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Determinants of risk factor control in subjects with coronary heart disease: a report from the EUROASPIRE III investigators

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Abstract

The EUROASPIRE audits of risk factor control have indicated that, even in those with established coronary heart disease, risk factor control remains poor. We therefore analysed the EUROASPRE III data set to establish the factors associated with success or failure in risk factor control in order to inform future risk factor management strategies. University education, attendance at a specialist cardiology clinic, and participation in a cardiac rehabilitation programme were associated with improved risk factor control. Risk factor control was poorer in women, those with diabetes, and those undergoing coronary artery bypass surgery as opposed to medical therapy or percutaneous coronary intervention. Increasing age, depression, and anxiety were not associated with poorer risk factor control.

Keywords

Coronary heart disease, risk factors, secondary prevention

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Introduction

Guidelines on cardiovascular disease (CVD) prevention recommend that risk factor modification should be based on an individual's total CVD risk.[1] The current European guidelines[1] categorize those with established CVD as the group with the highest total CVD risk and as such they are given the highest priority in terms of risk factor reduction. The EUROASPIRE III (European Action on Secondary and Primary Prevention by Intervention to Reduce Events III) audit was conducted in 2006/2007 in 22 European countries.[2] The hospital part of the audit focused on describing the risk factor levels in those with established coronary disease. This demonstrated that, despite improved control of blood cholesterol compared with the EUROASPIRE audits in 1996 and 2000, large proportions of coronary patients were not achieving the lifestyle, risk factor, and therapeutic targets for cardiovascular disease prevention.[2] In this analysis, we aim to identify the characteristics (demographic, social, clinical, and interventional) which are associated with success or failure in achieving guideline-recommended targets for the three major risk factors (smoking status, blood pressure, total cholesterol), using the EUROASPIRE III (secondary prevention) dataset. This information may facilitate improved implementation of guidelines on CVD prevention by identifying the type of patient who will need special help to achieve risk factor control.

Methods

The study population used for the analysis was the hospital arm of the EUROASPIRE III audit. The methods have been detailed elsewhere.[2] A total of 76 centres

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from 22 European countries participated in the audit. Consecutive patients, with a clinical diagnosis of coronary heart disease (CHD), were identified retrospectively and then followed up, interviewed, and examined at least 6 months after their coronary event.

The interview consisted of a detailed questionnaire which addressed medical history, risk factor history, education, and HADS (hospital anxiety and depression scale). The examination included measurement of body mass index, waist circumference, blood pressure, heart rate, and expired air carbon monoxide as an indicator of current smoking. A fasting venous blood sample was obtained and sent to a centralized laboratory for measurement of total cholesterol, high- and low- density lipoprotein cholesterol, blood glucose, and HbA1c in diabetics.

Logistic regression was used to establish which characteristics were associated with achievement of the combination of target levels of lipids, blood pressure, smoking, and HbA1c in diabetics. Since EUROASPIRE III audited the implementation in clinical practice of the third joint task force European guidelines on CVD prevention,[3] the primary definition of risk factor targets were based on these:

- total cholesterol <4.5 mmol/l
- blood pressure <140/90 mmHg
- no smoking (either self-reported or CO detected in breath)
- HbA1c ≤6.5% in diabetics.

Of note, the HbA1c target was changed from ≤6.1% to ≤6.5% based on recent trials showing unfavourable effects of very intensive glycaemic control.

The more recent 2007 fourth joint task force guidelines[1] recommend stricter targets in those with established CVD. Therefore, we have also assessed which factors are associated with reaching stricter targets defined as:

- total cholesterol <4 mmol/l
- blood pressure <130/80 mmHg
- no smoking (either self-reported or CO detected in breath)
- HbA1c ≤6.5% in diabetics.

The following characteristics were assessed:

Demographics
- gender
- age group
- country

Social characteristics
- education group: 1, primary school or less; 2, secondary school completed; 3, intermediate between secondary level and university (e.g. technical training); 4, college/university completed

Clinical characteristics
- depression (mild/moderate/severe based on the HADS questionnaire)
- anxiety (mild/moderate/severe based on the HADS questionnaire)
- previous diagnosis of CHD prior to the index event (including previous, coronary event, revascularization, cerebrovascular event, peripheral vascular disease)

Interventions
- diagnostic category of the index event (coronary artery bypass graft, percutaneous coronary intervention, myocardial infarction, myocardial ischaemia)
- attendance at cardiac rehabilitation
- specialist input in secondary prevention (cardiologist, physician, general practitioner).

Characteristics were assessed in separate univariable and multivariable logistic regression. Statistical analyses were undertaken using Stata statistical software, version 9.

Results

A total of 13,935 medical records (27% women) were reviewed and 8966 patients were interviewed. Of these, 7387 (24% women) had full data available for total cholesterol, blood pressure, smoking, and HbA1c if diabetic and are therefore included in this analysis.

Table 1 shows the odds ratios associated with some demographic factors and achievement of the risk factor goals for the first outcome, in univariable and multivariable models. An odds ratio greater than 1 indicates a factor associated with an increased risk of not achieving (all three) targets and vice versa.

Women were 63% less likely to achieve appropriate secondary prevention than men, after adjustment for other characteristics. While increasing age group was associated with increased risk of failing to meet targets in univariable analyses, this effect attenuated substantially on adjustment. The same occurred when age was assessed as a continuous variable (data not shown).

Having a university or college education was associated with better success in achieving secondary prevention targets compared to all other categories of education. Compared to those with university education, those with primary education only were 44% less likely to achieve targets.

The category of depression or anxiety was not significantly associated with achievement of targets on multivariable analyses. However, depression was associated with increased risk of not achieving targets on univariable analyses.

Table 1. Associated characteristics for the first outcome (failing to meet the targets of total cholesterol <4.5 mmol/l, blood pressure <140/90 mmHg, non-smoking)

Characteristic	Univariable	Multivariable
Demographic characteristics		
Female gender	**1.78 (1.53–2.08)**	**1.63 (1.38–1.93)**
Age (years)		
20–53 (median 49)	Reference	Reference
53–59 (median 57)	1.05 (0.88–1.26)	0.97 (0.80–1.18)
59–65 (median 62)	1.05 (0.87–1.26)	0.88 (0.72–1.07)
65–70 (median 68)	1.08 (0.90–1.30)	0.83 (0.68–1.02)
70–80 (median 74)	**1.27 (1.05–1.53)**	0.93 (0.75–1.14)
Social characteristics		
University/college	Reference	Reference
Technical college	**1.24 (1.02–1.51)**	1.19 (0.95–1.48)
Secondary education	**1.20 (1.01–1.39)**	**1.23 (1.02–1.47)**
Primary education or less	**1.95 (1.14–1.62)**	**1.44 (1.16–1.78)**
Clinical characteristics		
Depression		
None	Reference	Reference
Mild	**1.24 (1.04–1.48)**	1.04 (0.87–1.24)
Moderate	1.18 (0.94–1.53)	0.96 (0.75–1.22)
Severe	**1.36 (1.04–3.66)**	0.71 (0.47–1.07)
Anxiety		
None	Reference	Reference
Mild	1.15 (0.97–1.35)	1.15 (0.94–1.41)
Moderate	1.12 (0.92–1.37)	1.12 (0.84–1.49)
Severe	1.03 (0.72–1.45)	1.79 (0.89–3.60)
Coronary heart disease		
No diagnosis of CHD prior to the index event	Reference	Reference
Previous diagnosis of CHD	**1.21 (1.07–1.36)**	1.09 (0.95–1.25)
Diabetes		
No	Reference	Reference
Yes	**3.10 (2.51–3.83)**	**3.29 (2.61–4.15)**
Events		
Myocardial infarction	Reference	Reference
Myocardial ischaemia	1.11 (0.91–1.34)	1.02 (0.82–1.26)
Percutaneous coronary intervention	**0.78 (0.67–0.91)**	0.87 (0.73–1.05)
Coronary artery bypass graft	1.11 (0.91–1.35)	1.13 (0.89–1.44)
Intervention/treatment characteristics		
No cardiologist care vs. cardiologist care	1.26 (1.10–1.43)	1.33 (1.12–1.56)
No physician care vs. physician care	0.93 (0.72–1.20)	1.23 (0.92–1.66)
No GP care vs. GP care	1.03 (0.91–1.16)	1.04 (0.88–1.23)
No specialist nurse care vs. specialist nurse care	1.14 (0.75–1.74)	1.24 (0.76–2.04)
No secondary prevention input vs. any	**2.03 (1.27–3.23)**	1.56 (0.94–2.59)
Attendance at cardiac rehab	Reference	Reference
No attendance at cardiac rehab	**1.15 (1.02–1.30)**	1.15 (0.98–1.35)

Values are odds ratio (95% CI) for logistic regressions. Significant odds ratios are indicated in bold.

Those with a diagnosis of diabetes were three times as likely not to reach secondary prevention targets, compared to non-diabetics. However, a diagnosis of CVD prior to the index event did not affect the endpoint.

The diagnostic category of index event, whether myocardial ischaemia, myocardial infarction, percutaneous coronary intervention (PCI), or coronary artery bypass graft (CABG), did not seem to affect secondary prevention. However, on univariable analyses those with PCI were more likely to achieve secondary prevention targets, compared to the myocardial infarction group.

Attending a cardiologist for secondary prevention was associated with greater success, but whether an individual attended a physician, specialist nurse, or GP did not significantly affect the endpoint. Attendance at cardiac rehabilitation was associated with improved chances of reaching secondary prevention targets; however, this association lost statistical significance after multivariable adjustment.

The results based on the second outcome, which included the tighter lipid target of total cholesterol 4 mmol/l, were very similar (Table 2). However, some of the associations shown for the first outcome did not reach statistical significance for the second outcome.

Discussion

Subjects with established CVD are at high risk of further CVD events and benefit most from risk factor modification, resulting in them being given the highest priority for preventive efforts in the current European Guidelines on CVD prevention in clinical practice.[1] The three EUROASPIRE audits of risk factor control in such subjects have shown an improvement in blood cholesterol control, little change in control of blood pressure and smoking, and a rising problem with overweight and diabetes.[3] This prompted our analysis of which characteristics were associated with success or failure in achieving risk factor targets.

Achievement of secondary prevention targets was shown to be associated with high educational level and attendance at specialist cardiology and possibly cardiac rehabilitation clinics. Less expected results include the lack of association with anxiety or depression or age group. Older patients were just as likely to achieve secondary prevention targets as their younger counterparts on multivariable analyses. Of note, this finding held even when both the stricter blood pressure target of $<130/80$ mmHg and the lowest lipid target of total cholesterol <4 mmol/l were included. The demonstration of the decreased likelihood of women, those with lower education levels and diabetic patients to achieve risk factor targets, even after adjustment for other possible confounding factors is a matter for concern. Women were over 1.5-fold less likely to achieve targets and diabetic patients were 3-fold less likely, compared to those without diabetes.

Others have also demonstrated this inadequate secondary prevention in women.[4,5] This finding may be related to patient or physician factors. Doctors may be contributing through a gender bias in intensity of advice caused by a failure to recognize that CVD is of equal in importance in women; more women than men die of CVD, particularly stroke.[1] Female patients themselves may perceive prevention of CHD and risk factor control to be more important in men and pay more attention to risk factor control in their husbands than themselves.

Disease category was not associated with risk factor control on multivariable analysis. It is helpful to note that, although the inpatient stay associated with admission for percutaneous coronary intervention would be considerably shorter than for the other disease categories (myocardial infarction, ischaemia, or CABG), this does not appear to have worsened risk factor control. In some countries, PCI may be performed as a daycase procedure.

Other studies have addressed the factors which improve risk factor management. However, in general these have concentrated on achievement of single risk factors, principally lipid and blood pressure control. For example, the 'Get with the guidelines' registry examined the factors associated with discharge prescription of lipid-lowering treatment.[4] In agreement with our study, they showed lipid lowering was more common in men and less common in those undergoing CABG. They found patients with stroke and heart failure less likely to receive lipid lowering treatment compared to those with CHD.[4] A similar study conducted in Poland agreed with several of our findings including increased likelihood of appropriate lipid control in those undergoing PCI or having had myocardial infarction, non-diabetics, those with higher education, and those treated in hospital outpatient clinics as opposed to GP practices.[6] In contrast to our study, they demonstrated that younger individuals were most likely to achieve appropriate lipid control.[6] A study of lipid control in peripheral vascular disease patients showed that older individuals more likely and smokers were less likely to achieve targets. While those a concomitant diagnosis of CHD or cerebrovascular disease were more likely to achieve targets.[7] This latter finding was repeated in the analysis of the Vascular Protection and Guidelines-Orientated Approach to Lipid-Lowering registry in Canada.[5]

Table 2. Associated characteristics for the second outcome (failing to meet the targets of total cholesterol <4.0 mmol/l, blood pressure <130/80 mmHg, non-smoking)

Characteristic	Univariable	Multivariable
Demographic characteristics		
Female gender	**2.02 (1.55–2.63)**	**1.73 (1.30–2.31)**
Age (years)		
20–53 (median 49)	Reference	Reference
53–59 (median 57)	**1.32 (1.00–1.77)**	1.22 (0.90–1.66)
59–65 (median 62)	1.11 (0.85–1.47)	0.94 (0.70–1.27)
65–70 (median 68)	**1.36 (1.02–1.81)**	1.03 (0.75–1.42)
70–80 (median 74)	**1.45 (1.08–1.94)**	1.06 (0.76–1.46)
Social characteristics		
University/college	Reference	Reference
Technical college	**1.51 (1.11–2.07)**	**1.44 (1.02–2.03)**
Secondary education	**1.39 (1.08–1.78)**	**1.43 (1.09–1.88)**
Primary education or less	**1.59 (1.21–2.09)**	**1.72 (1.24–2.38)**
Clinical characteristics		
Depression		
None	Reference	Reference
Mild	**1.34 (1.00–1.80)**	1.12 (0.81–1.56)
Moderate	0.99 (0.69–1.43)	0.85 (0.55–1.32)
Severe	1.33 (0.54–3.29)	1.16 (0.42–3.19)
Anxiety		
None	Reference	Reference
Mild	1.26 (0.96–1.66)	1.16 (0.86–1.55)
Moderate	1.29 (0.92–1.82)	1.16 (0.78–1.72)
Severe	0.91 (0.54–1.53)	0.74 (0.40–1.37)
Coronary heart disease		
No diagnosis prior to the index event	Reference	Reference
Previous diagnosis	1.11 (0.92–1.33)	0.91 (0.73–1.13)
Diabetes		
No	Reference	Reference
Yes	**2.83 (1.99–4.01)**	**2.89 (1.97–4.23)**
Events		
Myocardial infarction	Reference	Reference
Myocardial ischaemia	1.23 (0.91–1.67)	1.28 (0.91–1.80)
Percutaneous coronary intervention	0.89 (0.70–1.13)	1.12 (0.85–1.49)
Coronary artery bypass graft	1.19 (0.87–1.62)	1.33 (0.91–1.94)
Intervention/treatment characteristics		
No cardiologist care vs. cardiologist care	**1.25 (1.01–1.54)**	1.24 (0.95–1.62)
No physician care vs. physician care	1.06 (0.72–1.56)	1.43 (0.92–2.24)
No GP care vs. GP care	0.96 (0.80–1.16)	0.98 (0.75–1.27)
No specialist nurse care vs. specialist nurse care	1.30 (0.69–2.42)	1.40 (0.68–2.88)
No secondary prevention input vs. any	1.26 (0.67–2.41)	1.02 (0.50–2.08)
Attendance at cardiac rehab	Reference	Reference
No attendance at cardiac rehab	1.12 (0.93–1.36)	1.18 (0.91–1.52)

Values are odds ratio (95% CI) for logistic regressions. Significant odds ratios are indicated in bold.

One of the strengths of this analysis is the significant volume of standardized patient information and risk factor levels provided by the EUROASPIRE III database. Additionally, there is good representation of Europe with 22 European countries included. The extension of the age range include in the EUROASPIRE III audit in 2006 to include the 70–80 year-old age group has provided an opportunity for the analysis of risk factor control in this group. This is particularly important given the high prevalence of CVD in older individuals and the aging population. Another strength, as discussed above, is the use of the endpoint which incorporated three major risk factors, in contrast to previous studies which have focused on lipid or blood pressure targets in isolation.

This analysis is limited in that it only addressed secondary prevention in CHD patients. It would be useful to look at achievement of risk factor targets in secondary prevention in other cardiovascular diseases, including cerebrovascular disease and peripheral vascular disease. Achievement of primary prevention targets is another important issue, which could potentially be explored in the future. Other patient factors which would have been interesting to assess include adherence to medication and lifestyle advice and patient awareness of risk factor levels and targets.

This study has several clinical implications. The demonstration of appropriate secondary prevention even in older age groups is reassuring. However, the lack of appropriate secondary prevention in key groups such as women and those with diabetes is alarming. Clearly, more attention needs to be paid to risk factor management in these groups. Additionally, more attention needs to be paid to CVD prevention those with less than university education. Secondary prevention will undoubtedly become increasingly managed by GPs in the community. Our demonstration of the superior risk factor control in those attending specialist cardiology clinics suggests the need for improved resources for GPs to provide the knowledge regarding appropriate risk factor targets and management. Facilitatory government strategies and reimbursement policies would also contribute. Increased provision of cardiac rehabilitation programs may also aid patients in achieving targets.

Conclusion

EUROASPIRE III has shown that, throughout Europe, risk factor targets for secondary prevention of CHD are still being inconsistently met. We have shown that several factors are associated with not achieving risk factor targets, specifically lipid, blood pressure, and smoking targets. These include: female gender, diabetes, lower education levels, not attending a specialist cardiology outpatient clinic, and not attending cardiac rehabilitation (borderline significance). Identification of these factors may help to direct efforts for improving implementation of guidelines on prevention of CVD.

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