ORIGINAL ARTICLE

The Wandsworth Heart and Stroke Study. A population-based survey of cardiovascular risk factors in different ethnic groups. Methods and baseline findings

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Abstract

Background and Aims: *Around the world the risk of cardiovascular disease varies by ethnic group. These differential risks are, in part, not acquired with migration, suggesting that genetic make-ups may be important. However, it is now clear that environmental and modifiable factors relating to diet and life-style play an important role. The aims of the present population-based survey in South London were (i) to estimate the prevalence of cardiovascular risk factors in both men and women of different ethnic background; (ii) to provide data on current detection rates and management of hypertension and diabetes; (iii) to study the differences in cardiovascular risk factors "between" ethnic groups as well as the associations "within" each ethnic group; (iv) to study the distributions by ethnic group of new putative risk factors.*
Methods and Results: *We carried out a population-based cross-sectional survey of 1,577 men and women all residents in a geographically-defined area of South London and belonging to the three ethnic groups mostly represented in the area. There were 523 whites, 549 people of African origin and 505 of South Asian origin. They underwent a comprehensive screening including physical measurements, a questionnaire, blood and urine tests and an oral glucose tolerance test. Amongst the results, hypertension was more common amongst people of African origin whereas diabetes was by far the most important risk factor amongst South Asians. The latter group displays a clear-cut metabolic pattern suggestive of insulin resistance such as hyperinsulinaemia and hyperglycemia, both fasting and post-load, high fasting triglycerides and low HDL-cholesterol levels and central obesity. Severe obesity amongst women of African origin is also of great concern.*
Conclusions: *The focus of cardiovascular prevention in ethnic minorities should concentrate on the improvement in the prevention, detection and management of hypertension and diabetes, as well as of severe obesity in women of African origin. Preventive and therapeutic strategies developed and assessed in white populations may not apply to ethnic minorities. Strategies should be specifically developed, validated and assessed to consider both cultural acceptability and underlying susceptibility. These actions will require the involvement of both primary and secondary health care settings.*
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Introduction

Cardiovascular disease is the most common and yet one of the most preventable causes of death. Moreover the risk of premature disease varies by ethnic group. Relative to white subjects, Afro-Caribbeans and people of African descent have high incidence of stroke (1) and end-stage renal failure (2, 3) whereas coronary heart disease (CHD) is less common. On the other hand, South Asians (from the Indian sub-continent and from East Africa) have a higher

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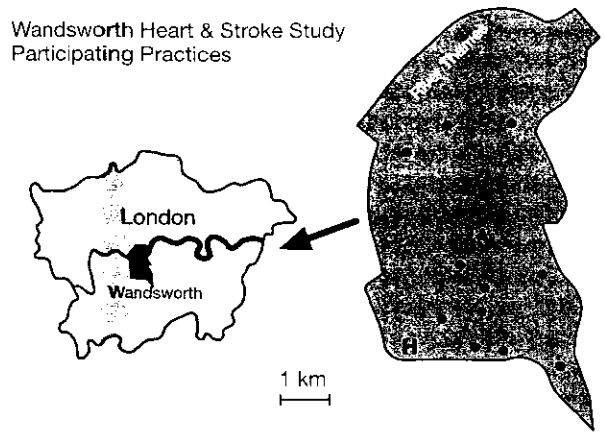
FIGURE 1
General Practice network in the Wandsworth Heart & Stroke Study. The study was carried out in a geografically defined area of South London (Wandsworth Health Authority). The symbol H indicates St. George's Hospital where the screening unit was set up. The triangle indicates the General Practice's surgery in which the pilot study was carried out in 1992. The circles indicate the participating surgeries where the study was carried out between 1994 and 1996.



incidence of CHD (1). These different risks are not acquired with migration (4). Although different genetic make-ups might, in part, explain such differences, environmental and modifiable factors relating to diet and life-style play an important role (5). Over the past twenty years the population belonging to ethnic minorities has increased in the United Kingdom as well as in many countries in Europe. Furthermore, these populations are now ageing and the burden of chronic disease is becoming an important one. In the United Kingdom, about 3 million people belong to ethnic minorities. They mostly cluster in and around inner city areas where they may represent a disproportionate number of the local population with specific health needs (6). Understanding the pattern of disease causation among ethnic minority groups in the UK may also help in understanding the mechanisms underlying the rapid onset of a cardiovascular epidemic in developing countries of Africa and Asia (7, 8).

We carried out a population-based survey in South London: (i) to estimate the prevalence of the major cardiovascular risk factors in both men and women of different ethnic background; (ii) to provide data on current detection rates and management of hypertension and diabetes; (iii) to study the differences in cardiovascular risk factors "between" ethnic groups as well as the associations "within" each ethnic group; (iv) to study the distributions by ethnic group of new putative risk factors.

Methods

Population sampling

The general practice sample was drawn from within the former Wandsworth Health Authority (WHA) in South London (Figure 1). It has a population of approximately 190,000. About 25% of residents were born outside the U.K.; 12% were of African descent and 6% of Indian or Pakistani origin. There were 65 General Practices in the WHA. The population of different ethnic background is not evenly distributed across practices and areas of the District (7). For instance, the majority of Caribbeans live in the Wandsworth-Clapham-Battersea area and in Streatham; West Africans are mostly concentrated in Balham, Mitcham and Streatham and South Asian communities live predominantly in Balham, Tooting, Mitcham and Wandsworth. As a consequence, a sampling procedure aimed at achieving a "random" sample of each ethnic group of "equal" size had to consider these demographic characteristics. The 65 practices were surveyed to assess the suitability and willingness to participate. Practices were considered unsuitable if they did not have a computerised age- and sex-register, did not have a sufficient ethnic minority population registered or were unwilling to participate. Out of the 25 practices deemed suitable, 9 were selected to provide a balanced geographic and ethnic mix. One was fund-holding, two were of single-handed practitioners and six were health centres with four to six practitioners. From each practice, a list was obtained of all men and women aged 40-59 years registered with the practice and resident within the study area. Participants with Chinese, Japanese or Vietnamese names were excluded, as were patients with cancer, severe disability, severe psychiatric disturbance or pregnant women. In order to obtain an approximately equal number of participants in each sex-ethnic-specific stratum, all names suggestive of a South Asian origin and of West African origin were selected. In addition patients of Afro-Caribbean origin were identified by a combination of name searching and contact with the general practitioners and the receptionist or practice nurse at the surgery. In a pilot study carried out in 1992, name searching identified 80% of whites, 94% of South Asians

and West Africans but only 51% of Caribbeans. This precision improved when contact with practices'staff was used. The results of the likely response rate of the pilot study were used in the main study to draw a proportional random sample of white patients so as to yield a number of participants approximately equal to the other ethnic groups.

Fieldwork was undertaken from March 1994 to July 1996. Ethnic group was recorded at the time of interview based on the answers to a combination of questions including place and country of birth, language, religion, history of migration and parental country of birth (8) and in accordance with the 1991 Census for England. Three thousand six hundred and six invitations were sent on headed paper of each individual practice and co-signed by a general practitioner and the study co-ordinator. Translations in four main Asian languages were also provided. A first and, if necessary, up to two reminders were sent by recorded delivery. Whenever possible the invitations were followed up by a telephone call. Nine hundred fifty-two (26%) letters of invitation were returned by the Post Office. Of the 2,654 men and women who received invitations, 479 (18%) never responded, 480 (18%) refused to participate and 1,695 (64%) took part. To those who refused to take part, a questionnaire was sent to establish basic demographic characteristics and medical history for vascular disease. The response rate was 76% (363/480).

Ten percent (96/952) of the addressees whose letters were returned by the Post Office and 56% (269/479) of those who never responded and whose letters were not returned appeared on the Electoral Register. It seems likely that a substantial proportion of those not responding were not currently living at the address and that, on balance, our response rate represents an underestimate of the true response rate. Eight records were removed due to incomplete examination so that a total sample of 1,687 was available. One hundred and ten participants were then removed from the present analysis since they did not belong to one of the three ethnic groups under study. The final sample size was 1,577.

Sample size considerations

Sample size estimates were carried out considering both power and precision. For example, the expected prevalence of diabetes in white men was 5% and in South Asian men was 15% (9). At least 250 participants in each group were therefore needed to have a power of 90% to detect that difference in prevalence at the 1% level of significance with a standard error of ±2% for the prevalence point estimates. A target sample size of at least 1,500 was chosen (approx. 250 in each sex and ethnic stratum). The study protocol was approved by the Local Ethics Committee. All participants gave their informed consent to participate.

Participants attended a dedicated screening unit at St.George's Hospital between 08:00 am and 12:00 noon after an overnight fast. Their invitation letters asked them to refrain from smoking and from taking vigorous exercise for at least one hour before the visit and to bring all medications with them for checking.

Physical measurements

Height was measured to the nearest cm with a ruler attached to the wall and the subject without shoes; weight was measured to the nearest 0.1 kg on an electronic scale (Marsden 770, Marsden Weighing Machine Group Ltd., London, England) with the subject wearing light indoor clothing and no shoes. The body mass index (BMI) was calculated as weight in kg divided by the square of the height in meters. After the subject had been resting for at least 10 minutes in the supine position, systolic and diastolic blood pressures were taken three times 2 minutes apart with an automatic ultrasound sphygmomanometer (Arteriosonde, Roche)(10) by nurses who had attended training sessions for standardisation of the procedure. Blood pressure was measured in the left arm using cuffs of a size appropriate to the arm circumference (11). The average of the last two readings was used for the analyses.

A urine Diastix (BM-Test 8: Boehringer Mannheim, Mannheim, Germany) was used to check for the presence of glycosuria. Fasting venous blood was taken in the seated position without stasis.

Oral glucose tolerance test

After these measurements and procedures, participants not known to be diabetic and without glycosuria (defined as urinary glucose ≥5.5 mmol/l) drank 75 g of dextrose monohydrate (Glucose BMS, Bio-Medical Services Ltd., York, England) dissolved in 250 ml of tap water over 5 min and a second venous blood sample was taken 2h later (±5 min).

Blood tests

Blood samples were processed within 2-3 h. Fluoride plasma was sent to the local laboratory for immediate determination of glucose by the glucose oxidase method. Blood for lipids was collected in plain Vacutainer tubes, left to clot, spun at 3000 rpm for 10 min at 4°C and serum separated and stored at -40°C until assayed. Aliquots were shipped in dry ice to the University of Naples (Prof. P. Strazzullo) for biochemical analysis. Serum electrolytes were measured by an

ion-selective electrode (Beckman Electrolyte EA2, Brea, California, USA), creatinine by the picric acid colorimetric method, uric acid by an enzymatic colorimetric method and lipids by automated methods (Cobas Mira, Roche, Milan, Italy). High-density lipoprotein (HDL) cholesterol was separated from the other lipoprotein fractions by precipitation with sodium phosphotungstate and magnesium chloride. The coefficients of variation (CV) between assays were 1.8% for total cholesterol, 1.6% for triglycerides, 2.9% for HDL-cholesterol, 2.1% for creatinine and 0.9% for uric acid. In addition lipid determinations underwent an external quality control from the WHO Lipid Reference Centre in Prague with calculations of precision (CV) and accuracy (bias) over the period of the study. The average CVs were 2.5% for total cholesterol, 3.2% for triglycerides and 3.3% for HDL-cholesterol. The average biases were +1.9% for total cholesterol, +1.3% for triglycerides and +2.0% for HDL-cholesterol. Insulin assays were performed in the Department of Medicine, University of Newcastle-upon-Tyne (Prof. K.G.M.M. Alberti) on fasting and 2h post-load samples which were stored at -40°C for a few months. Serum insulin concentration was determined by a two-site ELISA using commercially available monoclonal antibodies raised against human insulin (Novo Nordisk A/S, Denmark) which do not cross-react with proinsulin (12). The lower limit of detection for the ELISA was 1 mU/l. All haematological parameters were determined by Coulter Counter at St George's Hospital Medical School.

Questionnaire

An administered questionnaire included place of birth, language, religion, history of migration, parental place of birth, socio-economic status, family and personal medical history and drug therapy. Current and past smoking were recorded. Subjects were classified as non-smokers (if they had never smoked cigarettes, cigars or pipe), ex-smokers (if they had smoked cigarettes in the past and were not regular cigar or pipe smokers at the present) and current smokers (if they were regularly smoking one or more cigarettes, cigars or pipe per day). Each participant was also asked whether he/she drank alcohol on a regular basis. If yes they were asked to report their alcohol intake during the week preceding the interview, specifying three types of alcoholic beverages (beer, wine and spirits) and whether they drank during week-days or at week-ends. The participants were then grouped as abstainers or regular drinkers, and the latter were classified by increasing alcohol consumption defined as units of alcohol (1 unit being half a pint of beer, a glass of wine or a measure of spirits). Leisure-time physical activity (LTPA) was assessed by the Liverpool questionnaire, after modification (13). In brief, LTPA was assessed for a recall period of 14 days preceding the interview by one interviewer using a fixed protocol. Subjects were shown lists of leisure activities and reported which of these (and any other not shown) they had performed during the past 14 days, and on how many occasions. All reported activities were noted on similar lists by the interviewer. Subjects were then probed as to when each activity was performed and for how long. Following the interview, leisure activities were grouped according to previously defined classifications of intensity; very hard (≥0.122 kcal/kg/min or ≥7.0 METS, a MET being a multiple of a body's resting metabolic rate), hard (0.087-0.121 kcal/kg/min or 5.0-6.9 METS) and moderate (0.052-0.086 kcal/kg/min or 3.0-4.9 METS). This method has been shown to be a reliable measure of regular physical activity and a valid estimate of cardiorespiratory fitness (13).

24 h urine collection

After the interview, participants were asked to collect a 24h urine sample within a few days. They were given written detailed instructions on how to collect a complete 24h urine sample and were given a 2.5 l plastic bottle to take with them. Complete urine collections were either returned by the participants or were collected at the participant's address. Time and volume of collections were immediately recorded, aliquots taken and stored at -20°C until assayed. Sodium, potassium, creatinine and calcium were measured by standard methods.

Definition of risk factors

Hypertension was defined according to ISH/WHO criteria (systolic blood pressure ≥160 mmHg and/or diastolic blood pressure ≥95 mmHg (14), or being on pharmacological treatment for hypertension) and also according to JNC criteria (systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg (15), or being on pharmacological treatment for hypertension). The Arteriosonde has been validated as providing blood pressures directly comparable with standard mercury sphygmomanometers (10). Diabetes was defined according to the WHO criteria for epidemiological investigations by using venous plasma (16), that is fasting glucose ≥7.8 mmol/l or glucose 2h after oral loading ≥11.1 mmol/l, or both. Subjects who at the time of the study had already been diagnosed as diabetic ("known diabetic") and those with a Diastix glycosuria at the time of screening were assumed to be diabetic. Obesity was defined as a BMI>27 kg/m^2 (moderate) or BMI>30 kg/m^2 (severe) in

both men and women. Raised serum cholesterol was considered at two different cut-offs (>5.2 and >6.5 mmol/l).

Data handling and statistical analysis

All data from interviews and laboratory tests were entered into pre-coded standard forms and double-entered in computerised form. In many instances laboratories provided electronic copies of results. Data were then checked for consistency. Statistics presented in this paper are descriptive statistics of baseline findings. Totals that do not add up to the total for the whole population are due to missing values. The main emphasis is given to comparisons between ethnic groups within each gender. Throughout the presentation, statistical inference will be carried out using tests for heterogeneity between ethnic groups. Gender differences will not be formally tested, although it will be apparent that there are many significant differences between men and women. However, in most circumstances, the differences between ethnic groups are consistent within each gender. Descriptive characteristics are reported as numbers and proportions or means and 95% confidence intervals (95% c.i.), as appropriate. Further comparisons are made by using age-standardisation with the direct method, using five-year age bands with equal numbers in each band as a standard population for categorical variables and by analysis of covariance for continuous variables. Exact 95% c.i. are used. Where frequency distributions were significantly skewed, statistical analysis was carried out on log-transformed values and geometric means are reported for ease of reference to absolute values. Analysis of covariance was used to test for heterogeneity between ethnic groups.

Results

By design the three ethnic groups were of similar sample sizes (523 whites, 549 of African descent and 505 of South Asian origin) with comparable numbers of men and women. The South Asian group was slightly younger (49.4±5.9 yrs; mean±SD) and the group of African descent slightly older (51.1±5.8 yrs) than the white group (49.8±5.6 yrs).

Characteristics of the ethnic minority groups under study

In the group of African descent there were 326 individuals (59.4%) born in the Caribbean, 189 (34.5%) born in Africa and 31 (5.7%) born in South America (Guyana). The majority (391;71.9%) had English as their first language. Amongst the group of South Asian origin, about two-thirds (324; 64.3%) were born in South Asia and a quarter (142; 28.2%) in East Africa. Only 10% (n=50) had English as their first language. Common languages were Gujerati (196; 39.0%), Urdu (64; 12.8%) and Bengali (51; 10.2%). About half were Hindu (251; 49.8%) and over a third Muslim (188; 37.3%). There were 138 (27.4%) vegetarians. The majority of the ethnic minority groups studied were first-generation immigrants to the UK: 473/505 (93.7%) South Asians and 506/549 (92.2%) of African origin. In all cases both parents were born outside the UK. The median length of stay was 23 years in South Asians and 31 years in people of African origin (24 years in West Africans and 33 years in Caribbeans). This pattern reflects very well the separate waves of migration to the UK from Commonwealth countries, the first being from the Caribbean in the late 50's and early 60's, followed by more recent migration of South Asian groups from India, Pakistan, Bangladesh, Sri Lanka and East Africa and,

TABLE 1
Socio-economic characteristics of the participants in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian	
	n	%	n	%	n	%
Social Class of the Head of Household						
Professional and Managerial (I+II)	187	36.3	123	23.2	212	44.2
Clerical and Skilled Manual (IIINM+M)	241	46.8	249	47.0	202	42.1
Semi-skilled and Unskilled Manual (IV+V)	79	15.3	156	29.4	60	12.5
Others*	8	1.6	2	0.4	6	1.3
Total	515		530		480	
Head of the household in employment						
Yes	386	74.0	354	64.5	317	62.8
No	136	26.0	195	35.5	188	37.2
Total	522		549		505	

*Includes Armed Forces and Housewives

TABLE 2
Smoking habit in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian	
	n	%	n	%	n	%
Men						
Current cigarette smokers	80	34.5	35	16.8	57	22.5
Current pipes/cigars*	11	4.7	6	3.0	5	2.0
Ex-smokers	90	38.8	54	26.0	50	19.8
Never smokers°	51	22.0	113	54.3	141	55.7
Total	232		208		253	
Women						
Current cigarette smokers	94	32.4	29	8.5	7	2.8
Ex-smokers	81	27.9	29	8.5	5	2.0
Never smokers	115	39.7	283	83.0	240	95.2
Total	290		341		252	

*but not current cigarette; °includes ex-pipe/cigar smokers

finally, of groups of African origin from East as well as West Africa.

Socio-economic characteristics

The highest proportion of married participants was seen amongst the group of South Asian origin (430; 85.2%). Separated and divorced accounted for only 5.0% (n=25) of the overall South Asian sample. On the other hand 18.2% (n=95) of whites were single, and separated and divorced were higher in both whites (101; 19.3%) and in people of African origin (109; 19.8%). These differences reflect the great socio-cultural differences between ethnic groups.

Social class was coded using the Standard Occupational Classification (17). Our analysis is based on the occupation of the head of the household. Although extensively validated in the white population of England and Wales as a good

TABLE 3
Self-reported alcohol consumption in the previous week in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian	
	n	%	n	%	n	%
Men						
Number of Units/Week						
None	47	20.8	84	40.8	164	65.6
1-5	34	15.0	50	24.3	35	14.0
6-10	31	13.7	35	17.0	18	7.2
11-15	20	8.9	14	6.8	13	5.2
16-21	26	11.5	11	5.3	1	0.4
>21	68	30.1	12	5.8	19	7.6
Total	226		206		250	
Women						
Number of Units/Week						
None	110	39.0	209	62.2	229	91.2
1-5	74	26.2	93	27.7	15	6.0
6-10	47	16.7	36	8.0	4	1.6
11-14	20	7.1	19	1.2	1	0.4
>14	31	11.0	2,4	0.9	2	0.8
Total	282		336		251	

TABLE 4
Levels of leisure-time physical exercise in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian	
	n	%	n	%	n	%
Men						
Any exercise						
Yes	119	51.1	73	35.1	99	39.1
No	114	48.9	135	64.9	154	60.9
Any hard* exercise						
Yes	67	28.8	46	22.1	42	16.6
No	166	71.2	162	77.9	211	83.4
Women						
Any exercise						
Yes	156	53.8	110	32.3	73	29.0
No	134	46.2	231	67.7	179	71.0
Any hard* exercise						
Yes	83	28.6	55	16.1	22	8.7
No	207	71.4	286	83.9	230	91.3

* ≥ 0.087 kcal/kg/min or ≥ 5 METS

proxy measure of socio-economic status, there is no proper validation for this method when applied to ethnic minority groups. In particular the socio-economic structure of many South Asian families may not be well characterised by the measures we traditionally use. People of African origin tended to have a higher proportion of unskilled manual workers, whereas the highest proportion of people from social class I and II was amongst the South Asians (Table 1). At first sight, these social class distributions would point to a higher degree of socio-economic deprivation amongst people of African origin and a greater degree of affluence amongst the South Asian group. However, other traditional measures of socio-economic conditions indicate that South Asians had the lowest proportion of heads of household in employment (Table 1). At the same time South Asians were more likely to own their house (though on a mortgage) (82% *vs* 71% of African descent and 67% of whites) and least likely to depend on local authority housing (5% *vs* 12% of African descent and 15% of whites). These measures taken together suggest that more complex socio-economic markers are needed to characterise ethnic minority groups.

Life-style characteristics

As part of the survey on cardiovascular risk factors, emphasis has been given to a number of life-style factors directly associated with cardiovascular outcome, at least in white populations. One major objective was to obtain a good comparison of such factors between ethnic groups co-resident in a geographically defined area of South London and studied with highly standardised methods. Within each gender, there are differences in smoking rates by ethnic groups (Table 2). Ethnic minority groups have fewer smokers than whites, and very few amongst women. This is of great interest as it reflects, at least in part, cultural and religious practices. The risk behaviour associated with smoking is also different amongst people of African origin since the current smokers are almost exclusively amongst the Caribbean people and not amongst the West Africans (18). Although these lower smoking rates amongst people of African origin fit with their low risk of ischaemic heart disease, the low rates amongst the South Asian men and women do not explain their excess in coronary risk.

Self-reported alcohol consumption was recorded by questionnaire and results are reported in Table 3. In men, non-

TABLE 5
Age-adjusted anthropometry, blood pressure and heart rate in men aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Weight (kg)	232	78.6 (76.9, 80.2)	208	78.9 (77.2, 80.7)	252	71.7 (70.1, 73.2)	<0.001
Height (cm)	232	174.6 (173.7, 175.4)	208	172.7 (171.8, 173.6)	252	169.9 (169.1, 170.8)	<0.001
Body Mass Index/(kg/m^2)	232	25.8 (25.3, 26.3)	208	26.4 (25.9, 26.9)	252	24.8 (24.3, 25.2)	<0.001
Waist circumference (cm)	232	92.2 (90.9, 93.6)	208	91.2 (89.8, 92.6)	253	90.9 (89.6, 92.2)	0.324
Hip circumference (cm)	232	99.8 (98.9, 100.7)	208	99.3 (98.3, 100.3)	253	96.2 (95.3, 97.1)	<0.001
Waist-to-hip ratio	232	0.922 (0.915, 0.929)	208	0.918 (0.910, 0.925)	253	0.944 (0.937, 0.951)	<0.001
Systolic blood pressure (mmHg)	233	127.9 (125.5, 130.3)	208	133.8 (131.3, 136.3)	253	131.0 (128.7, 133.3)	0.004
Diastolic blood pressure (mmHg)	233	82.1 (80.7, 83.4)	208	87.6 (86.2, 89.0)	253	85.4 (84.1, 86.7)	<0.001
Heart rate (b/min)	231	64.0 (62.6, 65.4)	204	64.4 (62.9, 65.8)	246	66.9 (65.5, 68.2)	0.006

TABLE 6
Age-adjusted anthropometry, blood pressure and heart rate in women aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Weight (kg)	290	67.9 (66.4, 69.4)	340	76.3 (74.9, 77.7)	252	65.3 (63.7, 66.9)	<0.001
Height (cm)	290	161.4 (160.7, 162.1)	340	161.4 (160.7, 162.0)	251	155.1 (154.3, 155.8)	<0.001
Body Mass Index/(kg/m^2)	290	26.1 (25.5, 26.7)	339	29.3 (28.8, 29.8)	251	27.1 (26.5, 27.8)	<0.001
Waist circumference (cm)	290	82.0 (80.6, 83.3)	340	88.6 (87.4, 89.8)	252	86.4 (84.9, 87.8)	<0.001
Hip circumference (cm)	290	102.5 (101.5, 103.6)	340	106.5 (105.5, 107.5)	252	101.9 (100.7, 103.0)	<0.001
Waist-to-hip ratio	290	0.798 (0.789, 0.807)	340	0.832 (0.824, 0.841)	252	0.848 (0.838, 0.858)	<0.001
Systolic blood pressure (mmHg)	290	123.5 (121.5, 125.6)	341	134.1 (132.2, 136.0)	250	127.9 (125.7, 130.1)	<0.001
Diastolic blood pressure (mmHg)	290	77.2 (76.1, 78.3)	341	84.7 (83.7, 85.7)	250	79.8 (78.6, 81.0)	<0.001
Heart rate (b/min)	285	64.9 (63.7, 66.1)	336	66.3 (65.2, 67.4)	246	69.3 (67.9, 70.6)	<0.001

drinkers were more common amongst ethnic minority groups (twice more common amongst people of African origin and three times amongst South Asians). Nearly one in three white men admitted drinking in excess of the recommended levels for British adult men (*eg*>21 units per week). In women, the large majority (more than 90%) of South Asian women were non-drinkers. More than 10% of white women admitted drinking in excess of the recommended levels for British adult women (*eg*>14 units per week). Excessive drinking was rare in men of ethnic minority groups and almost undetectable in women of ethnic minority. These important differences in drinking habits by ethnic group reflect cultural and religious attitudes towards alcohol use.

Table 4 reports LTPA levels in both men and women of different ethnic groups. In the population as a whole 60% were totally inactive (403/694 men or 58% and 544/883 women or 62%). The proportion of people engaging in any regular exercise was much less in men and women of ethnic minorities and the proportions became very low when they were asked about levels of hard exercise. These figures point directly to an important lifestyle pattern typical of developed countries and of inner city areas, and suggest important disadvantages amongst middle-aged men and women of ethnic minority groups.

Anthropometric characteristics

There were significant differences in anthropometry by ethnic groups. In men (Table 5), South Asians were lighter

TABLE 7
Age-adjusted biochemical and metabolic variables in men aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Serum sodium (mmol/l)	220	140.0 (139.6, 140.4)	196	139.7 (139.3, 140.1)	235	139.1 (138.7, 139.5)	0.003
Serum potassium (mmol/l)	220	4.26 (4.22, 4.30)	196	4.16 (4.12, 4.20)	235	4.29 (4.25, 4.33)	<0.001
Serum creatinine (μmol/l)	220	91.0 (89.3, 92.7)	195	103.6 (101.8, 105.4)	235	94.2 (92.5, 95.9)	<0.001
Serum uric acid (μmol/l)	226	329 (319, 339)	197	337 (326, 348)	239	329 (319, 339)	0.474
Serum cholesterol (mmol/l)	226	6.21 (6.07, 6.35)	197	5.45 (5.30, 5.60)	239	5.74 (5.61, 5.88)	<0.001
*Serum triglycerides (mmol/l)	226	1.31 (1.23, 1.39)	197	0.89 (0.83, 0.95)	239	1.53 (1.44, 1.62)	<0.001
*Serum HDL-cholesterol (mmol/l)	226	1.22 (1.18, 1.26)	197	1.31 (1.27, 1.36)	239	1.05 (1.01, 1.08)	<0.001
*Fasting plasma glucose (mmol/l)	224	5.14 (4.98, 5.29)	193	5.40 (5.23, 5.59)	242	5.67 (5.50, 5.83)	<0.001
*Post-load plasma glucose (mmol/l)	173	5.02 (4.75, 5.30)	126	5.38 (5.04, 5.75)	166	6.10 (5.76, 6.46)	<0.001
*Fasting serum insulin (mU/l)	217	7.1 (6.5, 7.8)	187	7.9 (7.2, 8.7)	233	10.1 (9.2, 11.0)	<0.001
*Post-load serum insulin (mU/l)	170	25.1 (21.9, 28.9)	123	31.8 (27.0, 37.6)	161	66.4 (57.5, 76.8)	<0.001

*Geometric Means

TABLE 8
Age-adjusted biochemical and metabolic variables in women aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Serum sodium (mmol/l)	272	139.6 (139.3, 140.0)	300	140.0 (139.7, 140.3)	227	139.4 (139.0, 139.7)	0.036
Serum potassium (mmol/l)	272	4.26 (4.23, 4.29)	300	4.14 (4.11, 4.18)	227	4.23 (4.19, 4.26)	<0.001
Serum creatinine (μmol/l)	270	76.6 (75.2, 78.1)	300	84.0 (82.6, 85.3)	229	75.9 (74.4, 77.5)	<0.001
Serum uric acid (μmol/l)	272	241 (233, 249)	303	256 (249, 264)	230	260 (252, 269)	0.001
Serum cholesterol (mmol/l)	274	6.21 (6.08, 6.34)	303	5.66 (5.53, 5.78)	230	5.66 (5.52, 5.80)	<0.001
*Serum triglycerides (mmol/l)	274	1.13 (1.08, 1.19)	303	0.79 (0.75, 0.83)	230	1.24 (1.17, 1.31)	<0.001
*Serum HDL-cholesterol (mmol/l)	274	1.47 (1.42, 1.52)	303	1.55 (1.50, 1.59)	230	1.27 (1.23, 1.32)	<0.001
*Fasting plasma glucose (mmol/l)	275	4.96 (4.83, 5.08)	306	5.12 (5.00, 5.24)	233	5.34 (5.19, 5.49)	<0.001
*Post-load plasma glucose (mmol/l)	204	5.55 (5.32, 5.79)	216	5.81 (5.58, 6.06)	165	6.66 (6.36, 6.99)	<0.001
*Fasting serum insulin (mU/l)	266	6.6 (6.2, 7.1)	289	8.8 (8.2, 9.4)	219	11.0 (10.2, 11.9)	<0.001
*Post-load serum insulin (mU/l)	196	34.1 (30.8, 37.9)	207	43.9 (39.6, 48.5)	154	83.7 (74.4, 94.1)	<0.001

*Geometric Means

and shorter with a lower BMI. They also had greater waist-to-hip ratio than the other ethnic groups, mainly because, in spite of a smaller hip circumference, they had comparable waist circumference to the other groups. In women (Table 6), those of African origin were heavier and, as they were not taller than white women, their BMI was the highest. South Asian women were shorter but were not the lightest. Waist-to-hip ratio was highest in South Asian women, still higher in women of African origin than white women. In summary, measures of body mass and adiposity differed by ethnic group. It is also apparent that these measures have different meanings in different gender and ethnic groups.

Blood pressure and heart rate

Systolic and diastolic blood pressure were significantly higher in people of ethnic minorities in both men and women (Tables 5 and 6). Compared to whites, men of African origin had 5.9/5.5 mmHg higher blood pressure and South Asian men 3.1/3.3 mmHg. Women of African origin had 10.6/7.5 mmHg higher blood pressure and South Asians had 4.4/2.6 mmHg higher blood pressure than white women. These differences were present despite a greater proportion of people amongst ethnic minority groups being on antihypertensive treatment. Heart rate was significantly faster in South Asian men (Table 5) and women (Table 6) and may either indicate a higher degree of sympathetic nervous system activation or lack of cardiovascular fitness.

Biochemical characteristics

Tables 7 and 8 summarise the age-adjusted biochemical characteristics by ethnic groups in men and women. There were numerous significant differences. In particular serum potassium was significantly lower in people of African origin. The reason for this is not yet clear. It is important to remem-

TABLE 9
Age-adjusted haematological characteristics of men aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
White cell count (10^9/l)	226	6.6 (6.4, 6.8)	199	5.0 (4.7, 5.2)	248	6.5 (6.3, 6.7)	<0.001
Platelet count (10^9/l)	226	240 (234, 247)	198	198 (191, 205)	248	232 (226, 239)	<0.001
Haemoglobin (g/dl)	226	15.0 (14.8, 15.1)	199	14.3 (14.2, 14.5)	248	14.8 (14.6, 14.9)	<0.001
Red cell count (10^{12}/l)	226	4.87 (4.82, 4.93)	199	4.96 (4.90, 5.02)	248	5.11 (5.05, 5.16)	<0.001
Packed cell volume	226	0.438 (0.434, 0.442)	199	0.429 (0.424, 0.433)	248	0.439 (0.435, 0.442)	0.001
Mean corpuscolar volume (fl)	226	90.0 (89.3, 90.8)	199	86.7 (85.9, 87.5)	248	86.2 (85.4, 86.9)	<0.001

TABLE 10
Age-adjusted haematological characteristics of women aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
White cell count (10^9/l)	276	6.7 (6.5, 6.9)	308	5.1 (4.9, 5.3)	231	6.8 (6.6, 7.0)	<0.001
Platelet count (10^9/l)	276	263 (256, 270)	307	239 (232, 246)	231	269 (261, 276)	<0.001
Haemoglobin (g/dl)	276	13.4 (1 3.3, 13.6)	308	12.6 (12.5, 12.7)	231	12.7 (12.6, 12.9)	<0.001
Red cell count (10^{12}/l)	276	4.44 (4.40, 4.49)	308	4.47 (4.43, 4.51)	231	4.60 (4.55, 4.65)	<0.001
Packed cell volume	276	0.396 (0.392, 0.400)	308	0.380 (0.376, 0.383)	231	0.382 (0.377, 0.386)	<0.001
Mean corpuscolar volume (fl)	276	89.2 (88.4, 90.0)	308	85.3 (84.5, 86.0)	231	83.2 (82.3, 84.1)	<0.001

ber, however, the higher proportion of people of African origin on antihypertensive treatment, including thiazide diuretics. Serum creatinine was significantly higher in both men and women of African origin, reflecting their greater body mass.

Metabolic characteristics

The metabolic profile of lipids, glucose and insulin is reported in detail in Tables 7 and 8. There are striking differences between ethnic groups, consistent in both men and women. South Asians are characterised by high triglyceride levels, low HDL-cholesterol, both fasting and post-load hyperglycaemia and both fasting and post-load hyperinsulinaemia. These features suggest the presence of insulin resistance. In contrast, people of African descent appear to have the lowest triglyceride levels and high HDL-cholesterol levels, in spite of a tendency to hyperglycaemia and hyperinsulinaemia (both fasting and post-load), when compared to white people.

Haematology

Significant differences between ethnic groups were found in the haematological variables (Tables 9 and 10). Ethnic minority groups, as a whole, tended to have smaller red blood cell mean corpuscular volume. Haemoglobin concentration was lower in both men and women from ethnic minority groups. Also of interest is the lower white cell count in people of African origin.

Urinary sodium, potassium and calcium

In Tables 11 and 12 there is a tendency (statistically significant in women) for people of African origin to excrete more sodium than the other groups. Urinary potassium excretion is lowest amongst the South Asians, despite the higher proportion of vegetarians amongst them. When assessed as sodium-to-potassium ratio, there is a consistently higher ratio in South Asians, followed by people of African origin and, finally, whites. In both men and women (Tables 11 and 12) ethnic minority groups excreted significantly less calcium than whites.

Prevalence of cardiovascular risk factors

Tables 13 and 14 report the age-adjusted prevalence rates of major risk factors for cardiovascular disease in men and women separately according to ethnic origin. Different defi-

TABLE 11
Age-adjusted daily urinary variables in men aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Sodium (mmol/24h)	150	186.5 (175.0, 198.0)	144	187.6 (175.7, 199.5)	170	174.3 (163.3, 185.2)	0.195
Potassium (mmol/24h)	150	78.1 (74.5, 81.7)	144	68.8 (65.1, 72.6)	170	61.0 (57.5, 64.4)	<0.001
Sodium-potassium ratio	150	2.48 (2.32, 2.63)	144	2.85 (2.69, 3.01)	170	2.95 (2.81, 3.10)	<0.001
Calcium (mmol/24h)	145	4.8 (4.4, 5.1)	139	3.5 (3.2, 3.9)	163	3 9 (3.5, 4.2)	<0.001
Creatinine (mmol/24h)	148	14.2 (13.5, 14.9)	144	18.4 (17.7, 19.1)	167	12.3 (11.6, 12.9)	<0.001
Creatinine clearance (ml/min)	140	109.7 (104.2, 115.1)	133	123.1 (117.4, 128.7)	160	91.5 (86.4, 96.7)	<0.001
Volume (ml/24h)	156	2968 (2629, 3307)	147	2432 (2078, 2787)	176	2874 (2552, 3197)	0.077

TABLE 12
Age-adjusted daily urinary variables in women aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian		
	n	Mean (95% c.i.)	n	Mean (95% c.i.)	n	Mean (95% c.i.)	*P* values
Sodium (mmol/24h)	186	140.4 (131.8, 149.1)	238	158.3 (150.6, 166.0)	160	143.1 (133.7, 152.5)	0.005
Potassium (mmol/24h)	186	65.4 (62.4, 68.5)	238	63.7 (60.9, 66.4)	160	53.4 (50.1, 56.7)	<0.001
Sodium-potassium ratio	186	2.24 (2.10, 2.38)	238	2.64 (2.51, 2.76)	160	2.80 (2.65, 2.95)	<0.001
Calcium (mmol/24h)	188	4.1 (3.9, 4.4)	228	3.1 (2.9, 3.4)	157	3.0 (2.7, 3.3)	<0.001
Creatinine (mmol/24h)	181	9.7 (9.3, 10.1)	234	12.6 (12.2, 12.9)	159	8.0 (7.6, 8.4)	<0.001
Creatinine clearance (ml/min)	169	91.5 (87.6, 95.4)	212	106.1 (102.6, 109.6)	145	74.4 (70.1, 78.6)	<0.001
Volume (ml/24h)	195	2443 (2270, 2617)	248	2547 (2392, 2701)	164	2408 (2218, 2597)	0.489

nitions have been used according to the different cut-off points used in Europe and in the US. Whichever definition we used for hypertension, there was a higher prevalence in people of African descent, followed by a high prevalence in people of South Asian origin. This excess risk was present in both men and women. Prevalence of diabetes and of glucose intolerance were highest amongst people of South Asian origin. Increased rates of diabetes were also detected amongst people of African descent when compared to whites. Prevalence of obesity (BMI>27 kg/m^2) was 24% or higher in all groups, with an excess in women of African descent (68%). Severe obesity (BMI>30 kg/m^2) was also found to be disproportionately high in women of African descent (40%). More than 60% of the entire population sample had total cholesterol levels above 5.2 mmol/l. When the cut-off point of 6.5 mmol/l was used, more than a third of the white population had values exceeding that, whilst the prevalence of hypercholesterolaemia was lower in the ethnic minority groups. In summary, compared to whites, people of African descent have a greater prevalence of hypertension, diabetes and - in women only - severe obesity, whilst hypercholesterolaemia is less common. Similarly, people of South Asian origin have a higher prevalence of diabetes, and hypertension and hypercholesterolaemia are also less common.

Levels of detection, management and control of hypertension and diabetes

Using the definition of the WHO/ISH, 442 participants in the overall study had hypertension (28.0%). About half of these hypertensives were on drug therapy and their blood

TABLE 13
Age-adjusted prevalence rates of major risk factors for cardiovascular disease in men aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

Risk factor	White			African Origin			South Asian		
	n	%	(95% c.i.)	n	%	(95% c.i.)	n	%	(95% c.i.)
Hypertension (ISH/WHO)§	233	18	(13-24)	208	37	(31-44)	253	28	(22-34)
Hypertension (JNC)°	233	33	(27-40)	208	51	(44-58)	253	44	(38-51)
Diabetes (WHO)*	181	7	(4-11)	156	18	(12-25)	211	25	(20-32)
Impaired glucose tolerance (WHO)*	181	7	(4-12)	156	9	(5-15)	211	13	(9-18)
Obesity (BMI>27 kg/m^2)	232	31	(25-37)	208	39	(33-46)	252	24	(19-30)
Obesity (BMI>30 kg/m^2)	232	15	(11-20)	208	15	(11-21)	252	8	(5-13)
Hypercholesterolaemia (>5.2 mmol/l)	226	78	(73-83)	197	58	(51-65)	239	68	(62-74)
Hypercholesterolaemia (>6.5 mmol/l)	226	37	(31-44)	197	16	(11-22)	239	23	(18-28)

§ BP ≥160 and/or ≥95 mmHg or on drug therapy
°BP ≥140 and/or ≥90 mmHg or on drug therapy
*criteria following an OGTT (see methods)

TABLE 14
Age-adjusted prevalence rates of major risk factors for cardiovascular disease in women aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

Risk factor	White			African Origin			South Asian		
	n	%	(95% c.i.)	n	%	(95% c.i.)	n	%	(95% c.i.)
Hypertension (ISH/WHO)§	290	13	(9-17)	341	40	(35 - 45)	252	26	(21 - 32)
Hypertension (JNC)°	290	24	(19-29)	341	54	(48-59)	252	36	(30-42)
Diabetes (WHO)*	210	5	(3-9)	245	15	(11-20)	192	20	(15-27)
Impaired glucose tolerance (WHO)*	210	8	(5-12)	245	7	(4-11)	192	19	(14-25)
Obesity (BMI>27 kg/m^2)	290	34	(29-40)	339	68	(63-73)	251	48	(42-54)
Obesity (BMI>30 kg/m^2)	290	18	(14-24)	339	40	(35-45)	251	20	(15-25)
Hypercholesterolaemia (>5.2 mmol/l)	274	78	(73-83)	303	61	(55-66)	230	68	(62-74)
Hypercholesterolaemia (>6.5 mmol/l)	274	36	(31-43)	303	22	(17-27)	230	19	(14-24)

§ BP ≥160 and/or ≥95 mmHg or on drug therapy
°BP ≥140 and/or ≥90 mmHg or on drug therapy
*criteria following an OGTT (see methods)

pressure had been well controlled (Table 15). The proportion of hypertensives who were adequately treated was comparable across ethnic groups. Conversely, a greater proportion of hypertensives amongst people of African descent (25.2%) were receiving treatment that was inadequate to control their blood pressure. There were also hypertensive people who were not receiving treatment and those who had never been diagnosed before. The latter group was less amongst people of African descent. Using the definition of the JNC, 658 participants had hyperten-

TABLE 15
Levels of Detection, Management and Control of Hypertension of participants aged 40-59 years in the Wandsworth Heart & Stroke Study, 1994-96

	White		African Origin		South Asian	
	n	%	n	%	n	%
WHO/ISH criteria: Systolic ≥ 160 mmHg and/or Diastolic ≥ 95 mmHg or on anti-hypertensive treatment						
Hypertensive participants	79/523	15.1	230/549	41.9	133/505	26.3
adequately treated*	40	50.6	114	49.6	62	46.6
not adequately treated**	8	10.1	58	25.2	18	13.5
untreated°	14	17.7	31	13.5	17	12.8
undetected§	17	21.5	27	11.7	36	27.1
JNC criteria: Systolic ≥ 140 mmHg and/or Diastolic ≥ 90 mmHg or on anti-hypertensive treatment						
Hypertensive participants	148/523	28.3	310/549	56.5	200/505	39.6
adequately treated*	22	14.9	51	16.5	31	15.5
not adequately treated**	26	17.6	121	39.0	49	24.5
untreated°	40	27.0	56	18.1	31	15.5
undetected§	60	40.5	82	26.5	89	44.5

*participants with hypertension who were on treatment and whose blood pressure was below the cut-off point
**participants with hypertension who were on treatment and whose blood pressure was above the cut-off point
°participants with hypertension who were known hypertensives and on no drug therapy
§participants with hypertension who had never been told they had hypertension before the survey

sion (41.7%). Overall only one in six were receiving adequate treatment. A greater proportion of hypertensives amongst people of African descent (39.0%) were receiving treatment that was inadequate to control their blood pressure. There was still a substantial proportion of untreated hypertensives. More importantly, a proportion varying between 20% (WHO/ISH criteria) and 40% (JNC criteria) were unaware of their hypertension. This proportion was significantly lower amongst participants of African origin.

There were differences in the use of antihypertensive treatment between ethnic groups. Hypertensive people of South Asian origin made less use of diuretics (20%) and ACE inhibitors (12%) than the other ethnic groups (whites 31% and 25%, African descent 36% and 25% respectively). Furthermore, the use of combination therapy was more common amongst patients of African descent (43% *vs* 25% in whites and 16% in South Asians). These differences are difficult to interpret as they may reflect differences in the severity of blood pressure, in occurrence of side effects as well as in prescribing patterns between general practitioners.

Finally, 188 participants (15.7% of those undergoing an OGTT) had diabetes according to WHO criteria and 69 of them (36.7%) were receiving drug therapy. However, the proportion of those on drug therapy varied across ethnic groups (whites 25%, African descent 49%, South Asians 30%; p=0.025). Moreover, one-third of diabetics (62/188; 33.0%) were unaware of their condition and were diagnosed at the time of the survey. The detection of new cases tended to vary across ethnic groups and tended to be less amongst whites (*ie* more newly diagnosed diabetics at the time of the survey, whites 54%, African descent 26%, South Asians 33%). This may reflect a different degree of severity of diabetes leading to early diagnosis in patients of ethnic minority groups, or to different attitudes of the general practitioners to the early detection of asymptomatic diabetes.

Discussion

In the past 20 years several surveys have been carried out to establish the prevalence of risk factors for cardiovascular disease in different ethnic groups in England and Wales (9,19-26). Some were entirely (19, 20) or in part (9) of working populations, some studied mainly South Asian groups (22, 24, 25) or Afro-Caribbeans (21, 26), some focused on diabetes only (22, 24, 25).

The present study has some advantages. It is population-based, thus avoiding the "healthy worker" effect of surveys carried out in working populations. Given that ethnic minorities in Britain (in particular Caribbeans and Bangladeshi) are less likely to be in full-time regular employment, selection bias is likely. It uses highly standardised methodologies for the assessment of risk factors across different ethnic groups, thus avoiding systematic bias in comparisons between groups. It includes men and women in each ethnic group so that systematic analyses of gender differences in risk could be performed. It examines co-resident ethnic population samples in a geographically defined area so as to minimise variations in some environmental exposures and in factors influencing access to health care facilities, such as proximity factors. It is the first survey in the UK to include a large sub-sample of West African men and women, and to allow useful comparisons between people of African ancestry born in different parts of the world and settled in the same area of London. It explores for the first time the level of detection, management and control of hypertension and diabetes by ethnic group. This is of particular interest since it is the first survey on ethnic minorities carried out after the Health of the Nation strategy was launched in England, and primary and secondary care initiatives were implemented to increase the detection rates, and improve the quality of management and the effectiveness of the control of hypertension and diabetes.

The initial cross-sectional analysis of the Wandsworth Heart & Stroke Study has shown marked differences in the distribution of cardiovascular risk factors, their detection and management amongst different ethnic groups (18). Further analyses are ongoing to clarify several aspects of the differences in risk factors between ethnic groups but also the potential importance of each risk factor within each ethnic group (27-30).

Many of the risk factors are amenable to prevention and effective treatment. In particular, the focus of future activities should concentrate on the improvement in the prevention, detection and management of hypertension and diabetes, as well as of severe obesity in women of African descent. Preventive and therapeutic strategies developed and assessed in white populations may not apply to ethnic minorities. Strategies should be specifically developed, validated and assessed to consider both cultural acceptability, which is likely to affect uptake and compliance, and underlying susceptibility, which may vary the effectiveness of preventive and therapeutic options in different ethnic groups. These actions will require the involvement of both primary care health professionals (prevention and detection) and secondary health care settings (appropriate investigation and management and adequate control).

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