This study compared our admission policy before and after an intervention, and it is difficult to exclude the possibility that a different but coincident change could have affected the results, especially as we were unable to have a separate control group. However, there was no evidence of a changing admission policy during the six months before the unit opened. The only change in our practice during the study period was the moving of obstetric beds from Dulwich Hospital to King's College Hospital. This occurred on 14 September and the reduction in bed occupancy was seen before that date. By expressing the results per 100 deliveries we allowed for the increase in the number of deliveries that happened at this time and there was no evidence of a change in admission policy after this reorganisation.

From the health service's point of view the savings to be gained from a fetal surveillance unit are clear. The cost of a hospital bed is difficult to quantify, but £300 a day is a conservative estimate. Our results suggest that in our hospital about 38 antenatal bed days can be saved for every 100 deliveries. A unit with 4000 deliveries a year could therefore save $38\times40=1520$ bed days, which is equivalent to £456 000 a year. Although the cost of the unit must be subtracted from this figure, in view of the better patient care and saving of our patients' time, this is a cost effective reorganisation.

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Prevalences of diabetes and cardiovascular disease risk factors in Hindu Indian subcommunities in Tanzania

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Abstract

***Objectives*—To seek differences in the prevalence of diabetes mellitus and other coronary heart disease risk factors, and to identify factors associated with these differences within a Hindu Indian community.**

***Design*—Population based cross sectional survey.**

***Setting*—Dar-es-Salaam, Tanzania.**

***Subjects*—Of 20 Hindu subcommunities categorised by caste in Dar-es-Salaam, seven were randomly selected. 1147 (76·7%) of 1495 subjects aged 15 or over participated.**

***Main outcome measures*—Blood glucose concentrations (fasting and two hours after oral glucose loading), serum total cholesterol and serum triglyceride concentrations, blood pressure, and height and weight.**

***Results*—The subcommunities differed substantially in socioeconomic characteristics and lifestyle. Overall, 9·8% of subjects (109/1113) had diabetes, 17·0% (189/1113) impaired glucose tolerance, 14·5% (166/1143) hypertension, and 13·3% (151/1138) were obese. The mean fasting blood glucose concentration was 4·9 mmol/l, the blood glucose concentration two hours after oral loading (75 g) 6·0 mmol/l, the total cholesterol concentration 4·9 mmol/l, the serum triglyceride concentration 1·4 mmol/l, and body mass index (weight/height^2;kg/m^2) 24·3. Systolic and diastolic blood pressures were 121 and 77 mm Hg respectively. There were important intercommunity differences even after standardisation for age, sex, and body mass index—for example, in mean fasting blood glucose concentration (range 4·5 (Jains) to 5·9 mmol/l (Patels)), serum total cholesterol concentration (range 4·5 (Jains) to 6·2 mmol/l (Suthars)), systolic blood pressure (range 110 (Limbachias) to 127 mm Hg (Bhatias)), and prevalences of diabetes (range 3·4% (3/87 Limbachias) to 18% (20/111 Navnats)) and hypertension (range 5·7% (5/87 Limbachias) to 19·4% (43/222 Bhatias). Variables which showed significant linear correlation with subcommunity variations were entered into a multiple regression model. Intercommunity variations persisted. The Limbachia and Jain communities had the lowest prevalence of and mean values for coronary heart disease risk factors and the Bhatia and Patel communities had the highest.**

***Conclusions*—In this series intercommunity variations in disease and risk factors might have been related to genetic, dietary, socioeconomic, and lifestyle differences but could not be explained by the characteristics studied. Studies of Indian subcommunities are warranted to confirm and extend these descriptive findings and explore the genetic basis of diabetes. Communities of Indian origin should not be perceived as homogeneous.**

Introduction

Migrants from the Indian subcontinent in Trinidad,[1] South Africa,[2] Fiji,[3] Singapore,[4 5] United Kingdom,[6 7] Mauritius,[8] and east Africa[9] have a higher prevalence of diabetes or an increased frequency of coronary heart disease[10-18] compared with other ethnic groups residing in the same countries. Several ethnic groups from the Indian subcontinent (Gujarati, Punjabi, Bangladeshi, and Pakistani) have been shown to have a 50% higher mortality from coronary heart disease than the national average in the United Kingdom.[19] The high rates of coronary heart disease cannot be explained by classic risk factors for the disease (smoking, hypertension, hypercholesterolaemia) but have recently been attributed to insulin resistance and hyperinsulinaemia.[20 21]

Often migrants from the Indian subcontinent have been considered erroneously as a homogeneous group (so called "Asians"), but they differ in their religious, cultural, and geographical backgrounds.[22] Religion,[23] sex,[23] geographical origin,[17] and caste[24] have important influences in terms of lifestyle and health related behaviour. Caste has provided the main basis for social stratification of Indian society for thousands of years and retains its hold, particularly in rural India. Essentially caste was determined by occupation, which was passed from father to son, so that caste was (and remains) fixed. Discrimination on the basis of caste is illegal in India but the system remains an important determinant of wealth and opportunity, particularly as most marriages are between members of the same caste. On first principles a relation between caste and health would be expected. Studies in India suggest geographical differences in the frequency of diabetes and coronary heart disease.[25 26] Although these differences have not been explained, Indians from different parts of the Indian subcontinent probably vary in their culture, socioeconomic circumstances, and genetic constitution, which may underlie their varying health states. Possibly the excess frequency of diabetes and coronary heart disease observed in the generality of migrant Indians could largely be contributed by high risk groups within this population.

The objectives of this study were twofold: firstly, to test the hypothesis that there were differences in the frequency of diabetes mellitus and coronary heart disease risk factors within an Indian Hindu (Gujarati) community; and, secondly, to try to identify factors associated with these differences.

Subjects and methods

Twenty Hindu subcommunities, representing different caste groups, are registered under the single parent organisation Shree Hindu Mandal in Dar-es-Salaam, Tanzania. Each subcommunity has an elected committee which manages its affairs. The chairperson and secretary represent each subcommunity in the integration forum of the Shree Hindu Mandal. The purpose, details, and importance of this study were explained to the Shree Hindu Mandal by one of us (KLR) and to all the subcommunity committees. Consent to the study was obtained from 18 subcommunities, and seven were randomly selected (see appendix). Each subcommunity has an annually updated register containing the name, age, and sex of members. All members aged 15 and over were invited to the study.

SURVEY POPULATIONS

Bhatia community—The Bhatias are a Gujarati merchant community who in the past 50 years have become a wealthy class. Their ancestor was a Rajput prince of Lahore, who in the sixth century founded a dynasty that came to be known as the "Bhartis" or "Bhati." After being besieged for a year the King engineered the escape of most of the old people and children, who dispersed north in the Punjab and took up trading. Within a few generations the community had reconsolidated and started expanding. Members also settled in the Sindh, Rajasthan, Madhya Pradesh, and Gujarat. In each of these areas they adopted the local language but remained distinct. A large community settled in Kutch, Gujarat, and in Bombay and, along with the Parsees, became one of the major commercial and industrial communities of that city. From the Kutch port of Mandvi and from Bombay Bhatias took part in the Indian ocean trade and were the first Hindu merchants to do business in Zanzibar. Most of the Bhatias in Dar-es-Salaam have originated from Kutch, Gujarat, and are in business or the professions.

Lohana community—The Lohanas call themselves "Raghuvanshi," Raghu being another name of Rama's great grandfather and "vanshi" means descendants. Although Lohanas claim that their warrior ancestors were the ones who contained the "Turkish threat," at some point they gave up warring and took up weaving. From weaving they became textile traders and then general traders. Initially settled in northern parts of India (including Lahore, Pakistan), they turned their attention southwards towards Gujarat and are now mainly concentrated around Saurashtra and Kutch in Gujarat. In Dar-es-Salaam most Lohanas own their own businesses, a few opting for professional jobs.

Jain community—"Jina" means conqueror of worldly desires, and Jain is derived from this word. With the development of Hinduism, many people resented the increasing monopoly of ritual power by the Brahmins, their assumption of spiritual and intellectual supremacy, the stultifying strictures and restrictions of the caste structure, and the idolatry and animal sacrifices. Jainism together with Buddhism was an expression of this resentment. Both were led by men born into noble families of the Kshatriya caste. Vardhamana Mahavir founded Jainism in the fifth to sixth centuries BC. The travels and teachings of different "sadhus" (holy men) led to the development of different sects of Jainism. Jains in Dar-es-Salaam mostly hail from Gujarat and are predominantly business people.

Navnat community—"Nav" means nine and "nat" means community. Members of this community belong not only to different "vaniks" (castes or localised communities) but also to different religious communities. Among them in Dar-es-Salaam are some Hindus and some Derawasi Jains. Most of them, however, are followers of the Sthanakwasi stream of Jainism, who built no temples. The traditional occupation of this community was farming and it was mainly centred in Saurashtra in northern Gujarat. Navnats are increasingly turning to general trading, and in Dar-es-Salaam most are in business.

Patel community—Patel is a common surname for the people of "Patidar gnati," one of the multitudinous sections of the vaishya. Traditionally the Patidar were farmers and small landowners. From the agrarian base they diverged in two economic directions, some moving into government offices, others moving into the labouring sector. Patels are divided based on their origin (place) and religion. There are Leva Patels, originating from Kheda district in Gujarat; Surti

APPENDIX—*Characteristics of Hindu subcommunities randomly selected for study showing origin, occupation, dietary habits, and social class*

Subcommunity	Origin	Current main occupations	Traditional occupation	Dietary habits	Social class
Bhatia	Kutch district, Gujarat	Businessmen/women, professionals	Merchants	Vegetarian, lacto-ovovegetarian	High
Jain	Saurashtra district, Gujarat	Businessmen/women, professionals	Merchants	Strict vegetarian	High
Limbachia	Surat and Saurashtra districts, Gujarat	Manual workers, hairdressers	Hairdressers	Non-vegetarian, lacto-ovovegetarian	Low
Lobhana	Saurashtra district, Gujarat	Businessmen/women, office workers, professionals	Textile merchants	Vegetarian, non-vegetarian	High
Navnat	Saurashtra district, Gujarat	Businessmen/women, office workers, professionals	Farmers	Vegetarian, lacto-ovovegetarian	Middle
Patel	Kutch district, Gujarat	Building contractors, manual workers	Farmers	Vegetarian, lacto-ovovegetarian	Middle
Suthar	Saurashtra district, Gujarat	Carpenters, office workers, professionals	Carpenters	Vegetarian, lacto-ovovegetarian	Low

Patels, originating from Surat district in Gujarat; and Kutchi Patels, originating from Kutch, north Gujarat. All are Hindus by religion. Additionally, there are Rustan Patels, who are Parsees, and Muhammed Patels, who are Moslems. Patels studied in Dar-es-Salaam were Kutchi Patels, most of whom were building contractors and manual labourers.

Limbachia community—Most of the "Nayees" (hereditary barbers) were of the Limbachia community and came from Gujarat to east Africa to look for opportunities. Most Limbachias in Dar-es-Salaam are barbers, a few work as manual labourers, and some have started small businesses.

Suthar community—Suthars are hereditary carpenters and in the traditional Indian setting make and mend carts, ploughs, and other agricultural implements. "Sutradhar" is Sanskrit for a holder of string, referring to the strings used either in joining planks or in planning and measuring. Suthars in Gujarat are also called "mistris" (foreman) and "gaidhars" (the holder of a goj, a foot measure). They claim descent from Vishwakarma, the divine architect. In Dar-es-Salaam Suthars are usually self employed carpenters, and some engage in engineering and technical work.

Measurements and definitions

Subjects came fasting to the community hall at 0700. Height and weight without shoes and coats were measured on a beam balance. Venous blood was taken for estimation of fasting blood glucose, serum cholesterol, and serum triglyceride concentrations. Then 75 g glucose dissolved in 300 ml water was drunk in two to five minutes and the venous blood glucose concentration re-estimated two hours later. During the interval the subjects were asked to remain seated and refrain from smoking. The oral glucose tolerance test was not performed on subjects known to be diabetic. Fasting blood samples and blood samples taken two hours after oral glucose loading were drawn into fluoride tubes and analysed immediately for glucose by using a Yellow Springs glucose analyser (Yellow Springs Instruments, Ohio, USA). Every fifth sample was measured in duplicate and the remainder of the blood sample kept cool (4°C) and reanalysed later the same morning in the clinical biochemistry laboratory at Muhimbili Medical Centre, also with a Yellow Springs glucose analyser. A further aliquot was stored frozen and analysed by a hexokinase fluorometric method with a Cobas Bio centrifugal analyser in Newcastle upon Tyne. The coefficient of variation for measurements on site was 1·8%. There was no significant difference between results obtained on site and those found in Newcastle.

Serum total cholesterol and triglyceride concentrations were estimated from aliquots of the fasting blood sample. Within four hours of sampling the samples were centrifuged and the serum kept frozen until analysis in Newcastle with a Cobas Bio centrifugal analyser. The kinetic enzymatic colorimetric methods of Deeg and Ziegenhorn[27] for cholesterol and of Megram *et al*[28] for triglycerides were used. The coefficient of variation between assays was 3·5% for cholesterol and 4·5% for triglycerides.

Blood pressure was recorded by using a mercury sphygmomanometer with a standard cuff before and after the oral glucose, with an interval of about one hour between the measurements. The two measurements were averaged.

A questionnaire was completed by KLR by interview with each participant. The questionnaire was written in English but translated into the language spoken by the participants (Gujarati or Kutchi) by KLR. Physical activity was divided into two categories: sedentary, defined as rarely taking exercise and on one's feet less than half the day; and moderate, defined as taking regular exercise and on one's feet much of the day. The few subjects who reported vigorous exercise were included in the moderate category. A family history of diabetes or hypertension was recorded when any first degree relative had these disorders. As the number of ex-smokers was small they were counted with non-smokers. Subjects taking any type of alcohol were grouped together as alcohol drinkers. Non-drinkers included ex-drinkers as their number was small.

Diabetes and impaired glucose tolerance were defined according to the 1985 World Health Organisation criteria[29] for epidemiological studies by using whole blood—that is, a fasting venous whole blood glucose concentration $\geqslant 6·7$ mmol/l or a venous whole blood glucose concentration two hours after oral loading $\geqslant 10·0$ mmol/l, or both, for diabetes; and a fasting whole blood glucose concentration $\leqslant 6·7$ mmol/l with a venous whole blood glucose concentration two hours after oral loading of 6·7-9·9 mmol/l for impaired glucose tolerance. Subjects who at the time of study had already been diagnosed as diabetic ("known diabetic") were defined as diabetic. Mild hypercholesterolaemia was defined as a serum total cholesterol concentration of 5·2-6·4 mmol/l. Hypercholesterolaemia was defined as a serum total cholesterol concentration $\geqslant 6·5$ mmol/l. Hypertriglyceridaemia was defined as a serum triglyceride concentration $\geqslant 1·7$ mmol/l.

Hypertension was defined based on WHO criteria[30]—that is, systolic blood pressure $\geqslant 160$ mm Hg or diastolic pressure $\geqslant 95$ mm Hg, or both. Subjects who had been diagnosed as hypertensive previously were categorised as hypertensive regardless of the blood pressure reading. Body mass index was calculated as weight/height^2 (kg/m^2). Overweight was defined as a body mass index $\geqslant 27$ in men and $\geqslant 25$ in women and obesity as a body mass index of $\geqslant 30$ in both men and women.

STATISTICAL METHODS

The data were analysed with the statistical package for the social sciences. Standardisation for age, sex, and body mass index for prevalence rates was by the direct method using the structure of the whole survey population as the standard. For standardisation of the continuous variables a weighting factor was computed for each sex, age, and body mass index group, again using the whole survey population as the standard, and then analysis with the statistical package for the social sciences performed incorporating the weighting factor.[31,32]

Regression models were developed to investigate the differences among subcommunities taking into account the confounding factors. The Kolmogorov-Smirnov test was performed for each of the variables to confirm normal distribution of the data. To reduce skewness serum triglyceride values were transformed into their natural logarithm before introducing them into the regression models. Five outlying triglyceride measurements (greater than 4 SD from the mean) were excluded from the analysis after transformation. Analysis of covariance was done to look for interactions between independent variables before introducing them into the regression models. The only important interaction was for age with body mass index ($p<0·05$).

Pearson correlation coefficients were computed to examine the relations between the variables. Multiple regression models were then created by means of the forward stepwise procedure for each of the dependent variables. Each variable (fasting blood glucose concentration, blood glucose concentration two hours after oral loading, serum total cholesterol concentration, serum triglyceride concentration, systolic blood pressure, and diastolic blood pressure) was introduced into the regression model as a dependent variable with age, sex, body mass index, category of physical activity, presence or absence of a family history of diabetes or hypertension, and duration of residence in Tanzania as independent variables. Scheffe's test[33] was used to investigate the differences among the seven subcommunities. To reduce the effect of multiple comparisons a significance level of $p<0\cdot01$ was used.

Results

Characteristics of the subcommunities and their response rates are shown in table I. The response rate was 76·7% overall (1147/1495 subjects aged 15 or over) and varied from 66·9% to 91·7%. Non-respondents were mostly in the younger age groups or women. There were differences among the subcommunities in sex, age, place of origin, duration of residence in Tanzania, level of education, occupation, physical activity, smoking and drinking habits, and the presence of a family history of diabetes mellitus and hypertension. The highest prevalences of a family history of diabetes mellitus and hypertension were recorded in Patels and Bhatias respectively and the lowest in Limbachias.

The results for continuous variables adjusted for age, sex, and body mass index are given in table II. When compared with mean values in the whole community Jains and Limbachias had significantly lower mean values for fasting blood glucose, blood glucose two hours after oral loading, serum total cholesterol, systolic and diastolic blood pressures, and body mass index. Mean values for fasting blood glucose, blood glucose two hours after oral loading, and systolic and diastolic blood pressures tended to be higher in Bhatias and Patels. Lohanas had significantly lower mean fasting and two hour blood glucose concentrations, though their serum lipid values and systolic and diastolic blood pressures did not differ significantly from the overall means. The Suthar subcommunity had a greatly raised mean serum total cholesterol concentration and significantly higher systolic and diastolic blood pressures than the overall means. Serum triglyceride concentrations were similar across the subcommunities except for Jains, in whom they were lower.

Table III shows the percentage prevalence rates of impaired glucose tolerance, diabetes mellitus, hypertension, mild hypercholesterolaemia, hypercholesterolaemia, hypertriglyceridaemia, overweight, and obesity adjusted as appropriate for age, sex, and body mass index. There was evidence of both statistically and clinically important differences in the prevalence rates among the subcommunities and between the sexes (not shown here; tables available from authors). When compared with the overall prevalence rates for the whole community Jains and Limbachias had a lower prevalence of impaired glucose tolerance, hypercholesterolaemia, hypertriglyceridaemia, and obesity. The prevalence of impaired glucose tolerance was significantly higher and diabetes more frequent in the Bhatia and Patel subcommunities.

Differences among the subcommunities remained

TABLE I—*Characteristics of Hindu subcommunities (figures are percentages of subjects)*

	Bhatia (n=222)	Jain (n=240)	Limbachia (n=87)	Lohana (n=299)	Navnat (n=115)	Patel (n=55)	Suthar (n=129)	Total (n=1147)
Response rate	82·2	83·0	77·0	71·5	66·9	91·7	74·6	76·7
Male sex	50·0	55·4	56·3	45·5	53·0	58·2	47·3	50·8
Age (years):								
15-34	27·0	27·5	49·4	20·4	45·2	41·8	29·5	29·9
35-54	53·2	55·0	41·4	52·2	42·6	54·6	50·4	51·1
≥55	19·8	17·5	9·2	27·4	12·2	3·6	20·1	19·0
Place of origin:								
Tanzania	78·4	54·6	47·1	60·2	40·9	23·6	61·2	58·0
Other African country	3·6	11·2	2·3	6·0	5·2	12·7	10·1	7·1
India	17·6	32·5	50·6	30·1	53·0	60·0	28·7	33·3
Britain/United States	0·4	1·7	0	3·7	0·9	3·7	0	1·6
Duration of residence in Tanzania (years):								
<5	5·8	6·2	20·7	10·4	18·3	18·3	3·9	9·8
5-9	14·0	11·2	12·6	11·0	13·0	23·6	6·2	12·0
10-20	50·0	48·3	33·3	32·8	40·9	34·5	38·7	41·0
>20	30·2	34·3	33·4	45·8	27·8	23·6	51·2	37·2
Level of education:								
No formal education	4·0	5·5	12·6	2·3	0	7·3	7·0	4·6
Up to secondary school	82·0	70·7	83·9	82·6	70·4	92·7	85·3	79·6
Higher education	14·0	23·8	3·5	15·1	29·6	0	7·7	15·7
Occupation:								
Manual worker	3·1	2·2	3·5	1·0	0	0	34·9	5·5
Housewife	44·1	40·8	34·5	48·2	43·5	38·2	31·0	41·9
Non-sedentary office worker	18·9	26·2	43·7	6·0	5·3	7·3	19·4	17·1
Sedentary office worker	30·3	27·9	14·9	22·4	44·3	54·5	13·9	27·3
Professional	3·6	2·9	3·4	22·4	6·9	0	0·8	8·2
Moderately active	27·8	54·2	23·4	53·5	38·3	26·2	57·4	44·6
Male smokers	24·3	21·0	32·6	32·3	37·7	6·2	10·0	25·1
Male drinkers	19·8	27·8	30·6	28·7	49·2	6·2	13·3	26·3
Positive family history of:								
Diabetes mellitus	22·7	23·3	6·9	21·1	32·2	43·6	14·2	22·0
Hypertension	33·6	18·3	10·3	28·1	19·1	18·2	15·0	22·7

TABLE II—*Blood glucose and serum total cholesterol and triglyceride concentrations, blood pressure readings, and body mass index measurements in Hindu subcommunities. Values are means (SD in parentheses) [numbers of subjects studied given in square brackets]*

	Bhatia	Jain	Limbachia	Lohana	Navnat	Patel	Suthar	Overall
Fasting blood glucose (mmol/l)*	5·3 (1·8) [222]	4·5 (1·6) [239]	4·6 (1·6) [86]	4·7 (1·4) [295]	5·2 (2·7) [113]	5·9 (3·1) [53]	5·0 (1·6) [122]	4·9 (1·9) [1130]
Blood glucose 2 h after loading (mmol/l)*	6·8 (3·4) [212]	5·5 (2·9) [229]	5·5 (2·0) [85]	5·6 (2·3) [279]	6·3 (3·2) [104]	6·8 (3·0) [47]	5·8 (2·8) [124]	6·0 (2·9) [1080]
Serum total cholesterol (mmol/l)*	4·8 (1·1) [198]	4·5 (1·1) [231]	4·6 (1·1) [81]	4·9 (1·3) [279]	5·0 (1·2) [83]	4·8 (1·0) [51]	6·2 (1·6) [122]	4·9 (1·3) [1045]
Serum triglycerides (mmol/l)*	1·3 (0·7) [198]	1·1 (1·0) [230]	1·3 (0·7) [81]	1·5 (1·4) [279]	1·5 (1·0) [83]	1·4 (0·6) [51]	1·3 (0·7) [122]	1·4 (1·1) [1044]
Systolic blood pressure (mm Hg)*	127 (22) [222]	118 (20) [238]	110 (18) [87]	122 (19) [299]	114 (21) [115]	126 (17) [55]	126 (17) [127]	121 (20) (1143]
Diastolic blood pressure (mm Hg)*	80 (11) [222]	74 (12) [238]	70 (10) [87]	77 (11) [299]	74 (12) [115]	80 (9) [55]	79 (10) [127]	77 (12) [1143]
Body mass index (kg/m^2)†	25·2 (5·3) [220]	23·1 (5·3) [239]	22·2 (4·7) [87]	25·4 (6·0) [295]	24·0 (4·7) [115]	24·9 (3·9) [55]	24·3 (6·1) [127]	24·3 (5·5) [1138]

*Standardised for age, sex, and body mass index.
†Standardised for age and sex.

TABLE III—*Percentage prevalence rates of impaired glucose tolerance, non-insulin dependent diabetes mellitus, hypertension, mild hypercholesterolaemia, hypercholesterolaemia, hypertriglyceridaemia, overweight, and obesity in Hindu subcommunities. [Numbers of subjects studied given in square brackets]‡*

	Bhatia	Jain	Limbachia	Lohana	Navnat	Patel	Suthar	Total
Impaired glucose tolerance*	27·2 [217]	8·1 [235]	10·3 [87]	12·5 [288]	20·7 [111]	38·5 [52]	18·7 [123]	17·0 [1113]
Non-insulin dependent diabetes mellitus*	14·3 [217]	7·2 [235]	3·4 [87]	8·7 [288]	18·0 [111]	13·5 [52]	5·7 [123]	9·8 [1113]
Hypertension*	19·4 [222]	13·0 [238]	5·7 [87]	15·4 [299]	12·2 [115]	12·7 [55]	15·7 [127]	14·5 [1143]
Mild hypercholesterolaemia*	26·8 [198]	19·0 [231]	23·5 [81]	30·5 [279]	33·7 [83]	17·6 [51]	32·0 [122]	26·6 [1045]
Hypercholesterolaemia*	9·6 [198]	5·2 [231]	7·4 [81]	7·9 [279]	8·4 [83]	15·7 [51]	37·7 [122]	11·4 [1045]
Hypertriglyceridaemia*	26·3 [198]	13·5 [230]	21·0 [81]	26·9 [279]	24·1 [83]	29·4 [51]	22·1 [122]	23·1 [1044]
Overweight†	22·7 [220]	21·3 [239]	11·5 [87]	20·0 [295]	22·6 [115]	23·6 [55]	18·9 [127]	20·5 [1138]
Obesity†	17·7 [220]	6·7 [239]	6·9 [87]	19·0 [295]	8·7 [115]	12·7 [55]	13·4 [127]	13·3 [1138]

*Prevalence rates adjusted for age, sex, and body mass index.
†Prevalence rates adjusted for age and sex.
‡Confidence intervals available from the authors.

significant even after taking into account (by Scheffe's test) various confounding factors—namely, age ($r=0\cdot5$; $p<0\cdot001$), sex ($r=0\cdot4$; $p<0\cdot01$), body mass index ($r=0\cdot4$; $p<0\cdot001$), low level of physical activity ($r=0\cdot3$; $p<0\cdot01$), family history of diabetes ($r=0\cdot2$; $p<0\cdot05$) and hypertension ($r=0\cdot2$; $p<0\cdot05$), and duration of residence in Tanzania ($r=0\cdot1$; $p<0\cdot05$)—which had shown positive correlation with dependent variables by simple correlation. The Suthar subcommunity—which, except in mean serum total cholesterol concentration, tended to have mean levels and prevalence rates of coronary heart disease risk factors similar to those of the total community—showed significant differences compared with the other subcommunities. The Bhatia and Patel subcommunities also showed differences compared with the other groups, tending in particular to have higher blood glucose concentrations and blood pressures.

Discussion

Much epidemiological research on ethnic minority groups is based on the pragmatic assumption that the subjects come from a homogeneous community. Thus "Asians" of Indian origin have been compared with Afro-Caribbeans, Chinese, Malaysians, South Africans, Europeans, and many other groups.[1-8] Such comparisons, though crude, have shown clear variations in disease frequency, which provide fertile ground for the development of new hypotheses. Recognising that the Indian community is heterogeneous, some researchers have further categorised their subjects by religion,[23] region of origin (in one study on the basis of name),[17] and language.[34] Of these, only religion provides a robust and predictable indicator of lifestyle differences which may be useful in explaining disease variation. At present there are no useful proxy indicators of socioeconomic differences comparable to social class for use in studies of health and ethnicity. And social class has not clearly been shown to be of value in studies of ethnic minorities from the Indian subcontinent. Hence our finding of substantial variations in health and lifestyle within a Hindu community is interesting.

The variations in disease prevalence and risk factor profiles that we found were not simply a result of chance or artefact of study design, method, or analysis. The underlying possible explanations may therefore be analysed in terms of host factors—for example, lifestyle and genetic differences—and environmental factors—for example, exposure to the agents of disease or socioeconomic circumstances.

The caste system is slowly disintegrating in many urban and migrant Indian communities but its influence continues to be particularly powerful in determining the choice of marital partner, and this is true in Dar-es-Salaam. Caste is also important in determining income and social position and, certainly in India, is an indicator of social class in the broad sense of the term. Hence the association between caste group and disease frequency discovered in our survey is not surprising.

The genetic component of non-insulin dependent diabetes mellitus is undoubted but its precise nature is unknown. The Hindu community stratified by caste, being a large, accessible, potentially genetically heterogeneous population with an extremely high prevalence of diabetes, may be ideal for future genetic studies of this disease, and of others where disease variation can be shown.

McKeigue *et al* argued that an environmental factor for the high rates of coronary heart disease in south Asians is unlikely because such a factor would need to be common to all the main ethnic groups and to both sexes and to be persistent over several generations.[18] Yet they recognised that Indian populations overseas are likely to be genetically dissimilar. They could not reconcile the consistent findings of a high incidence of diabetes and heart disease with either genetic or environmental explanations. Our data complicate matters further. They show that the perspective that the prevalence of diabetes is consistently and uniformly higher in south Asians is incomplete; there are subgroup variations. The same probably applies to coronary heart disease but remains to be shown clearly.

Variations were seen in lifestyle (smoking, alcohol consumption, physical activity), socioeconomic activity (education, type of occupation, duration of residence in Tanzania, etc), and risk factors for coronary heart disease and diabetes such as cholesterol concentration and body mass index. The disease variations could not simply be explained on the basis of these differences. More detailed work on these and other factors relating to lifestyle and environment is needed to determine their true contribution to the disease variation; to assess whether the strength of their relation with disease outcome is comparable with that in Europid populations; and, as the basis of health education endeavours, to seek to understand the reasons for lifestyle differences among apparently similar people.

Diet has been suggested as an important contributory factor in the high rates of coronary heart disease in migrants from the Indian subcontinent[35 36] but other studies, from India[26] and the United Kingdom,[37] do not support this. Although our survey did not include a detailed dietary analysis, we could not explain the variations in terms of a vegetarian or non-vegetarian diet.

The subgroup variations identified, emphasising the diversity within ethnic minority groups, may thwart those developing policies and plans in their attempts to assess and make generalisations about the health needs of such communities. The variations are, however, extremely exciting epidemiologically, offering new opportunities to unravel the aetiology of a range of noncommunicable diseases and their risk factors. Detailed studies of Hindu Indian subcommunities both in India and abroad are warranted to confirm and extend the descriptive findings in this report and to seek variation in other diseases, lifestyles, and risk factors.

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Serum cholesterol concentration and coronary heart disease in population with low cholesterol concentrations

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Abstract

Objective—To examine the relation between serum cholesterol concentration and mortality (from coronary heart disease and from other causes) below the range of cholesterol values generally seen in Western populations.

Design—Prospective observational study based on 8-13 years of follow up of subjects in a population with low cholesterol concentrations.

Setting—Urban Shanghai, China.

Subjects—9021 Chinese men and women aged 35-64 at baseline.

Main outcome measure—Death from coronary heart disease and other causes.

Results—The average serum cholesterol concentration was 4·2 mmol/l at baseline examination, and only 43 (7%) of the deaths that occurred during 8-13 years of follow up were attributed to coronary heart disease. There was a strongly positive, and apparently independent, relation between serum cholesterol concentration and death from coronary heart disease ($z=3·47$, $p<0·001$), and within the range of usual serum cholesterol concentration studied (3·8-4·7 mmol/l) there was no evidence of any threshold. After appropriate adjustment for the regression dilution bias, a 4 (SD 1)% difference in usual cholesterol concentration was associated with a 21 (SD 6)% (95% confidence interval 9% to 35%) difference in mortality from coronary heart disease. There was no significant relation between serum cholesterol concentration and death from stroke or all types of cancer. The 79 deaths due to liver cancer or other chronic liver disease were inversely related to cholesterol concentration at baseline.

Conclusion—Blood cholesterol concentration was directly related to mortality from coronary heart disease even in those with what was, by Western standards, a "low" cholesterol concentration. There was no good evidence of an adverse effect of cholesterol on other causes of death.

Introduction

In populations in which the mean serum cholesterol concentration is relatively high (such as those in Europe and North America) prospective observational studies indicate a strong, direct association between serum cholesterol concentration and coronary heart disease.[1-6] Questions remain, however, about the relation at lower concentrations of cholesterol.