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**An assessment of physical activity levels in South Asians in the UK:
Findings from the Health Survey for England**

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ABSTRACT

Background: South Asians in Britain experience high rates of coronary heart disease (CHD) compared with other ethnic groups. Behavioural risk factors, such as physical inactivity, have been explored as possible explanations for this trend. However, there have been few comprehensive accounts describing physical activity levels of this ethnic group.

Methods: Data from the Health Survey for England (1999-2004) on 5421 South Asians and 8974 whites aged 18-55 were used to compare physical activity levels. Analyses of covariance tested the association between ethnicity and self-reported total physical activity metabolic equivalents of task (MET) scores, adjusting for age, sex, self-reported health, adiposity, and socioeconomic status.

Results: Total MET-minutes/week were consistently lower in UK South Asians compared with whites (973 compared with 1465 MET-minutes, $p < .001$). This ethnic group difference was consistent across sexes, age- and sub-groups, and was independent of covariates. South Asians born in the UK reported higher levels of physical activity than those South Asians born elsewhere ($p < .001$). Variables such as urbanisation and psychological distress were associated with physical activity; however, despite their inclusion in the models, ethnic group differences remained, indicating that physical inactivity in South Asians was not attributable to area or individual sociodemographic factors.

Conclusions: Physical activity levels are very low in UK South Asians; this is consistent across all examined population subsets. Physical inactivity is likely to contribute to their high risk of CHD. Increasing physical activity in all UK South Asians should be a public health priority for health professionals.

South Asian populations, originating from the Indian subcontinent suffer higher rates of coronary heart disease (CHD) compared with other ethnic groups.¹ This vulnerability is particularly apparent in migrant South Asians in the UK.² A number of biological explanations have been proposed as potential contributors to this vulnerability. South Asians are prone to have higher insulin resistance,³ central obesity,⁴ and lower high density lipoprotein cholesterol⁵ than other groups. Despite this, other conventional biological CHD risk factors, such as hypercholesterolaemia and hypertension, are not consistently elevated in UK South Asians.^{6,7}

Behavioural explanations have been explored, demonstrating a mixed risk profile. There is marked variation in smoking rates between South Asian sub-groups, with tobacco use particularly high in Pakistani and Bangladeshi men and low in Indian and female groups.⁸ Dietary habits remain insufficiently examined, although there is some evidence to suggest that South Asians eat more fruit and vegetables, and less fat than the general population.^{9,10} Regular physical activity reduces the risk of CHD and type 2 diabetes, through a range of mechanisms including reduced adiposity, improved endothelial function, improved lipid and glucose profiles, and lowering blood pressure.¹¹ Some studies have examined leisure-time physical activity among South Asians residing in the UK and in South Asia, demonstrating lower levels of activity in South Asians compared with other ethnic groups.^{12,13} However, these studies have not consistently accounted for age-group, sex, socioeconomic and country of birth sub-group variations,^{14,15} nor have they been performed in nationally-representative populations.^{16,17}

This study aimed to provide a comprehensive examination of leisure-time physical activity levels in South Asians in comparison with UK whites, using nationally-representative data from the Health Survey for England (HSE).

METHODS

The HSE comprises a series of annual surveys that began in 1991. All surveys covered the adult population aged 16 and over living in private households in England. HSE samples are selected using multi-stage stratified probability design to give a representative sample of the target population. Stratification is based on geographical entities and not on individual characteristics: postcode sectors selected at the first stage and household addresses selected at the second stage. Further details on sample design and sample selection can be found elsewhere.¹⁸ The present analyses combined data from the 1999, 2003, and 2004 HSE datasets. The focus of the 1999, 2003, and

2004 surveys was cardiovascular disease and related risk factors for adults. In addition, in 1999 and 2004 minority ethnic groups were over-sampled to boost the sample size of ethnic minorities living in households in England. Participants gave full informed consent to participate and ethical approval was obtained from the North Thames Multi-Centre Research Ethics Committee. **The average response rate over the survey years for the general population was 74% and 67% for the ethnic boost samples.**

Procedures and measures

Survey interviewers visited eligible households and collected data on demographics (e.g. marital status, country of birth, religion), anthropometry (height, weight, waist and hip circumference), psychological distress, and health behaviours (smoking, alcohol intake, and physical activity). **All survey materials were translated into Urdu, Punjabi, Gujarati, Hindi, and Bengali, by an external company using independent proof-reading and stringent verification procedures. Interviewers who spoke and read these languages (as well as English) were recruited and received full training.** Ethnicity was categorised by the subject's family origins (only South Asian participants originating from India, Pakistan, and Bangladesh, and white British were included in this study). Country of birth was used as a proxy acculturation measure.

Socioeconomic status (SES) was measured using highest educational qualifications, total equivalised (adjusted for household size) household income, and occupational status. Occupational grade was categorised using the Registrar General social classification system. Access to a car was assessed by one question and an additional two items measured the degree of urbanisation of residential area (*urban, suburban, or rural*) and availability of local leisure facilities. Psychological distress was assessed from the 12-item version of the General Health Questionnaire (GHQ-12).¹⁹ The well-established questionnaire enquires about depression and anxiety symptoms, and sleep disturbance over the last month. Measures of current health status were recorded: two questions explored self-reported health and limiting long-standing illnesses. Detailed information on the general and specific survey method can be found elsewhere.²⁰

Frequency and duration of leisure-time physical activities in the four weeks prior to the interview (walking and domestic activity: for at least 30 minutes per day; leisure-time sports/exercises: for at least 15 minutes per day) were assessed across three domains of activity: leisure-time sports/exercises (e.g. cycling, aerobics, and ball sports

such as football), domestic activities (heavy housework, heavy 'Do-It-Yourself', gardening, heavy manual), and walking for any purpose. All physical activities were assigned a metabolic equivalent task (MET) value, using the Compendium of Physical Activities.²¹ A MET score of 1 corresponds to the rate of energy expenditure when at rest (1 kcal/kg/h). MET-minutes per week were computed as MET for each specific activity multiplied by the number of minutes the activity was performed per week. MET-minutes per week were summed, creating a total score (totalMETs); a cut off of 8000 totalMETs (corresponding to approximately over 2 hrs per day of highly vigorous exercise) was set to eliminate potential outliers and participants involved in heavy sports and exercise-training. In addition, a total score was created for MET-minutes expended during sporting activities during the past week (sportMETs). **A binary variable was also created to explore the government's recommendations for weekly activity (those who did and did not perform ≥ 450 MET minutes of moderate-vigorous activities). For this, only sports activities were included, since sports MET scores do not include light activity.** Since the 1999 and 2003-4 versions of the HSE questionnaire had no duration questions on walking and domestic physical activity sessions, we extracted the sex and age (5-year bands) mean session duration values from the 1997-98 datasets and assigned the resulting values to each respondent to calculate time in moderate to vigorous physical activity and consequently MET scores, a method that has been used previously to impute duration of walking and domestic activity sessions.²² Convergent validity analyses are available in an appendix online. The validity of the physical activity questionnaire is also supported by objective measures of activity using accelerometry devices in 106 British adults (45 men) from the general population.²³

Statistical analyses

White participants were substantially older than South Asians; to limit the confounding effects of age, this paper included only those aged between 18 and 55. To compare baseline characteristics between the two groups, independent sample t-tests were performed for continuous and χ^2 tests for categorical variables. Comparisons of totalMETs between ethnic groups used analyses of covariance, with ethnicity as a between-subject factor. Adjustments were made for age (modelled as a continuous variable), sex, body mass index (BMI), and self-reported health (excellent/good/fair/poor). To establish whether group differences were the result of ethnic or socioeconomic variations, education was also included in the model as a

covariate. Sex by ethnicity interactions were added, the significance of which advocated examining sex-specific models. In addition, sportMETs were used as outcome measures to determine whether ethnic group variations were driven by differences in sports participation. **Logistic regression analyses (adjusting for the same covariates as above) examined the government's recommendations for physical activity.** Similar analyses were performed by age-group (18-35, 35-45, 45-55) to identify age range-specific variations in physical activity. South Asian sub-groups were split by country of birth (India, Pakistan, and Bangladesh) and this division was used to explore sub-group differences in physical activity. *Post hoc* analyses using Fisher's Least Significant Difference tests were performed. White British were included in these tests to establish whether physical activity differences observed previously were true ethnic group differences or whether sub-group variation was important. The South Asians were divided into 'UK born' and 'born elsewhere', and ANCOVAS (adjusting for covariates as before) were conducted to highlight the impact of westernisation on activity levels. Finally, exploratory analyses included socio-demographic factors (marital status, car ownership, psychological distress, urbanisation, and local leisure facilities) in the full sample ANCOVA models, to identify additional variables which might account for a proportion of the ethnic group differences. Data are presented as means with standard deviation or standard error, or as percentages. Partial η^2 values indicate effect sizes. All analyses were performed using SPSS 14.0.

RESULTS

Demographic information

Table 1 presents the descriptive characteristics of the sample. The average age of the sample was 36.49 (SD 10.41); whites were still significantly older than South Asians, despite the age-range restriction ($p < .001$). Both groups had a similar sex distribution. Of the South Asian sample, a quarter were born in the UK compared with 81% of whites. Migrant South Asians had lived in the UK for an average of 26 years, with 34% born in India, 31% in Pakistan, and 31% in Bangladesh. Over two-thirds were Muslim (70%), 19% Hindu and 10% were Sikhs. South Asians were more likely to be married ($p < .001$) and have more children ($p < .001$), however they were less likely to own their homes ($p < .001$) or have access to a car ($p < .001$). Half of the South Asian sample was working, compared with over three-quarters of the white group ($p < .001$). In terms of socioeconomic markers, South Asians reported lower household income ($p <$

Table 1: Descriptive characteristics of sample

		South Asians (n = 5421)	Whites (n = 8974)
Age (in years)		33.90 ± 10.10	38.06 ± 10.29**
Sex-	Male	46.2%	44.6%
Country of birth-	UK	25.5%	81.4%**
Years in UK [†]		26.15 ± 11.12	-
Marital status-	Married	71.4%	52.3%**
No. of children		1.44 ± 1.44	0.71 ± 1.00**
Home ownership-	Owner	62.2%	74.4%**
Car ownership-	Owner	74.9%	85.0%**
Employment status-	Working	50.0%	78.0%**
Annual total income-	< £20,800	64.8%	35.6%**
Education-	Up to GCSE	39.2%	49.1%**
Occupation-	Manual	47.6%	38.8%**
Body mass index		25.79 ± 4.82	26.68 ± 5.10**
Waist-hip ratio		.86 ± .08	.85 ± .08**
Self-reported health- Poor/very poor		8.5%	4.3%**
Limiting long-standing illness		18.6%	19.4%
Smoking-	Ever smoked	26.2%	65.8%**
TotalMETs		902.57 ± 1248.82	1449.18 ± 1577.69**
GHQ score		1.62 ± 2.73	1.38 ± 2.57**

Values in means and standard deviations, and %. [†] Only includes South Asians born outside the UK. *p* values represent ethnic differences. ** *p* < .001.

.001), lower levels of education ($p < .001$), and a higher proportion worked in manual occupations ($p < .001$).

Health data

BMI was significantly higher in whites compared with South Asians ($p < .001$). Conversely, waist-hip ratio was highest in the South Asians ($p < .001$). South Asians were more likely to report their health as poor/very poor ($p < .001$), although there was no ethnic group difference in the proportion of people suffering from limiting long-standing illnesses. Psychological distress was higher in South Asians than their white counterparts ($p < .001$). A quarter of South Asian participants had previously smoked compared with nearly two-thirds of whites ($p < .001$).

Physical activity (table 2)

Physical activity was markedly lower (by approximately 60%) in South Asians compared with whites, and this difference remained significant after controlling for age, sex, education, adiposity, and self-reported health variations ($F(1, 12704) = 94.70, p < .001$). An interaction effect for ethnicity and sex ($F(1, 12704) = 19.01, p < .001$) was observed. Thus, these analyses were performed separately by sex. Similar patterns were observed for both sexes, with South Asians displaying lower activity compared with whites (for men: $F(1, 5884) = 179.27, p < .001$; for women: $F(1, 6816) = 121.23, p < .001$).

Total sportMETs demonstrated a considerable ethnic group difference ($F(1, 12704) = 283.87, p < .001$); the average total MET-minutes per week expended during sporting activities per week were 194.06 (SD 6.17) in South Asians compared with 325.65 (SD 4.52) in whites. For sportMETs, the interaction between ethnic group and sex was not significant, and was therefore removed from the analyses. **Analyses applying the governmental recommendations for physical activity (>450 MET minutes per week, moderate-vigorous activity) showed that South Asian people were 60% less likely to comply with the current guidelines (OR = .41, 95% CI .38-.45).**

Age-groups (table 2)

The same pattern of low levels of physical activity was replicated in each of age-group analyses, 18-35, 35-45, and 45-55 ($F(1, 5423) = 121.02, p < .001$, $F(1, 3904) = 135.50, p < .001$, and $F(1, 3364) = 39.53, p < .001$, respectively). Self-reported health

became more important with increasing age (partial $\eta^2 = .003$ in the youngest group compared with partial $\eta^2 = .028$ in the oldest group).

Table 2: ANCOVA results showing impact of ethnic group on total MET minutes per week

		South Asians	Whites	Partial η^2
Full sample		973.21 (22.44)	1465.93 (16.43)**	.01
Men		1051.69 (36.36)	1670.94 (27.15)**	.03
Women		909.17 (27.37)	1289.51 (19.66)**	.02
Age groups:	18 – 35	1043.54 (29.58)	1484.83 (26.39)**	.02
	35 – 45	906.36 (43.70)	1528.80 (29.21)**	.03
	45 – 55	962.27 (51.76)	1344.82 (29.69)**	.01

Data presented as adjusted means (standard error). ** $p < .001$. Partial η^2 values indicate effect size. Adjustments made for age, sex and sex by ethnic interactions (full sample), BMI and self-reported health.

Sub-groups (table 3)

Sub-group analyses were performed separately by sex. In men, there were no sub-group differences in total physical activity between Pakistani, Bangladeshi and Indian men. The trend indicated Pakistani men reporting the lowest levels of exercise, then Bangladeshis, followed by Indians. This remained significantly lower than white men. Among women, as well as the ethnic group difference, Bangladeshi women reported lower levels of physical activity than women born in India ($p = .040$) and Pakistan ($p = .028$). In terms of sportMETs, Bangladeshis performed significantly less exercise compared with whites ($p < .001$) and Indians (men: $p = .046$; women: $p = .005$).

Country of birth

The comparison of South Asians born in the UK with those born outside the UK (table 3) demonstrated a marked difference in physical activity ($F(1, 4507) = 49.73, p < .001$), despite adjustment for age, sex, BMI, and self-reported health. A sex by country of birth interaction term was significant ($F(1, 4507) = 24.41, p < .001$); therefore sex-stratified analyses were conducted. There were group differences across men and women, with people born in the UK reporting higher levels of activity than those born

outside the UK ($F(1, 2134) = 59.55, p < .001$, and $F(1, 2368) = 4.68, p = .031$, respectively). However, the impact of country of birth on physical activity levels was much stronger in men than in women (partial $\eta^2 = .012$ compared with $.002$). The same pattern was true for total sports activities between UK born and non-UK born South Asian men and women ($F(1, 2134) = 55.52, p < .001$, and $F(1, 2368) = 35.04, p < .001$, respectively).

Table 3: ANCOVA results showing impact of subgroup and country of birth on total MET minutes per week (totalMETs)

		Mean totalMETs	Partial η^2
Subgroups (male):			
	White (n = 4006)	1672.05 (27.22) ^a	.03
	Indian (n = 806)	1089.33 (60.84) ^b	
	Pakistani (n = 850)	973.84 (61.42) ^b	
	Bangladeshi (n = 719)	1055.37 (71.35) ^b	
Subgroups (female):			
	White (n = 4968)	1292.67 (19.64) ^a	.02
	Indian (n = 943)	919.41 (44.38) ^b	
	Pakistani (n = 965)	926.47 (47.20) ^b	
	Bangladeshi (n = 862)	775.41 (53.76) ^c	
South Asians only:			
Country of birth- (Male)	UK born (n = 607)	1385.23 (69.72) ^a	.01
	Born outside the UK (n = 1895)	935.53 (36.21) ^b	
Country of birth- (Female)	UK born (n = 766)	972.50 (49.19) ^a	.00
	Born outside the UK (n = 2153)	843.66 (27.67) ^b	

Data presented as adjusted means (standard error). Different superscript letters represent significant differences between groups. Partial η^2 values indicate effect size. Adjustments made for age, BMI and self-reported health.

Explanatory demographic variables

Marital status was elevated and access to a car was reduced in South Asians; both variables were significantly related to physical activity ($p = .003$ and $p < .001$, respectively) but neither factor had an impact on the ethnic group difference. Living in urban environments was more common among South Asians and urbanisation was significantly associated with lower levels of overall physical activity compared with rural areas ($p < .001$). Although ethnic group remained significant, the inclusion of urbanisation reduced the variance explained by ethnicity from partial $\eta^2 = .023$ to $.017$. South Asians were more likely to perceive their area as having good local leisure facilities, although this factor was not strongly related to physical activity ($p = .071$). Its inclusion did, however, influence the impact of ethnic group on physical activity (partial $\eta^2 = .023$ to $.013$). Psychological distress, which was elevated in South Asians, was negatively related to physical activity levels ($p = .019$); more distressed respondents were less likely to be active. Ethnicity remained a significant factor in this model, with a marginal effect on effect size (partial $\eta^2 = .023$ to $\eta^2 = .020$). Finally, those variables which moderated the effect of ethnicity on physical activity (urbanisation and psychological distress) were included as covariates and despite the effect size of ethnicity being attenuated (partial $\eta^2 = .023$ to $.014$), physical activity levels were still significantly lower in South Asians compared with whites ($p < .001$).

DISCUSSION

This study aimed to provide a comprehensive assessment of non-occupational physical activity profiles of South Asians living in England using nationally-representative data. Previous studies have not used representative populations,²⁴ and have not explored sub-sets of the population in such depth.^{14,17} We have shown that, regardless of sex, age- and sub-group, and type of physical activity (general versus sport), South Asian people living in England perform significantly lower levels of physical activity compared with whites. The consistency of this ethnic group difference across every sub-set in this paper points towards a contributory factor for the elevated risk of CHD observed in this population.

Our findings support previous work highlighting low levels of exercise among UK South Asians.¹² The homogeneity of these findings across studies adds weight to these conclusions. Even after adjustment for socioeconomic variations, South Asians still performed less physical activity. This is an interesting result, since physical activity has

a socioeconomic gradient²⁵ and ethnic minorities in the UK consistently occupy the lower social grades²⁶ (subject to sub-group variations²⁷).

Other studies have demonstrated the exceptionally low levels of exercise among South Asian women;¹² we have reiterated this finding, irrespective of sub-group. In addition, the age-group analyses performed for this paper provide a clear indication that these ethnic group differences are not specific to certain ages, and persist across generations. To the best of our knowledge, this paper is the first paper to show such continuity across age-groups.

Some studies have shown heterogeneity in profiles of exercise across South Asian sub-groups;^{28,29} a similar trend was observed in this work, with Indian people generally engaging in more exercise than Pakistanis and Bangladeshis. Our finding that Pakistanis and Bangladeshis have worse physical profiles is commensurate with other health behaviour profiles documented in the HSE 2004 report. Pakistanis and Bangladeshis report greater use of tobacco products,⁸ consume fewer fruits and vegetables,³⁰ and report more psychological distress and lower social support³¹ than Indians. Cumulatively, this evidence highlights the non-uniform CHD risk across sub-groups, corroborating the observation that Pakistanis and Bangladeshis suffer elevated CHD and diabetes rates.^{26,32}

The final analyses attempted to provide some indication of factors which might explain this ethnic group difference in physical activity. Factors such as urbanisation and psychological distress may partially explain the ethnic group difference in physical activity rates, however, ethnicity remained a significant risk factor. Thus, if area- and individual-level demographic and socioeconomic factors do not fully explain the low rates of physical activity in South Asian samples compared with whites, it would suggest that cultural explanations may be appropriate. This is supported by the finding that those South Asians born in the UK performed considerably more exercise compared with those born elsewhere. Despite this very crude measure of acculturation, it is likely to demonstrate some assessment of westernisation, indicating that less traditional South Asians may adopt more active profiles. This implies that future generations of South Asians born and bred in England may increase their levels of exercise. Nevertheless recent data in 9-10 year olds suggests that British South Asian children have lower objectively measured physical activity levels than European whites and African-Caribbeans.³³

The HSE offers an opportunity to explore rates of physical activity in a large sample which provides representative data of people living in England. This is a key strength of this paper, presenting findings that can be generalised across England. Despite this, some limitations should be considered. Education was used as the SES marker in this paper, because more complete data was available for education than for income or Registrar General social class. We are aware of the issues associated with using education as a indicator of SES in South Asians,³⁴ however tests were performed to check the correlation between education and other markers of SES. Education had similar strength of associations with income and occupation in both ethnic groups. Additional analyses using income and occupational grade as the SES markers in the models revealed similar results, i.e. the ethnic group differences in physical activity remained regardless of socioeconomic marker (data not shown). There are numerous concerns about the accurate measurement of physical activity,³⁵ however the interview-based questionnaire used in the HSE comprised a comprehensive assessment of intensity, duration, frequency and type of activity and was validated using objective assessments. The self-reported physical activity questions have not been specifically validated in a South Asian population, although we have observed a clear and strong inverse association of resting heart rate with self-reported physical activity levels ($p < .05$) in all ethnic groups that would support the convergent validity of the questionnaire. **There is also the possibility that there may be cultural or ethnic differences in the interpretation of physical activity intensity measures, unfortunately there is no previous work exploring this issue in a South Asian population.**

This paper has shown that physical activity is consistently low across UK South Asian people, regardless of sex, age, and sub-group. Cultural factors are likely to be partly responsible. It is essential that the health benefits of exercise are disseminated to South Asian communities nationwide, and that health professionals promote increased physical activity as a priority in this population.

What is already known about this topic

UK South Asian groups suffer elevated risk of coronary heart disease compared with other ethnic groups in the UK.

Physical inactivity is a major risk factor for coronary heart disease.

What this study adds

Using a nationally-representative sample, this study shows that, compared with the UK White population, physical activity is low in all groups in the South Asian population, regardless of sex, age group, sub group, and type of activity. This physical inactivity is likely to contribute to the excess coronary heart disease mortality observed in UK South Asian people.

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COMPETING INTERESTS

All authors declare that the answer to the questions on the competing interest form are all 'No' and therefore have nothing to declare.

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