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Secondary prevention in myocardial infarction patients with known coronary artery disease

ORIGINAL ARTICLE

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Background

Secondary preventive treatment for patients with known coronary artery disease reduces the risk of new cardiovascular events. We studied the extent to which patients with known coronary artery disease who were admitted with acute myocardial infarction had achieved the treatment targets for secondary prevention.

Material and method

The study used data from the Norwegian Myocardial Infarction Registry and included patients below the age of 85 years with known coronary artery disease who were admitted with type 1 myocardial infarction to Norwegian hospitals in the period from 1 January 2013 to 31 December 2022.

Results

Out of 74,993 patients below the age of 85 years who were admitted with type 1 acute myocardial infarction, 22,825 (30.4 %) had known coronary artery disease. Of these patients, 24.4 % were women and the median age was 72 years (interquartile range 64–78). The proportion with known coronary artery disease was stable during the study period. The proportion of non-smokers increased from 71 % to 75 % (+0.7 % per year), the proportion of patients with a healthy weight decreased from 33 % to 29 % (–1.8 % per year), and the proportion receiving antiplatelet and/or anticoagulant therapy increased from 88 % to 91 % (+0.3 % per year). The proportion receiving lipid-lowering therapy (77.0 %) and the proportion who had LDL cholesterol < 1.8 mmol/L (21 %) was stable. The proportion of patients with blood pressure < 140/90 mmHg decreased from 43 % to 30 % (–4.6 % per year until 2020, then unchanged).

Interpretation

The study demonstrates the need for measures to improve secondary preventive treatment in patients with coronary artery disease in Norway.

Main findings

In the period 2013–2022, 30 % of patients under the age of 85 years who were hospitalised in Norway with type 1 myocardial infarction had known coronary artery disease prior to admission.

Only 2 % of patients with known coronary artery disease had achieved all the treatment targets for secondary prevention.

Target achievement was particularly low for weight (30 % had a body mass index < 25 kg/m^2), LDL cholesterol (21 % had LDL < 1.8 mmol/L) and blood pressure (36 % had blood pressure < 140/90 mmHg).

Target achievement for secondary preventive treatment was almost unchanged over the study period.

Patients with established coronary artery disease (CAD) have an increased risk of new cardiovascular events, including myocardial infarction and premature death (1, 2). There is a very well-documented risk-reducing effect from implementing lifestyle measures and treatment with antiplatelet drugs, lipid-lowering drugs and, where indicated, anti-hypertensive and antidiabetic drugs until treatment targets are achieved (3, 4).

The latest guidelines from the European Society of Cardiology (ESC) recommend the following treatment targets for secondary prevention in patients with CAD: smoking abstinence, healthy diet, regular exercise, healthy weight, follow-up of psychosocial factors, use of antiplatelet and lipid-lowering drugs, annual influenza vaccination, blood pressure < 130/80 mmHg, low density lipoprotein (LDL) cholesterol < 1.4 mmol/ L and glycated haemoglobin

A (HbA1c) < 53 mmol/mol in patients with diabetes. The treatment targets are recommended for all patients, and the guidelines do not give any weighting to the importance of the various targets. Despite the well-documented effect of following the guidelines, many studies demonstrate only limited achievement of the treatment targets (5–7).

Several studies have demonstrated the decreased incidence of myocardial infarction and decreased mortality in Norway in recent years (8–10). The extent to which this reflects better secondary preventive treatment in patients with established CAD is unknown.

The objective of this study was to investigate whether there were changes in the achievement of treatment targets for secondary prevention in patients under the age of 85 years with known CAD who were hospitalised with acute myocardial infarction in Norway in the period from 1 January 2013 to 31 December 2022. Known CAD was defined as prior myocardial infarction or prior coronary revascularisation with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG). The aim was to identify areas for improvement of secondary preventive treatment in patients with myocardial infarction in Norway.

Material and method

Study population

All patients under the age of 85 years hospitalised in Norway in the period from 1 January 2013 to 31 December 2022 with known CAD (prior myocardial infarction and/or PCI or CABG), who were admitted with type 1 myocardial infarction and registered in the Norwegian Myocardial Infarction Registry (NORMI), were included in the study. Type 1 myocardial infarction was defined as myocardial infarction caused by an atherothrombotic event (11). Patients who had multiple infarctions during the period were only registered once.

NORMI is a nationwide, personally identifiable quality registry that is part of the Norwegian Cardiovascular Disease Registry. It is a legal requirement to register all patients admitted to a Norwegian hospital with acute myocardial infarction in NORMI, cf. the Norwegian Cardiovascular Disease Registry Regulation. The main purpose of the registry is to improve the quality of treatment for patients with myocardial infarction.

The registry contains data about demographics, such as age, sex and place of residence, as well as cardiovascular risk factors, such as smoking, hypertension, hyperlipidaemia, overweight and diabetes. Data are also recorded about medical history, including previous myocardial infarction, heart failure and atrial fibrillation, as well as medication use prior to hospitalisation. The registry also contains details about symptoms and clinical findings on admission, including changes in electrocardiogram (ECG) findings and biochemical markers, as well as information about the treatment received by the patient during the hospitalisation. This includes the use of thrombolysis, coronary angiography, PCI and pharmacological treatment. Complications arising during

the admission, such as arrhythmia, heart failure, haemorrhage or repeat infarction, are also recorded. On discharge, medication and recommended further follow-up are documented.

NORMI follows international criteria for the diagnosis of myocardial infarction (11). All data are recorded at each individual hospital on an ongoing basis in an electronic database. Continuous variables such as blood pressure and cholesterol levels are only recorded once, usually at the time of admission.

Endpoint

The primary endpoint in the study was achievement of recommended treatment targets for secondary prevention in the patient population with known CAD at the time of admission for acute myocardial infarction. The treatment targets are based on multiple versions of the ESC recommendations in the time period: smoking abstinence, body mass index (BMI) < 25 kg/m^2, use of antiplatelet and/or anticoagulant drugs, use of lipid-lowering drugs, LDL cholesterol < 2.5/1.8/1.4 mmol/L (changes were made during the study period), blood pressure < 140/90 mmHg (changes were made after the study period) and HbA1c < 53 mmol/mol (or < 7 %) in patients with diabetes (4, 12–15).

Statistics

Continuous variables are presented as mean (standard deviation (SD)) or median (interquartile range). Categoric data are presented as number and percentage. Proportions of different response options are specified as the proportion of answers given, and the proportion without answers is indicated. Annual change has been analysed using Joinpoint Regression Program version 4.0. We used a log-linear model, and time trends are presented as annual percentage change with a 95 % confidence interval (CI). Other data were analysed in the statistics programme STATA version 18. A *p*-value < 0.05 was considered the level of statistical significance.

Ethics

The study was approved by the Regional Committee for Medical and Health Research Ethics North (REK 2016/170). The study used registry data that did not require consent. All personal data were processed in compliance with applicable data protection legislation and in accordance with the ethics committee approval.

Results

A total of 105,439 patients with at least one myocardial infarction were registered in NORMI in the period from 1 January 2013 to 31 December 2022. Of these, 75,364 (71.5 %) patients were under the age of 85 years and registered with type 1 myocardial infarction. Information about prior CAD was available for 74,993 (99.5 %) of these patients, and 22,825 (30.4 %) patients were registered as having known CAD on admission. The total number of myocardial infarction patients per year was relatively stable during the study period, and

the proportion with known CAD was stable (annual change: +0.4 % (95 % CI: −0.6 to 1.3)) (Table 1). Median age (72 (interquartile range 64–78) years), sex distribution (24.4 % women) and proportion with ST-elevation myocardial infarction (22.0 %) among the patients with known CAD was stable during the study period. There was a mean annual increase in the proportion receiving hypertensive treatment of 0.9 % (95 % CI: 0.4 to 2.6) from 2016. There was a mean annual increase in the proportion with diabetes of 2.2 % (95 % CI: 1.2 to 3.1) over the whole study period.

The proportion of patients who achieved the lifestyle-related treatment targets of smoking abstinence and BMI < 25 kg/m^2 is shown in Figure 1. There was a mean annual increase in the proportion of non-smokers of 0.7 % (95 % CI: 0.2 to 1.1), but a mean annual decrease in the proportion with a BMI < 25 kg/m^2 of 1.8 % (95 % CI: 0.5 to 3.1).

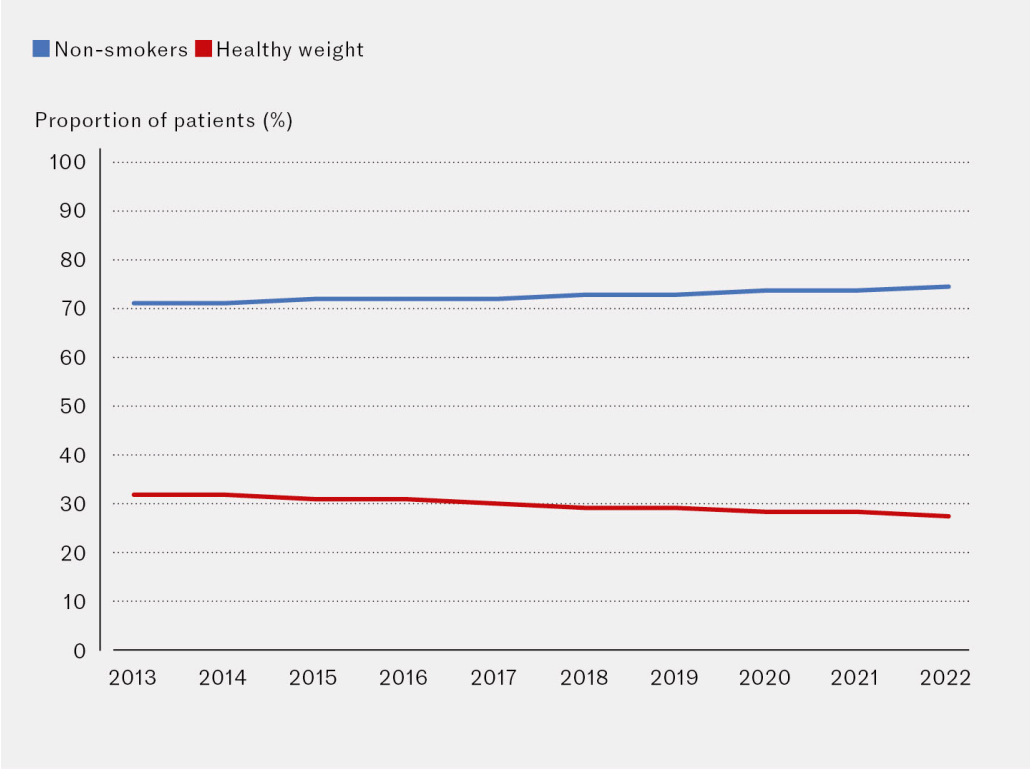

Figure 1 Proportion of patients under the age of 85 years with known CAD hospitalised with type 1 myocardial infarction in Norway in the period from 1 January 2013 to 31 December 2022 who achieved the lifestyle-related treatment targets of smoking abstinence and body mass index (BMI) < 25 kg/m2. The values are modelled in a log-linear model using Joinpoint Regression Program version 4.0. Information about smoking habits and BMI was missing in 10.4 % and 20.4 % of patients, respectively.

There was a mean annual increase in the use of antiplatelet and/or anticoagulant therapy of 0.3 % (95 % CI: 0.0 to 0.5) in patients with known CAD (Table 1). The proportion receiving lipid-lowering therapy was stable (mean annual percentage change: 0.6 (95 % CI: −0.4 to 1.5)).

During the study period, the treatment target for LDL cholesterol was changed in the ESC guidelines, from < 2.5 mmol/L to < 1.8 mmol/L and then to < 1.4 mmol/L. Depending on the treatment target, 50.6 %, 20.8 % and 9.3 % of patients had achieved these targets on admission, respectively (Figure 2). We

found no significant change in this target during the study period for any of the LDL levels (mean annual change was respectively –0.8 % (95 % CI: –1.6 to 0.2), 0.2 % (95 % CI: –2.2 to 2.6) and 2.4 % (95 % CI: –0.7 to 6.3)).

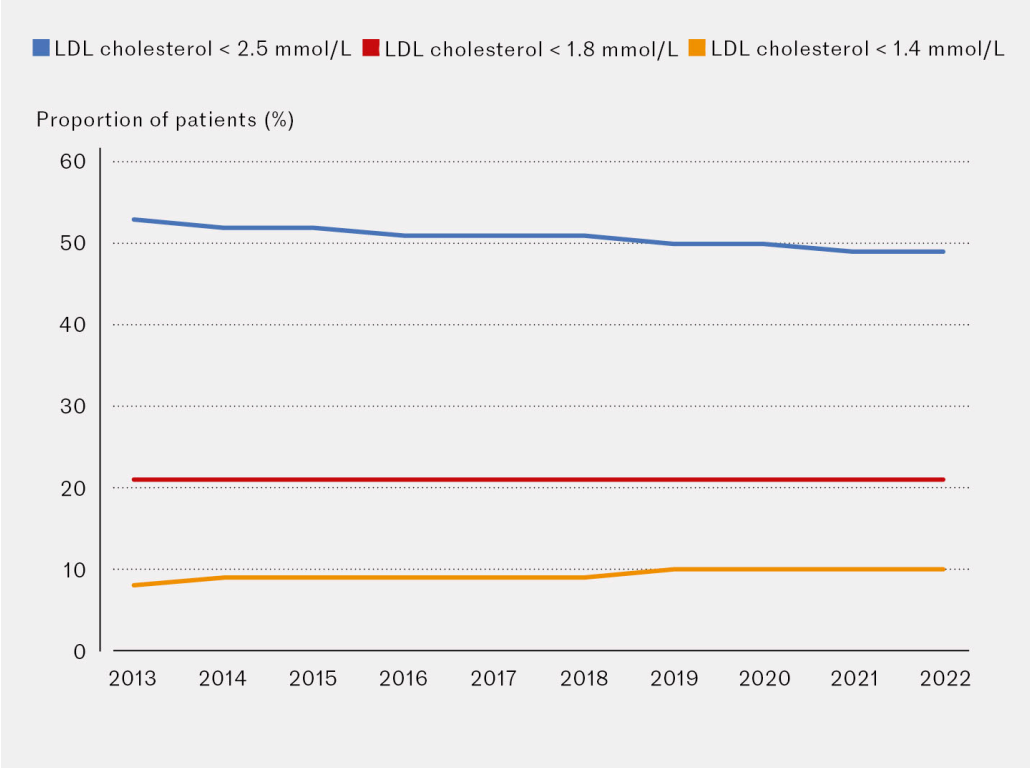

Figure 2 Proportion of patients under the age of 85 years with known CAD hospitalised with type 1 myocardial infarction in Norway in the period from 1 January 2013 to 31 December 2022 who achieved different treatment targets for levels of LDL (low density lipoprotein) cholesterol. The values are modelled in a log-linear model using Joinpoint Regression Program version 4.0. Information about LDL cholesterol was missing for 26.8 % of patients.

The applicable treatment target for blood pressure was < 140/90 mmHg throughout the study period. During that period, a total of 7,953 (35.7 %) patients had blood pressure < 140/90 mmHg on admission for acute myocardial infarction. There was a mean annual decrease in the proportion with blood pressure within the treatment target of 4.6 % (95 % CI: 3.3 to 8.7) up to 2020, after which the proportion was stable (Figure 3).

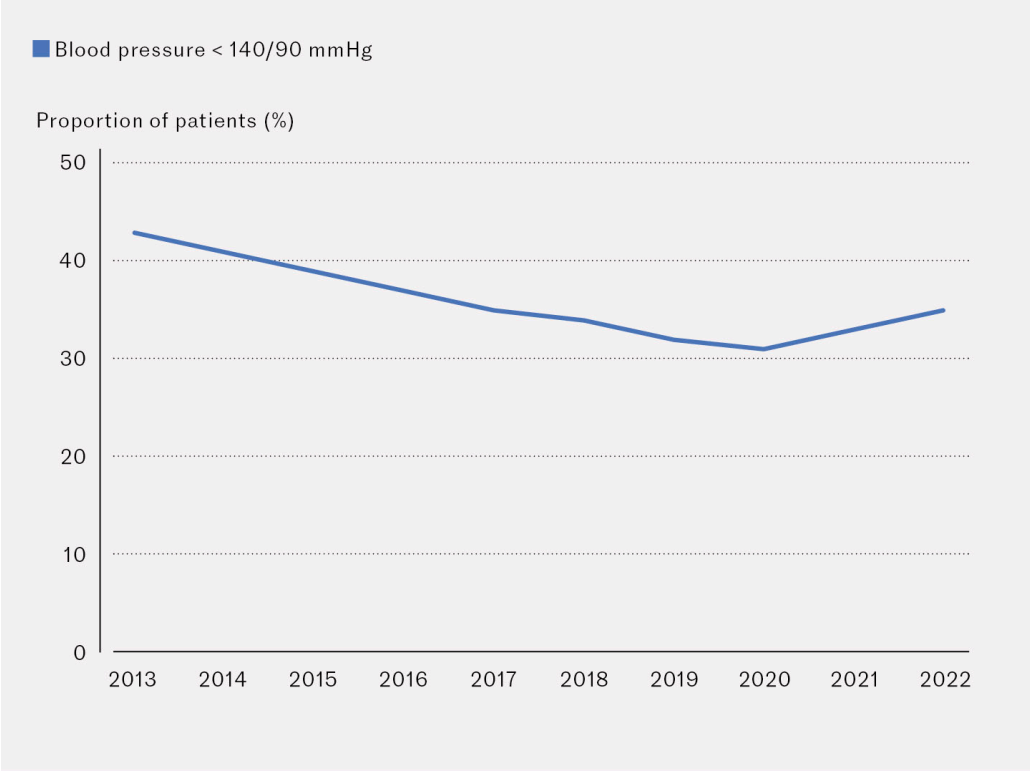

Figure 3 Proportion of patients under the age of 85 years with known CAD hospitalised with type 1 myocardial infarction in Norway in the period from 1 January 2013 to 31 December 2022 who had blood pressure < 140/90 mmHg. The values are modelled in a log-linear model using Joinpoint Regression Program version 4.0. Information about blood pressure was missing for 2.4 % of patients.

HbA1c values were rarely recorded in NORMI before 2019. After this, HbA1c values within the treatment target were recorded for 40.2 % of patients with diabetes, with no statistically significant change during that period.

Information about achievement of all recorded treatment targets for secondary prevention (apart from HbA1c) were available for 12,535 (54.9 %) patients. If the cholesterol treatment target for the whole period is taken to be LDL cholesterol < 1.8 mmol/L, patients achieved a mean of 3.3 (SD 1.1) treatment targets, although only 1.8 % achieved all six treatment targets. Overall achievement of treatment targets was stable (mean annual change −0.6 % (95 % CI: −1.8 to 0.7)) during the study period.

Discussion

Approximately one in three patients with myocardial infarction admitted to Norwegian hospitals in the 10-year period 2013–2022 had known CAD. There was limited achievement of treatment targets for secondary prevention. Target achievement for weight, LDL cholesterol levels and blood pressure was particularly low. The proportion of non-smokers and the proportion of patients receiving antiplatelet/anticoagulant therapy increased slightly during the study period, but otherwise there were no improvements in the treatment targets achieved.

The incidence of a first-time myocardial infarction event in Norway has decreased in recent years (9, 10). This study found no decrease in the proportion of patients with known CAD under the age of 85 years who were admitted to hospital in Norway with type 1 acute myocardial infarction in the period 2013–2022. The 1994–2008 Tromsø study demonstrated that the decreasing incidence of acute CAD could largely be attributed to changes in coronary risk factors (8). Although the patient population selected with myocardial infarction and prior CAD might have a particularly poor target achievement, our findings may indicate that there has been greater success with primary prevention than secondary prevention.

All treatment targets for secondary preventive treatment are strong recommendations (class 1) in the ESC guidelines, and have evidence of high benefit (level A) (4). Despite this, few patients participate in systematic follow-up after myocardial infarction (16). This type of treatment can take place under the care of a general practitioner, specialist or by means of digital solutions. The guidelines recommend multidisciplinary, specialist follow-up to achieve the best effect, which is also supported by individual studies (4, 5, 15). Many Norwegian hospitals do not currently offer such a service (17). Unlike Sweden, Norway also has no legal requirement for patients to be registered in a follow-up registry after myocardial infarction. NORMI has relatively recently set up a voluntary programme to record follow-up visits in the registry, but very few hospitals have made use of this.

Poor compliance with treatment guidelines and poor achievement of secondary prevention targets have been reported previously (5, 7, 18, 19). The vast majority of patients are discharged from hospital following myocardial infarction with secondary preventive medication in line with the recommendations (20). Therefore, the failure to achieve targets may be partly due to lack of drug titration and/or a lack of patient compliance with recommended measures and treatment. Although the proportion of patients who smoked decreased slightly over the period, more than one in four myocardial infarction patients with known CAD was a smoker. Systematic smoking cessation programmes and the use of pharmacological therapy for smoking cessation are effective and should be offered to more patients (21).

The majority of patients were overweight, and the proportion increased during the study period. The use of newer weight-loss drugs was not recorded in NORMI, but the ESC guidelines recommend these medications in patients with obesity (3).

The proportion of patients receiving antiplatelet and/or anticoagulant therapy was high and rising. This may be related to the increased use of anticoagulants in patients with myocardial infarction and atrial fibrillation (22). Although the proportion of patients receiving lipid-lowering therapy was high, very few patients achieved the treatment target for LDL cholesterol. NORMI did not record the type of lipid-lowering therapy in the study period, but it is important to point out that combination therapy with a high-dose potent statin and ezetimibe plus, if appropriate, a proprotein convertase subtilisin/kexin type 9

(PCSK9) inhibitor is recommended to achieve the treatment target (3). Combination therapy is also recommended to achieve the treatment target for blood pressure (3).

Although the guidelines apply to all age groups, it is important to stress that the treatment targets should be adjusted to take account of tolerability, comorbidities, frailty and patient wishes, especially in older patients.

The study includes nearly all patients under the age of 85 years with known CAD who were hospitalised with type 1 acute myocardial infarction in Norway in the period 2013–2022. However, there are also several important limitations and weaknesses. This is an observational study and, consequently, it cannot demonstrate causal relationships between treatment and repeat myocardial infarction.

NORMI does not give an insight into the achievement of treatment targets for secondary prevention in patients *after* myocardial infarction. Therefore, this study cannot present data for the achievement of treatment targets for secondary prevention in general. Patients with known CAD who were hospitalised with acute myocardial infarction may represent a population with particularly low achievement of the treatment targets. The timeframe from the first episode of CAD to the respective admission with acute myocardial infarction, i.e. the time to attain the treatment targets for secondary prevention, was not recorded.

Data regarding individual treatment targets were missing for some patients. Information was also missing about myocardial infarction that did not result in hospitalisation and about patients who died from out-of-hospital myocardial infarction. We only had access to de-identified data from NORMI and were not able to verify data at an individual patient level. NORMI also does not contain information about some of the recommended treatment targets, such as physical activity, healthy diet, psychosocial follow-up and influenza vaccination.

This nationwide study of patients with acute myocardial infarction in the period 2013–2022 demonstrated that the proportion of patients with known CAD was high and remained stable. The achievement of treatment targets for secondary prevention in these patients was low, with few changes over the period. Therefore, there is a need for increased efforts to attain the treatment targets for secondary prevention in Norway. Clear advice about the treatment targets at the time of discharge, mandatory registration in the national follow-up registry, greater involvement of both the primary care and specialist health sectors with a focus on better target achievement, as well as increased use of digital follow-up at home, may be useful for improving treatment.

The article has been peer-reviewed.

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