapists and three cardiologists participated, totalling 19 participants. The participants gave rich descriptions of their experiences, and we judged the data collected large enough to provide richness and depth to the analysis and to answer to the aims of the studies. When determining the sample size (III, IV), we judged the quality of the data collected against the aims, research method and the intended research product. A sample size should be large enough to give variations, and small enough to do an in-depth analysis of the data (Sandelowski, 1995).

In Study III, the data collection took longer than we had planned due to difficulties recruiting participants. It was not possible to recruit patients without assistance from RNs at the hospitals. They were given verbal and written

information about the study aim and inclusion criteria and were positive about assisting with recruitment. During this period, I reminded them several times about recruiting participants. They said it was hard to remember to inform eligible patients about the study because they had a lot of other information to give patients during the follow-up. The interviews were conducted between December 2014 and October 2017. There is a risk of inconsistency when data collection ranges over time (Graneheim & Lundman, 2004). According to Graneheim et al. (2017), dependability in qualitative content analysis also involves deciding which codes and illustrating quotations from the original text that should be included in respective categories. This was continually discussed and tested during the analysis processes.

Dependability is about including more than one researcher in the analysis to discuss alternative interpretations, also described as consensus (Graneheim et al., 2017). In Studies III and IV, we independently checked the analysis then discussed to reach a final agreement. It is essential to be aware of the preunderstanding you have as a researcher and how that can influence the questions asked and how these questions are asked, and how participants' answers are perceived and interpreted (Graneheim et al., 2017). I am aware of my preunderstanding as RN, critical care nurse and nursing researcher with experience from practice where I have met people living with cardiovascular illness. I have tried to make myself aware of my preunderstanding, for instance, by thinking about what questions to ask, how to ask them. I have been curious and asked follow-up questions to get further examples instead of thinking, "I already know what that means". Preunderstanding can also be a prerequisite for the quality of the study by knowing what is relevant to ask participants to explain. Graneheim et al. (2017) highlight the need to be aware and reflect over of one's preunderstanding to ask the "right" questions the "right" way, ask follow-up questions and be open-minded regarding the data collected. This is a matter of dependability and close to confirmability, which is about findings and

conclusions not being a result of researchers' preunderstanding. To increase confirmability we used quotations from participants to show some of the original data, and we described the analysis process. The interpretations in Studies III and IV are not abstract and therefore easier for the reader to judge the confirmability.

For transferability, the selection of participants and having descriptions of the culture and context where the study takes place is important (Graneheim & Lundman, 2004; Graneheim et al., 2017). We have tried to describe this clearly, but without risking participants' confidentiality.

Study III was performed inductively, and in Study IV we discussed using a deductive approach by following deductive qualitative content analysis as described by (Elo & Kyngäs, 2008). Here, in Study IV, the starting point was the data collected in Study III and comparing the expressed needs for CR with the data collected in Study IV and answering the question: Is there any congruence between patients' expressed needs and staff's description of their work? This work was not driven by previous theories or a previous decision of what categories that should be used. Instead, the analysis was done with all the interviews as the analysis unit. Therefore, I have chosen to not define Study IV as deductive qualitative content analysis.

## Conclusion

The second MI is experienced as a different and more serious event than the first one. For patients in this study, the second MI was a wake-up call for lifestyle changes, and the threat of a third MI was tangible. This phenomenon has been discussed and can be understood within the theory of illness representation, which suggests that the second MI might be experienced as a stronger health threat than the first one. Increased knowledge among personnel in cardiac rehabilitation about patients' illness representation might help develop individual and systematic education and counselling. The suggested clinical implication is the use of person-centred care. Care should be tailored to patients' needs, resources and illness experiences.

During the work with this thesis, some new research questions have arisen. One that could be of interest is to examine illness representation in patients with a first MI and in patients with a second MI. Such a comparison might confirm this thesis's results indicating that the patients' illness representation shifts after having a second MI. More studies in this area with a long-term perspective are also needed, as well as studies from the perspective of relatives of people suffering from a second MI to better understand what it means for the person and how to meet the afflicted persons' needs and give the best care.

## Summary in Swedish – Svensk sammanfattning

Att drabbas i en hjärtinfarkt sker ofta akut och oväntat för den som drabbas. Många som drabbas beskriver att de lever med en rädsla och osäkerhet inför om eller när de ska drabbas av en andra hjärtinfarkt. Vid litteraturgenomgång fann vi att upplevelsen av att återinsjukna i hjärtinfarkt är sparsamt beskrivet.

Det övergripande syftet med avhandlingen var att utforska den andra hjärtinfarkten och beskriva upplevelsen av att drabbas av en andra hjärtinfarkt utifrån drabbade personers perspektiv samt utifrån personal som är verksamma inom hjärtrehabilitering.

Fyra studier ingår i avhandlingen, två kvantitativa (I,II) och två kvalitativa (III,IV). Studie I och II baseras på data från norra Sveriges MONICA hjärtinfarkt register. Studie III och IV baserad på data insamlad via intervjuer.

**Studie I:** I studie I ingår 1017 patienter som mellan åren 1990 – 2009 drabbades två av hjärtinfarkter. Syftet var att jämföra andelen patienter som hade riskfaktorerna diabetes, högt blodtryck och rökning vid första och andra hjärtinfarkten samt att mäta tidsintervallet mellan hjärtinfarkterna. Resultatet visade att fler patienter hade riskfaktorerna diabetes och högt blodtryck vid den andra hjärtinfarkten och att färre rökte. Ett större antal kvinnor i jämförelse med männen hade samtliga dessa riskfaktorer både vid första och andra hjärtinfarkten. Kvinnor hade ett kortare tidsintervall mellan hjärtinfarkterna än vad männen hade.

**Studie II.** I studie II ingår 820 patienter som mellan 1986 – 2009 drabbades av två hjärtinfarkter. Syftet var att jämföra typ av symptom och tid till sjukvård mellan första och andra hjärtinfarkten, samt att undersöka faktorer som kan påverka tid till sjukvård vid den andra hjärtinfarkten. Resultatet visade att det vanligaste symtomet var så kallade typiska symptom, d. v. s central bröstsmärta som sitter i minst 20 minuter, både vid den första och andra hjärtinfarkten för både kvinnor

och män. Vid den andra hjärtinfarkten ökade andel kvinnor med atypiska symtom. Det var ca 10 % av männen och 16 % av kvinnorna som hade olika symtom vid de båda hjärtinfarktarna. Tid till sjukvård var kortare vid den andra hjärtinfarkten vilket betyder att fler kom till sjukvård inom två timmar. Den tid till sjukvård patienterna hade vid den första hjärtinfarkten påverkade tiden vid den andra hjärtinfarkten, d v s det fanns ett samband mellan en tid till sjukvård  $\geq 2$  timmar vid den första hjärtinfarkten och  $\geq 2$  timmar till sjukvård vid den andra hjärtinfarkten.

**Studie III.** I studie III deltog åtta personer, två kvinnor och sex män, som drabbats av en andra hjärtinfarkt. Syftet var att beskriva upplevelsen av att drabbas av en andra hjärtinfarkt. Datainsamlingen genomfördes med individuella intervjuer där personerna fick berätta om sin upplevelse av att drabbas av en andra hjärtinfarkt. Det var mellan en och 4.5 månader sedan de drabbades när intervjuerna gjordes. Resultatet visade att den andra hjärtinfarkten upplevdes som en annorlunda och allvarligare händelse. De blev mer begränsade både fysiskt och psykiskt och återhämtningen tog längre tid. Flera av dem var övertygade om att de skulle drabbas av ytterligare hjärtinfarkter och kanske inte överleva det. De beskrev att de på allvar förstod vikten av att göra de föreslagna livsstilsförändringarna. De uttryckte också att de genom sin tidigare erfarenhet fått kunskap som gjorde att de trots annorlunda symtom vid den andra hjärtinfarkten var de säkra på att de drabbats igen.

**Studie IV.** I studie IV ingick patienterna från studie III samt personal som i sin profession möter personer som kallas till återbesök på sjukhus efter att ha drabbats av hjärtinfarkt. Syftet var att undersöka om patienternas uttryckta behov under hjärtrehabiliteringen stämde överens med hur personalen beskrev att de arbetade. Personalen, fyra sjuksköterskor, fyra fysioterapeuter samt tre kardiologer intervjuades beskrev sitt sätt att arbeta med dessa patienter. Intervjuerna med patienterna analyserades på nytt och delar som handlade om deras uttryckta

behov under hjärtrehabiliteringen analyserades. Det resulterade i fem olika kategorier. Utifrån dessa kategorier analyserades intervjuerna med personalen. Detta resulterade i ett gemensamt tema: att bli sedd som en unik person. Patienterna uttryckte att det var viktigt för dem att vården var skräddarsydd, de ville veta vad som var viktigt just för dem. Personalen å sin sida beskrev att det var viktigt att se den unika individen. Även om de hade riktlinjer att förhålla sig till var det viktigt att utgå från den specifika personen.

### **Slutsats**

Att drabbas av en andra hjärtinfarkt upplevs som en annorlunda och allvarigare händelse. Patienterna hade genom sin tidigare erfarenhet fått värdefull kunskap och den andra hjärtinfarkten fick dem att verkligen förstå vikten av att göra de föreslagna livsstilsförändringarna. Resultatet tyder på att patienternas uppfattning om sjukdomen förändras efter att de drabbats av en andra hjärtinfarkt. De kunde till exempel identifiera symtomen lättare, de förstod på ett tydligare sätt att de själva kunde påverka sjukdomen genom att göra livsstilsförändringar och de upplevde konsekvenserna av sjukdomen som allvarigare. Utifrån att patienterna uttryckte behov om att vården skulle vara skräddarsydd för dem och att personalen uttryckte vikten av att vården utgick från den specifika personen föreslår vi att vården ska bedrivas utifrån ett person-centrerat arbetssätt. På detta sätt skulle patienter och personal mötas och patienterna skulle kunna få sina behov tillgodosedda.

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# The second myocardial infarction: Higher risk factor burden and earlier second myocardial infarction in women compared with men. The Northern Sweden MONICA study

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Ulrica Strömbäck<sup>1</sup>, Irene Vikman<sup>1</sup>, Dan Lundblad<sup>2</sup>,  
Robert Lundqvist<sup>3</sup> and Åsa Engström<sup>1</sup>

## Abstract

**Background:** Several studies have examined various parameters and experiences when patients suffer their first myocardial infarction (MI), but knowledge about when they suffer their second MI is limited.

**Aim:** To compare risk factors for MI, that is, diabetes, hypertension and smoking, for the first and second MI events in men and women affected by two MIs and to analyse the time intervals between the first and second MIs.

**Methods:** A retrospective cohort study of 1017 patients aged 25–74 years with first and second MIs from 1990 through 2009 registered in the Northern Sweden MONICA registry.

**Results:** More women than men have diabetes and hypertension and are smokers at the first MI. Similar differences between the genders remain at the time of the second MI for diabetes and hypertension, although both risk factors have increased. Smoking decreased at the second MI without any remaining difference between genders. Women suffer their second MI within a shorter time interval than men do. Within 16 months of their first MI, 50% of women had a second MI. The corresponding time interval for men was 33 months.

**Conclusion:** Patients affected by an MI should be made aware of their risk of recurrent MI and that the risk of recurrence is highest during the first few years after an MI. In patients affected by two MIs, women have a higher risk factor burden and suffer their second MI earlier than men do and thus may need more aggressive and more prompt secondary prevention.

## Keywords

Modifiable risk factors, retrospective cohort study, self-management, time interval, second myocardial infarction

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For individual patients a myocardial infarction (MI) is always a serious event and feelings of uncertainty related to whether or when they will have a recurrent MI are common.<sup>1</sup> The prevalence of recurrences has been estimated to be between 10% and 12.7%.<sup>2,3</sup> In many countries, including Sweden, the morbidity and mortality of coronary heart diseases (CHDs) has declined over the last several decades.<sup>4,5</sup> It has been shown that this is due to a reduction in risk factors as well as improved treatments.<sup>6</sup>

There are four major modifiable risk factors for MI: diabetes mellitus, hypertension, dyslipidaemia and smoking.<sup>6,7</sup> Both primary prevention, with the goal of preventing or

delaying the onset of CHD, and secondary prevention, which aims to delay the progression of the disease through

<sup>1</sup>Department of Health Science, Luleå University of Technology, Sweden

<sup>2</sup>Sunderby Research Unit, Department of Public Health and Clinical Medicine, Umeå University, Sweden

<sup>3</sup>Department of Research, Norrbotten County Council, Luleå, Sweden

## Corresponding author:

Ulrica Strömbäck, Department of Health Science, Luleå University of Technology, SE-971 87 Luleå, Sweden.

Email: [ulrica.stromback@ltu.se](mailto:ulrica.stromback@ltu.se)

treatment and rehabilitation,<sup>8</sup> are crucial for diminishing the number of MI events. Atherosclerosis is usually the result of a combination of risk factors, and prevention should be adapted to the patient's total risk of CHD.<sup>9</sup>

The aim of this study was to compare risk factors for MI, that is, diabetes, hypertension and smoking, for the first and second MI events in men and women affected by two MIs and to analyse the time intervals between first and second MIs.

## Methods

### The MONICA registry

Data in the present retrospective cohort study are population-based and were collected from the Northern Sweden MONICA Myocardial Infarction registry.<sup>10</sup> The registry was developed from the World Health Organization (WHO) MONICA project (MONItoring of trends and determinates in Cardiovascular disease), which was initiated in 1985. Two centres in Sweden have participated, one in the south (Gothenburg area) and the second in Norrbotten and Västerbotten, the two northernmost counties, as one centre. The WHO MONICA project was officially completed in 1995 but continued as a local project in northern Sweden,<sup>10,11</sup> ending in 2009. WHO MONICA criteria were used to code MI events,<sup>12</sup> and the events were registered and validated according to the WHO MONICA manual.<sup>13</sup> At the beginning of the registration period, MI diagnoses were based on typical symptoms, cardiac biomarkers and electrocardiogram (ECG) findings. Since 2000, MI diagnoses have been based on typical symptoms and cardiac biomarkers only, although ECG findings have been used to confirm diagnoses if only one of the two parameters noted above was positive.<sup>11,14</sup>

Risk factors registered in MONICA were diabetes, hypertension and smoking. Information about whether or not the patients had those risk factors was collected from medical records. During the period 1990–2009, 10,785 patients (8020 men and 2765 women) were registered in the MONICA register; 1017 patients (9.4%) had suffered two or more MIs. For men, this number was 775 (9.7%) and for women, 242 (8.8%). Of those, 115 patients (11.3%) (82 men (10.6%) and 33 (13.6%) women) died within 28 days after suffering their second MI. In this registry, recurrent MI referred to situations in which a new MI event occurred at least 28 days after the first MI, according to the WHO definition.<sup>10,12</sup> Initially, people between 25 and 64 years of age were registered; since the year 2000, people aged 65–74 years have also been included in the registry.

### Participants

The present study includes 1017 patients (775 men (76.2%) and 242 women (23.8%)) who had at least two MI events

**Table 1.** Ages of men and women at first (MI 1) and second (MI 2) myocardial infarction.

	MI 1 Men n (%)	Women n (%)	MI 2 Men n (%)	Women n (%)
	775 (76.2)	242 (23.8)	775 (76.2)	242 (23.8)
Age, years, mean $\pm$ SD	55.8 $\pm$ 8.4	61.3 $\pm$ 8.3	60.9 $\pm$ 8.3	64.3 $\pm$ 7.6

recorded in the MONICA registry from January 1990 to December 2009. The two MI events analysed in this study are the first and second events.

### Statistical analysis

Comparisons between groups, men and women, were analysed using  $\chi^2$ -test for categorical data, Mann–Whitney *U* test for non-parametric data and by Student's *t*-test for continuous data. McNemar's test was used to compare the paired groups. When presenting time intervals between first and second MIs, the median time is used due to the skewed distribution. Differences were considered to be significant if  $p < 0.05$ . Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS), version 23.0.

### Ethics

Patients who met the criteria for registration in the MONICA registry were informed by a personal letter about the registration. Less than 1% declined participation. The project was approved by the Regional Ethics Review Board, Umeå University (DNR 96-154). The investigation conforms to the principles outlined in the Declaration of Helsinki.

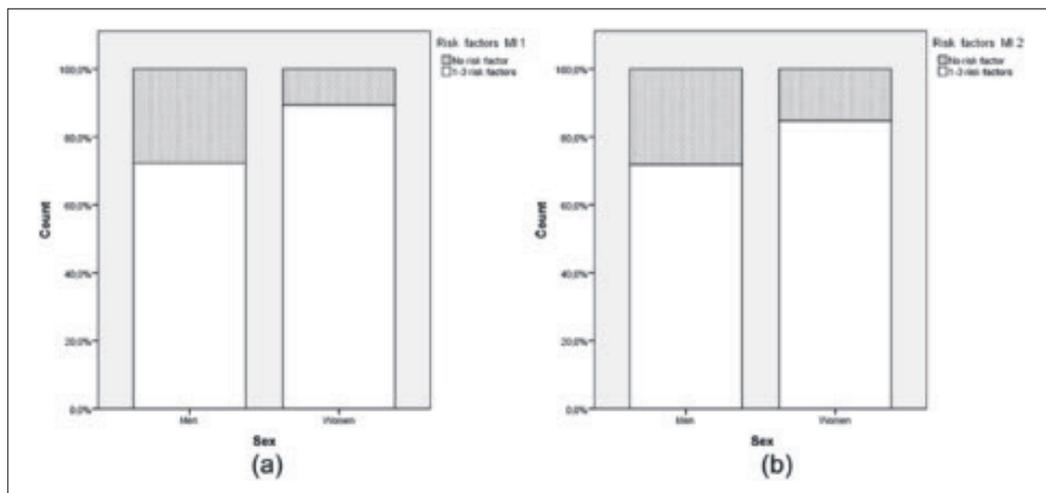
## Results

The mean age at first and second MI events for men was 55.8 and 60.9 years respectively, and for women the figures correspond to 61.3 and 64.3 years respectively (Table 1).

At the time of the first MI, 33.5% of women and 20.1% of men had diabetes ( $p < 0.001$ ); the corresponding figures for hypertension were 57.9% and 40.8% ( $p < 0.001$ ). More women than men were smokers: 44.2% versus 37.4% ( $p = 0.010$ ). Similar results are found when comparing risk factors at the second MI: diabetes 36.8% in women, 27.7% in men ( $p = 0.014$ ); hypertension 64% in women, 49.5% in men ( $p < 0.001$ ); and for smokers, 24.4% in women and 19.5% in men ( $p = 0.162$ ) (Table 2). When comparing risk factors in women at the first and second MIs, 33.5% had diabetes at the time of the first MI, and the percentage for the second MI was 36.8% ( $p = 0.096$ ). The numbers for hypertension were 57.9% and 64.0% ( $p = 0.017$ ) for the first and second MIs, respectively. The number of women

**Table 2.** Risk factors for men and women for first (MI 1) and second (MI 2) myocardial infarction.

Risk factor	MI 1			MI 2			p-value Men MI 1 and MI 2	P-value Women MI 1 and MI 2
	Men n (%)	Women n (%)	p-value Men and women MI 1	Men n (%)	Women n (%)	p-value Men and women MI 2		
Diabetes	156 (20.1)	81 (33.5)	< 0.001	215 (27.7)	89 (36.8)	= 0.014	<0.001	= 0.096
Hypertension	316 (40.8)	140 (57.9)	< 0.001	384 (49.5)	155 (64%)	< 0.001	< 0.001	= 0.017
Smoking	290 (37.4)	107 (44.2)	= 0.010	151 (19.5)	59 (24.4)	= 0.162	< 0.001	< 0.001

**Figure 1.** (a) Risk factors in first myocardial infarction (MI 1) in men and women;  $p < 0.001$ . (b) Risk factors in second myocardial infarction (MI 2) in men and women;  $p < 0.001$ .

who were smokers declined from 44.2% at the first MI to 24.4% at the second MI ( $p < 0.001$ ). For men, 20.1% had diabetes at the first MI, and 27.7% had diabetes at the second MI ( $p < 0.001$ ). Regarding hypertension in men, the numbers are 40.8% and 49.5% ( $p < 0.001$ ) at the first and second MIs respectively. Similar to the case for women, fewer men were smokers when they suffered their second MI: 19.5% compared with 37.4% at the time of the first MI ( $p = 0.010$ ) (Table 2).

In regard to risk factors, 72.2% of the men and 89.4% of the women had at least one or more of the risk factors of hypertension, diabetes and smoking at the first MI ( $p < 0.001$ ). The corresponding figures for the second MI were 71.8% in men and 84.8% in women ( $p < 0.001$ ) (Figure 1(a) and (b)).

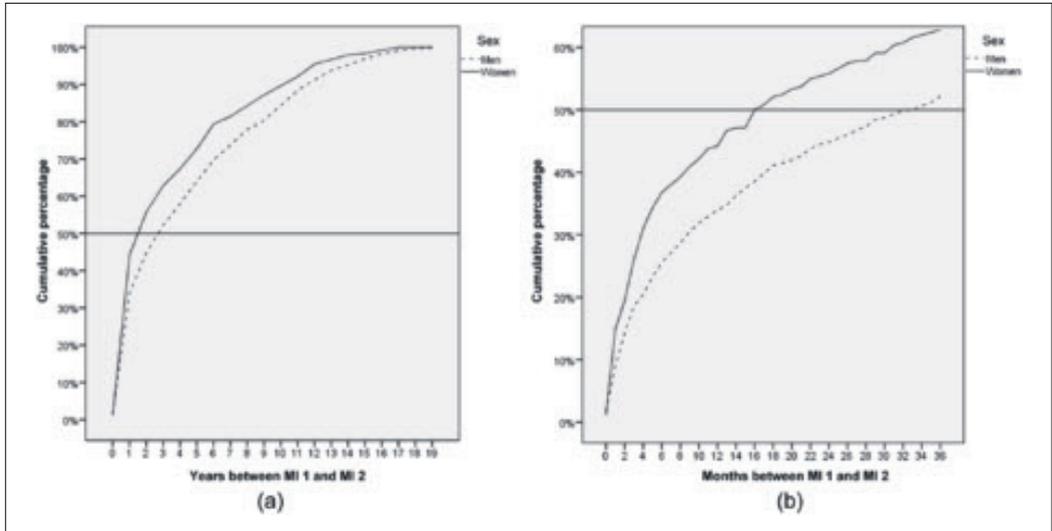
Within 29 months of their first MI, 50% of the patients suffered their second MI. For women, the time interval between MI 1 and MI 2 was 16 months and for men 33 months ( $p < 0.001$ ). Within 83 months (6 years 11 months), 75% of the patients had suffered their second MI; the numbers for men and women are 89 (seven years and five

months) and 64 (five years and seven months) months respectively. During the first year after the first MI event, 44% of the women and 34% of the men had suffered their second MI (Figure 2(a) and (b)).

## Discussion

In the population in Sweden, the prevalence of diabetes is estimated at approximately 4%, and of that figure, 57% are men.<sup>15</sup> In the present study, more women have diabetes both at the first and the second MI compared with men. It has been shown that women with diabetes have an increased risk of CHD events compared with men.<sup>16</sup>

About 27% of the adult population in Sweden has hypertension, and the condition is just as common among men as among women.<sup>17</sup> In the present study, more women than men had hypertension at both the first and the second MI. Hence, more women than men with MIs have diabetes and hypertension, despite the fact that, in the population as a whole, fewer women have diabetes, and hypertension is equally common in men and women.



**Figure 2.** (a) Number of years between first (MI 1) and second (MI 2) myocardial infarction for men and women. (b) Number of months between MI 1 and MI 2 for men and women.

This is consistent with previous studies showing that diabetes and hypertension are more common in women than in men among patients with acute coronary syndrome (ACS).<sup>18–20</sup>

It seems that women are more prone to have risk factors than men.<sup>21</sup> This might explain why women often suffer a second MI earlier than men, which our results show. The time interval between first and second MIs showed that 50% of women suffered their second MI within 16 months of the first MI, while for men, the time interval between MIs was just over twice as long. The results, regardless of gender, showed that the risk of suffering a second MI was greatest within the first few years after the initial MI. Only a few studies have focused on the time interval between first and second MIs and to our knowledge there is no previous study that analyses and/or discusses the gender disparities regarding the time interval between first and second MI. Smolina et al.<sup>2</sup> found that, among patients who experienced a second MI, about half of these occurred within the first year. Gulliksson et al.<sup>22</sup> showed that the risk for a second MI fell sharply during the first two years after the first MI and reached a minimum after five years. Notably, both Smolina et al.<sup>2</sup> and Gulliksson et al.<sup>22</sup> express some uncertainty about whether the first MIs reported in the patients in their studies are, in fact, their actual first MI event. In a study that used data from the MONICA/KORA MI registry, the median time interval between first and second MIs was 49 months; figures for men and women are not presented separately.<sup>23</sup> In an experimental study conducted in mice, atherosclerotic plaques grew faster following an ischemic

event due to increased inflammation.<sup>24</sup> If this finding is applicable to humans, it could explain the result in the present study; 44% of the women and 34% of the men had suffered their second MI during the first year after the first MI event.

In line with our results, Gulliksson et al.<sup>22</sup> show that the time interval between the first and second MI is shorter for women, with a median time of 14 months compared with 20 months for men. Hence, the time interval for men is shorter in their study. However, the patients were older, and their data covered a longer period, which might explain the difference.

Previous studies show that there is a gender disparity in treatment in patients with ACS. For example, fewer women than men underwent coronary angiography and percutaneous coronary revascularization.<sup>19,20</sup> Stenestrand et al.<sup>25</sup> compared the outcomes of primary percutaneous coronary intervention (PCI) and thrombolysis in patients with ST elevation MI and found that both early and late recurrent MIs were reduced by primary PCI. Furthermore, in a study with data collected from the Northern Sweden MONICA registry, there were differences in drug treatment in patients with MI, with women being prescribed  $\beta$ -blockers and antiplatelet drugs less often than men.<sup>26</sup>  $\beta$ -blockers and antiplatelet drugs are recommended as secondary prevention in both men and women with MI.<sup>27,28</sup> Another study which indicates that gender disparities can be present is Jernberg et al.<sup>29</sup> They compared patients with MI who did not experience a new cardiovascular event within the following year with patients who had a new cardiovascular event within

the same period. The results showed that a higher proportion of patients in the first group received guideline-recommended therapies at discharge and, in addition, the proportion of women in that population was lower.<sup>29</sup> These findings may explain some of our results, that is, a gender disparity in recommended treatment after an MI may be a contributing factor to the reason why women suffer their second MI within a shorter time interval than men.

The European guidelines on cardiovascular disease prevention in clinical practice highlight that patients with MI are at high risk for a future MI event and thus need help and support to be aware of and reduce the risk factors that affect them.<sup>9</sup> According to the guidelines, prevention of CHD includes both lifestyle changes and drug therapies.<sup>9</sup> A barrier to managing lifestyle changes and modifying risk factors can be associated with a lack of knowledge about the disease and what lifestyle changes need to be made and why.<sup>30,31</sup>

Our results show that the prevalence of diabetes and hypertension increased when patients suffered their second MI. Hence, more patients have these diagnoses at the second MI. However, since we only register having a diagnosis or not, it is impossible to estimate the eventual secondary preventive effect of lifestyle changes and/or medication. In contrast, the number of smokers decreased between the first and second MI for both genders. This indicates that some patients were motivated and had the ability to act in order to reduce this well-known risk factor. If the patient understands that an MI represents acute symptoms of an underlying disease process,<sup>32</sup> and believes in his/her ability to change,<sup>33</sup> he or she may be more motivated and find it easier to make lifestyle changes proven to reduce risk. It has been shown that patients who perceived their MI as a life-threatening illness were more committed to making lifestyle changes than patients who experienced uncertainty about the severity of their illness.<sup>34</sup>

Patients described that during the first period after being discharged from the hospital they struggled with how to handle life after an MI event.<sup>35</sup> They intended to change their lifestyle but expressed difficulty in changing their risk factors after discharge.<sup>36</sup> The present study shows that 44% of the women and 34% of the men suffered their second MI within one year after the first MI event. According to Chow et al.,<sup>37</sup> the impact of lifestyle changes after an MI has a prompt effect and reduces the risk of recurrent MI events. These findings<sup>35-37</sup> and our result indicate that patients suffering from an MI have benefits from an early start of interventions to enhance lifestyle changes. Self-management programmes, which improve the level of perceived self-efficacy in modifying lifestyle, have been proven to be successful in patients with chronic disease; for instance, CHD.<sup>38</sup> One definition of self-management is: 'the day-to-day management of chronic conditions by individuals over the course of an illness'.<sup>39</sup> Supporting self-management

includes educating patients about their health and motivating them to take an active role in their own care.<sup>40</sup> These programmes emphasize that the patients have an important role in managing their chronic disease.<sup>33</sup> There are several different programmes for promoting self-management and Lawn and Schoo<sup>41</sup> find in their review that the different programmes all have advantages and disadvantages. The base for what model to use depends on the patient's specific needs.

### Strengths and limitations

The data are collected from a large database, and the strict use of the MONICA criteria for validation of MI diagnosis is a strength of the study. The registry has internal and external quality control, with few persons involved in the registration process, and Northern Sweden is a unit with very high-quality data.<sup>42</sup> Another strength is that patients with some kind of uncertainty about whether the first MI event in the registration really was their first MI were excluded from the study. Patients older than 74 years are not included in the MONICA register, which is a limitation. Another limitation is that we were not able to analyse one of the major modifiable risk factors, cholesterol levels, as this information is not included in the MONICA register.

### Implications for practice

- In patients who have been affected by two myocardial infarctions women have a higher risk factor burden for the first and second myocardial infarction (MI) and suffer the second MI earlier than men do, and thus may need more aggressive and more prompt secondary prevention.
- Patients affected by an MI should be made aware of their risk of suffering a recurrent MI and that the risk of recurrence is highest during the first few years after an MI event.
- Self-management programmes based on the patient's specific needs is suggested as a nursing intervention that should be initiated as quickly as possible after an MI event.

### Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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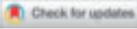
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# The second myocardial infarction: Is there any difference in symptoms and prehospital delay compared to the first myocardial infarction?

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Ulrica Strömbäck<sup>1</sup>, Åsa Engström<sup>1</sup>, Robert Lundqvist<sup>2</sup>,  
Dan Lundblad<sup>3</sup> and Irene Vikman<sup>1</sup>

## Abstract

**Background:** Knowledge is limited concerning the type of symptoms and the time from onset of symptoms to first medical contact at first and second myocardial infarction in the same patient.

**Aim:** This study aimed to describe the type of symptoms and the time from onset of symptoms to first medical contact in first and second myocardial infarctions in men and women affected by two myocardial infarctions. Furthermore, the aim was to identify factors associated with prehospital delays  $\geq 2$  h at second myocardial infarction.

**Methods:** A retrospective cohort study with 820 patients aged 31–74 years with a first and a second myocardial infarction from 1986 through 2009 registered in the Northern Sweden MONICA registry.

**Results:** The most common symptoms reported among patients affected by two myocardial infarctions are typical symptoms at both myocardial infarction events. Significantly more women reported atypical symptoms at the second myocardial infarction compared to the first. Ten per cent of the men did not report the same type of symptoms at the first and second myocardial infarctions; the corresponding figure for women was 16.2%. The time from onset of symptoms to first medical contact was shorter at the second myocardial infarction compared to the first myocardial infarction. Patients with prehospital delay  $\geq 2$  h at the first myocardial infarction were more likely to have a prehospital delay  $\geq 2$  h at the second myocardial infarction.

**Conclusions:** Symptoms of second myocardial infarctions are not necessarily the same as those of first myocardial infarctions. A patient's behaviour at the first myocardial infarction could predict how he or she would behave at a second myocardial infarction.

## Keywords

First and second myocardial infarction, prehospital delay, typical and atypical symptoms

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## Introduction

During the last decade, treatment and secondary prevention following myocardial infarction (MI) have increased both short- and long-term survival rates.<sup>1</sup> However, despite these improvements, patients are still at risk of a second MI. Data regarding the prevalence of recurrence is slightly divergent and has been estimated at 11% in a seven-year follow-up<sup>2</sup> and 12.7% in a five-year follow-up.<sup>3</sup> The risk of suffering a second MI is highest during the first years after the first MI.<sup>2,4</sup>

<sup>1</sup>Department of Health Science, Luleå University of Technology, Sweden

<sup>2</sup>Department of Research, Norrbotten County Council, Luleå, Sweden

<sup>3</sup>Sunderby Research Unit, Umeå University, Sweden

### Corresponding author:

Ulrica Strömbäck, Department of Health Science, Luleå University of Technology, SE-971 87 Luleå, Sweden.

Email: ulrica.stromback@ltu.se

There is a wide range of symptoms associated with MI and patients commonly present with more than one symptom.<sup>5</sup> The most common symptom – referred to as a typical symptom in some literature – is chest pain lasting for 20 min or more. The pain is often described as a pushing or burning sensation and may radiate to the neck, towards the jaw or the back.<sup>6</sup> Examples of atypical symptoms include nausea, vomiting, dyspnoea, abdominal pain, fatigue and syncope.<sup>7</sup> Although chest pain is the most common symptom for both men and women,<sup>8,9</sup> a systematic literature review<sup>10</sup> shows that women are more likely than men to present with atypical symptoms, and women also tend to present with more symptoms than men.

Treatment of MI consists of restoring perfusion to the coronary arteries. The main outcome of treatment depends on how soon treatment is initiated after symptoms appear; early reperfusion can prevent further injury to heart muscle tissue.<sup>11</sup> Management of a patient with ST elevation myocardial infarction (STEMI), which includes diagnosis and treatment, starts from the first medical contact (FMC). According to the European Society of Cardiology (ESC), the definition of FMC is the point when the patient is assessed by skilled medical personnel. This can be either in the prehospital setting or upon arrival at the hospital or the healthcare centre.<sup>12</sup> In patients with STEMI, the recommended reperfusion therapy is a primary percutaneous coronary intervention (PCI) provided as rapidly as possible. The target times for PCI are:  $\leq 90$  min when direct transport to a PCI capable hospital;  $\leq 120$  min when the initially transport is to a non-PCI-capable hospital and an immediate transfer to a PCI capable hospital is required. In areas where PCI is not possible to perform within 120 min, fibrinolysis within 10 min from STEMI diagnosis is recommended followed by rescue or routine PCI depending of outcome.<sup>12,13</sup>

There are several causes of treatment delays in patients with MI. These include the patient's delay between symptom onset and FMC, delay between FMC and diagnosis, and delay between FMC and reperfusion therapy.<sup>14</sup> The most significant cause of delay is patient decision time; that is, the time between onset of symptoms and the patient's decision to seek medical help.<sup>15</sup> In a global review of delay time in seeking medical care for symptoms associated with MI, it was found that delay times differed between countries and the mean time of delay was 3.4 h.<sup>16</sup> Some of the factors associated with longer prehospital delay are older age, women, diabetes and being alone at onset of symptoms.<sup>15</sup> In patients with an MI history, previous research shows conflicting results regarding prehospital delay, a reduced prehospital delay<sup>17,18</sup> or no association with shorter prehospital delay.<sup>19</sup>

The literature review revealed a lack of knowledge related to symptoms and time from onset of symptoms to FMC when comparing the first and second MI in the same patients. According to this our hypothesis were: (a) patients, men and women, with two MIs report different

type of symptoms at first and second MI event, (b) in patients, men and women, with two MIs there is a difference in prehospital delay at the two MI events. An additional aim was to identify factors associated with a prehospital delay of  $\geq 2$  h at the second MI.

## Methods

### *The MONICA registry*

Data in the present retrospective cohort study were population-based and collected from the Northern Sweden MONICA Myocardial Infarction registry.<sup>20</sup> The World Health Organization (WHO)'s MONICA criteria were used to code MI events.<sup>21</sup> The events were registered and validated according to the WHO MONICA manual.<sup>22</sup> All patients in the registry have a clinically diagnosed MI, STEMI or non-ST elevation myocardial infarction (NSTEMI), based on typical symptoms, cardiac biomarkers, and electrocardiogram (ECG) findings.

During 1985–2009, a total of 15,279 patients – 11,583 (75.8%) men and 3696 (24.2%) women – were included in the MONICA registry. Of this number, 1423 patients (9.3%) had suffered two or more MIs. For men, this number was 1116 (9.6%), and for women, 307 (8.3%). Of those, 199 patients (14.0%) – 149 men (13.4%) and 50 (16.3%) women – died within 28 days after suffering their second MI. In this registry, second MI referred to situations in which a new MI event occurred at least 28 days after the first MI, according to the WHO definition.<sup>20,21</sup> Initially, people between 25–64 years of age were registered, but since the year 2000, patients aged 65–74 years have also been included in the registry.

The variables examined in the present study were MI symptoms at the first and the second MI event and the time between onset of MI symptoms and FMC. Symptoms of coronary events were classified as follows according to the MONICA registry:

1. Typical symptom: when chest pain was present and characterised by duration of more than 20 min. Synonyms for pain, including pressure, discomfort and ache, were also acceptable.
2. Atypical symptoms (involving one or more of the following conditions): atypical pain, recorded if pain was intermittent or lasted for less than 20 min; atypical pain at an unusual site, such as upper abdomen, arms, jaw, or neck.
3. Other symptoms: those symptoms described well but not meeting any of the criteria for typical or atypical symptoms, such as nausea or dyspnoea.
4. No symptoms.

In this study, the categories of atypical symptoms, other symptoms and no symptoms were merged into atypical

**Table 1.** Type of symptoms at first and second myocardial infarction (MI) for men and women.

Symptom	First MI			p-Value first MI men and women	Second MI			p-Value second MI men and women	p-Value first and second MI total	p-Value first and second MI men	p-Value first and second MI women
	Men n (%)	Women n (%)	Total n (%)		Men n (%)	Women n (%)	Total n (%)				
Typical n (%)	641 (78.2)	179 (21.8)	820 (100)		641 (78.2)	179 (21.8)	820 (100)				
Atypical n (%)	42 (6.6)	9 (5.0)	51 (6.2)	0.599	46 (7.2)	24 (13.4)	70 (8.5)	0.015	0.067	0.716	0.008

symptoms, meaning that two variables of symptoms emerged: typical and atypical symptoms.<sup>9,23</sup>

In the MONICA registry, FMC is defined in concordance with ESC guidelines<sup>12</sup> as the time when paramedics, medical care staff or medical practitioners first become available to the patient. Arrival at a hospital or healthcare centre counts as the time for FMC if there is no prehospital medical presence. In the MONICA registry, time between onset of MI symptoms and FMC are originally coded into seven categories. In this study, we merged these into four categories: time from onset of symptoms to FMC <1 h; 1 h to 1 h and 59 min; 2 h to 3 h and 59 min; and ≥4 h. When performing multiple logistic regressions, there are two categories for onset of symptoms to FMC: <2 h and ≥2 h. Data regarding MI symptoms and time from onset of symptoms to FMC in the MONICA registry were collected from medical records. Hereafter, the time from onset of symptoms to FMC is referred to as prehospital delay.

### Participants

A total of 1423 patients with at least two MI events were registered. Patients coded as 'insufficient data' or 'not known' for the variables types of symptoms and time from onset of symptoms to FMC, 603 patients (42.4%), were excluded. In all, 820 patients – 641 men (78.2%) and 179 women (21.8%) – who had at least two MI events recorded in the MONICA registry from November 1986 through December 2009 were included in the analysis. Of the included patients, 58 (7%), 33 men (5.1%) and 15 women (8.3%), died within 28 days after suffering the second MI. The two MI events analysed in this study were the patient's first and second MI. In the excluded patients, the mean age at first MI was 56.8 years and 61.2 years at second MI, which is slightly higher than in the study population. The proportion of men and women was similar to the study population.

### Statistical analysis

McNemar's test was used to compare the paired groups for categorical data. Comparisons between groups (men and

women) were analysed using the  $\chi^2$ -test for categorical data. Differences were considered to be significant if  $p < 0.05$ . Multiple logistic regression was used to estimate the association between prehospital delay of ≥2 h at the second MI and age, sex, diabetes at the second MI, type of symptoms at the second MI, months between first and second MI, and prehospital delay at the first MI. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS), version 23.0.

### Ethics

Patients who met the criteria for registration in the MONICA registry were informed by personal letter about the registration. Less than 1% declined participation. The project was approved by the Regional Ethics Review Board, Umeå University (dnr 2017-204-23M). The investigation conforms to the principles outlined in the Declaration of Helsinki.

### Results

The mean age at first and second MI for men was 55.9 (±8.2) and 60.6 (±8.3) years, respectively, and for women the figures were 59.0 (±8.5) and 62.9 (±7.6) years. Median time between the first and second MI was 36.5 months for men and 22 months for women. Within the first year after the first MI, 30.2% of the men had suffered their second MI, and the corresponding figure for women was 38%.

### Symptoms at first and second MI

At the first MI, 93.4% of men and 95.0% of women reported typical symptoms, not significant (ns), compared to 92.8% of men and 86.6% of women ( $p = 0.015$ ) at the second MI. When comparing men and women separately, the results were significant for women ( $p = 0.008$ ) but not for men (Table 1). A majority of the patients, 87.8% of the men and 82.7% of the women, reported typical symptoms

**Table 2.** Prehospital delay for first and second myocardial infarction (MI) in men and women.

Prehospital delay	First MI				Second MI			p-Value men and women second MI	p-Value first and second MI	p-Value men first MI second MI	p-Value women first MI second MI
	Men n (%)	Women n (%)	Total n (%)	p-Value men and women first MI	Men n (%)	Women n (%)	Total n (%)				
<1 h n (%)	116 (18.1)	40 (22.3)	156 (19.0)		147 (22.9)	46 (25.7)	193 (23.5)				
60–119 min n (%)	142 (22.2)	28 (15.6)	170 (20.7)		154 (24.0)	36 (20.1)	190 (23.2)				
2 h–3 h 59 min n (%)	144 (22.5)	43 (24.0)	187 (22.8)		132 (20.6)	40 (22.3)	172 (21.0)				
≥4 h n (%)	239 (37.3)	68 (38.0)	307 (37.4)	0.225	208 (32.4)	57 (31.8)	265 (32.3)	0.659	0.018	0.034	0.718

MI: myocardial infarction; h: hours.

**Table 3.** Crosstab; prehospital delay first and second myocardial infarction (MI).

Prehospital delay					
First MI	Second MI <1 h n (%)	1 h – 119 min n (%)	2 h–3 h 59 min n (%)	≥4 h n (%)	Total n (%)
<1 h n (%)	47 (30.1%)	34 (21.8%)	33 (21.2%)	42 (26.9%)	156 (100%)
1 h–119 min n (%)	47 (27.6%)	47 (27.6%)	24 (14.1%)	52 (30.6%)	170 (100%)
2 h–3 h 59 min n (%)	40 (21.4%)	46 (24.6%)	49 (26.2%)	52 (27.8%)	187 (100%)
≥4 h n (%)	59 (19.2%)	63 (20.5%)	66 (21.5%)	119 (38.8%)	307 (100%)

h: hour.

at both the first and the second MI. The prevalence of men who did not report the same types of symptoms at both MI events was 10.6%, and the corresponding figure for women was 16.2%.

### Prehospital delay at first and second MI

Nineteen per cent of the patients had a prehospital delay time of <1 h at the first MI; for the second MI this was 23.5%. The prevalence of a prehospital delay of ≥4 h for the first MI and the second MI was 37.4% and 32.3%, respectively (Table 2). The proportion of patients with a prehospital delay of <1 h at both MI events was 5.7% and the corresponding figure for a prehospital delay of ≥4 h was 14.5%. Among all patients, regardless of prehospital delay time category, 32% were categorised in the same category for both the first and the second MI (Table 3).

### Factors associated with a prehospital delay time ≥2 h at the second MI

In univariate logistic regression analysis, sex, age at the second MI, diabetes at the second MI and months between MIs were not significantly associated with a prehospital delay of ≥2 h at the second MI. Prehospital delay of ≥2 h

at the first MI was associated with a prehospital delay of ≥2 h at the second MI; patients with atypical symptoms at the second MI were less likely to have a prehospital delay time of ≥2 h. In a multivariate logistic regression model, factors associated with a prehospital delay of ≥2 h at the second MI was; a prehospital delay of ≥2 h at first MI (OR 1.55,  $p < 0.05$ ) and atypical symptoms at the second MI (OR 0.43,  $p < 0.05$ ) (Table 4).

### Discussion

The typical symptom (i.e. chest pain lasting for 20 min or more) was the most frequently reported type of symptom at both the first and the second MI in patients affected by two MIs. This finding is in line with Kirchberger et al.<sup>5</sup> who examined the frequency of symptom mismatches in patients affected by two MIs, where mismatch means not having the same symptoms at the first and the second MI. Their results show that chest pain was the most common symptom; a mismatch was lowest for this symptom in both men and women. However, the present study indicates that the numbers of women with atypical symptoms increased at the second MI. Atypical symptoms are associated with longer prehospital delay<sup>16</sup> and an increased mortality.<sup>5</sup> Canto et al.<sup>24</sup> found that MI without chest pain/discomfort (i.e. atypical symptoms) occurred more often in patients with NSTEMI. The patients

**Table 4.** Univariate and multivariate logistic regression of factors associated with a prehospital delay of  $\geq 2$  h at second myocardial infarction (MI).

	Univariate analysis			Multivariate analysis		
	OR	95% CI	p-Value	OR	95 % CI	p-Value
Sex						
Men						
Women	1.08	0.75–1.46	0.786	1.11	0.78–1.58	0.556
Age second MI	1.01	0.99–1.03	0.132	1.01	0.99–1.03	0.226
Prehospital delay $\geq 2$ h first MI						
No						
Yes	1.55	1.20–2.11	0.001	1.55	1.16–2.07	0.003
Symptoms second MI						
Typical						
Atypical	0.43	0.26–0.71	0.001	0.51	0.30–0.86	0.013
Diabetes second MI						
No						
Yes	1.30	0.95–1.79	0.098	1.31	0.94–1.83	0.109
Months between first MI and second MI	1.0	0.99–1.00	0.980	1.00	0.99–1.00	0.706

CI: confidence interval; h: hours; OR: odds ratio.

were more frequently women, older, and had a history of diabetes. The present study includes patients with STEMI and NSTEMI but we do not know what MI type (i.e. STEMI or NSTEMI) each patient was diagnosed with. We do know that the women were older than the men and a previous study in this study population showed that more women than men had diabetes at the first and the second MI.<sup>4</sup> This could explain why more women than men presented with atypical symptoms at the second MI.

A number of patients, 10.6% of the men and 16.2% of the women, reported different types of symptoms at the first and the second MI. This underscores the importance of patients' understanding that symptoms at a second MI are not necessarily similar to those during initial MIs, as previous studies have also highlighted.<sup>25–27</sup>

The number of patients with a prehospital delay time of  $< 2$  h increased at the second MI. However, all patients in the present study had a history of a previous MI and, despite this, showed a considerable prehospital delay at the second MI. Few (5.7%) had a prehospital delay of  $< 1$  h at both MI events, and the figure for patients with a prehospital time of  $\geq 4$  h at both MI events was 14.5%. People with a history of a previous MI can be expected to have knowledge and experience of the symptoms of MI and how to act if they experienced symptoms of an MI. One factor that might influence the patient's behaviour when suffering a second MI is the time elapsed between the two MIs. In the present study, 30.2% of the men and 38% of the women suffered their second MI within one year of the first one which is quite a short interval between the MIs. However, previous studies have conflicting results. Some studies found that patients with a prior MI had a reduced prehospital delay<sup>17,18</sup> while others found the opposite,<sup>16,19</sup> patients

with a history of a previous MI do not seek medical help more promptly than patients suffering their first MI.

Few of the interventions aimed to reduce prehospital delay have been successful.<sup>28</sup> Over the years, prehospital delay time has not improved significantly. In a study examined trends in prehospital delay over two decades, conducted in Massachusetts, the result showed no substantial change in prehospital delay time during the study period 1986–2005.<sup>29</sup>

Alonzo and Reynolds<sup>30</sup> suggest that emotions resulting from a patient's previous experience from suffering an MI can impact his or her coping response to a new MI event. Patients with a previous MI experience might delay seeking medical care for the following reasons: their coping response is affected by the trauma associated with their first MI experience and that can lead to denial. Furthermore, they can be convinced that they will not suffer a recurrent MI due to lifestyle changes they have made after their first MI.<sup>30</sup> Pattenden et al.<sup>26</sup> confirm that patients who had changed their lifestyle since their previous MI thought that they were protected from a future MI.

When comparing the use of coping strategies during an acute cardiac event for patients experiencing a first MI with those experiencing a recurrent MI, it was found that both groups tend to respond to their symptoms with similar coping strategies.<sup>31</sup> Knowing about these similarities in coping response is important in the rehabilitation process; now we need to focus on coping mechanisms that can contribute to a shorter prehospital delay.

In the present study, a predictor for a prehospital delay of  $\geq 2$  h at the second MI was a prehospital delay of  $\geq 2$  h at the first MI, indicating that the patient's behaviour at the first MI predicts how he or she will behave at a second MI.

Another indication of this is that one-third of the patients had a prehospital delay within the same time interval at both MI events. These findings are consistent with Kirchberger et al.<sup>32</sup> who determined the factors associated with the emergency service (EMS) used by patients with a second MI. It was found that patients who used EMS at the first MI were likely to use EMS at the second MI as well.

The following points should be considered when patients suffer an MI: How did the patient react to the MI? How should the patient have reacted to reduce the prehospital delay? Patients should be aware of the risk of suffering a second MI and be given information about the correct action to take in the event of MI symptoms. This might lead to shortened prehospital delay in these high-risk patients. In our result, presenting with atypical symptoms was not a predictor for a prehospital delay of  $\geq 2$  h at the second MI, and this finding was unexpected. This is not consistent with previous research that shows that atypical symptoms are associated with longer prehospital delay.<sup>16</sup>

### Strength and limitations

The present study has limitations. In the MONICA registry, MI symptoms such as pain in the upper abdomen, arms, jaw and neck are categorised as atypical symptoms, while in some previous studies these symptoms were classified as typical symptoms of myocardial ischaemia.<sup>6,33</sup> This means that we must be aware of these differences in categorising symptoms when comparing the results of previous studies. Another limitation is that patients older than 74 years are not registered in the MONICA registry. The data analysed in the present study is quite old, 1986–2009, and during these years both treatment and definition of MI has changed and there is a possibility that our results are affected by these developments. However, in the present study, we focus on describing symptoms and time from onset of symptoms to FMC at the first and second MI event in the same patients. Another limitation of this study is that the variables registered in the MONICA registry were based on data extracted from medical records which means that the data were collected by multiple physicians and this might have influenced the data. Use of standardised questionnaires would probably have reduced the impact from having different persons collecting the data. The fact that data are collected from medical records might explain the amount of missing data; 42% of the recorded patients have ‘insufficient data’ or ‘not known’ for the variables type of symptoms and time from onset of symptoms to FMC. In a review paper conducted by Davies<sup>34</sup> two methods used to derive the time from onset of symptoms to FMC (abstraction from medical records and structured data from interviews) were compared. When data were abstracted from medical records, the percentage of missing data and records varied between 14% and 40%.

One strength of this study is the internal and external quality control that ensures the reliability of the data. A central quality assurance program performed in the MONICA Data Centre in Helsinki stated that the data from the northern Sweden MONICA project held a good quality score.<sup>35</sup> A continued good quality score is guaranteed by the use of standardised measurements and routine checks form as described in the paper.<sup>35</sup> Another strength is that the MONICA registry enables the selection of patients registered with both the first and the second MI. Thus all patients in the Northern Sweden MONICA area, up to the age of 74 years, with a diagnosed MI are included in the MONICA registry the risk of selections bias is reduced.

### Conclusion

The typical symptom is the most frequently reported symptom at first and second MI in both men and women. However, patients – especially women, described different types of symptoms at the second MI. Patients with reduced prehospital delay increased at the second MI. A predictor for prehospital delay of  $\geq 2$  h at the second MI was prehospital delay of  $\geq 2$  h at the first MI and one-third of the patients had a prehospital delay within the same time interval at both MIs. Presenting with atypical symptoms was not a predictor for a prehospital delay of  $\geq 2$  h at the second MI. This result indicates the importance of patient awareness of the risk of suffering a second MI. We suggest that patient’s symptoms and behaviour at symptom onset should be highlighted to gain the patient tools to reduce prehospital delay if suffering a second MI.

### Implications for practice

- Patients suffering an myocardial infarction (MI) need to gain knowledge that a future MI might not be similar to the previous one.
- Patient’s behaviour at the first MI could predict how he or she behaves at a second MI.
- Nursing staff involved in the care of MI patients could highlight how the patient acted when suffering an MI and inform the patient how she or he should act to reduce the prehospital delay.

### Declaration of conflicting interests

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