Coronary and cardiovascular risk estimation for primary prevention: validation of a new Sheffield table in the 1995 Scottish health survey population

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Abstract

Objective To examine the accuracy of a new version of the Sheffield table designed to aid decisions on lipids screening and detect thresholds for risk of coronary heart disease needed to implement current guidelines for primary prevention of cardiovascular disease.

Design Comparison of decisions made on the basis of the table with absolute risk of coronary heart disease or cardiovascular disease calculated by the Framingham risk function. The decisions related to statin treatment when coronary risk is ≥30% over 10 years; aspirin treatment when the risk is ≥15% over 10 years; and the treatment of mild hypertension when the cardiovascular risk is ≥20% over 10 years.

Setting The table is designed for use in general practice.

Subjects Random sample of 1000 people aged 35-64 years from the 1995 Scottish health survey.

Main outcome measures Sensitivity, specificity, and positive and negative predictive values of the table.

Results 13% of people had a coronary risk of ≥15%, and 2.2% a risk of ≥30%, over 10 years. 22% had mild hypertension (systolic blood pressure 140-159 mm Hg). The table indicated lipids screening for everyone with a coronary risk of ≥15% over 10 years, for 95% of people with a ratio of total cholesterol to high density lipoprotein cholesterol of ≥8.0, but for <50% with a coronary risk of <5% over 10 years. Sensitivity and specificity were 97% and 95% respectively for a coronary risk of ≥15% over 10 years; 82% and 99% for a coronary risk of ≥30% over 10 years; and 88% and 90% for a cardiovascular risk of ≥20% over 10 years in mild hypertension.

Conclusion The table identifies all high risk people for lipids screening, reduces screening of low risk people by more than half, and ensures that treatments are prescribed appropriately to those at high risk, while avoiding inappropriate treatment of people at low risk.

Introduction

When hydroxymethyl glutaryl coenzyme A (HMG Co-A) reductase inhibitors (statins), antihypertensive drugs, and aspirin are used for primary prevention of coronary heart disease or cardiovascular disease, the absolute risk determines benefit to the individual, cost effectiveness, proportion of the population treated, and the total cost of treatment.[1–5] Joint guidelines by four British societies[6] and British Hypertension Society guidelines[7] recommend aspirin and treatment of mild hypertension when a risk of coronary heart disease is 15% over 10 years. For hypertension treatment this risk is considered equivalent to a risk of cardiovascular disease of 20% over 10 years.[7] Statins are also justified when coronary risk is 15% over 10 years, but because of resource implications the guidelines recommend treatment when coronary risk is ≥30% over 10 years as a priority, with treatment when coronary risk is 15% to be given when and where resources permit.[6 7] Absolute coronary risk relates only weakly to single risk factors such as blood pressure or lipid concentrations, and it is estimated best by counting and weighting major coronary risk factors using risk functions derived from epidemiological studies.[8 9]

Several risk assessment methods based on the Framingham risk function,[3 6 10–12] including the Sheffield table,[13 14] are widely used. We modified the Sheffield table to identify coronary risk thresholds specified in the new guidelines—namely, 15% and 30% over 10 years—and to improve accuracy we based it on the ratio of total cholesterol to high density lipoprotein cholesterol (TC:HDL ratio) rather than on cholesterol concentration alone.[15] We report the accuracy of this table for identifying risk of coronary heart disease of 15% and 30% over 10 years in a general population; examine whether coronary risk of 15% over 10 years is an acceptable surrogate for cardiovascular risk of 20% over 10 years in mild hypertension; and evaluate the table as a tool for selective lipids screening.

Definitions of heart disease

- Coronary heart disease is defined as a fatal or non-fatal myocardial infarction plus incident angina
- Cardiovascular disease is defined as coronary heart disease but also including stroke, peripheral vascular disease, and heart failure

Editorial by Jackson

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Sheffield table for primary prevention of cardiovascular disease

Showing serum total:HDL cholesterol ratios conferring estimated risk of coronary heart disease events of 15% and 30% over 10 years.

Men	Total: HDL cholesterol ratio															
Hypertension		**Yes**		No		**Yes**		**Yes**		No		No		**Yes**		No	
Smoking		**Yes**		**Yes**		**Yes**		No		**Yes**		No		No		No	
Diabetes		**Yes**		**Yes**		No		**Yes**		No		**Yes**		No		No	
CHD risk		*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*
Age	70	2.0	3.0	2.0	3.6	2.1	3.8	2.4	4.4	2.5	4.6	2.9	5.3	3.1	5.6	3.7	6.7
	68	2.0	3.2	2.1	3.8	2.2	4.1	2.6	4.7	2.7	4.8	3.0	5.6	3.3	6.0	3.9	7.1
	66	2.0	3.4	2.2	4.0	2.4	4.3	2.7	5.0	2.8	5.2	3.2	5.9	3.5	6.3	4.1	7.6
	64	2.0	3.6	2.4	4.3	2.5	4.6	2.9	5.3	3.0	5.5	3.5	6.3	3.7	6.8	4.4	8.1
	62	2.1	3.8	2.5	4.6	2.7	4.9	3.1	5.6	3.2	5.9	3.7	6.7	3.9	7.2	4.7	8.6
	60	2.2	4.1	2.7	4.9	2.9	5.2	3.3	6.0	3.4	6.3	3.9	7.2	4.2	7.7	5.0	9.2
	58	2.4	4.4	2.9	5.3	3.1	5.6	3.5	6.5	3.7	6.7	4.2	7.7	4.5	8.3	5.4	9.9
	56	2.6	4.7	3.1	5.7	3.3	6.0	3.8	7.0	4.0	7.2	4.6	8.3	4.9	8.9	5.8	10.6
	54	2.8	5.1	3.3	6.1	3.6	6.5	4.1	7.5	4.3	7.8	4.9	9.0	5.2	9.6	6.3	-
	52	3.0	5.5	3.6	6.6	3.9	7.0	4.4	8.1	4.6	8.4	5.3	9.7	5.7	10.4	6.8	-
	50	3.3	6.0	3.9	7.1	4.2	7.6	4.8	8.8	5.0	9.1	5.7	10.5	6.1	-	7.3	-
	48	3.6	6.5	4.3	7.8	4.5	8.3	5.2	9.6	5.4	9.9	6.3	-	6.7	-	8.0	-
	46	3.9	7.1	4.6	8.5	5.0	9.1	5.7	10.4	5.9	10.8	6.8	-	7.3	-	8.7	-
	44	4.3	7.8	5.1	9.3	5.4	9.9	6.3	-	6.5	-	7.5	-	8.0	-	9.6	-
	42	4.7	8.6	5.6	10.2	6.0	10.9	6.9	-	7.2	-	8.2	-	8.8	-	10.5	-
	40	2.0	9.5	6.2	-	6.6	-	7.6	-	7.9	-	9.1	-	9.7	-		
	38	2.0	10.5	6.9	-	7.3	-	8.5	-	8.8	-	10.1	-	10.8	-		
	36	2.0	-	7.7	-	8.2	-	9.5	-	9.8	-						
	34	2.0	-	8.6	-	9.2	-	10.6	-								
	32	2.1	-	9.8	-	10.5	-										
	30	9.4	-														
	28	10.8	-														

Women	Total: HDL cholesterol ratio															
Hypertension		**Yes**		No		**Yes**		**Yes**		No		No		**Yes**		No	
Smoking		**Yes**		**Yes**		No		**Yes**		No		**Yes**		No		No	
Diabetes		**Yes**		**Yes**		**Yes**		No		**Yes**		No		No		No	
CHD risk		*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*	*15%*	*30%*
Age	70	2.3	4.1	2.7	4.9	3.3	6.1	3.8	7.0	4.0	7.2	4.6	8.3	5.6	10.2	6.7	-
	68	2.3	4.2	2.7	5.0	3.4	6.1	3.9	7.0	4.0	7.3	4.6	8.4	5.7	-	6.8	-
	66	2.3	4.2	2.8	5.1	3.4	6.2	3.9	7.1	4.1	7.4	4.7	8.5	5.7	-	6.9	-
	64	2.4	4.3	2.8	5.2	3.5	6.4	4.0	7.3	4.2	7.6	4.8	8.7	5.9	-	7.0	-
	62	2.4	4.4	2.9	5.3	3.6	6.5	4.1	7.5	4.3	7.8	4.9	9.0	6.0	-	7.2	-
	60	2.5	4.6	3.0	5.5	3.7	6.7	4.2	7.7	4.4	8.1	5.1	9.3	6.2	-	7.4	-
	58	2.6	4.8	3.1	5.7	3.8	7.0	4.4	8.0	4.6	8.4	5.3	9.6	6.5	-	7.8	-
	56	2.7	5.0	3.3	6.0	4.0	7.4	4.6	8.4	4.8	8.8	5.5	10.1	6.8	-	8.1	-
	54	2.9	5.3	3.5	6.3	4.3	7.8	4.9	8.9	5.1	9.3	5.8	-	7.2	-	8.6	-
	52	3.1	5.6	3.7	6.8	4.5	8.3	5.2	9.5	5.4	9.9	6.2	-	7.7	-	9.2	-
	50	3.3	6.1	4.0	7.3	4.9	9.0	5.6	-	5.9	-	6.7	-	8.3	-	9.9	-
	48	3.6	6.6	4.3	7.9	5.3	9.8	6.1	-	6.4	-	7.3	-	9.0	-		
	46	4.0	7.3	4.8	8.8	5.9	-	6.8	-	7.1	-	8.1	-	10.0	-		
	44	4.5	8.2	5.4	9.8	6.6	-	7.6	-	7.9	-	9.1	-				
	42	5.1	9.4	6.1	-	7.5	-	8.6	-	9.0	-	10.3	-				
	40	5.9	-	7.1	-	8.7	-	10.0	-								
	38	7.0	-	8.4	-												
	36	8.5	-	10.2	-												

Read before using table

- **Do not use for secondary prevention:** patients with MI, angina, PVD, non-haemorrhagic stroke, TIA, or diabetes with microvascular complications have high CHD risk. Treat mild hypertension: treat with aspirin; and treat with statin if serum cholesterol ≥ 5.0 mmol/l
- **Treat hypertension above mild range** (average ≥160 or ≥100)
- **Treat mild hypertension** (140-159 **or** 90-99) with **target organ damage** (LVH, proteinuria, renal impairment) or with **diabetes** (type 1 or 2)
- Consider drug treatment only **after** 6 months of appropriate advice on smoking, diet and repeated BP measurements
- Use **average** of repeated total:HDL-C measurements. If HDL-C not available, assume 1.2 mmol/l
- Those with total:HDL-C ratio ≥8.0 may have **familial hyperlipidaemia**
- The table **underestimates** CHD risk in
  - LVH on ECG (risk doubled - add 20 years to age)
  - family history of premature CHD (add 6 years)
  - familial hyperlipidaemia
  - British Asians

Instructions

- Choose table for men or women
- **Hypertension** means SBP ≥140 or DBP ≥90 or on antihypertensive treatment
- Identify correct column for hypertension, smoking, and diabetes
- Identify row showing age
- Read off total:HDL-C ratios at intersection of column and row. If there is an entry, **measure serum cholesterol:HDL ratio**. If no entry, lipids need not be measured unless familial hyperlipidaemia suspected
- If total:HDL-C ratio confers CHD risk of 15%, consider treatment of **mild hypertension** (SBP 140-159 or DBP 90-99) and with **aspirin**
- If total:HDL-C ratio confers CHD risk of 30%, consider **statin** if serum cholesterol ≥5.0 mmol/l
- Decisions on statin at CHD risk between 15%-30% depend on local policy
- The table can be used to assess CHD risk at an older age

Fig 1 New Sheffield table

Methods

Sheffield table

The Sheffield table was constructed by using the Framingham function[8] to compute TC:HDL ratios conferring coronary risks of 15% and 30% over 10 years from age, sex, smoking, diabetes, and systolic blood pressure. The upper limit for the TC:HDL ratio was set at three standard deviations above the population mean. As before, systolic blood pressure was dichotomised to 160 mm Hg for those with "hypertension" and 139 mm Hg for "no hypertension." The table and instructions (fig 1) are designed as a one page guide to screening, assessment of coronary risk, treatment with aspirin and statins, and treatment for mild hypertension according to current guidelines.[6 7]

Population data

The 1995 Scottish health survey is a cross sectional survey of a stratified random sample of the Scottish population aged 35-64 years.[16] From 4910 people screened we excluded those with no lipids measurement (946); requiring secondary prevention (339); with incomplete data (549); and taking lipid lowering drugs (19). From the 3057 people with complete data we studied a random sample of 1000 people representative of those aged 35-64 years in the Scottish population who might require primary prevention. Using age, sex, blood pressure, smoking habit, diabetes status, and TC:HDL ratio and assuming absence of left ventricular hypertrophy, we calculated coronary and cardiovascular risks for each individual using the Framingham function.

Risk assessment with table

Seven doctors who were blind to calculated risk estimates used the new table to carry out risk assessments. Each of the 1000 people had their coronary risk assessed by two different doctors; thus each doctor assessed two sevenths of the population sample. Each doctor was given the person's age, sex, blood pressure, smoking habit, diabetes status, and TC:HDL ratio and recorded three decisions: *(a)* was measurement of the TC:HDL ratio indicated? (*b*) was coronary risk ≥15% over 10 years? and *(c)* was coronary risk ≥30% over 10 years? There were seven errors in 6000 decisions (0.1%); error rates for all seven assessors were between 0% and 0.7%. These errors were reconciled for final decisions by the table.

Statistical analysis

Using Framingham estimates of coronary heart disease as the gold standard, we calculated the sensitivity, specificity, and predictive values with 95% confidence intervals for the table for coronary risks of 15% and 30% over 10 years. In the people with mild hypertension (systolic blood pressure 140-159 mm Hg) we examined the accuracy of coronary risk of 15% over 10 years for predicting cardiovascular risk of 20% over 10 years.

Results

Population

Of the 1000 people studied 56.2% (562) were women; 29.9% (299) smoked; and 1.6%[16] were diabetic. The mean age was 49 years; mean blood pressure was 132/75 mm Hg; mean cholesterol concentration was 6.0 mmol/l; mean high density lipoprotein cholesterol was 1.45 mmol/l; and the mean TC:HDL ratio was 4.5. Altogether, 21.7% (217) of people had mild hypertension, and 7.0% (70) had systolic blood pressure of ≥160 mm Hg. Mean 10 year coronary and cardiovascular risks according to the Framingham risk function were 7.2% and 10.4% respectively, and the 10 year coronary risk was ≥15% in 13.3% (133) of people and ≥30% in 2.2% (22).

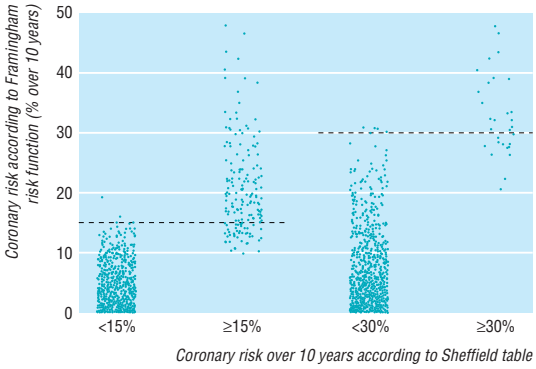

Fig 2 Accuracy of new Sheffield table for predicting risk of coronary heart disease of 15% over 10 years and 30% over 10 years in 1000 people assessed for primary prevention. For the 15% threshold, sensitivity was 97% and specificity 95%; for the 30% threshold, sensitivity was 82% and specificity 99%

Accuracy for coronary and cardiovascular risk thresholds

The Sheffield table had 97% sensitivity and 95% specificity for coronary risk of ≥15% over 10 years. The predictive value of a negative test was 99.5% and of a positive test 73%, with all those with false positive results having a coronary risk of 10.0-15.0% over 10 years (fig 2). For coronary risk of ≥30% over 10 years the sensitivity was 82% and the specificity 99% (table 1). False negative results were all only marginally above the 30% threshold, and those with false positive results all had coronary risk of ≥20% over 10 years (fig 2). In those with systolic blood pressure of 140-159 mm Hg, coronary risk of ≥15% over 10 years according to the table had 88% sensitivity and 90% specificity for predicting cardiovascular risk ≥20% over 10 years (table 1). Those classified incorrectly all lay close to the 20% threshold.

Table 1 Sensitivity, specificity, and positive and negative predictive values (95% confidence intervals) for new Sheffield table in predicting risk of coronary heart disease of 15% and 30% over 10 years in 1000 people, and risk of cardiovascular disease of 20% over 10 years in mild hypertension (systolic blood pressure 140-159 mm Hg)

	Risk over 10 years		
	Coronary risk ≥15%	Coronary risk ≥30%	Cardiovascular risk ≥20%*
No of subjects	1000	1000	217
Sensitivity	97 (94 to 100)	82 (66 to 98)	88 (79 to 96)
Specificity	95 (93 to 96)	99 (98 to 100)	90 (85 to 95)
Positive predictive value	73 (67 to 80)	60 (43 to 78)	76 (65 to 86)
Negative predicitive value	100 (99 to 100)	100 (99 to 100)	95 (92 to 99)

*In those with mild hypertension (systolic blood pressure 140-159 mm Hg).

Table 2 Proportion of 1000 people in whom measurement of ratio of total cholesterol to high density lipoprotein cholesterol (TC:HDL ratio) was indicated, according to new Sheffield table

TC:HDL ratio	Proportion	% Screened (95% confidence interval)
≥8.0	33/35	94 (87 to 100)
7.0-7.9	37/43	86 (76 to 96)
6.0-6.9	84/97	87 (80 to 93)
5.0-5.9	115/144	80 (73 to 86)
4.0-4.9	199/250	80 (75 to 85)
3.0-3.9	178/288	62 (56 to 67)
2.0-2.9	56/138	41 (32 to 49)
<2.0	1/5	20 (0 to 55)

Screening on basis of Sheffield table

According to this table, lipids would have been measured in 70% of this population (in 100% with coronary risk of ≥15%, in 97% with coronary risk of 5.0-14.9%, and in 46% with coronary risk <5% over 10 years). The proportion of people who would have been screened was higher in men than in women and increased with age (from 61% of men and 11% of women aged 35-44; to 100% of men and women aged 55-64 years) (fig 3). The proportion of people screened increased as the TC:HDL ratio increased (table 2). This reflects clustering of hyperlipidaemia with other risk factors and is not a specific function of the table. The screening rate in people with a TC:HDL ratio of ≥8.0 was high (94%), so that only two people above this level would not have been screened, unless a family history of hyperlipidaemia was suspected (see notes in figure 1).

Discussion

Accuracy of table

The table identified correctly 97% of those with a risk of coronary heart disease of ≥15% over 10 years; these people might require treatment with aspirin and (where resources permit) statins for primary prevention.[6] High risk people not identified were only marginally above the 15% threshold, and decisions that coronary risk was below 15% over 10 years were 99.5% correct. The table incorrectly identified for treatment 5% of people with coronary risk below 15% over 10 years, but all had coronary risks of 10-15%, which is a risk level at which statin treatment is safe.[17] No one with very low risk was identified for treatment.

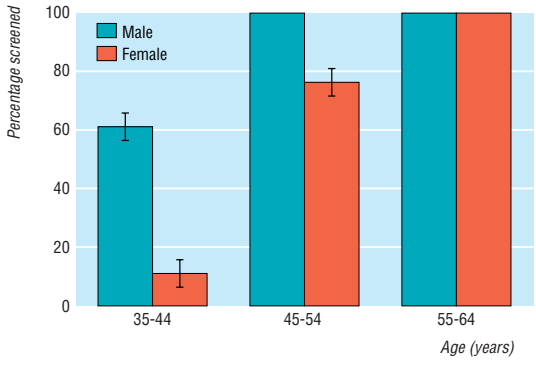

Fig 3 Pattern of lipids screening in population, according to age and sex, if new Sheffield table had been used for decisions on screening (error bars are 95% confidence intervals)

Current guidelines recommend that, because of resource constraints, statin treatment should be given as a priority to people whose coronary risk is ≥30% over 10 years.[6 7 18] The table identified correctly 82% of those at such a risk, with those not identified for treatment only marginally above the threshold. One per cent of the population were identified incorrectly as having coronary risk ≥30% over 10 years, but all of these had a risk of 20-30%. Coronary risk increases with age, and the table can be used to look forward in time. Analyses of sensitivity and specificity ignore this and underestimate the information provided by the table.

Dichotomising blood pressure

Most Framingham based risk methods offer a wide range of blood pressures[3–12] and seem more accurate than this table, but our results indicate that little accuracy is sacrificed by dichotomising blood pressure, even when uncontrolled hypertension is ignored. The table is designed for use only after the control of moderate to severe hypertension, with assessment for aspirin and statins postponed until this is achieved. False negatives would not have occurred had it been used in this way. The apparent accuracy for blood pressure offered by other methods is misleading. In people whose hypertension has been treated, pretreatment blood pressure overestimates long term risk,[19] whereas blood pressure taken while a person is taking treatment underestimates the risk because the risk remains higher than is predicted during treatment.[19 20] The Sheffield table assumes that coronary risk assessment is done after hypertension has been controlled, and it approximates the persistently increased coronary risk in people receiving treatment by using systolic blood pressure 160 mm Hg for risk calculation.

Treatment decisions for uncomplicated mild hypertension are best guided by risk assessment,[3 4] but it is counterintuitive to target coronary rather than cardiovascular risk because antihypertensive treatment causes larger reductions in stroke (38%) than in coronary heart disease (16%).[19] However, the 15% coronary risk threshold predicted cardiovascular risk of ≥20% over 10 years in people with mild hypertension, with 88% sensitivity and 90% specificity.

Use of table as screening tool

In the United Kingdom selective lipids measurement in those at high risk has been preferred to population screening, but this may need reappraisal, given new evidence for the statins. The Sheffield table identified for screening everyone with a coronary risk of ≥15% over 10 years without the need for general screening. Everyone aged ≥55 years, and almost everyone aged 45-54, needed screening. Savings from selective screening will be attained only in younger people. At age 35-44 years, 65% of people (39% of men, 89% of women) need not be screened, and few people aged under 35 would be screened. Selective screening may miss some people with extremely high lipid concentrations resulting from familial hyperlipidaemia; the Sheffield table, however, detected most people with severe hyperlipidaemia because screening aimed at those with high coronary risk coincidentally also reaches those with high lipid concentrations. Among 1000

What is already known on this topic

New guidelines for prescribing of statins, aspirin, and treatment of mild hypertension for primary prevention recommend targeting treatment according to absolute risk of coronary heart disease

Doctors need simple but accurate methods for estimating such risk

What this study adds

A new Sheffield table has been developed to identify the coronary risk thresholds in current guidelines

In a random sample of the population aged 35-64 years without atherosclerotic disease, estimates of coronary risk by this table were accurate when compared with coronary risk calculated using the Framingham risk function

The sensitivity and specificity values were high for coronary risk of ≥15% over 10 years, coronary risk of ≥30% over 10 years, and cardiovascular risk of ≥20% over 10 years in mild hypertension

people, only two with a ratio of total cholesterol to high density lipoprotein cholesterol of ≥8.0 were missed; they had ratios of 12.4 and 12.6 and would generally be treated with a statin if detected. Unless diagnosed through their family history, detection would require additional routine screening of 297 people not otherwise screened, including 65% of people aged 35-44 years. The value of detecting these relatively uncommon individuals needs to be weighed against the additional cost, resources, and harm from "labelling" (when "well" people become "patients") as a result of general screening.

Targeting treatment at absolute risk

Compared with decisions based on blood pressure or lipids thresholds alone, methods that entail simple counting of risk factors[21–23] improve the accuracy of risk assessment significantly[9] yet still identify for treatment some people at very low risk[15] who may be harmed by treatment with, for example, aspirin, while failing to treat some with exceptionally high risk. Framingham based methods are a step towards ensuring that those at high risk get treatment and those at low risk are not endangered. The Framingham estimates of coronary risk seem acceptably accurate for the British population,[24] but additional risk factors, such as left ventricular hypertrophy, family history, familial hyperlipidaemia, and ethnic status, influence coronary risk (see notes in figure 1). Framingham based methods should therefore guide but not dictate treatment decisions. The Sheffield table identifies those who definitely should be offered treatments, but it should not be used to deny treatment to people close to treatment thresholds.

Numerous Framingham based risk assessment methods are available.[3 6 10–14] Computer based methods[6 12] provide absolute coronary risks accurately, and also relative risk, stroke risk, and the effects of interventions.[12] However, doctors need to identify and manage about 13% of adults for primary prevention, plus 5% for secondary prevention,[1] and this level of sophistication may not be necessary or even helpful. Among paper based methods, those based on the ratio of total cholesterol to high density lipoprotein cholesterol[3 6] are more accurate than those based on total cholesterol concentration alone.[10 13 14] Methods for assessing coronary risk[6] rather than cardiovascular risk[3] are better suited to British and European guidelines, which target coronary risk thresholds.[6 10] The chart produced jointly by British societies[6] and the Sheffield table described here are similar in principle and policy. The British societies' chart offers one additional coronary risk level (20% over 10 years) and apparent accuracy for blood pressure, but lower accuracy for the ratio of total cholesterol to high density lipoprotein cholesterol and for age. The Sheffield table is more compact and is designed as a one page guideline in addition to its risk assessment function. It is unique among paper based methods in offering an explicit screening function that allows doctors to adopt an accurate selective policy for lipids screening.

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Contributors: All authors contributed to the design of the study, development of the table, risk assessments, writing of the manuscript, and approval of the final version. IUH generated the Sheffield table from the Framingham equation. EJW coordinated development of the format of the table. IUH and EJW prepared the population data. KRY prepared study materials and coordinated the risk assessments. PG and PRJ performed the statistical analysis. LER designed the study, drafted the manuscript, and will act as guarantor for the study.

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Using the Framingham model to predict heart disease in the United Kingdom: retrospective study

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Editorial by Jackson

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Guidelines on the use of drugs to lower serum concentrations of lipids to prevent coronary heart disease target treatment to patients who have a high absolute risk of the disease. Although a patient's absolute risk of heart disease can be derived using risk tables[1]—for example, the Sheffield table—these are based on the Framingham model which may not be applicable to the population in the United Kingdom.[2] We aimed to determine whether the Framingham model accurately predicts the risk of coronary heart disease among white men and women in the United Kingdom.

Participants, methods, and results

A cross section of the population of Whickham, north east England, was enrolled in a study of ischaemic heart disease between 1972 and 1974 and followed up 20 years later.[3] At baseline, data was collected on body mass index, family history of coronary heart disease, fasting glucose concentrations, and triglyceride concentrations. Standardised WHO questionnaires on chest pain were administered, and the information necessary to complete the Framingham model (age, sex, systolic blood pressure, ratio of total cholesterol to high density lipoprotein cholesterol, presence of left ventricular hypertrophy, presence of diabetes, and smoking habits[4]) was also collected, with the exception of concentrations of high density lipoprotein cholesterol for which values of 1.15 mmol/l were used for men and 1.4 mmol/l for women.[1]

Altogether, 77 (2.8%) of the 2779 adults initially enrolled were lost to follow up. Of the remaining 2702, a total of 1877 were still alive at follow up, of whom 1802 (96%) participated. A total of 927 participants were excluded from the analysis for one or more of the following reasons: if they had had heart disease at baseline (172), were aged younger than 30 or older than 75 (702) years, or if they had previously been smokers (371); those who had previously been smokers were excluded because the length of time since quitting was unknown.

Evidence of heart disease occurring in those who had died was identified using death certificates, records from postmortem examinations, hospital notes, or the general practitioner's notes. Coronary morbidity was determined in participants by identifying a history of myocardial infarction or angina, evaluating answers to the WHO questionnaire, and by examining the results of repeat electrocardiography which were classed according to the Minnesota Code. The predicted 20 year risk of heart disease was calculated for each participant using baseline measurements and the Framingham model. Participants were ranked in groups according to predicted risk (for example, 0-4.99%, 5-9.99%, etc), and the percentage of participants in each group who actually had had an event during follow up was determined. Differences between patients with and without heart disease and the goodness of fit between actual and predicted coronary events were tested using the Student's t test and χ^2 analysis.

Of the 1700 participants remaining, 529 (31.1%) had developed heart disease. A higher proportion of men than women had developed heart disease (257/751 (34.3%) men v 272/949 (28.7%) women; $P = 0.015$), as had a higher proportion of smokers than non-smokers (344/1017 (33.8%) v 185/683 (27.1%); $P = 0.003$); and 8 (57%) of 14 participants with diabetes had developed heart disease. Those participants who had developed heart disease were older (mean age 54.7 years v 48.1 years, $P < .0001$), had higher serum cholesterol concentrations (6.32 mmol/l v 6.05 mmol/l, $P < .0001$), and higher systolic blood pressure (151.2 mm Hg v 138.9 mm Hg, $P < 0.0001$). In terms of the Framingham risk score, those who had developed heart disease had a mean 20 year risk of 30.5% (95% confidence interval 29.2% to 31.8%) compared with those who did not (20 year risk 20.5%, 19.7% to 21.4%;