Heterogeneity of coronary heart disease risk factors in Indian, Pakistani, Bangladeshi, and European origin populations: cross sectional study

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Abstract

Objective To compare coronary risk factors and disease prevalence among Indians, Pakistanis, and Bangladeshis, and in all South Asians (these three groups together) with Europeans.
Design Cross sectional survey.
Setting Newcastle upon Tyne.
Participants 259 Indian, 305 Pakistani, 120 Bangladeshi, and 825 European men and women aged 25-74 years.
Main outcome measures Social and economic circumstances, lifestyle, self reported symptoms and diseases, blood pressure, electrocardiogram, and anthropometric, haematological, and biochemical measurements.
Results There were differences in social and economic circumstances, lifestyles, anthropometric measures and disease both between Indians, Pakistanis, and Bangladeshis and between all South Asians and Europeans. Bangladeshis and Pakistanis were the poorest groups. For most risk factors, the Bangladeshis (particularly men) fared the worst: smoking was most common (57%) in that group, and Bangladeshis had the highest concentrations of triglycerides (2.04 mmol/l) and fasting blood glucose (6.6 mmol/l) and the lowest concentration of high density lipoprotein cholesterol (0.97 mmol/l). Blood pressure, however, was lowest in Bangladeshis. Bangladeshis were the shortest (men 164 cm tall *v* 170 cm for Indians and 174 cm for Europeans). A higher proportion of Pakistani and Bangladeshi men had diabetes (22.4% and 26.6% respectively) than Indians (15.2%). Comparisons of all South Asians with Europeans hid some important differences, but South Asians were still disadvantaged in a wide range of risk factors. Findings in women were similar.
Conclusion Risk of coronary heart disease is not uniform among South Asians, and there are important differences between Indians, Pakistanis, and Bangladeshis for many coronary risk factors. The belief that, except for insulin resistance, South Asians have lower levels of coronary risk factors than Europeans is incorrect, and may have arisen from combining ethnic subgroups and examining a narrow range of factors.

Introduction

Coronary heart disease is apparently commoner in South Asians in Britain than in the general population[1] despite lower levels of several classic coronary risk factors.[2 3] Insulin resistance is proposed to be the underlying factor in high rates of coronary heart disease among South Asians worldwide and has been related to lack of exercise and obesity. Bhopal, and Shaukat and de Bono, however, emphasised a wide range of risk factors including smoking and poverty.[4 5] Williams et al concluded that South Asians had a higher prevalence of a broad range of non-biochemical risk factors than the general population.[6] Nazroo showed that the prevalence of self reported coronary heart disease was higher in Bangladeshis and Pakistanis combined, and lower in Indians, than in the white population after standard of living was adjusted for.[7] The Newcastle heart project compared coronary heart disease risk factors in Indians, Pakistanis, and Bangladeshis and also compared South Asians as a whole with Europeans.[8 9]

Participants and methods

The methods and some data on the European study have been published,[8 9] and more detail is available on the *BMJ*'s website. South Asians are defined as Newcastle residents with ancestral origins in India, Pakistan, or Bangladesh and who had three or more grandparents born there. Indians, Pakistanis, and Bangladeshis self identified as such at interview, using 1991 census categories of ethnic group. Europeans are defined as Newcastle residents with ancestral origins in European countries and were identified by excluding people from ethnic minority populations. In referring to published work we generally use the authors' terms (white, general population, etc).

Sample

We selected European subjects from the 6448 people identified from the family health services authority

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register for the Newcastle health and lifestyle survey (NHLS).[8 9] People with South Asian sounding names were selected from the full register.[10] The age group studied was 25-74 years. The sampling frame was divided into 10 year age and sex strata, and equal numbers from each stratum randomly selected. Europeans were screened between April 1993 and October 1994 and South Asians between May 1995 and March 1997.

Biochemical measurements

Participants not requiring insulin fasted from 2200 the night before attending a clinic at Royal Victoria Infirmary, Newcastle. Venous blood was taken for the measurement of lipids (including Lp(a) lipoprotein), insulin, and glucose. Subjects not reporting a diagnosis of diabetes took a standard World Health Organisation oral glucose tolerance test and glucose tolerance was based on the 2 hour result, as previously described.[9] Insulin was measured using an enzyme linked immunosorbent assay (DAKO Diagnostics, Ely).

Anthropometric measurements, blood pressure, pulse, and electrocardiography

Height, weight, waist and hip circumference, and blood pressure were measured as previously described for the European subjects.[8 9] We used established criteria to define risk factors for coronary heart disease.[11 12] Participants with a carbon monoxide concentration >8 ppm on the Bedfast Smokerlyzer carbon monoxide monitor[13] and who did not admit to smoking were counted as carbon monoxide adjusted smokers. A 12 lead resting electrocardiogram was recorded and Minnesota coded by two independent coders.[8]

Questionnaire

Participants completed a questionnaire including questions on state of health, health behaviour, and socioeconomic circumstances. Europeans self completed the questionnaire. The questionnaire was translated into four South Asian languages then independently retranslated into English, with translators and researchers conferring and agreeing on equivalence of meaning. South Asian interviewers completed the questionnaire in the participants' homes and preferred languages. The Rose chest pain questionnaire was interpreted as recommended.[14]

Analysis of data

We analysed data using SPSS/PC+ version 6. Direct age standardisation was to the 1991 England and Wales population. Differences between Europeans and South Asians for continuous variables were assessed by independent samples *t* tests, and differences between Indians, Pakistanis and Bangladeshis by analysis of variance. Income data, for men only, were adjusted for household composition using the formula: income/(1 + 0.7 x adults + 0.5 x children).[15] As triglycerides, Lp(a) lipoprotein, and insulin had skewed distributions log transformations were used in analysis and geometric means are presented. For categorical variables, age adjusted variances were calculated.

Ethics

Newcastle upon Tyne joint ethics committee approved the study. Informed consent was obtained from participants. If participants did not consent to three venepunctures, our priority was baseline and then 2 hour samples. For example, 20 Indian, 26 Pakistani, and 22 Bangladeshi women did not consent to a 2 hour sample.

Results

Of 2160 people with South Asian sounding names, 1050 people were eligible and contacted; 288 refused and 53 completed only the interview, leaving 709 (67.5% of 1050). Of these, 684 classified themselves as Indian, Pakistani, or Bangladeshi. Of 1744 people sampled from the Newcastle health and lifestyle survey, 1308 were contacted and 840 were screened (64.2%). Fourteen were South Asian and one of African origin, leaving 825 Europeans.

Population characteristics

Table 1 shows Bangladeshi men were the youngest group and the most recent immigrants (data on *BMJ*'s website). Indians were most, and Bangladeshis least, educated. Indians were most likely to be in social classes I, II and IIIN (70%) and Bangladeshis least (26%). Europeans and Indians had the highest median income and Bangladeshis the lowest. Table 2 shows similar findings in women.

Lifestyle

Table 3 shows the highest prevalence of smoking was in Bangladeshi men. Pakistanis and Indians were most likely to eat fruit or vegetables daily. Few Pakistanis and Bangladeshis drank alcohol; most Indians did. Indians were the most physically active South Asians, Bangladeshis the least. Large differences existed between Europeans and South Asians except in smoking.

Few Indian, Pakistani, or Bangladeshi women smoked or drank alcohol (table 3). Daily consumption of fruit or vegetables was commoner in Indians than in

Table 1 Background, social, and economic characteristics of men in study. Values are numbers (percentages) and denominators within 10 of n unless stated otherwise

	Indian (n=105)	Pakistani (n=156)	Bangladeshi (n=64)	All South Asian (n=325)	European (n=425)
Mean (SD) age (years)	50.73 (13.2)	52.21 (12.9)	47.69 (13.1)	50.84 (13.1)	54.17 (13.1)
Birth place:					
Indian subcontinent	84 (80)	146 (94)	64 (100)	294 (90)	—
United Kingdom	12 (11)	8 (5)	—	20 (6)	—
Other	9 (9)	2 (1)	—	11 (3)	—
Year moved to UK (n=297)*:					
Before 1962	34 (42)	63 (44)	14 (23)	115 (39)	—
1962-75	37 (41)	59 (41)	34 (55)	130 (44)	—
After 1975	16 (18)	22 (15)	14 (23)	52 (18)	—
Education (n=414, European):					
None	4 (4)	14 (9)	6 (9)	24 (7)	2 (0.5)
Primary	9 (9)	25 (16)	13 (20)	47 (15)	79 (19)
Secondary	31 (30)	54 (35)	33 (52)	118 (36)	248 (59)
Further education	22 (21)	37 (24)	7 (11)	66 (20)	26 (6)
Higher	37 (35)	24 (15)	5 (8)	66 (20)	47 (12)
Social class (n=311, S Asian; 388 European):					
I, II, or IIIN	70 (70)	71 (48)	16 (26)	157 (51)	144 (43)
IIIM, IV, or V	30 (30)	78 (52)	46 (74)	154 (50)	194 (57)
Median (interquartile range) income (£000s) (n=307, S Asian; 391, European)	5.1 (3.0-10.8)	3.4 (2.2-4.4)	2.3 (1.6-3.4)	3.4 (2.2-5.5)	5.5 (3.8-8.0)

*From subset of 305.

Bangladeshis and Europeans. Bangladeshis were the least, and the Indians the most, physically active South Asians. The differences between Europeans and South Asians were large.

Prevalence of clinical problems

Table 4 shows non-significant variation in diabetes between the three male South Asian groups, which collectively had a five times higher prevalence of diabetes than Europeans. There were important differences between the three South Asian groups in total cholesterol:high density lipoprotein cholesterol ratio and triglyceride concentration. South Asians had lower high density lipoprotein cholesterol concentration, higher total cholesterol:high density lipoprotein cholesterol ratio and higher triglyceride concentrations than Europeans.

Obesity was commoner in Pakistanis and Indians than in Bangladeshis. Differences in central obesity between South Asian groups were small. Waist:hip ratios of ⩾0.95 were commoner in South Asians than Europeans. Differences in hypertension between Indians, Pakistanis and Bangladeshis were not significant, but hypertension was least common in Bangladeshis and less common in South Asians than Europeans.

Prevalence of Rose angina was similar among the South Asian groups and between them and Europeans. Possible myocardial infarction was higher (not significant) in Bangladeshis than Indians or Pakistanis. Evidence of coronary heart disease on electrocardiography was similar among the three South Asian groups, which combined had more probable heart disease than Europeans.

A higher propertion of Indian women had diabetes than Pakistanis and Bangladeshis (not significant). Diabetes was four to five times commoner in South Asians than in Europeans (table 5). Among South Asians, Bangladeshis were most likely to have low high density lipoprotein cholesterol concentration, high cholesterol:high density lipoprotein cholesterol ratio and high triglyceride concentrations. South Asians had a less favourable lipid profile than Europeans with the exception of total cholesterol.

Table 2 Background, social, and economic characteristics of women in study. Values are numbers (percentages) and denominators with 10 of n unless stated otherwise

	Indian (n=154)	Pakistani (n=149)	Bangladeshi (n=56)	All South Asian (n=359)	European (n=399)
Mean (SD) age (years)	52.40 (11.7)	48.33 (12.0)	48.14 (12.7)	50.05 (12.1)	54.03 (12.9)
Birth place:					
Indian subcontinent	137 (89)	137 (93)	54 (100)	328 (93)	—
United Kingdom	9 (6)	9 (6)	—	18 (5)	—
Other	7 (5)	1 (1)	—	8 (2)	—
Year moved to UK (n=323)*:					
Before 1962	47 (34)	14 (11)	—	61 (19)	—
1962-75	59 (43)	77 (58)	13 (25)	149 (46)	—
After 1975	31 (23)	42 (32)	40 (76)	113 (35)	—
Education (n=364, European):					
None	29 (19)	62 (42)	19 (35)	110 (31)	1 (0)
Primary	26 (17)	22 (15)	17 (31)	65 (18)	54 (14)
Secondary	42 (27)	37 (25)	16 (29)	95 (27)	245 (62)
Further education	32 (21)	17 (12)	3 (6)	52 (15)	33 (8)
Higher	20 (13)	9 (6)	—	29 (8)	31 (8)
Social class (n=265, S Asian; 295, European):					
I, II, or IIIN	92 (73)	71 (64)	6 (21)	169 (64)	152 (52)
IIIM, IV, or V	34 (27)	40 (36)	22 (79)	96 (36)	143 (49)
Housing:					
Homeowners	145 (95)	123 (84)	26 (46)	294 (83)	275 (70)
Overcrowding (>1 person/room) (n=343, S Asian; 383, European)	23 (16)	41 (29)	32 (57)	96 (28)	4(1)
Problems with area	26 (17)	20 (14)	5 (9)	51 (15)	65 (17)

*From subset of 336.

Obesity was commoner in Indian and Pakistani women than in Bangladeshis. High waist:hip ratios were commoner in Pakistanis and Bangladeshis, and about four times commoner in South Asians than Europeans.

Coronary heart disease was too rare for reliable comparisons among South Asian groups, but on both questionnaire and electrocardiography there was slightly less coronary heart disease in Bangladeshis than Indians and Pakistanis. South Asians had more possible myocardial infarction on questionnaire and probable coronary heart disease on electrocardiography than Europeans.

Table 6 shows that Bangladeshi men and women had the highest risk profiles for 9 of 15 coronary heart

Table 3 Smoking, diet, alcohol consumption, and exercise among men and women. Values are numbers (percentages) weighted to 1991 England and Wales population. Denominators are within 10 of n unless stated otherwise

	Indian	Pakistani	Bangladeshi	P value	All South Asian	European	95% CI for difference
Men	n=105	n=156	n=64		n=325	n=425	
Current smoking:							
Self reported	14 (14)	50 (32)	34 (57)	<0.001	98 (33)	137 (32)	–7.25 to 8.08
Carbon monoxide adjusted	18 (18)	54 (35)	38 (61)	<0.001	110 (35)	140 (33)	–5.29 to 10.2
Fruit or vegetables eaten daily (n=407, European)	91 (87)	140 (90)	48 (75)	0.017	279 (86)	244 (60)	18.5 to 33.4
No alcohol consumption (n=311, S Asian; 380, European)	28 (28)	136 (88)	57 (98)	<0.001	221 (71)	19 (5)	57.8 to 73.8
Weekly aerobic activity (n=322, S Asian; 415, European)	34 (33)	30 (19)	9 (14)	0.007	73 (22)	192 (47)	–32.4 to –16.7
Women	n=154	n=149	n=56		n=359	n=399	
Current smoking (n=336, S Asian; 398, European):							
Self reported	1 (1)	7 (5)	1 (2)	0.008	9 (3)	123 (31)	–34.8 to –21.5
Carbon monoxide adjusted	3 (2)	7 (5)	2 (4)	0.345	12 (4)	128 (32)	–35.5 to –21.7
Fruit or vegetables eaten daily (n=380, European)	152 (99)	130 (89)	46 (84)	<0.001	328 (91)	302 (78)	6.16 to 19.0
No alcohol consumption (n=332, S Asian; 338, European)	136 (91)	136 (99)	45 (100)	0.003	317 (96)	55 (16)	71.1 to 88.3
Weekly aerobic activity	44 (29)	30 (20)	6 (12)	0.031	80 (22)	178 (47)	–32.8 to –17.1

Table 4 Prevalence of glucose intolerance, dyslipidaemia, obesity, hypertension, and coronary heart disease in men. Values are numbers (percentages) age adjusted to 1991 England and Wales population

	Indian (n=105)	Pakistani (n=156)	Bangladeshi (n=64)	P value	All South Asian (n=325)	European (n=425)	95% CI for difference
Glucose intolerance:							
Impaired glucose tolerance (n=291, S Asian; 413, European)	17 (17)	33 (24)	9 (16)	0.569	59 (20)	55 (13)	1.55 to 12.6
All diabetes	16 (15)	35 (22)	17 (27)	0.174	68 (20)	16 (4)	12.2 to 20.5
Dyslipidaemia:							
Total cholesterol ⩾6.5 mmol/l	19 (19)	34 (22)	9 (14)	0.410	63 (19)	95 (22)	–8.88 to 2.78
HDL cholesterol ⩽0.9 mmol/l (n=301, S Asian; 410 European)	16 (17)	44 (30)	30 (52)	<0.001	90 (30)	53 (13)	10.9 to 22.9
Total cholesterol:HDL cholesterol ⩾5 (n=301, S Asian; 408 European)	37 (40)	79 (53)	41 (71)	0.001	157 (53)	140 (34)	11.2 to 25.8
Triglycerides ⩾1.7 mmol/l	45 (44)	85 (54)	44 (69)	0.006	174 (55)	153 (37)	11.0 to 25.3
Overweight:							
Body mass index ⩾25	68 (66)	107 (69)	30 (47)	0.007	213 (63)	250 (56)	–0.8 to 15.1
Waist:hip ⩾0.95	59 (57)	95 (61)	40 (63)	0.746	193 (60)	115 (27)	25.9 to 39.4
Reported hypertension or blood pressure >160/95 mm Hg at screening	15 (14)	14 (9)	4 (6)	0.202	32 (10)	76 (18)	–12.7 to –3.2
Rose questionnaire:							
Angina (n=325, S Asian; 407, European)	4 (4)	4 (3)	2 (3)	*	10 (3)	24 (6)	–6.11 to 0.32
Possible myocardial infarction (n=324, S Asian; 400, European)	12 (11)	14 (9)	15 (24)	0.103	41 (12)	39 (10)	–2.32 to 7.41
Electrocardiogram:							
Possible coronary heart disease	14 (13)	21 (14)	9 (14)	0.84	44 (14)	43 (10)	–1.20 to 7.63
Probable coronary heart disease	4 (4)	10 (7)	5 (8)	0.512	19 (6)	8 (2)	1.43 to 5.95

*χ^2 not valid (>20% of cells have expected frequency <5).

disease risk factors. Indians were advantaged by comparison. South Asians had higher levels than Europeans in 10 of 15 factors.

Discussion

Newcastle South Asians, mostly from the north of the Indian subcontinent and Sylhet, have a mix of religions, languages, and lifestyles, similar to those described nationally.[16] Our findings that coronary risk factors patterns are different in Indians, Pakistanis, and Bangladeshis and that South Asians combined have higher levels than Europeans, probably apply elsewhere. The heterogeneity of South Asian populations has too rarely been acknowledged in the context of coronary heart disease.[2 3 17–20] New and larger studies are needed to assess whether the incidence and prevalence of coronary heart disease and diabetes differs between Indians, Pakistanis, and Bangladeshis as suggested here and elsewhere.[1 7]

Table 5 Prevalence of glucose intolerance, dyslipidaemia, obesity, hypertension, and coronary heart disease in women. Values are numbers (percentages) age adjusted to 1991 England and Wales population

	Indian (n=154)	Pakistani (n=149)	Bangladeshi (n=56)	P value	All South Asian (n=359)	European (n=399)	95% CI for difference
Glucose intolerance:							
Impaired glucose tolerance (n=305, S Asian; 380, European)	27 (19)	32 (25)	11 (34)	0.170	70 (24)	47 (12)	6.16 to 17.8
All diabetes	20 (13)	34 (23)	13 (23)	0.057	68 (18)	15 (4)	10.2 to 18.9
Dyslipidaemia:							
Total cholesterol ⩾6.5 mmol/l	30 (19)	28 (19)	2 (4)	0.033	61 (17)	86 (22)	–9.95 to 0.45
HDL cholesterol ⩽0.9 mmol/l (n=345, S Asian; 385, European)	8 (5)	20 (14)	10 (21)	0.003	38 (11)	7 (2)	6.00 to 13.0
Total cholesterol:HDL cholesterol ⩾5 (n=345, S Asian; 392 European)	31 (20)	43 (29)	18 (38)	0.032	92 (26)	53 (14)	6.74 to 17.9
Triglycerides ⩾1.7mmol/l	57 (37)	59 (40)	29 (59)	0.020	145 (41)	119 (30)	4.26 to 17.4
Overweight:							
Body mass index ⩾25	107 (69)	98 (66)	32 (58)	0.311	231 (66)	207 (52)	6.20 to 19.9
Body mass index ⩾30	59 (38)	50 (34)	8 (15)	0.006	117 (32)	63 (16)	10.3 to 22.2
Waist:hip ⩾0.85	65 (42)	88 (60)	29 (55)	0.006	182 (53)	66 (17)	30.2 to 43.3
Reported hypertension or blood presssure >160/95 mm Hg at screening	23 (15)	18 (12)	3 (5)	0.164	44 (14)	47 (12)	–2.20 to 6.13
Rose questionnaire:							
Angina (n=358, S Asian; 372, European)	11 (7)	2 (1)	—	0.007	13 (4)	18 (5)	–4.41 to 1.47
Possible myocardial infarction (n=354, S Asian; 373, European)	24 (16)	27 (18)	8 (14)	0.728	59 (17)	24 (7)	5.48 to 15.28
Electrocardiography:							
Possible coronary heart disease	29 (19)	30 (20)	7 (13)	0.051	66 (17)	55 (14)	–1.65 to 9.02
Probable coronary heart disease	12 (8)	4 (3)	—	0.023	16 (5)	4 (1)	1.88 to 6.83

Table 6 Ethnic groups with highest risk profiles for various coronary heart disease risk factors

	Women		Men	
Risk factor	**Indians, Pakistanis, Bangladeshis, and Europeans**	**South Asians and Europeans**	**Indians, Pakistanis, Bangladeshis, and Europeans**	**South Asians and Europeans**
Economic circumstances (education, social class, overcrowding, income)	Bangladeshi	South Asian	Bangladeshi	European
Smoking	European	European	Bangladeshi	South Asian
Fruit and vegetable consumption	Bangladeshi	European	European	European
No cardioprotective level of alcohol	Bangladeshi	South Asian	Bangladeshi	South Asian
Level of exercise	Bangladeshi	South Asian	Bangladeshi	South Asian
Height	Bangladeshi	South Asian	Bangladeshi	South Asian
Obesity (body mass index)	Indian	European	Indian	South Asian
Impaired glucose tolerance	Bangladeshi	South Asian	Pakistani	South Asian
Diabetes	Bangladeshi	South Asian	Bangladeshi	South Asian
HDL cholesterol	Bangladeshi	South Asian	Bangladeshi	South Asian
LDL cholesterol	European	South Asian	European	European
Triglycerides	Bangladeshi	South Asian	Bangladeshi	South Asian
Lp(a) lipoprotein	Pakistani	South Asian	Bangladeshi	South Asian
Fibrinogen	Indian	European	Pakistani	European
Blood pressure	European/Indian	European	European	European

We acknowledge potential bias because Europeans self completed the questionnaire whereas South Asians had home interviews and Europeans and South Asians were studied sequentially. These decisions were pragmatic and resource driven; self completion of questionnaires by South Asians was inappropriate, and interviewing Europeans beyond our resources. The South Asian study needed staff with appropriate languages and cultural knowledge so screening them separately was more practical. Changes in disease and risk factors would be small between 1993-4 (European study, midpoint January 1994) and 1995-7 (South Asian study, midpoint August 1996). This paper, moreover, focuses on variations among South Asian subgroups, for whom data were collected simultaneously.

Hypotheses for the high rates of coronary heart disease in South Asians include the use of ghee and other cooking oils[21]; non-vegetarian diets[22]; subclinical hypothyroidism[23]; stress, racism, and poverty[6]; deprivation in infancy and childhood[6 24]; and insulin resistance.[2 17] The insulin resistance hypothesis has overshadowed other explanations.[3 17 25] This study draws attention to a wide range of risk factors and shows that combining data for South Asians is misleading.

Key messages

- South Asians have more coronary heart disease than Europeans despite apparently lower levels of risk factors
- This study shows that Indians, Pakistanis and Bangladeshis differ in a wide range of coronary risk factors and combining their data is misleading
- Among South Asians, Indians were least and Bangladeshis most disadvantaged in a range of coronary risk factors. South Asians were disadvantaged in comparison with Europeans
- Future research and prevention strategies for coronary heart disease in South Asians should acknowledge a broad range of risk factors, the heterogeneity of these populations, linguistic and cultural needs, and environmental factors

As ethnic and racial differences are almost never demonstrably genetic, social and environmental differences are likely to be crucial. Our observations emphasise poverty (among Pakistanis and Bangladeshis), smoking (among Bangladeshis, Pakistanis, and European men), high blood pressure (among Europeans and Indians), obesity (in all groups), and a lack of exercise (in all groups). Our study supports a role for infant deprivation (South Asians were shorter, an indicator of poorer early life nutrition),[24] central obesity and insulin resistance (all South Asians), abstinence from alcohol (especially Pakistanis and Bangladeshis), and chronic inflammation (higher white cell counts in Pakistani and Bangladeshi men; data shown on *BMJ*'s website) as potentially important causes of coronary heart disease.[26]

Strategies to control coronary heart disease in South Asians should emphasise all important factors including social and environmental ones such as employment and poverty, propose linguistic and cultural adaptations, and consider the heterogeneity of Indians, Pakistanis, and Bangladeshis.

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Contributors: RB contributed to the study hypotheses and design, supervision of project, planning and interpretation of data analyses, and was the lead writer. NU and MW contributed to the study hypotheses and design, supervision, screening, planning, and interpretation of data. JY participated in management of screening in South Asian study, analysis of data, and drafting methods section. LW participated in preparation and analysis of data, and drafting methods, results, and tables of manuscript. KGMMA contributed to the study hypotheses and

design and supervision of project. JH participated in development of study design, methods, and questionnaire for European study, management and screening of European population, and data coding. SP participated in screening South Asians, community liaison and recruitment to study, and data coding. NA contributed to development of South Asian questionnaire, translation, sampling, screening, recruitment, and data preparation. NU, MW, JY, LW, KGMMA, JH, SP, and NA commented on the manuscript. CT participated in screening, development of questionnaire, recruitment, and community liaison. BW managed and participated in screening for European and South Asian samples and helped with entry and preparation of data for analysis. DK participated in coordination of recruitment and data collection for the South Asian study, data analysis on response rates, and drafting text. AK participated in screening, development of questionnaire, community liaison, and recruitment. ML advised on biochemical methods, supervised laboratories doing biochemical tests, and had responsibility for Lp(a) lipoprotein assays. AT participated in the Lp(a) lipoprotein study and provided data and advice on Lp(a) lipoprotein. RB, GA, NU, and MW are the study guarantors.

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1 Balarajan R. Ethnicity and variations in mortality from coronary heart disease. *Health Trends* 1996;28:45-51.
2 McKeigue P, Sevak L. *Coronary heart disease in South Asian communities*. London: Health Education Authority, 1994.
3 McKeigue PM. Coronary heart disease in South Asians overseas: a review. *J Clin Epidemiol* 1989;42:597-609.
4 Bhopal RS. Several key facts need to be considered. *BMJ* 1996;312:375.
5 Shaukat N, de Bono DP. Are Indo-origin people especially susceptible to coronary artery disease. *Postgrad Med J* 1994;70:315-8.
6 Williams R, Bhopal R, Hunt K. Coronary risk in a British Punjabi population: comparative profile of non-biochemical factors. *Int J Epidemiol* 1994;23:28-37.
7 Nazroo J. *The health of Britain's ethnic minorities*. London: Policy Studies Institute, 1997.
8 Harland JO, Unwin N, Bhopal RS, White M, Watson B, Laker M, et al. Low levels of cardiovascular risk factors and coronary heart disease in a UK Chinese population. *J Epidemiol Community Health* 1997;51:636-42.
9 Unwin N, Harland J, White M, Bhopal RS, Winocour P, Stephenson P, et al. Body mass index, waist circumference, waist-hip ratio, and glucose intolerance in Chinese and Europid adults in Newcastle, UK. *J Epidemiol Community Health* 1997;51:160-6.
10 Coldman A, Braun T, Gallagher R. The classification of ethnic status using name information *J Epidemiol Community Health* 1988;42:390-5.
11 WHO MONICA Project. Geographical variation in the major risk factors of coronary heart disease in men and women aged 35-64 years. *World Health Org Q* 1988;41:115-38.
12 Flegal KM, Carroll MD, Kuuczmarski RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960-1994. *Int J Obesity Relat Metab Disord* 1998;22:39-47
13 Bedfont Scientific. *Operator's manual for mini and micro smokerlyzers*. Upchurch: Bedfont Scientific, 1993.
14 Rose G, Blackburn A, Gillum R, Prineas R. *Cardiovascular survey methods*. 2nd ed. Geneva: World Health Organisation, 1982.
15 Coombs M, Raybould S, Long CA. *Index of deprivation*. London: Department of Environment, 1992.
16 Modood T, Berthoud R, eds. *Ethnic minorities in Britain*. London, Policy Studies Institute, 1997.
17 McKeigue PM, Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. *Lancet* 1991;337:382-6.
18 McKeigue PM, Marmot MG, Adelstein AM. Diet and risk factors for coronary heart disease in Asians in Northwest London. *Lancet* 1985;ii:1086-90.
19 McKeigue PM. Mortality from coronary heart disease in Asian communities in London. *BMJ* 1988;297:903-7.
20 Marmot MG, Adelstein AM, Bulusu L. Immigrant mortality in England and Wales 1970-1978. Causes of death by country. Studies on medical and population subjects. London: HMSO, 1984.
21 Nath BS, Murthy R. Cholesterol in Indian ghee. *Lancet* 1988;ii:39.
22 Pais P, Pogue J, Gerstein H, Zachariah E, Savitha D, Jayprakash S, et al. Risk factors for acute myocardial infarction in Indians: a case-control study. *Lancet* 1996;348:358-63.
23 Fowler PBS. Diet and risk factors for coronary heart disease in Asians in north west London. *Lancet* 1985;ii:1363.
24 Barker DJP. Mothers, babies and disease in later life. London: BMJ Publishing, 1994.
25 Gupta S, de Belder A, Hughes LO. Avoiding premature coronary deaths in Asians in Britain. *BMJ* 1995;311:1035-6.
26 Mendall M. Inflammatory responses and coronary heart disease. *BMJ* 1998;316:953-4.

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Influence of bacterial vaginosis on conception and miscarriage in the first trimester: cohort study

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Abstract

Objectives To assess whether bacterial vaginosis affects the rates of conception and miscarriage in the first trimester.
Design Cohort study.
Setting Assisted conception unit of a teaching hospital in Leeds.
Participants 867 consecutive women undergoing in vitro fertilisation.
Interventions Screening for bacterial vaginosis with a Gram stained vaginal smear before egg collection.
Main outcome measures The presence of bacterial vaginosis or normal vaginal flora, and the rate of conception and miscarriage in the first trimester.
Results 190 of 771 (24.6%) women had bacterial vaginosis. No difference in conception rate was found between those women with bacterial vaginosis and those with normal vaginal flora: 61 women (32.1%) and 146 of 493 women (29.6%) respectively (relative risk 1.08, 95% confidence interval 0.85 to 1.39; odds ratio 1.12, 0.77 to 1.64). However, 22 women (31.6%) with bacterial vaginosis who conceived had a significantly increased risk of miscarriage in the first trimester compared with 27 women (18.5%) with normal vaginal flora (crude relative risk 1.95, 1.11 to 3.42; crude odds ratio 2.49, 1.21 to 5.12). This increased risk remained significant after adjustment for factors known to increase the rate of miscarriage: increasing maternal age, smoking, history of three or more miscarriages, no previous live birth, and polycystic ovaries (adjusted relative risk 2.03, 1.09 to 3.78; adjusted odds ratio 2.67, 1.26 to 5.63).
Conclusions Bacterial vaginosis does not affect conception but is associated with an increased risk of miscarriage in the first trimester in women undergoing in vitro fertilisation, independent of other risk factors.

Introduction

Bacterial vaginosis is the most common cause of abnormal vaginal discharge among women of