

Early evidence of ethnic differences in cardiovascular risk: cross sectional comparison of British South Asian and white children

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Abstract

Objectives To examine whether British South Asian children differ in insulin resistance, adiposity, and cardiovascular risk profile from white children.

Design Cross sectional study.

Setting Primary schools in 10 British towns.

Participants British children aged 8 to 11 years (227 South Asian and 3415 white); 73 South Asian and 1287 white children aged 10 and 11 years provided blood samples (half fasting, half after glucose load).

Main outcome measures Insulin concentrations, anthropometric measures, established cardiovascular risk factors.

Results Mean ponderal index was lower in South Asian children than in white children (mean difference -0.43 kg/m^3 , 95% confidence interval -0.13 kg/m^3 to -0.73 kg/m^3). Mean waist circumferences and waist:hip ratios were similar. Mean insulin concentrations were higher in South Asian children (percentage difference was 53%, 14% to 106%, after fasting and 54%, 19% to 99%, after glucose load), though glucose concentrations were similar. Mean heart rate and triglyceride and fibrinogen concentrations were higher among South Asian children; serum total, low density lipoprotein, and high density lipoprotein cholesterol concentrations were similar in the two groups. Differences in insulin concentrations remained after adjustment for adiposity and other potential confounders. However, the relations between adiposity and insulin concentrations (particularly fasting insulin) were much stronger among South Asian children than among white children.

Conclusions The tendency to insulin resistance observed in British South Asian adults is apparent in children, in whom it may reflect an increased sensitivity to adiposity. Action to prevent non-insulin dependent diabetes in South Asian adults may need to begin during childhood.

Introduction

In the United Kingdom men and women from many parts of the Indian subcontinent (including India, Pakistan, and Bangladesh) have markedly higher mortality

from coronary heart disease than is seen in the general population.¹ The greater prevalence of non-insulin dependent (type II) diabetes, impaired glucose tolerance, and insulin resistance observed in South Asian men may be important contributory factors,²⁻⁹ though South Asian men tend to have lower blood cholesterol concentrations and smoke less than white people.^{2-5 7-9} While genetic factors probably play a part in these differences, the expression of insulin resistance differs between environmental settings, and there may be a strong environmental component.^{10 11}

Although cardiovascular disease and non-insulin dependent diabetes may originate early in life,^{12 13} there has been little attempt to study whether differences in cardiovascular risk profiles (particularly in insulin resistance) in South Asian and white people are apparent in childhood. We compared such profiles in British South Asian and white children.

Participants and methods

The "ten towns heart health studies" are based in 10 towns in England and Wales with widely differing adult cardiovascular mortality. Of these, Burnley and Rochdale include a substantial proportion of children of South Asian origin. This study took place in a stratified random sample of 10 primary schools in each town. In each school we invited 50 children aged 8-11 years to take part and asked the 22 oldest (aged 10-11 years) to provide additional measurements including a blood sample.

Two research teams visited towns in sequence between April and November 1994. They measured height, weight, and blood pressure in all children. The older pupils fasted overnight before their assessments, which also included measurements of waist and hip circumference, a simplified assessment of Tanner staging for breast development among girls,¹⁴ and the collection of a blood sample. In half the children this was collected after fasting and in half it was collected 30 minutes after a standard oral glucose load (1.75 g/kg).

Ethnicity and social class

We classified ethnicity into four main groups on the basis of the child's appearance (white, Asian, other, mixed race) and cross checked with surname and with

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questionnaire information on parents' place of birth, religion, and first language. Parents provided information on their longest held occupation, which we classified using the registrar general's 1980 classification of occupations.

Results

Overall, 3415 white and 227 South Asian children took part (response rates 73% and 80% respectively). We took blood samples from 1287 white and 73 South Asian children (response rates 64% and 61% respectively).

Ethnic group and cardiovascular risk factors

Body build, blood pressure, and heart rate—White children were heavier and slightly taller on average, with a greater mean ponderal index than their South Asian counterparts (table 1). However, mean waist and hip circumferences and waist:hip ratios were similar in the two groups. Mean diastolic blood pressure and heart rate were higher in the South Asian children, particularly after adjustment for height and ponderal index. The difference in mean diastolic blood pressure was greatly reduced after we also adjusted for heart rate (from 1.4 to 0.7 mm Hg, 95% confidence interval –0.3 to 1.7 mm Hg, $P=0.19$).

Blood lipids and coagulation factors—Mean concentrations of total, low density lipoprotein, and high density lipoprotein cholesterol were slightly but not significantly lower in South Asian children (table 2). Mean triglyceride concentration was significantly higher in South Asian children than white children.

Mean fibrinogen concentrations were markedly higher in South Asian children. Factor VII concentrations were similar in the two groups.

Glucose and insulin concentration—Mean glucose concentrations were similar in South Asian and white children, but insulin concentration after fasting and after a glucose load were markedly higher in South Asian children (table 3). These differences in insulin concentration persisted after we adjusted for height and ponderal index. The mean difference in insulin resistance between South Asian and white children with homeostasis model assessment¹⁵ was similar to the difference in fasting insulin concentration: 54% (14% to 108%) after adjustment for age and sex and 69% (29% to 121%) after additional adjustment for height and ponderal index.

Body build and insulin concentration: relation in different ethnic groups

Ponderal index, waist circumference, and to a lesser extent waist:hip ratio were related to fasting insulin concentration ($r=0.36, 0.35, 0.05$, respectively with log insulin concentration) and to insulin concentration after glucose load ($r=0.35, 0.35, 0.05$, respectively with log insulin concentration). We examined the relations between body build and insulin concentration separately in white and South Asian children. The slopes regressing log insulin concentration on each of the three measures of body build were markedly steeper in South Asian children than in white children (figure). For fasting insulin concentration the differences in slope between ethnic groups (tests for interaction)

Table 1 Body build, blood pressure, and pulse rate in South Asian and white children. Figures are means (SE)

	South Asian§ (n=227)	White§ (n=3415)	Difference (95% CI)	
			Adjustment 1§	Adjustment 2¶
Height (cm)	140.5 (0.5)	140.9 (0.1)	–0.4 (–1.4 to 0.6)	—
Weight (kg)	34.5 (0.6)	35.8 (0.1)	–1.3 (–2.5 to –0.1)*	—
Ponderal index (kg/m ³)	12.27 (0.15)	12.70 (0.03)	–0.43 (–0.73 to –0.13)†	—
Systolic blood pressure (mm Hg)	111.7 (0.9)	112.4 (0.2)	–0.6 (–2.4 to 1.1)	0.3 (–1.3 to 1.9)
Diastolic blood pressure (mm Hg)	66.6 (0.5)	65.5 (0.1)	1.1 (0.0 to 2.2)	1.4 (0.3 to 2.5)*
Heart rate (beats/min)	84.9 (0.9)	81.5 (0.2)	3.4 (1.6 to 5.2)‡	3.7 (1.9 to 5.5)‡
Waist circumference (cm)**	61.2 (1.0)	61.0 (0.2)	0.3 (–1.7 to 2.3)	—
Hip circumference (cm)**	75.6 (0.9)	76.3 (0.2)	–0.7 (–2.5 to 1.2)	—
Waist:hip ratio**	0.807 (0.006)	0.799 (0.001)	0.008 (–0.005 to 0.021)	—

*0.01 ≤ $P < 0.05$.

†0.005 ≤ $P < 0.01$.

‡ $P < 0.005$.

§Adjusted for age, sex, and town.

¶Adjusted for age, sex, town, childhood height, and ponderal index (not carried out for body build measures).

**No=86 for South Asian children and 1415 for white children.

Table 2 Blood lipids and haemostatic factors in South Asian and white children

	South Asian§		White§		Difference (95% CI)	
	No	Mean (SE)	No	Mean (SE)	Adjustment 1§	Adjustment 2¶
Cholesterol (mmol/l):						
Total	73	4.56 (0.10)	1287	4.66 (0.02)	–0.10 (–0.30 to 0.11)	–0.10 (–0.31 to 0.10)
Low density lipoprotein	73	2.70 (0.09)	1286	2.78 (0.02)	–0.09 (–0.27 to 0.10)	–0.09 (–0.28 to 0.09)
High density lipoprotein	73	1.38 (0.04)	1286	1.43 (0.01)	–0.05 (–0.13 to 0.03)	–0.05 (–0.13 to 0.03)
Triglyceride (mmol/l)**	73	1.01	1287	0.91	11.7% (0.0 to 24.8%)*	12.1% (0.9 to 24.5%)*
Fibrinogen (g/l)	55	2.80 (0.08)	667	2.52 (0.02)	0.28 (0.10 to 0.45)‡	0.22 (0.06 to 0.39)‡
Factor VII (%)	55	105.9 (4.3)	667	104.9 (1.1)	1.0 (–7.9 to 10.0)	–0.9 (–9.7 to 7.9)

*0.01 ≤ $P < 0.05$.

†0.005 ≤ $P < 0.01$.

‡ $P < 0.005$.

§Adjusted for age, sex, and town.

¶Adjusted for age, sex, town, childhood height, and ponderal index.

**Geometric mean.

Table 3 Plasma glucose and serum insulin concentrations in South Asian and white children

	South Asian*		White*		Difference (95% CI)	
	No	Mean (SE)	No	Mean (SE)	Adjustment 1*	Adjustment 2†
Fasting						
Glucose (mmol/l)	41	4.85 (0.07)	625	4.85 (0.01)	0.00 (-0.14 to 0.14)	0.02 (-0.12 to 0.15)
Insulin (pmol/l)‡	40	47.8	622	31.2	53.4% (14.4% to 105.6%)§	68.0% (29.1% to 118.5%)§
After glucose load						
Glucose (mmol/l)	31	7.16 (0.32)	587	7.01 (0.06)	0.15 (-0.49 to 0.79)	0.18 (-0.46 to 0.82)
Insulin (pmol/l)‡	31	459.8	581	298.7	54.0% (19.1% to 99.0%)§	42.7% (12.8% to 80.3%)§

*Adjusted for age, sex, and town.

†Adjusted for age, sex, town, childhood height, and ponderal index.

‡Geometric mean.

§P<0.005.

were significant for all three measures. For insulin concentration after a glucose load only the difference for waist:hip ratio was significant (P=0.08).

Discussion

This cross sectional study has shown that the tendency among British South Asian adults to develop insulin resistance is apparent in childhood, though it is not associated with overt glucose intolerance at that stage. The proportional difference in fasting insulin concentration between South Asian and white children was similar to that seen in British adults.^{5,6} However, the difference in insulin concentration after glucose load in children was smaller than that seen in most adult studies.^{3,5}

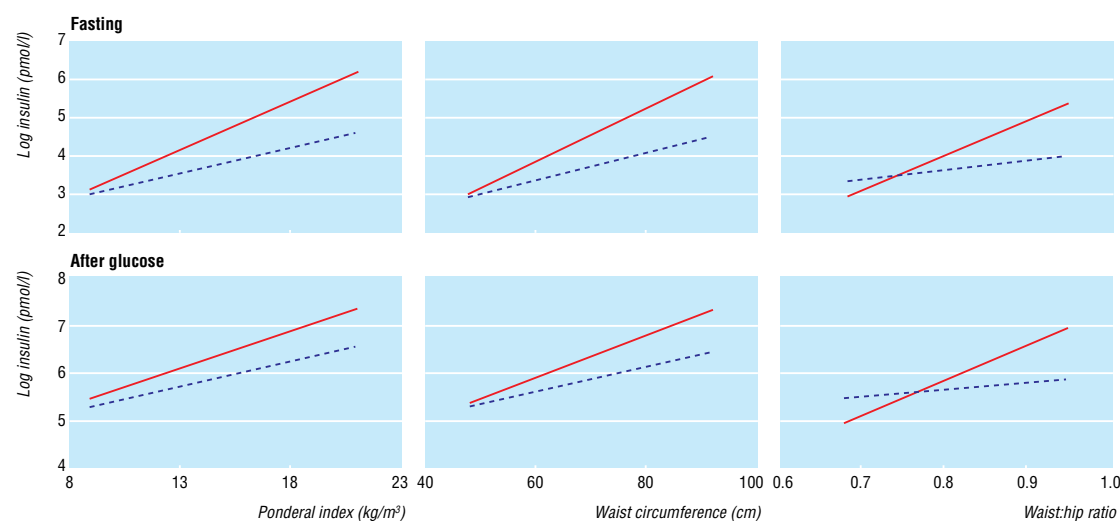
Previous studies

Previous studies have suggested that ethnic differences in insulin resistance develop before adulthood. Among young adult relatives of patients with coronary artery disease, South Asian people had higher insulin concentrations than white people.¹⁶ Among South African schoolchildren aged 10-12 years, those of Indian origin had higher insulin concentrations after glucose load than white children.¹⁷ In populations at exceptionally high risk for non-insulin dependent diabetes (for example, Pima Indians) overt insulin resistance and diabetes is seen in childhood.¹⁸

The increased mean concentrations of triglyceride and somewhat lower concentrations of high density lipoprotein cholesterol in South Asian children are consistent both with the higher degree of insulin resistance observed¹⁹ and with earlier reports in adults.^{3,5,8} The higher mean fibrinogen concentration seen among the South Asian children is unexpected. Fibrinogen concentrations in South Asian adults have generally been similar to or lower than those in white people,^{3,4,9,20} except for those seen in one recent US study.²¹ Our finding is not explained by active cigarette smoking, which is less common among South Asian children, and awaits confirmation. The higher mean heart rate observed in South Asian children could reflect lower levels of physical fitness or increased sympathoadrenal activity in this group.²²

Explanation for findings

The causes of the increased insulin resistance in these South Asian children remain unclear. Adiposity (particularly central adiposity) is a prominent correlate of insulin resistance in South Asian adults.⁵ However, even though our measures of adiposity (including central adiposity) are limited, our results suggest that the ethnic difference in insulin concentrations is not accompanied by a concomitant difference in adiposity. Hyperinsulinaemia may precede adiposity in the early stages of the pathogenesis of insulin resistance,²³ and insulin metabolism of South Asian people may be



Regressions of log insulin concentration (fasting and after glucose load) on three measures of adiposity (ponderal index, waist circumference, waist:hip ratio) in South Asian (continuous line) and white (broken line) children

What is already known on this topic

Compared with white people British South Asians are at increased risk of coronary heart disease, stroke, and non-insulin dependent diabetes

There is evidence that these conditions originate in early life

What this study adds

British South Asian children show higher average levels of insulin and insulin resistance than white children

These ethnic differences in insulin resistance in childhood are not associated with corresponding differences in adiposity, particularly central adiposity

Insulin metabolism seems to be more sensitive to a given degree of adiposity among the South Asian children compared with white children

The prevention of insulin resistance and its consequences may need to begin during childhood, particularly in South Asians

more sensitive to a given degree of adiposity, general or central. Similar findings have been described in one recent study in adults,²⁴ though not in earlier ones.^{2 5} The cause of the ethnic difference in the sensitivity of insulin metabolism to obesity is difficult to establish within the present small study, though both environmental and genetic influences are likely to be important.

Implications

Our results imply that the primary prevention of insulin resistance, non-insulin dependent diabetes, and cardiovascular disease in high risk populations (including British South Asians) may need to begin before adult life. Given that South Asian people may be particularly sensitive to the metabolic consequences of obesity (currently increasing in prevalence among British children²⁵), the prevention of obesity in childhood and adolescence among South Asian people, with a combination of dietary measures and increased physical activity,²⁶ is a strong priority while other influences on the development of ethnic differences in insulin resistance are assessed.

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Endpiece

Scottish doctors' esteem

The seating arrangements at a banquet held by Alexander, Lord of the Isles (died 1449), specifically placed "Beatton, the principal physician" even above "MacMurrich, the poet" in order of precedence.

Bannerman J. *The Beattons: a medical kindred in the classical Gaelic tradition*. Edinburgh: John Donald, 1988:18

Submitted by Jeremy Hugh Baron, honorary professorial lecturer, Mount Sinai School of Medicine, New York