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Funding: The Welsh Office for Research and Development provided £22 000 ($34 206; €34,854) towards the study. It had no role in the conduct of the study, interpretation of the results, or the decision to send the study for publication.

Competing interests: None declared.

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(Accepted 5 September 2002)

Application of Framingham risk estimates to ethnic minorities in United Kingdom and implications for primary prevention of heart disease in general practice: cross sectional population based study

ELPS

This is an abridged version; the full version is on bmj.com

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Abstract

Objective To compare the 10 year risk of coronary heart disease (CHD), stroke, and combined cardiovascular disease (CVD) estimated from the Framingham equations.

Design Population based cross sectional survey.

Setting Nine general practices in south London.

Population 1386 men and women, age 40-59 years, with no history of CVD (475 white people, 447 south Asian people, and 464 people of African origin), and a subgroup of 1069 without known diabetes, left ventricular hypertrophy, peripheral vascular disease, renal impairment, or target organ damage.

Main outcome measures 10 year risk estimates.

Results People of African origin had the lowest 10 year risk estimate of CHD adjusted for age and sex (7.0%, 95% confidence interval 6.5 to 7.5) compared with white people (8.8%, 8.2 to 9.5) and south Asians (9.2%, 8.6 to 9.9) and the highest estimated risk of stroke (1.7% (1.5 to 1.9), 1.4% (1.3 to 1.6), 1.6% (1.5 to 1.8), respectively). The estimate risk of combined CVD, however, was highest in south Asians (12.5%, 11.6 to 13.4) compared with white people (11.9%, 11.0 to 12.7) and people of African origin (10.5%, 9.7 to 11.2). In the subgroup of 1069, the probability that a risk of CHD ≥15% would identify risk of combined CVD ≥20% was 91% in white people and 81% in both south Asians and people of African origin. The use of thresholds for risk of CHD of 12% in south Asians and 10% in people of African origin would increase the probability of identifying those at risk to 100% and 97%, respectively.

Conclusion Primary care doctors should use a lower threshold of CHD risk when treating mild uncomplicated hypertension in people of African or south Asian origin.

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BMJ 2002;325:1271–4

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Introduction

The prevention of coronary heart disease (CHD) and cardiovascular disease (CVD) now relies on the reduction of the overall absolute risk of disease rather than management of individual risk factors.[1] British hypertension guidelines suggest that people with moderate blood pressure (140-159/90-99 mm Hg) but no target organ damage, cardiovascular complications, or diabetes should be treated if their 10 year risk of CHD (myocardial infarction, death from other CHD, angina, and coronary insufficiency) is ⩾15%.[2] This assumes that the risk of combined CVD (risk of CHD plus stroke, transient ischaemic attack, congestive cardiac failure, and peripheral vascular disease) may be obtained by multiplying the estimated 10 year risk of CHD by 4/3 (for example, 15% risk of CHD=20% risk of CVD).[3] The risk estimation is based on the 10 year prospective experience of the Framingham cohort: white middle class men and women aged 30-74 years living in semiurban Massachusetts. Compared with white people, people of African origin have less CHD but more hypertension, diabetes, strokes, and renal failure, and south Asians have more hypertension, diabetes, central obesity, and CHD.[4 5]

The estimate of risk with the Framingham equation may not accurately estimate the risk of vascular disease in some ethnic minorities.[2 3 6] In addition, the equivalence between the risk of CHD and the risk of CVD may not apply.

We compared the estimated risks of CHD, stroke, and combined CVD in a general practice sample of white people, south Asians, and people of African origin from south London and looked at the implications of using these risk estimates.

Methods

Between March 1994 and July 1996 we recruited men and women aged 40-59 years from nine general practices in Wandsworth, south London, where about a quarter of the residents are from ethnic minorities.[5 7] The overall response rate to invitations was 64%.[7] Ethnic group was recorded at the time of interview on the basis of answers to a combination of questions including place and country of birth, language, religion, history of migration, and parents' country of birth.[5 7] Measurement of cardiovascular risk factors has been described elsewhere[5 7] (see also bmj.com). We included 1069 participants (404 white people, 342 south Asian, and 323 of African origin).

The detailed statistical methods used can be found with the full version of this paper (see bmj.com). We used published equations for predicting the incident risk of CHD, stroke, and combined CVD from the Framingham study to calculate each participant's 10 year risk of a first event, fatal or not fatal (see bmj.com).[8]

The independent variables included in the equation were age, sex, systolic blood pressure, total:high density lipoprotein cholesterol, smoking, and diabetes. Blood pressure was considered irrespective of whether or not participants were on antihypertensive treatment.[9]

The sensitivity of the estimated risk of CHD to predict the risk of CVD in people with no cardiovascular complications was calculated in each ethnic group and for different thresholds of risk of CHD.[10] The population attributable risk for high blood pressure was estimated by assuming that treatment would result in a systolic blood pressure <140 mm Hg. We calculated the average reduction in risk for all participants in each ethnic group.[10] This is a conservative estimate of the number of cardiovascular events (per 1000 population per year) that would be prevented if all participants with a systolic blood pressure above target were successfully treated and their blood pressure was reduced to <140 mm Hg because in some patients systolic blood pressure would be reduced to lower than 139 mm Hg.

Table 1 Age adjusted means (95% confidence interval) of variables used in Framingham equation to estimate 10 year risk of coronary heart disease, stroke, and combined cardiovascular disease

Variables	White	South Asian	African origin
Men			
No of men	215	227	184
Age (years)*	50.4 (49.6 to 51.1)	49.2 (48.4 to 49.9)	51.6 (50.8 to 52.4)
Systolic blood pressure (mm Hg)	127 (125 to 130)	131 (128 to 133)	133 (130 to 136)
Diastolic blood pressure (mm Hg)	82 (80 to 83)	86 (84 to 87)	87 (86 to 89)
Total cholesterol (mmol/l)	6.2 (6.1 to 6.4)	5.7 (5.6 to 5.9)	5.4 (5.3 to 5.6)
HDL cholesterol (mmol/l)†	1.22 (1.18 to 1.26)	1.05 (1.02 to 1.09)	1.30 (1.26 to 1.35)
Total:HDL cholesterol†	5.0 (4.8 to 5.2)	5.3 (5.1 to 5.5)	4.1 (3.9 to 4.3)
Current smoking (%)	40 (33 to 46)	26 (20 to 32)	18 (12 to 24)
Diabetes by WHO (%)	6 (2 to 9)	24 (18 to 30)	16 (10 to 22)
Diabetes by ADA (%)	3 (1 to 5)	20 (15 to 25)	16 (10 to 21)
Women			
No of women	260	220	280
Age (years)*	49.1 (48.4 to 49.8)	48.7 (47.9 to 49.4)	50.2 (49.5 to 50.8)
Systolic blood pressure (mm Hg)	124 (121 to 126)	128 (126 to 130)	133 (131 to 136)
Diastolic blood pressure (mm Hg)	77 (76 to 78)	80 (79 to 81)	85 (84 to 86)
Total cholesterol (mmol/l)	6.2 (6.1 to 6.4)	5.7 (5.6 to 5.8)	5.7 (5.6 to 5.8)
HDL cholesterol (mmol/l)†	1.47 (1.42 to 1.52)	1.28 (1.23 to 1.32)	1.54 (1.50 to 1.59)
Total:HDL cholesterol†	4.2 (4.0 to 4.3)	4.4 (4.2 to 4.5)	3.6 (3.5 to 3.7)
Current smoking (%)	33 (27 to 39)	3 (1 to 5)	8 (5 to 12)
Diabetes by WHO (%)	5 (2 to 8)	18 (13 to 24)	13 (8 to 17)
Diabetes by ADA (%)	3 (1 to 6)	12 (8 to 16)	9 (5 to 12)

HDL=high density lipoprotein; WHO=World Health Organization; ADA=American Diabetes Association. *Not adjusted. †Geometric means.

Table 2 Age and sex adjusted 10 year risk* of coronary heart disease (CHD), stroke, and cardiovascular disease (CVD) in each ethnic group as estimated by Framingham equations. Figures are means (95% confidence interval)

	White (n=475)	South Asian (n=447)	African origin (n=464)	P value†
CHD‡	8.8 (8.2 to 9.5)	9.2 (8.6 to 9.9)	7.0 (6.5 to 7.5)	<0.001
Stroke	1.4 (1.3 to 1.6)	1.6 (1.5 to 1.8)	1.7 (1.5 to 1.9)	0.036
CVD§	11.9 (11.0 to 12.7)	12.5 (11.6 to 13.4)	10.5 (9.7 to 11.2)	0.003

*Equivalent to incidence rate per 1000 per year.
†For heterogeneity.
‡Includes myocardial infarction, CHD death, angina, and coronary insufficiency.
§Includes CHD plus stroke, transient ischaemic attack, congestive cardiac failure, and peripheral vascular disease.

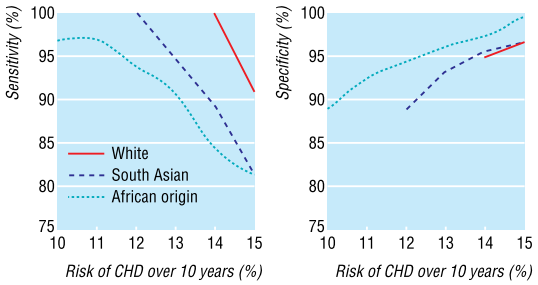
Results

People of African origin had higher blood pressure and higher concentrations of high density lipoprotein cholesterol compared with the other ethnic groups (table 1). Diabetes was more common among ethnic minority groups, and smoking was more common among white people.

The estimated 10 year risk of CHD adjusted for age and sex, varied significantly by ethnic group (table 2). South Asians had the greatest risk of CHD and combined CVD, whereas people of African origin had the lowest. However, people of African origin had the highest risk of stroke.

Estimates for risk of CHD and CVD showed a high degree of correlation in each ethnic group (r=0.97, 0.96, 0.96 in white people, south Asians, and people of African origin, respectively). However, the slope of the regression line of risk of CVD against risk of CHD was steeper in people of African origin and south Asians than in white people (see bmj.com). This indicates that for a given 10 year risk of CHD the estimated risk of combined CVD is higher in people of African and south Asian origin than in white people.

After we excluded those with known diabetes, left ventricular hypertrophy, peripheral vascular disease, renal impairment, and other organ damage, the probability of having a risk of CVD ≥20% if the risk of CHD is ≥15% (that is, sensitivity) was higher in white people (50/55 (91%)) than in south Asians (30/37 (81%)) and people of African origin (26/32 (81%)). However, a risk of CHD ≥12% would identify 100% of south Asians, and a risk of CHD ≥10% would identify 97% of people of African origin with a risk of CVD ≥20% (figure). If these new thresholds were used, about 8% of south Asians and 11% of people of African origin with mild hypertension whose risk of CVD was <20% would also receive treatment.



Sensitivity and specificity of thresholds for 10 year risk of CHD to identify 10 year risk of CVD ≥20% in each ethnic group after exclusion of people with known diabetes, left ventricular hypertrophy, peripheral vascular disease, renal impairment, or other clinical target organ damage

The proportion of participants with blood pressure above the National Service Framework target of 140/85 mm Hg[11] was highest among people of African origin (274/464 (59%, 55% to 64%)), intermediate in south Asians (193/447 (43%, 39% to 48%)), and lowest in whites (155/475 (33%, 28% to 37%)), even though the group of people of African origin had the highest proportion of treated individuals (30% *v* 12% south Asians and 8% white people).

The population risks for CHD, stroke, and CVD attributable to systolic blood pressure above target were higher in people of African origin—and to a lesser extent in south Asians—than in white people. For CVD they were 1.11 (0.88 to 1.34), 0.92 (0.68 to 1.15), and 0.67 (0.49 to 0.85) per 1000 population per year, respectively. These differences suggest that adequate treatment of high blood pressure might prevent a proportionally greater number of cardiovascular events in people of African origin and in south Asians than in white people.

Discussion

This is the first study based in general practice to show that the use of risk of CHD in south Asians and people of African origin underestimates their risk of CVD. Our results imply that we should be using different thresholds—for example, 12% and 10%, respectively—to manage the same overall vascular risk. The associations between risks of CHD and CVD are different between groups so that the use of an estimate of risk of CHD ≥15% in primary care may result in undertreatment of mild hypertension in south Asians and in people of African origin with a risk of CVD of ≥20%. Although more people of African origin were receiving treatment, they also had the highest prevalence of blood pressure above target. Therefore, in people of African origin the population risk attributable to blood pressure above target was higher and the potential benefits of adequate management greater.

Strengths and weaknesses

Our participants were from a community population and were being cared for in primary care. Our results are relevant to general practice, where most primary prevention of CHD and management of people with hypertension takes place. All measurements of risk factors were done according to a strict protocol.[5 7] Finally the fact that the study was population based avoided the "healthy worker" effect.

The application of risk equations to ethnic groups is based on the assumption that the effect of each risk factor is constant across groups as prospective data on British ethnic minority cohorts are lacking. The differences in estimated risks therefore depend on the level

What is known on this topic

The Framingham equations predict risk of CHD and CVD with reasonable accuracy in white people

These equations have not been validated in the United Kingdom in ethnic minorities

Compared with white people, those of African origin have less CHD but more hypertension, diabetes, strokes, and renal failure; and south Asians have more CHD, hypertension, diabetes, and central obesity

What this study adds

Current CHD risk thresholds underestimate the risk of CVD in people of south Asian and African origin

Use of a 10 year risk of CHD ≥15% to decide how to manage people with mild uncomplicated hypertension would identify for treatment 91% of white people with a 10 year risk of combined CVD ≥20% but only 81% of south Asians and people of African origin

If general practitioners used a lower threshold for risk of CHD (for example, 12% and 10%) in south Asian and African people with mild hypertension, they would have a higher probability of identifying and treating those with a risk of CVD ≥20%

Risk of CVD would be an even better measurement

or prevalence of the risk factor. This seems realistic as we have no evidence to suggest that management of risk factors may have differential benefit according to ethnic origin. The study was relatively small and may lack statistical power, particularly where estimates of risk are small, as in stroke. Furthermore, the analysis was restricted to men and women aged 40-59 years, and results may therefore apply only to this age group. We did not take into account family history of premature CHD,[6] and we considered blood pressure irrespective of treatment. All these factors will tend to underestimate our calculations of risk. We recorded blood pressure as the average of two measurements taken on a single occasion. National guidelines recommend that blood pressure is considered after repeated measurements.[2 3] This may have led to overestimates. However, if this effect was evenly distributed across measurements it should not have biased our results in either direction. General practitioners should use lower risk thresholds for CHD when they are treating hypertension in patients from ethnic minorities.

We thank general practitioners in Wandsworth for allowing us to approach people on their lists and the people who took part in the study. A list of the Wandsworth Heart and Stroke Study Group is given elsewhere.[7] We thank Derek Cook for his useful comments to the manuscript. FPC is a member of the St George's Cardiovascular Research Group.

Contributors: See bmj.com

Funding: Former Wandsworth Health Authority, South Thames Regional Health Authority, NHS research and development directorate, British Heart Foundation, British Diabetic Association, and Stroke Association.

Competing interests: None declared.

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(Accepted 2 September 2002)

One hundred years ago

The Army Medical Service as a career

In our advertisement columns this week there will be found an announcement which must be looked upon as, in Carlyle's phrase, "significant of much." The Director-General of the Army Medical Service makes known to all whom it may concern that thirty commissions in the Royal Army Medical Corps are offered for competition to men possessing the necessary qualifications. It is a considerable time now since such an advertisement has been issued. In spite of the transformation of the Department into a Royal Corps, and the concession of real rank and corresponding military titles, the service had become so unpopular with the rising generation of the medical profession that the supply of candidates practically ceased. The causes of this unpopularity are too well known to readers of the BRITISH MEDICAL JOURNAL to need recapitulation. In the alienation of the medical profession from the service the War Office has only reaped what it had sown. And when wiser counsels began to prevail there came a "blind Fury" of hysterical denunciation and calumny which slit the thin-spun thread that already gave promise of drawing the profession and the army once more together. The charges were shown to be grossly exaggerated, and it was proved that the responsibility for such breakdown in the medical arrangements as did occur could not justly be laid on the shoulders of the Royal Army Medical Corps. But as Voltaire cynically said, "If dirt enough is thrown some of it will stick," and it is not surprising that self-respecting men should not care to expose themselves to the eruption of "mud volcanoes" of slander. (*BMJ* 1902;i:1223)