

Cardiovascular risk factor management of myocardial infarction patients with and without diabetes in the Netherlands between 2002 and 2006: a cross-sectional analysis of baseline data

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ABSTRACT

Objective: We examined levels and trends in cardiovascular risk factors and drug treatment in myocardial infarction (MI) patients with and without diabetes.

Design: Cross-sectional analysis of baseline Alpha Omega Trial data, a randomised controlled trial.

Setting: 32 hospitals in the Netherlands.

Participants: In total, we had 1014 MI patients with diabetes (74% men) and 3823 without diabetes (79% men) aged 60–80 years, analysed over the period 2002–2006.

Results: Between 2002 and 2006, a significantly decreasing trend in the prevalence of obesity (–5%, $p_{\text{trend}}=0.02$) and in systolic blood pressure (BP) levels (–5 mm Hg, $p_{\text{trend}}<0.0001$) was demonstrated in non-diabetic patients, but not in diabetic patients. In 2006, obesity, mean systolic BP and serum triglyceride levels were significantly higher, whereas high-density lipoprotein cholesterol levels were lower in diabetic patients compared to those without. Prescription of antihypertensive drug (diabetic vs non-diabetic patients respectively, 95% vs 93%, $p=0.08$) and statin treatment were high (86% and 90%, $p=0.11$).

Conclusions: A high proportion of MI patients with and without diabetes was similarly treated with cardiovascular drugs. In spite of high drug treatment levels, more adverse risk factors were found in patients with diabetes.

BACKGROUND

The prevalence of type 2 diabetes mellitus is rising at an alarming rate.¹ Globally, there were 285 million adults with type 2 diabetes in 2010 which may increase to 439 million by 2030.² The adverse microvascular and macrovascular consequences of diabetes are well recognised, as is the accompanying rate of atherosclerosis that predisposes patients to coronary heart disease (CHD), including

ARTICLE SUMMARY

Article focus

- We examined levels and trends in cardiovascular risk factors and drug treatment in myocardial infarction (MI) patients with and without diabetes: 4837 patients with MI, out of which 1014 had type 2 diabetes and 3823 had no diabetes.

Key messages

- We demonstrated adverse risk factors and deteriorating trends over time in patients with type 2 diabetes and MI compared to those without diabetes.
- Despite high cardiovascular drug treatment levels in both MI patients with and without diabetes, the prevalence of obesity, mean systolic BP and serum triglyceride levels were significantly higher, whereas HDL-cholesterol levels were lower in diabetic patients compared to those without.
- More aggressive drug treatment in combination with diet and lifestyle interventions could help to reach the target levels for blood pressure and lipid lowering.

Strengths and limitations of this study

- We used cross-sectional data of a large number of MI patients with and without diabetes recruited in collaboration with cardiologists at 32 hospitals in the Netherlands.
- We assessed diabetes status by combining self-reported physician diagnosis, antidiabetic treatment and casual plasma glucose values.
- We collected measurements on risk factors and medication in a standardised manner across all 32 hospitals.
- We included volunteers in a clinical trial who could be healthier and/or better treated than other MI patients leading to selection-bias.

cardiac arrhythmias and sudden death.³ The prevalence of type 2 diabetes in Europe is around 7%,² and typically about 20% of

patients with CHD have a history of type 2 diabetes.^{4–7} The survival time after myocardial infarction (MI), unstable angina or coronary bypass surgery is lower in patients with diabetes compared to those without.^{4–8}

Several studies showed that risk factor profiles were more adverse in CHD patients with diabetes compared to those without diabetes between 1995 and 2006.^{9–11} How this adverse risk factor profile in these diabetes patients with CHD has developed since then is not known. This is important to investigate, since the prevalence of diabetes will have increased over time. In the EUROASPIRE study, the prevalence of diabetes already increased from 17.4% in 1999 to 28.0% by 2006.¹² In comparison with the on-average 10-year younger EUROASPIRE CHD patients,¹² we observed in MI patients lower levels of obesity, elevated BP, elevated cholesterol and diabetes, and lower prescription rates of antiplatelets and β -blockers in 2006.¹³ Despite lower observed levels, there was still room for improvement in cardiovascular risk management and it is unclear as to whether MI patients with diabetes need a different management from those without diabetes.

Randomised controlled trials indicated a need for more aggressive treatment in diabetes patients, for blood pressure (BP),¹⁴ dyslipidemia^{15 16} and hyperglycemia¹⁷ to reduce CHD. Therefore, several guidelines recommended stricter target BP levels <130/80 mm Hg for patients with diabetes.^{18–20} In the Netherlands, on the contrary, recommendations advise similar target BP values in all patients, including the elderly and diabetes patients, namely <140 mm Hg systolic BP.^{21 22} In American, European and Dutch guidelines low-density lipoprotein (LDL) cholesterol levels are recommended to be below 2.5 or 2.6 mmol/l (approximately 100 mg/dl).^{18–22} Some guidelines,^{18 20} but not all,^{21 22} recommend even lower LDL cholesterol target levels of less than 1.8 mmol/l (70 mg/dl) for very high-risk patients with diabetes and CHD. Whether these guidelines have effectively been implemented in current practice is unknown.

The issue was raised as to whether diabetes should be treated as a coronary risk equivalent.²³ A comprehensive meta-analysis showed that diabetes should not be treated as a CHD risk equivalent and recommended individual risk assessment to be used rather than diabetes status per se.²⁴ Conflicting views on whether cardiovascular risk management in diabetic patients should be different from those without diabetes triggered us to evaluate this in clinical practice especially in secondary prevention where even less evidence exists. Therefore, we examined differences between MI patients with and without diabetes mellitus in cardiovascular risk factors and drug use between 2002 and 2006.

METHODS

Study design and population

We used baseline cross-sectional data of the Alpha Omega Trial (www.alphaomegatrial.com), a multicentre

trial on the effect of n-3 fatty acids and cardiovascular endpoints.^{25 26} Details of the trial design and patient inclusion and exclusion criteria were previously described.^{25 26} This study involved 4837 men and women aged 60–80 years with a documented history of MI who were recruited from 32 hospitals in the Netherlands between April 2002 and December 2006. Written informed consent was obtained from each subject. The study was conducted in accordance with the Helsinki Declaration and approved by the central Medical Ethics Committee South-West Holland and local medical ethics committees of participating hospitals (see online supplementary material for participating cardiology centres).

Measurements

Patients were physically examined by trained research nurses who also collected data on health status, lifestyle and drug treatment by means of self-administered questionnaires. Smoking status was defined as current, former or never. Educational level was assessed in nine categories, the highest being completed university education. Diabetes was defined as self-reported physician diagnosis, antidiabetic medication (including insulin) or by casual plasma glucose concentrations (≥ 7 mmol/l (126 mg/dl) for those fasting and ≥ 11.1 mmol/l (200 mg/dl) for non-fasting patients). Self-reported medication of the participants was coded by a pharmaco-epidemiologist according to the Anatomical Therapeutic Chemical Classification System (ATC).²⁷ ATC codes were C02, C03, C07, C08 and C09 for BP-lowering medication, C10 for lipid-modifying medication, A10 for antidiabetic treatment and B01 for all antithrombotic medication and B01AC specifically for antiplatelet therapy.

Weight and height were measured with the patient wearing light clothes without shoes, and the body mass index (BMI) was calculated as weight (kg)/height² (m²). Overweight was defined as BMI ≥ 25.0 and <30 kg/m² and obesity as BMI ≥ 30.0 kg/m². Waist circumference was measured at the midpoint between the bottom rib and the top of the hipbone. Central obesity was defined as a waist circumference of ≥ 88 cm in women or ≥ 102 cm in men.²⁸ Systolic and diastolic BP (1st and 5th Korotkoff sound, respectively) were measured twice at the left upper arm after a 10 min seated rest with an automatic device (Omron HEM-711, Omron Healthcare Europe B.V., Hoofddorp, The Netherlands) and values were averaged. Casual venous blood samples were taken and blood lipids and glucose were analysed by standard kits using an autoanalyzer (Hitachi 912, Roche Diagnostics, Basel, Switzerland). LDL-cholesterol was calculated according to the Friedewald formula if serum triglyceride levels were <4 mmol/l.²⁹

Statistical analysis

Data on risk factors and drug treatment are presented as mean (SD) for continuous normally distributed data, median (IQR) for skewed data or percentages for

categorical data. To estimate significant differences in levels of risk factors between those with and without diabetes Student's t-tests were used for continuous variables and χ^2 tests for dichotomous variables. To estimate adjusted proportions or mean changes over time in risk factors and medication general linear models were used with year, age and gender as covariates. The Tukey method was used to estimate paired differences in risk factors and drug treatment between 2006 and 2002.³⁰ The p for trend was calculated with age- and gender-adjusted linear (for continuous variables) or logistic (for binary variables) regression models with year as the independent variable. χ^2 tests were used to compare proportions of diabetic and non-diabetic patients below target levels as recommended in current guidelines^{21 22} for the main (by drug treatment) modifiable risk factors.

Time trend differences in certain risk factors (obesity, systolic BP) between diabetic and non-diabetic patients were evaluated with p values for interaction (diabetes \times year).

For all analyses, two-sided p values<0.05 indicated statistical significance. SAS version 9.1 (SAS Institute, Cary, North Carolina, USA) was used for all statistical analyses.

RESULTS

Patients with diabetes (n=1014, 21%) were on average 69.4 years (74% men) and those without diabetes (n=3823; 79%) were aged 68.9 years (79% men). As shown in table 1, in 72% of the diabetes cases the diagnosis was based on a combination of self-reported physician diagnosis, antidiabetic medication and elevated plasma glucose concentrations (≥ 7 mmol/l (126 mg/dl)

Table 1 Definition of diabetes in 1014 diabetic postmyocardial infarction patients recruited for the Alpha Omega Trial (total n=4837)

Definition	N	%
Combination self-reported physician diagnosis, antidiabetic treatment and plasma glucose values	728	72
Plasma glucose values only*	147	14
Self-reported physician diagnosis only	99	10
Antidiabetic treatment only	34	3
Both treatment and plasma glucose values	6	1
Total	1014	100

*Diabetes defined by plasma glucose values was based on fasting values (≥ 7 mmol/l) in 134 or non-fasting values (≥ 11.1 mmol/l) in 13 patients.

for those fasting and ≥ 11.1 mmol/l (200 mg/dl) for non-fasting patients). Of the remaining patients, 10% had a self-reported physician diagnosis only, 14% had elevated plasma glucose values and 3% used antidiabetic medication only.

Table 2 describes risk factors and medication of patients with and without diabetes. Diabetes patients were more often women (26%, compared to 21% in non-diabetic patients), and had higher BMI (29.2 vs 27.4 kg/m²), waist circumference (105.6 vs 101.0 cm) and plasma glucose values (8.50 vs 5.61 mmol/l; all p<0.0001). Serum total, LDL and high-density lipoprotein (HDL)-cholesterol levels were significantly lower and serum triglyceride levels were significantly higher in diabetes than non-diabetes patients. BP levels, educational level, antithrombotic drug use and current smoking levels were similar in both groups.

Table 2 Characteristics of myocardial patients with and without diabetes

	N missings	Diabetes (n=1014)	No diabetes (n=3823)	p Value
Age (years)	0	69.4 (5.7)	68.9 (5.5)	0.008
Women % (n)	0	26 (267)	21 (787)	<0.0001
High education % (n)*	33	11 (106)	13 (491)	0.05
Anti-thrombotic drugs % (n)	0	97 (981)	98 (3737)	0.06
Statins % (n)	0	83 (844)	86 (3278)	0.04
Antihypertensive drugs % (n)	0	93 (944)	89 (3396)	<0.0001
Time since MI (years)	63	4.5 (3.1)	4.2 (3.2)	0.03
BMI (kg/m ²)	9	29.2 (4.5)	27.4 (3.6)	<0.0001
Waist circumference (cm)	26	105.6 (11.7)	101.0 (9.9)	<0.0001
Plasma glucose (mmol/l)	104	8.50 (3.27)	5.61 (1.02)	<0.0001
Serum total cholesterol (mmol/l)	131	4.64 (0.96)	4.75 (0.97)	0.003
HDL-c (mmol/l)	131	1.21 (0.33)	1.30 (0.34)	<0.0001
LDL-c (mmol/l)	345	2.44 (0.81)	2.62 (0.84)	<0.0001
Serum triglycerides (mmol/l)†	131	1.93 (1.37, 2.72)	1.59 (1.18, 2.20)	<0.0001
Systolic BP (mm Hg)	6	142.9 (21.8)	141.3 (21.6)	0.04
Diastolic BP (mm Hg)	6	78.2 (10.9)	80.6 (11.2)	<0.0001
Current smoking % (n)	1	17 (169)	17 (643)	0.9

*High education=from bachelor degree onwards.

†Median (interquartile range).

BMI, body mass index; BP, blood pressure; HDL-c, high-density lipoprotein-cholesterol; LDL-c, low-density lipoprotein-cholesterol. Values are mean (SD) or percentages (n).

Trends in medication use between 2002 and 2006

Table 3 shows the prevalence of drug treatment and trends between 2002 and 2006 for all main medication groups by diabetes status. Almost three-quarters of the MI patients with diabetes were treated with antidiabetic drugs. Between 2002 and 2006, there was a significant increase (+13%) in the use of insulin and the use of biguanides (included only metformin) (+17%), whereas the use of sulphonylureas decreased significantly (-23%). Antithrombotic medication was used by almost 100% of the patients and did not change over time. There was a significantly increasing trend in statin use between 2002 and 2006 in both patients with diabetes (+8%) and those without (+17%), and similar levels (86% vs 90%, p=0.11) were observed in 2006.

There was also a significant trend in antihypertensive medication between 2002 and 2006 in patients with diabetes (+6%) and in those without (+12%), with similar levels (95% vs 93%, p=0.08) in 2006. Of all major drug classes, β-blockers were mostly used (up to 75%). Strong increases were observed in β-blockers and angiotensin II receptor blockers in both diabetic and non-diabetic patients. The use of ACE inhibitors, calcium channel blockers and diuretics remained stable or slightly decreased between 2002 and 2006.

Trends in risk factors between 2002 and 2006

Table 4 shows risk factor levels and trends in risk factor levels between 2002 and 2006 in diabetic and non-diabetic patients. A significantly decreasing trend between 2002 and 2006 in the prevalence of obesity was found in patients without diabetes only (-5%, p for trend=0.02), but not in those with diabetes (+2%, p=0.9) (p interaction=0.11). In 2002, 35% of the diabetic patients was obese compared to 25% of those without diabetes (p=0.045). In 2006, the prevalence of obesity (BMI≥30 kg/m²) was almost twice as high in diabetic compared to non-diabetic patients (37% vs 20%, p<0.0001). Plasma glucose levels increased between 2002 and 2006 in those without diabetes and remained unchanged in those with diabetes. In 2006, plasma glucose levels were 3 mmol/l higher in diabetic compared to non-diabetic patients (p<0.0001).

Lipid levels improved over time, and similar trends were seen both in those with and without diabetes. In 2006, average serum total cholesterol levels were similar in diabetic and non-diabetic patients (4.52 vs 4.44 mmol/l, p=0.2). Lower LDL (2.18 vs 2.35, p=0.001) and HDL-cholesterol (1.28 vs 1.38, p<0.0001) and 0.3 mmol/l higher serum triglyceride levels (p<0.0001) were found in diabetic patients compared to non-diabetic patients.

Table 3 Prevalence of drug treatment between 2002 and 2006 by diabetes status

	Diabetes (1014)				No diabetes (3823)			
	2002 (94) % (n)	2006 (330) % (n)	Change from 2002-2006	p for trend	2002 (428) % (n)	2006 (1154) % (n)	Change from 2002-2006	p for trend
Glucose-lowering therapy	65 (61)	72 (236)	6.4% (-6.0, 18.7)	0.4	-	-	-	
Insulin	14 (13)	27 (89)	13.2% (9.2, 25.4)	0.006	-	-	-	
Biguanides	26 (24)	42 (139)	16.8% (3.2, 30.3)	0.008	-	-	-	
Sulphonamides	52 (49)	30 (99)	-22.5% (-35.7, -9.3)	<0.0001	-	-	-	
Antithrombotic drugs	97 (91)	97 (320)	0.3% (-4.6, 5.3)	0.7	97 (416)	98 (1133)	0.9% (-1.1, 2.9)	0.02
Antiplatelets	80 (75)	85 (280)	5.6% (-5.2, 16.4)	0.048	82 (349)	84 (975)	2.6% (-2.3, 7.5)	0.15
All lipid-modifying drugs	80 (75)	87 (288)	7.8% (-2.2, 17.8)	0.03	72 (309)	90 (1043)	17.7% (13.1, 22.3)	<0.0001
Statins	79 (74)	86 (285)	7.9% (-2.4, 18.3)	0.03	71 (307)	90 (1033)	17.3% (12.7, 22.0)	<0.0001
Other lipid-modifying drugs	2 (2)	5 (16)	2.8% (-2.7, 8.3)	0.2	2 (7)	3 (40)	1.8% (-0.3, 3.9)	0.02
Antihypertensive drugs	89 (84)	95 (315)	6.1% (-1.0, 13.1)	0.007	81 (346)	93 (1070)	12.2% (7.9, 16.4)	<0.0001
β-blockers	61 (57)	76 (251)	15.7% (3.2, 28.2)	0.0001	52 (224)	75 (863)	22.5% (16.3, 28.7)	<0.0001
ACE inhibitors	50 (47)	46 (153)	-3.7% (-17.6, 10.3)	0.9	38 (164)	41 (478)	2.9% (-3.8, 9.6)	0.03
Angiotensin II receptor blockers (ARBs)	12 (11)	23 (77)	11.5% (0.3, 22.7)	0.03	9 (37)	16 (188)	7.9% (3.3, 12.5)	<0.0001
ACE inhibitors and ARBs	61 (57)	68 (223)	6.8% (-6.4, 20.0)	0.09	47 (200)	57 (655)	10.1% (3.4, 16.9)	<0.0001
Calcium-channel blockers	19 (18)	22 (73)	2.8% (-9.2, 14.8)	0.8	17 (71)	18 (207)	1.5% (-3.8, 3.8)	0.6
Diuretics	39 (37)	39 (128)	-1.6% (-14.6, 11.5)	0.7	28 (118)	23 (260)	-3.9 (-9.4, 1.5)	0.3

This table represents age-adjusted and sex-adjusted prevalence rates and changes over time (between 2002 and 2006).

Table 4 Risk factor levels between 2002 and 2006 by diabetes status

	Diabetes (1014)				No diabetes (3823)			
	2002 (94)	2006 (330)	Change between 2002 and 2006	p for trend	2002 (428)	2006 (1154)	Change between 2002 and 2006	p for trend
BMI (kg/m ²)	29.0 (4.0)	29.3 (4.6)	0.33 (-0.89, 1.56)	0.7	27.6 (3.9)	27.3 (3.6)	-0.38 (-0.86, 0.10)	0.004
Obesity* % (n)	35 (33)	37 (122)	1.9% (-11.4, 15.1)	0.9	25 (108)	20 (230)	-5.2% (-10.6, 0.2)	0.02
Waist circumference (cm)	105.0 (10.6)	106.0 (11.7)	1.23 (-2.00, 4.46)	0.1	100.6 (10.3)	101.5 (10.3)	0.72 (-0.59, 2.03)	0.1
Central obesity % (n)	71 (67)	72 (237)	0.2% (-12.0, 12.5)	0.5	56 (241)	57 (656)	1.6% (-5.0, 8.2)	0.4
Glucose (mmol/l)	8.72 (3.26)	8.55 (3.19)	-0.17 (-1.09, 0.75)	0.6	5.49 (0.99)	5.89 (1.06)	0.40 (0.26, 0.54)	<0.0001
Total cholesterol (mmol/l)	4.96 (0.89)	4.44 (0.94)	-0.52 (-0.78, -0.26)	<0.0001	5.23 (1.08)	4.52 (0.92)	-0.70 (-0.82, -0.57)	<0.0001
LDL-c (mmol/l)	2.76 (0.75)	2.18 (0.77)	-0.57 (-0.80, -0.34)	<0.0001	3.09 (0.93)	2.35 (0.77)	-0.74 (-0.85, -0.62)	<0.0001
HDL-c (mmol/l)	1.19 (0.29)	1.28 (0.31)	0.09 (0.002, 0.18)	0.03	1.29 (0.35)	1.38 (0.35)	0.09 (0.05, 0.14)	<0.0001
Triglycerides (mmol/l)†	1.98 (1.40, 2.63)	1.90 (1.32, 2.72)	-0.08 (-0.44, 0.27)	0.5	1.63 (1.27, 2.32)	1.59 (1.18, 2.18)	-0.12 (-0.25, 0.02)	0.0005
Systolic BP (mm Hg)	145.3 (20.9)	142.2 (22.3)	-3.24 (-9.29, 2.81)	0.2	143.4 (21.8)	138.3 (21.8)	-4.97 (-7.87, -2.07)	<0.0001
Diastolic BP (mm Hg)	81.3 (11.0)	76.5 (11.1)	-4.7 (-7.7, -1.7)	0.0002	82.0 (11.4)	78.5 (11.5)	-3.7 (-5.2, -2.2)	<0.0001
Current smoking % (n)	28 (26)	14 (46)	-13.4 (-23.7, -3.1)	0.003	22 (95)	16 (185)	-6.6% (-11.7, -1.6)	0.002

†Median (interquartile range).
MI, myocardial infarction; BMI, body mass index; BP, blood pressure; HDL-c, high-density lipoprotein-cholesterol; LDL-c, low-density lipoprotein-cholesterol.
This table represents age-adjusted and sex-adjusted mean levels or prevalence rates and changes over time (between 2002 and 2006). Data are presented as mean (SD) or percentages (n).
*Obesity: defined as BMI ≥30.0 kg/m².

Between 2002 and 2006, a significantly decreasing trend in average systolic BP levels (-5 mm Hg, p for trend <0.0001) was observed in those without diabetes and a non-significant decrease of 3 mm Hg in those with diabetes (p for interaction=0.07). As a result, in 2006 mean systolic BP was significantly higher in diabetes patients compared to those without (142 vs 138 mm Hg, p=0.004). This difference in systolic BP could not be explained by antihypertensive drug use (table 3), which was high in 2006 (93% and 95%, respectively) in both groups.

On average, current smoking was more prevalent in 2002 in those with diabetes compared to those without (28% vs 22%). The decreasing trend in the prevalence of smokers was two times stronger in diabetic (-13%) than in non-diabetic patients (-7%). In 2006, the prevalence of smokers was similar in the two groups (approximately 15%).

Comparison with current guidelines

Guidelines for cardiovascular risk management in the Netherlands advise drug treatment to keep serum total cholesterol <4.5 mmol/l and/or LDL-cholesterol levels <2.5 mmol/l and systolic BP levels <140 mm Hg for both diabetic and non-diabetic patients.^{21 22} In 2006, 73% of diabetic patients compared to 67% of non-diabetic patients (p=0.05) had serum total cholesterol and LDL-cholesterol concentrations in line with the recommendations. In the same year, 45% of diabetic patients and 56% of non-diabetic patients (p=0.0005) had systolic BP levels <140 mm Hg.

DISCUSSION

This study showed that in the Netherlands most MI patients with and without diabetes were treated with cardiovascular drugs. Diabetes patients were not more aggressively treated than patients without diabetes. In 2006, the prevalence of obesity, and average systolic BP and serum triglyceride levels were higher and HDL-cholesterol levels were lower in those with diabetes compared to those without.

Strengths of the present study are the large number of MI patients recruited from 32 geographically distributed centres in the Netherlands. Data were collected by trained research nurses who followed a standard protocol for physical examination. Data on cardiovascular and diabetes medication were coded by one pharmaco-epidemiologist according to the ATC classification system.

In the present study, diabetes was defined based on self-reported physician diagnosis, use of antidiabetes medication and/or elevated casual glucose levels. Limitations of our diabetes diagnosis are that no oral glucose tolerance tests (OGTT) were performed. However, performance of OGTT in cardiological routine care is limited, mainly due to its time-consuming protocol, costs and overall inconvenience.²⁰ In the Euro Heart Survey an OGTT was only carried out in 56% of the patients with coronary artery disease but without

known type 2 diabetes.³¹ In the Netherlands, fasting plasma glucose is usually measured by cardiologists. The prevalence of diabetes (20%) corresponded with other studies in MI patients which showed rates between 20 and 33%.^{4 7 32 33} Other limitations of our study are that our patients were volunteers in a clinical trial who could be healthier and/or better treated than other MI patients leading to selection-bias. Generalisability may also be restricted because university hospitals were underrepresented and MI patients who were severely ill, living in nursing homes and patients with cognitive impairment were excluded from the trial. However, the comparisons between diabetic and non-diabetic patients were probably similar compared to other patient populations. Misclassification could have occurred for self-reported risk factors, such as smoking and medication. The number of patients in each examination year varied and was limited, but remained sufficiently high to describe diabetes prevalence rates (18%, 21%, 24%, 19%, 22% in subsequent years from 2002 to 2006), risk factor levels and trends over time.

Many clinical trials on lipid-lowering,³⁴ BP-lowering^{14 35 36} and antiplatelet drugs³⁷ showed that the relative risk reduction in CHD risk resulting from risk factor interventions was similar in diabetic and non-diabetic patients. However, diabetes patients have a higher absolute CHD risk and could potentially benefit more from treatment than non-diabetic patients. In our study the proportions of antithrombotic, lipid-modifying and antihypertensive drug use were high and did not differ between those with and without diabetes.

Approximately 73% of our MI diabetes patients were pharmacologically treated to control glucose levels. Previous studies on high-risk diabetic patients with concomitant CHD reported similar percentages treated with insulin (43%), sulphonylureas (27%) and/or metformin (18–28%).^{38 39}

We found an increasing trend in insulin and metformin and a decreasing trend in sulphonylureas between 2002 and 2006. This suggests that insulin and metformin (partly) have replaced sulphonylureas. Adverse effects of sulphonylureas on CHD risk have been reported in diabetic patients,^{39–43} although this was not confirmed in more recent studies.^{44 45} The prescription of metformin showed an increasing trend in the present study and may reduce mortality in patients with diabetes and CHD, as observed in observational studies⁴⁶ and trials.^{47 48} A meta-analysis of five major randomised trials showed that intensive glucose control significantly reduced the incidence of non-fatal MI (OR 0.83, 95% CI 0.75 to 0.93) and total CHD events (OR 0.85, 95% CI 0.77 to 0.93).¹⁷ This meta-analysis also showed a beneficial effect on macrovascular disease without increasing all-cause mortality. The numbers needed to treat to prevent one CHD event is 69 for all patients achieving on average a 0.9% reduction in glycated haemoglobin concentrations during 5 years (starting from mean 7.8% at baseline). The glucose-lowering regimens used in the

five trials involved mainly metformin, sulphonylureas, insulin and glitazones, comparable to our study.¹⁷

Several studies reported trends in risk factors and medication in CHD patients^{12 49 50} and in CHD patients with and without diabetes,^{9–11} which were in line with our study. In the EUROASPIRE study, similar to our study, 1086 CHD patients with diabetes and 4464 without diabetes were included.⁹ Similar to our findings, EUROASPIRE showed a high prevalence of adverse lifestyle-related risk factors in European diabetic and non-diabetic patients with CHD, with a more adverse profile in diabetic patients. In their diabetic subpopulation (2000) in comparison with our diabetic patients (2002), they had less smokers (17% vs 28%) and more obese patients (43% vs 35%). However, more adverse lipid profiles (eg, LDL-cholesterol 3.2 vs 2.8 mmol/l) were found in EUROASPIRE II compared to our study, whereas BP levels were similar. The main differences in medication were a higher use of calcium antagonists (32% vs 19%), a lower use of diuretics (25% vs 39%) and a lower use of statins (56% vs 79%) in EUROASPIRE. We were not able to compare our 2006 data to EUROASPIRE, since no update of EUROASPIRE analyses by diabetes status was published after 2000.

Our finding that systolic BP levels were not low enough in diabetic MI patients, despite high treatment levels with antihypertensives is consistent with that in EUROASPIRE. The authors⁹ suggested the following explanations for the failure to control BP among diabetic CHD patients: misunderstanding or negligence of treatment goals by physicians, suboptimal dosages and/or poor compliance by patients. These suggestions, however, could not be explored in our data.

Approximately three-quarters of our patients had target levels of total cholesterol <4.5 mmol/l and LDL-cholesterol levels <2.5 mmol/l in line with current Dutch recommendations.^{21 22} In all recommendations,^{18–22} lipid-lowering therapy advise is focused on LDL-cholesterol and total cholesterol, whereas HDL-cholesterol and triglycerides are not even mentioned in some guidelines.²² The joint European guidelines recognise low HDL-cholesterol (<1 mmol/l (39 mg/dl) in men and <1.2 mmol/l (46 mg/dl) in women) and fasting triglycerides >1.7 mmol/l (151 mg/dl) as markers of increased vascular risk.²⁰ Treatment of hypertriglyceridaemia with fibrates is not yet mentioned in recommendations^{21 22} due to lack of beneficial effects on long-term complications. A recent meta-analysis of six randomised controlled trials in patients with type 2 diabetes did not report an effect of fibrates on all-cause or cardiac mortality, stroke, unstable angina or invasive coronary revascularisation.⁵¹

Systolic BP levels target levels below 140 mm Hg as recommended in the Netherlands^{21 22} were found in 2006 in just over half of the non-diabetic patients (56%), and less than half of the diabetic patients (45%). If (hypothetically) European or American guidelines were followed with target systolic BP levels <130/80 mm Hg

even fewer of the diabetic patients would have been treated accordingly.

This study showed that diabetic patients had more obesity, higher levels of systolic BP, higher serum triglyceride levels and lower HDL-cholesterol levels compared to non-diabetic MI patients. According to current guidelines, systolic BP levels were controlled in only half of patients and total serum cholesterol and LDL-cholesterol levels were controlled in almost three-quarters of patients. Diabetic patients were not more aggressively treated than non-diabetic patients and there is scope for improvement. More aggressive drug treatment in combination with diet and lifestyle interventions could help to reach the target levels for BP and lipid lowering.

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