

Population implications of lipid lowering for prevention of coronary heart disease: data from the 1995 Scottish health survey

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Abstract

Objective—To determine the proportion of the population, firstly, with cholesterol ≥ 5.0 mmol/l and, secondly, with any cholesterol concentration, who might benefit from statin treatment for the following: secondary prevention of coronary heart disease (CHD); primary prevention at CHD risk 30%, 20%, 15%, and 6% over 10 years; and primary prevention at projected CHD risk 20% over 10 years (CHD risk at age 60 years if actual age < 60 years).

Subjects—Random stratified sample of 3963 subjects aged 35–64 years from the Scottish health survey 1995.

Results—For secondary prevention 7.8% (95% confidence interval (CI) 6.9% to 8.6%) of the population with cholesterol ≥ 5.0 mmol/l would benefit from statins. For primary prevention, the prevalence of people at CHD risk 30%, 20%, 15%, and 6% over 10 years is 1.5% (95% CI 1.2% to 1.9%), 5.4% (95% CI 4.7% to 6.1%), 9.7% (95% CI 8.8% to 10.6%), and 32.9% (95% CI 31.5% to 34.4%), respectively. At projected CHD risk 20% over 10 years, 12.4% (95% CI 11.4% to 13.5%) would be treated with statins. Removing the 5.0 mmol/l cholesterol threshold makes little difference to population prevalence at high CHD risk.

Conclusions—Statin treatment would be required for 7.8% of the population for secondary prevention. For primary prevention, among other factors, guidelines should take into account the number of patients needing treatment at different levels of CHD risk when choosing the CHD risk to target. The analysis supports a policy of targeting treatment at CHD risk 30% over 10 years as a minimum, as recommended in current British guidelines, with a move to treating at CHD risk 15% over 10 years as resources permit.

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The results of five randomised trials have established that cholesterol lowering by statins prevents coronary heart disease (CHD) in both secondary^{1–3} and primary prevention,^{4,5} with cholesterol reduction of 20–25% reducing major coronary events by about 33%. Additional benefits are prevention of hospital admissions, revascularisation procedures, and, in secondary but not primary prevention, strokes. In these trials relative risk reduction for major CHD events by statins was constant at about 33%, both between trials and in subgroup analyses within trials. This holds true for primary and secondary prevention, in men or women, and in numerous other subgroups such as patients with diabetes or hypertension, or smokers. Because relative risk reduction is constant, benefit from statin treatment is determined by the absolute CHD risk of an individual person,⁶ not by pretreatment concentrations of cholesterol or other lipid fractions.^{7,8} Absolute CHD risk determines the number of patients who need to be treated to prevent one major coronary event⁹; the cost effectiveness of treatment^{7,10}; the proportion of the population that would require treatment⁷; and the total cost of statin treatment.^{7,10} Given unlimited resources, statin treatment can be justified at a CHD event risk as low as 6% over 10 years⁵ but current guidelines all advise a risk threshold higher than this.^{11–14} All emphasise secondary prevention as the first priority, but

for primary prevention they differ in their recommendations for the CHD risk to target. Joint British Society guidelines recommend treatment at CHD risk 30% over 10 years as a minimum and treatment at 15% over 10 years as optimal.¹¹ Joint European Task Force guidelines suggest treatment at CHD risk 20% over 10 years and when CHD risk projected to the age of 60 years is estimated at $\geq 20\%$ over 10 years in those younger than 60 years old.¹²

We have previously set out the implications of possible policies for statin treatment for the English population given the evidence then.⁷ The analysis of the Scottish health survey population described here¹⁵ has important differences. The Scottish health survey database has additional information, for example on peripheral vascular disease, which allows more complete quantification of the need for secondary prevention, and on high density lipoprotein (HDL) cholesterol, which notably increases the accuracy of CHD risk estimation for primary prevention.^{16,17} The previous analysis did not consider treatment at CHD risk below 15% over 10 years in accordance with the evidence then available.⁷ Here we examine the implications of statin treatment at CHD risk 6% over 10 years and at CHD risk 20% over 10 years projected to the age of 60 years as recommended in the joint European guidelines. The previous analysis was based on a total cholesterol threshold of 5.5 mmol/l but guidelines

now advise treatment at a cholesterol threshold of 5.0 mmol/l because of new evidence.^{11–14} However, this threshold is based on a subgroup analysis of one trial,² and it remains possible that statins should be prescribed for all those with high CHD risk regardless of the total cholesterol concentration. We have examined the implications in the population of applying the 5.0 mmol/l cholesterol threshold, or of adopting no threshold at all and treating all people at high CHD risk.

Methods

SCOTTISH HEALTH SURVEY 1995

This survey, commissioned by the Scottish Office Department of Health and carried out by the Joint Health Surveys Unit at Social and Community Planning Research and University College London Medical School, examined CHD risk factors in the Scottish population aged 16–64 years and was conducted between March 1995 and February 1996.¹⁵ A random sample of addresses selected by postcode was visited by an interviewer, who randomly selected one resident aged between 16 and 64 years, and elicited information on symptoms, diagnoses, and treatment of cardiovascular disease. In subjects who agreed, a nurse subsequently obtained details of prescribed medications and measured blood pressure and total and HDL cholesterol. Blood was drawn with minimal venous stasis and cholesterol concentration was measured in a single laboratory by the cholesterol oxidase method using a SUMMIT monitor (American Monitor Co, now disbanded, USA).

DEFINITION OF RISK FACTORS

Myocardial infarction, angina, stroke, and diabetes were defined in the survey and this paper as recall of a doctor's diagnosis of these conditions. Peripheral vascular disease was diagnosed by a symptom questionnaire for claudication. Smoking history was recorded and we define as smokers those who smoke cigarettes currently or in the past year, as in the

Framingham study.¹⁸ Blood pressure was measured three times at one minute intervals after sitting for five minutes, using a Dinamap 8100 monitor (GE Medical Systems IT, Basingstoke, UK) and an appropriate cuff size. The mean of the second and third readings was analysed.

LEVELS OF CHD RISK EXAMINED FOR PRIMARY PREVENTION

Four CHD event rates were examined for those with cholesterol ≥ 5.0 mmol/l and separately for those with any cholesterol concentration, as follows:

- *CHD risk 30% over 10 years*, which was recommended for treatment in Standing Medical Advisory Committee guidance¹³ and as a minimum in recent Joint British Societies guidelines.¹¹
- *CHD risk 20% over 10 years*, at which treatment is recommended in the Second Joint European Task Force guidelines.¹² Treatment is also recommended at a “projected risk” of 20% over 10 years, meaning the CHD risk assuming that age is 60 years if age is below 60, or actual age if age is ≥ 60 years.
- *CHD risk 15% over 10 years*, which is considered optimal in Joint British guidelines¹¹—a goal to be attained progressively after treatment of CHD risk 30% over 10 years has been implemented.
- *CHD risk 6% over 10 years*, which was the level of risk of placebo treated people in the AFCAPS/TexCAPS (Air Force/Texas coronary atherosclerosis prevention study).⁵ This analysis therefore explores the implications of treating for primary prevention all who have a risk of CHD similar to that in the AFCAPS/TexCAPS study, which represents the limits of current trial evidence.

METHOD OF ANALYSIS

The analysis in 4910 subjects aged 35–64 years is outlined in figs 1 and 2. One subject had no

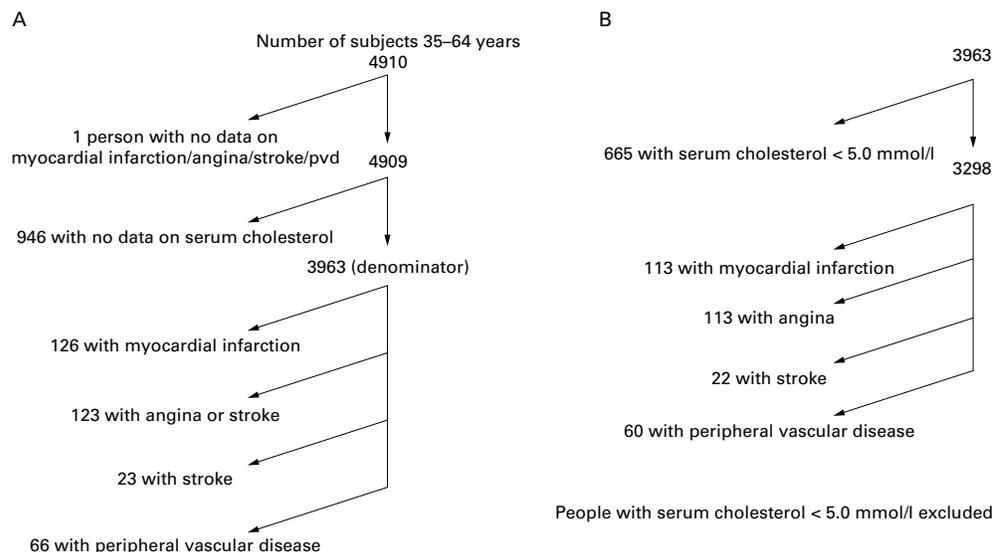


Figure 1 Sequential route of data analysis from the Scottish health survey to estimate the proportion of the population for secondary prevention. (A) Subjects with any serum total cholesterol concentration. (B) Subjects with serum total cholesterol concentration ≥ 5.0 mmol/l.

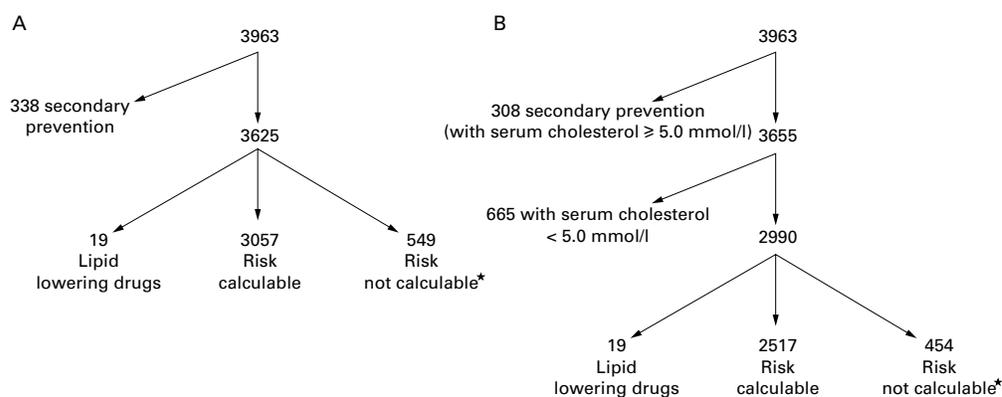


Figure 2 Sequential route of data analysis from the Scottish health survey to estimate the proportion of the population for primary prevention at different levels of CHD event risk. (A) Subjects with any serum total cholesterol concentration. (B) Subjects with serum total cholesterol concentration ≥ 5.0 mmol/l. *Risk was not calculable for 549 subjects (or 454 subjects with serum cholesterol ≥ 5.0 mmol/l) because of absence of data for one or more coronary risk factors.

data on myocardial infarction, angina, stroke, or peripheral vascular disease, and 946 had no cholesterol measurement, leaving 3963 with full data on myocardial infarction, angina, stroke, peripheral vascular disease, and serum cholesterol. Data were analysed in those with serum cholesterol ≥ 5.0 mmol/l and in all subjects regardless of any cholesterol threshold. The latter analysis included 665 subjects (16.8%) who had serum total cholesterol < 5.0 mmol/l.

SECONDARY PREVENTION

Among the 3298 (83.2%) subjects who had serum cholesterol ≥ 5.0 mmol/l, those with a history of myocardial infarction were identified; then those with angina but no myocardial infarction; then those with stroke but no myocardial infarction or angina; and finally those with peripheral vascular disease but no myocardial infarction, angina, or stroke. The denominator for estimates of prevalence in the population was 3963 subjects—that is, all those aged 35–64 years with information on these diagnoses and a serum cholesterol measurement (fig 1). Prevalence and 95% confidence intervals (CIs) were calculated for 10 year age bands. This analysis was repeated for all subjects regardless of the cholesterol concentration, using the same denominator.

Table 1 Coronary heart disease risk factors and prevalence of myocardial infarction, angina, stroke, and peripheral vascular disease in people aged 35–64 years who did and did not have serum cholesterol measurement

	Men		Women	
	Cholesterol measured	Cholesterol not measured	Cholesterol measured	Cholesterol not measured
Serum cholesterol (mmol/l)	6.1 (0.03)	–	6.0 (0.03)	–
Number	1812	396	2151	550
Age (years)	48.7 (0.21)	49.2 (0.46)	48.7 (0.19)	49.7 (0.40)*
Systolic blood pressure (mm Hg)	134.5 (0.43)	137.1 (0.76)	129.4 (0.43)	132.8 (0.63)*
Smokers (%)	35.4	46.2**	36.0	44.7**
Diabetes (%)	2.5	3.8	2.1	4.0*
Lipid lowering drugs (%)	1.6	0.8	0.7	0.4
Myocardial infarction (%)	5.0	5.8	1.6	2.7
Angina (%)	5.6	7.1	4.5	4.7
Stroke (%)	1.7	3.0	0.8	2.2
Peripheral vascular disease (%)	2.2	3.8	2.1	2.2

Values are expressed as means (SEM).

Significance tests compare people of the same sex with and without cholesterol measured:

* $p < 0.05$, ** $p < 0.001$.

PRIMARY PREVENTION

To examine the prevalence of CHD risk strata in subjects free of vascular disease, those with myocardial infarction, angina, stroke, or peripheral vascular disease were excluded, leaving 3665 people who had cholesterol measurement but no indication for secondary prevention. Of these, 665 had serum total cholesterol < 5.0 mmol/l and 2990 cholesterol ≥ 5.0 mmol/l (fig 2). Nineteen were taking lipid lowering drugs and were excluded because CHD risk could not be calculated. There were complete data for 2517 (84%) subjects to calculate CHD risk (see below), and 454 had one or more variables missing for risk calculation. Exclusion of these subjects might bias the findings, and the prevalence of risk level strata in the population was calculated assuming the same prevalence for those with missing data ($n = 454$) as in those in whom risk could be calculated ($n = 2517$). The analysis was repeated for subjects with any cholesterol concentration—that is, retaining those with cholesterol < 5.0 mmol/l. The method of analysis ensures that the population prevalence of those for primary prevention is additive to that for secondary prevention.

CHD RISK CALCULATION

Risk of CHD events was calculated by the Framingham risk function¹⁸ using the following risk factors: age, sex, systolic blood pressure, total to HDL cholesterol ratio, smoking status, and diabetes. Left ventricular hypertrophy was assumed to be absent. The Framingham function is accurate for prediction between 4–12 years, and risks of CHD events over five years were computed for consistency with previous analyses⁷ and because the duration of the statin trials has been approximately five years. British and European guidelines now express risk as CHD events in 10 years, and the calculated five year estimates were doubled and expressed as CHD risk over 10 years to conform with this. Comparison of 10 year risk calculated thus, and 10 year risk calculated directly by the Framingham risk function, shows no important difference.

Table 2 Proportion (%) of people at different ages with a history of myocardial infarction, angina, stroke, or peripheral vascular disease and serum total cholesterol ≥ 5.0 mmol/l, and separately for those with any cholesterol concentration

Age (years)	Men						Women					
	No with TC measured	MI	Angina	Stroke	PVD	Total	No with TC measured	MI	Angina	Stroke	PVD	Total
TC ≥ 5.0 mmol/l												
35–44	671	1.0	0.0	0.0	0.9	1.9	804	0.1	0.9	0.4	0.6	2.0
45–54	583	3.6	2.1	0.5	0.7	6.9	673	1.9	1.6	0.3	2.5	6.4
55–64	558	9.5	5.6	2.0	2.5	19.5	674	2.7	7.7	0.4	2.1	12.9
Total 35–64	1812	4.5	2.4	0.8	1.3	8.9	2151	1.5	3.3	0.4	1.7	6.8
95% CI		3.5 to 5.4	1.7 to 3.1	0.4 to 1.2	0.8 to 1.9	7.6 to 10.3		1.0 to 2.0	2.5 to 4.0	0.1 to 0.6	1.2 to 2.2	5.7 to 7.9
All TC												
Total 35–64	1812	5.0	2.6	0.8	1.5	9.9	2151	1.6	3.5	0.4	1.8	7.3
95% CI		4.0 to 6.0	1.9 to 3.4	0.4 to 1.2	0.9 to 2.0	8.6 to 11.3		1.1 to 2.2	2.7 to 4.3	0.1 to 0.7	1.2 to 2.4	6.2 to 8.4

CI, confidence interval; MI, myocardial infarction; PVD, peripheral vascular disease; TC, total cholesterol.

Results

FEATURES OF THE POPULATION

The 3963 subjects with a cholesterol measurement had a mean age of 49 years and a mean systolic blood pressure 132 mm Hg; 36% were smokers and 2.3% had diabetes. The mean serum cholesterol was 6.1 mmol/l in men and 6.0 mmol/l in women. Table 1 shows mean data for those with (n=3963) and without (n=946) a cholesterol measurement. Those with no cholesterol measurement were more often women; had a higher prevalence of myocardial infarction, angina, stroke, and peripheral vascular disease; were older; were more often smokers; and had higher blood pressure.

SECONDARY PREVENTION

Myocardial infarction

The prevalence of a history of myocardial infarction with serum cholesterol ≥ 5.0 mmol/l was 4.5% in men, 1.5% in women, and 2.9% (95% CI 2.3% to 3.4%) overall. Removing the 5.0 mmol/l cholesterol threshold increased the prevalence of myocardial infarction to 5.0% in men, 1.6% in women, and 3.2% (95% CI 2.6% to 3.7%) overall. The increasing prevalence with age is shown in table 2.

Angina

The prevalence of self reported angina (but no myocardial infarction) and total cholesterol ≥ 5.0 mmol/l (table 2) rose in men from 0% at age 35–44 years to 5.6% at age 55–64 years, and in women from 0.9% at age 35–44 years to 7.7% at age 55–64 years. The overall prevalence was 2.4% in men, 3.3% in women, and 2.9% (95% CI 2.3% to 3.4%) in men and women together. Removing the 5.0 mmol/l threshold increased the prevalence from 2.9% to 3.1% (95% CI 2.6% to 3.6%), comprising 2.6% of men and 3.5% of women.

Stroke

The prevalence of a history of stroke (but no myocardial infarction or angina) and cholesterol ≥ 5.0 mmol/l (table 2) was 0.8% for men, 0.4% for women, and 0.6% (95% CI 0.3% to 0.8%) overall. No men and only one woman with stroke had a serum cholesterol concentration < 5.0 mmol/l and therefore the prevalence of stroke was similar when those with cholesterol < 5.0 mmol/l were included.

Peripheral vascular disease

The prevalence of peripheral vascular disease and cholesterol ≥ 5.0 mmol/l was 1.3% in men, 1.7% in women, and 1.5% (95% CI 1.1% to 1.9%) overall. Removing the 5.0 mmol/l cholesterol threshold increased the overall prevalence from 1.3% to 1.5% in men, from 1.7% to 1.8% in women, and from 1.5% to 1.7% (95% CI 1.3% to 2.1%) in men and women together.

Myocardial infarction, angina, stroke or peripheral vascular disease

Combining these indications for secondary prevention, 8.9% (95% CI 7.6% to 10.3%) of men, 6.8% (95% CI 5.7% to 7.9%) of women, and 7.8% (95% CI 6.9% to 8.6%) overall gave a history of one of these diagnoses and had serum cholesterol ≥ 5.0 mmol/l (table 2). Removing the cholesterol threshold increased the prevalence to 9.9% (95% CI 8.6% to 11.3%) for men, 7.3% (95% CI 6.2% to 8.4%) for women, and 8.5% (95% CI 7.7% to 9.4%) in all subjects.

PRIMARY PREVENTION

Tables 3 and 4 show that the CHD risk threshold selected for treatment has a profound effect on the population need for primary prevention.

Table 3 Proportion (%) of people at different ages with serum total cholesterol ≥ 5.0 mmol/l, and separately for those with any cholesterol concentration who have a predicted risk of CHD events of 30%, 20%, 15%, or 6% over 10 years

Age (years)	Denominator	Men: 10 year risk				Women: 10 year risk				
		$\geq 30\%$	$\geq 20\%$	$\geq 15\%$	$\geq 6\%$	Denominator	$\geq 30\%$	$\geq 20\%$	$\geq 15\%$	$\geq 6\%$
TC ≥ 5.0 mmol/l										
35–44	671	0.3	0.3	1.7	20.4	804	0.0	0.1	0.1	1.8
45–54	583	1.0	1.0	15.3	56.0	673	0.3	1.0	2.7	19.8
55–64	558	7.6	7.6	35.4	61.8	674	1.4	3.9	10.8	53.7
Total 35–64	1812	2.8	10.1	16.3	44.4	2151	0.5	1.6	4.3	23.5
95% CI		2.0 to 3.5	8.7 to 11.4	14.6 to 18.0	42.1 to 46.7		0.2 to 0.8	1.1 to 2.1	3.4 to 5.1	21.7 to 25.3
All TC										
Total 35–64	1812	2.9	10.9	18.1	51.3	2151	0.5	1.6	4.4	25.0
95% CI		2.1 to 3.6	9.5 to 12.4	16.3 to 19.8	49.0 to 53.6		0.2 to 0.9	1.1 to 2.2	3.5 to 5.3	23.1 to 26.8

Table 4 Proportion (% and 95% CI) of the population aged 35–64 years who have serum total cholesterol concentration ≥ 5.0 mmol/l, < 5.0 mmol/l, and any total cholesterol

Policy	TC ≥ 5 mmol/l	Any TC	TC < 5 mmol/l
Secondary prevention	7.8 (6.9 to 8.6)*	8.5 (7.7 to 9.4)	0.8 (0.5 to 1.0)
and Primary prevention at 30%†	1.5 (1.2 to 1.9)	1.6 (1.2 to 2.0)	0.0 (0.0 to 0.1)
or Primary prevention at 20%	5.4 (4.7 to 6.1)	5.8 (5.1 to 6.5)	0.4 (0.2 to 0.6)
or Primary prevention at 15%	9.7 (8.8 to 10.6)	10.5 (9.5 to 11.5)	0.8 (0.6 to 1.1)
or Primary prevention at 6%	32.9 (31.5 to 34.4)	36.8 (35.3 to 38.3)	3.8 (3.2 to 4.4)
or Primary prevention at projected 20%‡	12.4 (11.4 to 13.5)	13.4 (12.3 to 14.4)	0.9 (0.6 to 1.2)

*Figures are percentages of Scottish men and women age 35–64 years with 95% CIs.

†Percentages for primary prevention represent CHD risk over 10 years.

‡Risk calculated with age projected to 60 years if current age < 60 .

Treatment at CHD risk 30% over 10 years targets 2.8% of all men and 0.5% of all women, whereas treatment at 6% over 10 years would embrace 44% of all men and 24% of all women. For the whole population aged 35–64 the prevalence of 10 year CHD risk 30% is 1.5%, of CHD risk 20% is 5.4%, of CHD risk 15% is 9.7%, and of CHD risk 6% is 32.9%. In practice the proportion of the population for primary prevention would be added to those for secondary prevention, who have top priority. Figure 3 illustrates the need for secondary prevention plus primary prevention at different CHD risk thresholds.

Age has a powerful effect on CHD risk, and the effect of age on population prevalence is most pronounced at lower CHD thresholds. For example, in men the prevalence of 30% 10 year risk increased from 0.3% at age 35–44 years to 7.6% at age 55–64 years, an increase of 7.3 percentage points. The prevalence of 6%

10 year CHD risk increased from 20% at age 35–44 years to 62% at age 55–64 years, an increase of 42 percentage points.

At any risk threshold more men than women would need statin treatment, but the sex difference is less pronounced at low risk thresholds and in older people. For example, at age 55–64 years and CHD risk threshold of 6% over 10 years, 54% of women and 62% of men have this risk.

CHOLESTEROL THRESHOLD

Tables 3 and 4 show the effect of removing the 5.0 mmol/l cholesterol threshold. For secondary prevention, the percentage of the population for treatment would increase from 7.8% to 8.5%. For primary prevention at high CHD risk, the cholesterol threshold makes little discernible difference. As CHD risk is lowered there is some increase in prevalence, for example, from 32.9% to 36.8% at the 6% 10 year risk threshold.

PROJECTED CHD RISK

Projected CHD risk is calculated using the age of 60 years when the actual age is less than 60 years. Figure 4 shows the effect of targeting treatment at *actual* CHD risk 20% over 10 years and *projected* CHD risk 20% over 10 years. At age 35–44 the population prevalence for the 20% threshold is 10.2% for projected risk compared with 0.4% for actual CHD risk. At age 55–64 the prevalence for projected risk is 14.5% and for actual risk 13.0%. The overall prevalence for projected CHD risk of 20% is 12.4% (24.1% of men and 2.9% of women) and for actual CHD risk 5.4% (10.1% of men and 1.6% of women).

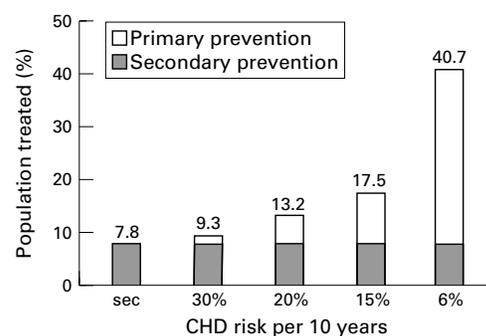


Figure 3 Proportion of the population aged 35–64 years with serum total cholesterol concentration ≥ 5.0 mmol/l for secondary prevention and primary prevention with predicted risk of CHD events of 30%, 20%, 15%, or 6% over 10 years.

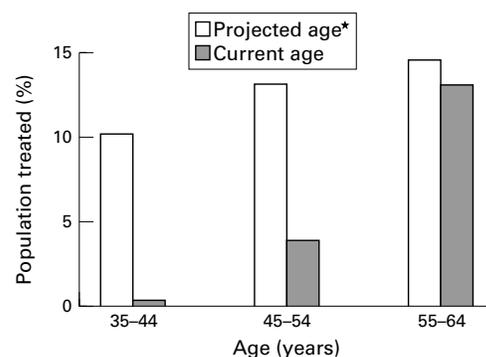


Figure 4 Proportion of people with serum cholesterol concentration ≥ 5.0 mmol/l and CHD risk 20% over 10 years using current age, and age projected to age 60 years if current age is $< 60^*$ as in the Joint European Task Force guidelines, displayed by age.

Discussion

The sample surveyed is closely representative of the Scottish population,¹⁵ and most had all the data required to assess the need for statin treatment for secondary and primary prevention. Possible sources of bias and error in such data have been discussed in detail elsewhere.⁷ Those who decline to participate generally have higher cardiovascular risk. Those excluded because they had no cholesterol measurement more often reported myocardial infarction, angina, stroke, and peripheral vascular disease (table 1). For primary prevention, those with cholesterol measurement probably had a slightly lower CHD risk than those without cholesterol measurement because of their lower age (by 0.7 years), systolic blood pressure (by 2.9 mm Hg), prevalence of smoking (by

9.6%), and prevalence of diabetes (by 1.6%). The need for statin treatment in the whole population may therefore be underestimated. Other sources of bias or error include use of self reported diagnoses; inclusion of cerebral haemorrhage or embolic stroke from the heart in the all encompassing diagnosis of "stroke"; and the use of only one measurement of serum total cholesterol and HDL cholesterol. Despite these shortcomings the population estimates obtained from this type of analysis are likely to be reasonably accurate, as we have discussed elsewhere.⁷

IMPLICATIONS FOR STATIN TREATMENT

Secondary prevention

About 7.8% (8.9% of men and 6.8% of women) of the Scottish population aged 35–64 years would need secondary prevention with a statin using cholesterol ≥ 5.0 mmol/l as threshold. Removing the 5.0 mmol/l cholesterol threshold for treatment would increase the need for statins from 7.8% to 8.5% of people. These figures considerably underestimate the total need for secondary prevention in the population because there is evidence for benefit up to the age of 75 years,² and the upper age in this survey was 64 years. Implementation of secondary prevention alone is a major undertaking.

Primary prevention

The CHD risk targeted for primary prevention determines the number needed to treat,⁹ cost effectiveness,¹⁰ proportion of the population requiring treatment,⁷ and the total cost of treatment.^{7–10} This analysis sets out the population implications of treatment policies at four levels of CHD risk. Diet and lifestyle measures would be advised before statin treatment for primary prevention, but their effect on CHD risk in controlled trials is modest.^{19–21} Statin treatment can be justified at CHD risk $\geq 6\%$ over 10 years, which was the risk of placebo treated patients in the AFCAPS/TexCAPS study.⁵ This would entail treating 33% of the Scottish population aged 35–64 (44% men, 24% women) for primary prevention. Adding the 7.8% of people who need secondary prevention, no less than 41% of all adults aged 35–64 would be treated with statins. This is beyond any health care system on grounds of both cost and workload, and because of this recent Joint British guidelines have recommended treatment at a higher CHD risk threshold.¹¹

Treatment for primary prevention at a CHD risk of 30% over 10 years with total cholesterol concentration ≥ 5.0 mmol/l, recommended as a minimum in these guidelines, would entail statin treatment of 1.5% of the population aged 35–64 for primary prevention and of 9.3% in total for secondary and primary prevention. The Joint British guidelines also recommend a progressive move to treatment at 15% over 10 years as resources permit.¹¹ This would entail statin treatment for 9.7% of people for primary prevention and 17.5% for primary plus secondary prevention. This can not be implemented in the UK at present because of the

cost and workload but may be feasible in populations with lower mean cholesterol values, a lower absolute CHD risk in relation to cholesterol, or both.

EFFECT OF THE CHOLESTEROL THRESHOLD

Guidelines currently advise treatment at a cholesterol threshold of 5.0 mmol/l based on a subgroup analysis of the CARE (cholesterol and recurrent events) trial,² and it remains possible that statins should be prescribed for all those with high CHD risk regardless of the total cholesterol concentration. There are suggestions that all patients who have survived a myocardial infarction should have statin treatment. Table 4 shows the likely increase in statin treatment if the 5.0 mmol/l cholesterol threshold were removed. The percentage of the population aged 35–64 years needing treatment for secondary prevention would rise from 7.8% to 8.5%. For primary prevention, removal of the cholesterol threshold makes little difference at high CHD risk. The percentage of the population with CHD risk 30% over 10 years is 1.5% with cholesterol ≥ 5.0 mmol/l and 1.6% when the threshold is removed, implying that high cholesterol is generally required to attain this level of risk. At low CHD risk, the percentage increase is greater. For example the prevalence of CHD risk 6% per 10 years increases from 33% to 37% when the 5.0 mmol/l cholesterol threshold is disregarded.

PROJECTED CHD RISK

British guidelines recommend that statin treatment be targeted at absolute coronary risk,¹¹ whereas Joint European Task Force guidelines advise statin treatment for "projected risk" defined as the absolute risk of a person using age 60 years when the current age is less than 60 years.¹² This policy increases statin treatment of young people massively (fig 4). No less than 21.7% of men aged 35–39 would be treated using age projected to 60, whereas none would be treated using actual age. The average CHD risk of people in the Scottish health survey aged 35–39 is 3.0% over 10 years: 4.9% in men and 1.2% in women. The average CHD risk in AFCAPS/TexCAPS was higher than this, at 6% over 10 years.⁵ Treatment aimed at projected risk would therefore entail treatment of over one fifth of men aged 35–39 who have a level of risk that has not been examined in randomised controlled trials with statins. At this CHD risk, 200 people would need treatment for five years to prevent one event at a cost of £556 000 for each event prevented.

COMPARISON WITH ANALYSIS OF HEALTH SURVEY FOR ENGLAND

We have previously reported the implications of targeting statin treatment at different CHD risk thresholds in the English population.⁷ The present analysis in the Scottish population has similarities but is not directly comparable. Age in the Scottish population sample was 35–64 years and in the English sample 35–69 years; peripheral vascular disease was not elicited in the English survey, thus underestimating the

need for secondary prevention; and the English survey did not measure HDL cholesterol, so that risk prediction for primary prevention was less accurate. The last difference is important because the average HDL in the Scottish sample (1.30 mmol/l for men and 1.56 mmol/l for women) was, surprisingly, much higher than the values from published sources assumed in our analysis of the English population (1.15 for men and 1.40 for women).⁷ Direct comparisons between the two analyses are therefore difficult. However, this study suggests a higher need for secondary prevention in the Scottish population (7.8% *v* 4.8% in the English population), and this difference would be even more pronounced if the age range in the Scottish population were extended to 69 years. Primary prevention for subjects with a CHD event rate of 30% over 10 years was predicted for 3.4% of the English population aged 35–69, compared with 1.5% of the Scottish population aged 35–64. At CHD risk 15% over 10 years, 19.6% of the English population and 9.7% of the Scottish population appeared to be candidates for treatment. The apparent need for more primary prevention in the English population is likely an artefact due to the older age in the English sample, the lower HDL assumed, and the higher cholesterol threshold (5.5 mmol/l) that was appropriate then, compared with 5.0 mmol/l now.

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