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Ethnic Differences in Physical Activity and obesity

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Obesity has been identified as a risk factor in many health problems, including arthritis, stroke, heart disease, cancer and diabetes. In England around a quarter of all adults are classified as obese and projections estimate this will rise to one-third by 2012. This paper uses the Health Survey for England (HSE) to examine ethnic differences in diet, physical activity and obesity in adults. It begins by providing a detailed break-down of differences in levels of obesity and physical activity for men and women in eight major ethnic groups for a nationally representative sample of the adult population of England. It then goes on to use modelling methods to ask whether additional factors related to the individual or the locality explain the differences between ethnic groups on both these outcome measures.

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Ethnic differences in physical activity and obesity

1.0 Obesity as a policy issue

What is seen as desirable in terms of body shape and image has changed over time and differs between societies. However, until recent decades very few groups in western society enjoyed a life-style that allowed them to become over-weight or obese. The physical demands of everyday life (heavier manual work, housework with few modern aids, limited access to cars) combined with limited availability of pre-prepared or convenience foods provided little opportunity for obesity. However, recent decades have seen a much more sedentary lifestyle for most people, an increase in leisure time and super-markets with an abundance of tempting food at low prices. The rapid rise in obesity over a similar time period has now resulted in wide-spread concern over its implications for public health.

Obesity has been identified as a risk factor in many health problems, including arthritis, stroke, heart disease, cancer and diabetes (Lee et al, 1999; Stevens et al, 2004, Kopelman, 2000; Gensini et al 1998; Jonsson et al 2002). In England around a quarter of all adults are classified as obese (Craig & Mindell, 2008 Volume 1) and projections estimate this will rise to one-third by 2012 (Zaninotto et al, 2009).

There is a well established link between low levels of physical activity, poor diet and obesity (WHO, 2002; WHO, 2003; Department of Health, 2004). Over the past decade the UK Government has set recommended guidelines and a series of action plans to encourage the population to eat a healthier diet and participate in more physical activity. For example, the Department of Health's 5-a-day campaign (2000) aims to increase the consumption of fruit and vegetables, whilst the Food Standards Agency is working to reduce the consumption of salt (DH, 2000; Food Standards Agency, 2003). The UK Government has set physical activity guidelines for adults to participate in moderate or vigorous intensity physical activity on at least five days a week for at least 30 minutes per day either in one session or through a number of shorter sessions of 10 minutes or longer (The Chief Medical Officer, 2004). The importance of the imbalance between energy consumed through food and energy expended through physical activity is recognized in the UK's recent cross-government strategy *Health Weight, Healthy Lives* which identifies five areas for tackling excess weight - two of which are the promotion of healthier food choices and building physical activity into our lives (Cross-Government Obesity Unit, Department of Health, Department for Children, Schools and Families, 2008). Although ethnic differences in obesity in the UK and US are fairly well-documented the various UK Government strategies do not make any distinction by ethnic group. In this chapter we provide detailed information about the way in which obesity varies between and within different ethnic groups. We also identify major ethnic differences in the uptake of physical activity. First we review some of the literature relating to these issues.

Ethnicity and obesity

In western countries women of higher socio-economic status are less likely to be obese than women of lower socio-economic status (Sobal, 1989). However, in less affluent societies there is often a positive relationship between body weight and socio-economic status (Tovee et al, 2006) and, in some traditional, non-Western societies body fat is deemed an indicator of wealth, prosperity, femininity and sexual capacity (McGarvey 1991; Ghannam, 1997; Nasser, 1988). Cross-cultural studies suggest that young women from culturally English backgrounds dislike body fat more than peers from Black-Caribbean and Black African backgrounds (Furnham & Alibhai 1983; Furnham & Baguma 1994; Wardle & Marsland, 1990).

Migration may also affect physical activity levels, although there is mixed evidence of this in the literature (Williams et al , 1996; Hayes et al, 2002; Dawson et al, 2005). Migration to a

more affluent society may result in a change of lifestyle which, in turn, may lead to increased body weight (Goel et al, 2004; Mellin-Olsen & Wandel, 2005). Jackson et al (2007) have shown that overweight and obesity among populations of African origin in Cameroon, Jamaica and the UK were higher in those who had migrated to the UK than those who live in Cameroon or Jamaica. Similarly Patel et al (2005) have shown that British Gujeratis had higher mean BMIs than Gujeratis in India. Thus we may expect obesity levels for minority ethnic groups to be related to time since migration to the UK.

The extent of physical activity is expected to be a major influence on obesity. A number of studies have shown low levels of physical activity among ethnic minority groups within the UK, particularly South Asians (Sproston & Mindell, 2006, Vol 1; Hayes et al, 2002; Dhawan & Bray, 1997; Pomerleau et al, 1999; Williams et al, 1994; Johnson, 2000; Chambers et al, 2006 Carrington et al, 1987; Lean et al, 2001). Some of these studies provide comparative information on separate South Asian groups and suggest that Bangladeshis have markedly lower levels of physical activity than other South Asian groups, while Indians have the highest levels (Rudat, 1994; Hayes et al, 2002).There may be particular barriers to physical activity among South Asian women which include dress code, modesty, lack of single sex facilities and disease perceptions (Sriskanthatrajah & Kai, 2006; Grace et al, 2007; Scraton et al, 1999 and 2005). However, other factors such as racial harassment and discrimination and the relatively closed nature of some sports (e.g. golf) will affect all minority groups. Ethnic differences in the occupational structure will also affect physical activity with those groups more heavily represented in manual work more likely to be physically active.

In contrast, many minority ethnic groups have healthier eating patterns than the population as a whole or the white majority. (Sproston & Mindell, 2006, Vol 1; Erens et al, 2001, Vol 1; Gibbens & Julian, 2006; McKeigue al, 1985, McKeigue & Chaturvedi, 1996, Williams et al, 1994; Sharma et al, 1998; Sharma & Cruickshank, 2001; Sharma et al, 2002; Miller et al 1998; Dowler & Calvert, 1995; Lip et al, 1995). However, diet varies with religious and cultural background and it is important to note that ethnic minority groups are not a homogenous group and that there are dietary differences within ethnic groups (Williams et al 1994; Smith et al, 1995; Wyke & Landman, 1997. Cultural beliefs and traditions play an important role in dietary habits as culture is often expressed through food (Anderson et al, 1995; Kalka, 1988; Lawrence at al, 2007; Bush et al, 1998; Scott, 1998). As with physical activity, migration to the UK, and length of time since migration also plays a significant role in dietary change among ethnic minority populations with the adoption of the 'unhealthy' aspects of the British diet upon migration (Lawrence et al, 2007; Landman & Cruickshank, 2001; Anderson et al, 2005, Simmons & Williams, 1997; Anderson & Lean, 1995; Wandel, 1993; Kassam Khamis et al, 1996). Also, for most minority ethnic groups fruit and vegetable consumption is highest amongst the older age-groups (Sproston & Mindell, 2006, Vol 1). This raises the question of whether older people retain more traditional eating patterns that may not be followed by younger generations.

Finally, unhealthy life-styles are associated with socio-economic factors such as social class, education, deprivation and income (Marmot et al 1991; Pill et al, 1995; Wardle et al, 2003) and this is indeed the case with obesity, diet and physical activity (Sobal, 1989; Sproston & Mindell, 2006; Craig & Mindell, 2008; Shelton, 2005; Pratala et al, 2003; Hunt et al, 2000). By comparison with the majority white group, minority ethnic groups tend to have higher levels of unemployment, experience less upward social mobility; have lower incomes and are more likely to live in areas of high deprivation within the UK (Modood et al, 1997; Blackaby et al, 2002; Clark and Drinkwater, 2007; Platt, 2007). However, the extent to which ethnicity is related to obesity independently of these socio-economic characteristics is not well established (Saxena, 2004; Dawson et al, 2005). Similarly little is known about the independent effects of diet and physical activity upon obesity for different ethnic groups.

We begin by providing a detailed break-down of differences in levels of obesity and physical activity for men and women in eight major ethnic groups for a nationally representative sample of the adult population of England. We then go on to use modelling methods to ask whether additional factors related to the individual or the locality explain the differences between ethnic groups on both these outcome measures.

2.0 Data and methods

2.1 The Health Survey for England

This research uses the Health Survey for England (HSE) to examine ethnic differences in diet, physical activity and obesity in adults. The HSE is a large-scale nationally representative cross-sectional survey which has been carried out annually since 1991 and is commissioned by the Health and Social Care Information Centre and conducted by the National Centre for Social Research. The 2004 survey covers adults and children living in private households and focuses on the health of ethnic minority groups. The ethnic boost increased the number of Black Caribbean, Black African, Indian, Pakistani, Bangladeshi, Chinese and Irish participants and contains approximately 10,000 ethnic minority participants (Sproston et al, 2006, Vol 1). The 2004 HSE has a nationally representative, multi-stage, stratified probability sampling design with three components: the core (which provides a nationally representative sample); the minority ethnic group boost sample and the Chinese special boost sample. The survey comprises two stages: (1) an interviewer-administered questionnaire to all individuals and (2) a nurse visit to informants from the specified minority ethnic groups. The 2004 questionnaires collected information on cardio-vascular disease and related risk factors such as physical activity, diet (fruit and vegetables, fat and salt intake), smoking, drinking and height/weight measurements to measure obesity (BMI). The nurse visit collected information such as medication, blood and saliva samples, blood pressure, waist and hip measurement. Both stages translated all materials and questionnaires into seven languages: Urdu, Punjabi, Gujarati, Hindi, Bengali, Mandarin and Cantonese. Informants who could not carry out an interview in English were provided with an interviewer who could speak the appropriate language (Sproston et al, 2006, Vol 1; Sproston et al, 2006, Vol 2).

The physical activity questionnaire records physical activity in the previous four weeks and includes heavy housework, heavy manual work, continuous walks of 30 minutes or more and sports/exercise. The questionnaire asks about the number of times the respondent has done each type of activity in the last four weeks and it also collects information on occupational activity.

The 2004 HSE survey includes sections on fruit and vegetable consumption and fat intake. The questions are designed to monitor consumption in line with the '5 a day' programme – which means that information related to the '5 a day' specified portions is collected. The 'diet' aspect of the survey is limited in that it only presents a partial measure of diet, for example there is no information available about the consumption of sugar, fizzy drinks or carbohydrates. The fat consumption data is particularly limited for measuring the link between diet and obesity because it does not provide information on portion sizes - so there is no indication of the volumes of fat consumed. For this reason the fat data has been excluded from the analysis in this paper. However the fruit and vegetable consumption has been included in the obesity model, although it does not give an overall indication of eating habits and cannot, therefore, provide any indication of overall calorie intake.

The response rate to the survey interview achieved 66 percent for eligible adults (63 percent for the ethnic minority boost) and about 56 percent for weight and height (51% for the ethnic minority boost).

Whilst the HSE has formed the main source of our analysis we have also held three focus groups of Pakistani and Kashmiri women in Rochdale during July 2008. A total of 10 women

attended the focus groups; all were under thirty, most born overseas, and all were contacted through their participation in community organisations. Analysis of the transcripts from these focus groups has been used to inform our understanding of the survey results.

2.2 Analysis strategy

Obesity is measured by Body Mass Index (BMI) which is an internationally recognised measurement of obesity and overweight. BMI is defined as weight (kg) / height $(m2))^2$ and it highly correlates with adiposity. In extreme cases BMI may lead to misclassification, for example athletes may be classified as obese because they have high muscle mass which weighs more than fat (International Diabetes Institute, 2001). However, the BMI measurement is generally used as an indicator of adiposity and is widely used in epidemiological studies and clinical settings. The analyses used a dichotomous variable of obese/not obese with obese defined as a BMI $\geq$ 30kg/m.

Moderate intensity physical activity includes:

- walks of 30 minutes or more at a fairly brisk or fast pace,
- heavy housework such as moving furniture, carrying heavy shopping or scrubbing floors for at least 30 minutes at a time,
- heavy gardening/DIY such as digging or bricklaying for at least 30 minutes at a time
- sports and exercise that lasted 30 minutes or more. Activity is classified according to the type of sport/exercise and the respondent's own assessment of the effort involved.
- occupational activity, based on the respondent's own assessment of how active they are at work combined with information on whether they work full-time or part-time and the nature of their occupation using the Standard Occupational Classification 1990 (OPCS, 1990)

A summary measure has been used which indicates whether or not the respondent has met the weekly physical activity guidelines of at least five occasions of moderate intensity activity each lasting for at least 30 minutes.

The 2004 HSE sampling scheme, described above, was designed to give adequate numbers for analysis of the following minority ethnic groups: Black Caribbean, Black African, Indian, Pakistani, Bangladeshi, Chinese and Irish. Although the general population sample contains a representative spread of all ethnic groups, only the minority groups listed here have a boosted sample size and they therefore form the focus of this analysis. Ethnic minority groups are defined as in the 2001 Census, except for the Irish who were defined as Irish if either the respondent, or their mother or father had been born in the Republic of Ireland or Northern Ireland. Informants of mixed origin which included one of the groups listed above are included in that group (Sproston and Mindell, 2006).

All analyses are performed in STATA using the SVY commands to account for the complex sample design and are weighted to account for unequal probabilities of selection and non-response.

Exploratory analysis examines ethnic differences in physical activity and obesity among adults separately by sex and age within each ethnic group. Age is divided into 3 categories for the exploratory analysis (16-34 years, 35-55 years and 55 years and over).

The two binary outcomes of interest – meeting physical activity guidelines and obesity – are then modelled separately by gender using logistic regression. Each ethnic group is included as a dummy variable and other explanatory variables are also included. Age (in single years) and age-squared are included to control for differences between and within ethnic groups for both physical activity and obesity (see section 3.1). A 'migrant status' variable is included because the literature suggests that migration may have an impact on obesity and physical activity (see

section 1.0). The migrant status variable is divided into 3 categories: British born, adult migrant (came to GB aged 16 or over) and child migrant (came to GB before 16 years old). Socio-economic factors may influence obesity and physical activity levels (see section 1.0) so a number of socio-economic indicators are included in the models, namely highest educational qualification, economic status and equivalised household income. National Statistics Socio-economic Classification (NS-SEC) is available from the dataset but it is not significant in initial models so it is excluded from the final analysis in order to make the models more parsimonious. Current literature on obesity focuses on the influences of the built environment (for example Cummins and MacIntyre, 2006; Stafford et al, 2006; Cummins et al, 2008; Cross-Government Obesity Unit, Department of Health, Department for Children, Schools and Families, 2008) therefore a number of area-level variables are included in the models. These include a rural/urban/suburban indicator (based on the interviewer's observations of the area), quintiles of the 2004 Index of Multiple Deprivation (a ranking of area according to levels of deprivation) based on 2001 Census Super Output Areas (SOAS), and the respondents' views of the local area in terms of leisure facilities, public transport and access to a supermarket.

Finally, physical activity (defined as meeting/not meeting the 5*30 minutes of at least moderate intensity physical activity per week) and fruit and vegetable intake (defined as eating/not eating five or more portions of fruit or vegetables a day) are included in the obesity model to examine the effect of these two factors on obesity when holding all other factors constant.

3.0 Results
3.1 Exploratory Analysis

3.1.1 Physical activity

Figures 1 and 2 show the percentage of respondents meeting the physical activity guidelines (at least 5 days of moderate intensity exercise lasting 30 minutes, per week) by ethnic group by age group for men and women separately. Appendix Table 1 provides the data used to construct these figures.

For all groups, men are more likely to meet the guidelines than women and younger age groups more likely to do so than older groups. The one exception is the Chinese group where there is very little variation by age for either men or women.

Among men, the Irish, White and Black Caribbean groups are the most likely to meet the physical activity recommendations – about 50 percent of the youngest age group do so. Levels are significantly lower for South Asian and Chinese males with around 30 percent of the youngest age-group meeting the activity guidelines.

Among women the Black Caribbean, Black African and Irish groups have the highest levels of activity whilst Pakistani, Bangladeshi and Chinese women all have significantly lower rates of activity, and these are particularly low for the oldest Bangladeshi age-groups (2 percent for the over 55s).

Overall Pakistani, Bangladeshi, Chinese, Irish and White men are significantly more likely than their female counterparts to meet the recommended physical activity guidelines. Among the Pakistani, Bangladeshi and Chinese groups the gender differences are only significant for the 16-34 and 35-54 age-groups but within the White group the gender difference is significant across all ages and within the Irish group only the 16-34 age group have significant gender differences. There are no significant gender differences in meeting the physical activity guidelines for the Black Caribbean, Black-African and Indian groups overall or by age-group.

3.1.2 Obesity

Figures 3 and 4 show the percentage BMI obese by ethnic group by age for men and women separately. Appendix table 2 provides the data used to construct these figures.

Among men, the Irish, Black-Caribbean and White groups have the highest levels of obesity (up to 37 percent for Irish men aged 55+), whilst Chinese and Bangladeshi men have the lowest levels (5 percent for the 55+ Bangladeshi group). Among women, the Black-African, Black-Caribbean and Pakistani groups have the highest levels of obesity and are significantly more likely to be obese than those in all other groups. For these three ethnic groups obesity levels are markedly higher for older women (for example, over 50 percent for Black African women aged 35-54 and 55+) than for younger women (16-34). As for the men, Chinese and Bangladeshi women have significantly lower levels of obesity than women within each of the other ethnic groups and the Chinese women have significantly lower levels than the Bangladeshi women.

Black African, Bangladeshi and Pakistani females are significantly more likely than their male counterparts to be BMI-obese but for the Pakistani group these differences are only significant for those aged 34-55 and 55+. No significant gender differences are detected within the other ethnic groups.

Obesity varies by age within ethnic groups. Bangladeshi and Chinese men have very low levels of obesity with no significant differences between age groups. Black Caribbean men have high levels of obesity within each age-group with no significant differences between the age groups. Levels of obesity increase with age for Black African, Pakistani, Irish and White men but these increases vary by ethnic group, for example Irish males aged 16-34 and aged 35-54 have similar levels of obesity but this is significantly higher (37%) at age 55+. By contrast, White males aged 16-34 are significantly less likely to be obese than the two older age-groups which have similar levels of obesity – at almost 30%.

There is an increase in obesity with age for women in all ethnic groups, except for the Chinese. Obesity steadily increases with each age-group among Black-Caribbean, Pakistani and White females. However for Black African, Indian and Bangladeshi females there is an increase between the aged of 16-34 and 35-54 but this increase stops at 55+. Irish females aged 16-34 and aged 35-54 have similar levels of obesity but this increases significantly at age 55+.

3.2 Logistic regression analysis

Logistic regression models are used to assess ethnic differences in, firstly, physical activity (defined as meeting moderate physical activity guidelines) and, secondly, obesity (defined as a BMI of 30kg/m^2). Logistic regression is appropriate because the two outcome variables are expressed as binary variables, coded 1/0, where the respondent either does or does not fulfil the criterion. Separate models are run for males and females as the exploratory analysis shows that there are gender differences in relation to both physical activity and obesity. Other explanatory variables, expected to influence the outcome, are included in each model: age, age squared, ethnic group, migrant status, highest qualification, economic status, equivalised household income tertile, urban indicator, IMD quintile, area opinion. Physical activity and consumption of fruit and vegetables were also included as explanatory variables in the obesity model. Details of these variables are given in section 2.2.

Results are presented in the form of odds ratios. Odds ratios (OR) are defined as the probability of an outcome occurring divided by the probability of the outcome not occurring.

The reference category for each variable provides the comparator against which the odds ratios for other categories are assessed and thus has the value of 1. Tables 3 and 4 present the fully adjusted odds ratios for physical activity and obesity

3.2.1 Physical Activity

Model 1 in Table 3 (age and ethnic group) confirms the results in Figures 1 and 2. For men, all minority groups are less likely to meet the physical activity guidelines than the white reference group, except for Black Caribbean and Irish men who are not significantly different. For women, South Asian and Chinese women are significantly less likely to meet the physical activity guidelines whilst the Black and Irish groups are not significantly different from the white reference category. Age is entered into the model as a continuous variable in single years. For women only, activity initially increases with age and then, for both men and women, declines with age (shown by the age-squared polynomial term).

Model 2 includes the other explanatory variables expected to influence physical activity, again with separate models for men and women. Highest educational qualification is a significant predictor of physical activity for men but not for women. For men, those with qualifications below degree-level have increased odds of meeting the physical activity guidelines. Men who are in employment also have increased odds of meeting the physical activity guidelines when compared with those who are unemployed or economically inactive, whilst for women this was only the case for the economically inactive. Migrant status, household income, urban indicator, IMD quintile, leisure facilities in the area and local transport are not significantly associated with meeting the physical activity guidelines when controlling for other factors.

Once these additional factors are included in the model we find that, for men, only Pakistanis and Bangladeshis remain less likely to be physically active than the white reference group. For Black African, Indian and Chinese men the lower level of physical activity is no longer significant once other factors (e.g. qualifications and economic activity) are included in the model.

For women, the same ethnic groups remain less likely to meet the physical activity guidelines – Indian, Pakistani, Bangladeshi and Chinese - as in Model 1. None of the additional factors which we hypothesised might affect levels of physical activity – with the one exception of economic inactivity – have any significant effect on this measure of physical activity and the odds ratios for each ethnic group by comparison with white women, remain very similar.

3.2.2 Obesity

Model 1 in table 4 shows that, for men, Indian, Pakistani, Bangladeshi and Chinese men have significantly lower odds of being obese than the white reference group. Black Africans, Black Caribbean and Irish men are not significantly different than the white group. Women show a rather different pattern, with Black Caribbean, Black African and Pakistani women significantly more likely to be obese than white women and Chinese women significantly less so. For both men and women, the odds of being obese initially increase with age and then decline. This decrease with age was not captured in Figures 1 and 2 which were unable to provide fine break-downs with age for each ethnic group.

Model 2 adds other explanatory variables into the model to establish whether the observed ethnic differences are, in fact, explained by other factors. For men, the only explanatory factors that have a significant effect on the likelihood of being obese (by comparison with the reference categories) are having no qualifications, which increases the odds of being obese by about 50%; having poor leisure facilities in the area; and meeting the physical activity guidelines. The ethnic differences between men, identified in model 1, remain largely unchanged once all these additional factors have been included.

For women, those with no qualifications are twice as likely to be obese as women with a degree-level qualification and women with qualifications at NVQ level 3 or below are about 50% more likely to be obese. Unlike men, household income level is also a predictor of obesity when holding other factors constant – those in the middle and lowest income tertiles have higher odds of being obese than those in the highest tertile. Women also differ from men in that good leisure facilities do not predict obesity whilst good transport facilities are a significant negative predictor. As for men, meeting the physical activity guidelines reduces the odds of being obese by comparison with those who do not meet the guidelines. For both men and women, migrant status, urban indicator, IMD quintile, supermarkets in the local area and consumption of fruit and vegetables are not significantly associated with obesity when controlling for other factors.

The odds of obesity by comparison with white women are higher for Black Caribbean and Black African women (odds ratios of 2 and 3 respectively) once the full set of controls are added to the model, whilst Chinese women remained nearly three times less likely to be obese than white women.

Despite the strong inverse relationship between physical activity and obesity for both men and women, it was apparent from Figures 1 and 2 that some ethnic groups with low levels of physical activity also have low levels of obesity, for example Chinese women and Bangladeshi men. We have therefore tested an interaction term between ethnic groups and physical activity for both men and women to establish whether the relationship shown in table 4 varies between ethnic groups. However, no terms are significant for either men or women and therefore we have not reported them here.

4.0 Discussion

Current UK government guidelines for tackling obesity include steps to increase physical activity and encourage healthy eating habits. Although there is evidence of ethnic differences in obesity there is limited evidence of the independent effects of ethnicity, physical activity, diet, age, sex and socio-economic characteristics upon obesity and likewise the independent effects of ethnicity, socio-demographic and socio-economic factors upon physical activity.

4.1 Ethnicity, physical activity and obesity

Ethnicity differences in obesity and physical activity remain after holding constant socio-demographic, socio-economic and area characteristics but these differences vary between ethnic groups and by gender. Black-Caribbean and Black African women have odds ratios of 2 and 3, respectively by comparison with White women, but obesity among Black-Caribbean and Black African men is not significantly different to White men. Chinese men and women both have significantly lower odds of being obese than their White counterparts whilst South Asian men have lower odds of being obese than White men but South Asian women are not significantly different from White women. This suggests that there is no straightforward relationship between ethnicity and obesity and that we need to examine in more depth factors that influence the life-style and behaviour of different groups and, in particular, gender differences. The relationship between physical activity and obesity is also far from straightforward. Although our models show that meeting moderate physical activity guidelines is a significant predictor of reduced levels of obesity, both Chinese men and women and Bangladeshi men are less likely to be obese than the white comparator group and also less likely to meet the physical activity guidelines – although formal tests for an interaction failed to research significance.

The lower levels of physical activity for South Asian women are consistent with other research (Sproston & Mindell, 2006, Hayes et al 2002, Pomerleau et al 1999 etc) and with literature that suggests that cultural or religious barriers may have a role in participation in

physical activity. (Sriskanthatrajah & Kai, 2006; Grace et al, 2007; Scraton et al, 1999 and 2005). The presence of cultural or religious barriers is consistent with our focus groups interviews of Pakistani and Bangladeshi women aged between 18 and 30. These women recounted being restricted in doing physical sports, and outdoor activities generally, by their parents at the time of transition to secondary school/puberty. Some of these women imposed similar restrictions on their daughters and all felt that swimming, for example, was only possible in women-only sessions in the local pool. However, these women-only sessions, including women-only gym sessions and dance classes in a female setting, seemed to be very popular. Whilst these results suggest that there may be cultural barriers to physical activity for Pakistani and Bangladeshi women, our regression models shows that Chinese women have even lower odds of physical activity once control variables have been added to the model. Also, Pakistani and Bangladeshi men have lower odds of meeting the physical activity guidelines than any other ethnic groups. Therefore, whilst cultural restrictions may well influence physical activity for Pakistani and Bangladeshi women in particular, this can only provide a partial explanation.

4.2 Migration, physical activity and obesity

Migration is not a significant predictor of obesity or physical activity when holding other factors constant. These findings support the research of Hayes et al (2002) who have shown little difference between the physical activity levels of British-born Asians and their migrant peers and contradicts other literature (for example, Goel et al, 2004 and Dawson et al, 2005) which suggests that migration affects lifestyle which in turn affects obesity. However, the odds-ratios in the obesity model (although not significant) suggest that both female adult and child migrants and male adult migrants are less likely to be obese than those who are born in Britain.

Again, the Pakistani and Bangladeshi women who took part in our focus groups provided some evidence of life-style differences between themselves and their (first-generation) parents that suggested a process by which changes may influence obesity level. For example, they described ways in which they and their children were adopting more 'western' food, e.g. pasta, lasagne, shepherds pie, chips, pizza, whilst their parents preferred more traditional food. However, traditional food uses a lot of ghee (clarified butter) and, thus highlights the difficulty of making any simplistic assumptions about the impact of traditional versus western diets on obesity.

4.3 Socio-demographic and socio-economic determinants of physical activity and obesity

Only a few of the socio-demographic and socio-economic characteristics included in the logistic regression models are independent predictors of obesity and physical activity when controlling for other factors. For both men and women obesity increases with age and then decreases at the oldest end of the age spectrum. Men and women with no qualifications or low level qualifications have higher odds of being obese than those with degree-level qualifications. This may reflect an increased willingness amongst the more highly qualified to respond to public health messages – and, in this regard, parallels smoking patterns. For men, those with qualifications lower than degree-level have higher odds of meeting the physical activity guidelines than those with degrees or equivalent but this may reflect higher levels of occupational activity among those less qualified. Women on middle or low equivalised incomes have higher odds of being obese when compared with those on high incomes (although the odds are not significantly different for different income groups among men they are in the same direction as women). This supports the findings of many other research studies which suggest a relationship between deprivation and obesity (for example, Sobal, 1989; Craig & Mindell, 2008; Sproston & Mindell, 2006; Diez Roux et al, 2000; Pickett et al, 2005). Economic status is related to physical activity (but not obesity) when controlling for other factors; unemployed men and economically inactive men and women have lower odds of meeting the physical activity guidelines than men and women in employment, probably reflecting the role of travel to work and occupation itself in providing exercise. Mutrie and

Hannah (2004) have shown that exercise obtained through manual work is important for men and, on retirement it is not fully replaced by alternative forms of activity (Berger at al, 2005).

Area is not generally an important predictor of obesity or physical activity when controlling for other factors. None of the area-indicator variables are significant predictors of physical activity for men or women. Only two of the area-indictor variables are significant predictors of obesity and both have an effect in the opposite direction to that expected. For men, a perception of *poor* leisure facilities in the area is associated with a significant reduction in the odds of obesity, whilst, for women, poor transport facilities similarly predict lower odds of obesity, holding constant other factors.

The role of transport facilities in the area can only be understood in the context of whether the respondent has access to a car and, in the HSE, this information in only available for the household as a whole, rather than the individual. It may be that women with poor transport facilities walk more than those with better transport, but we cannot test this.

4.3 Diet and physical activity as predictors of obesity

As one might expect, those who meet the physical activity guideline have lower odds of being obese than those who do not meet the guidelines, when controlling for other factors. However, fruit and vegetable consumption is not a significant predictor of obesity - and the model results, although not significant, show an inverse relationship with fruit and vegetable intake and obesity. This can be explained by the fact that fruit and vegetable consumption is only a partial measure of diet and it does not reflect eating habits as a whole. We do not have information on the extent to which other types of food are consumed, such as fizzy drinks, or on the total calorific intake of the respondent. One cannot assume that eating five or more fruit and vegetables a day is a predictor of a healthy diet in general.

5.0 Conclusions

These results highlight the importance of recognising differences in both levels of exercise and obesity not just between ethnic groups but also between men and women. The relatively weak association between obesity and meeting moderate exercise guidelines (meeting the exercise guidelines increases the odds of NOT being obese by about 40%) demonstrates that exercise, of itself, does not provide a sufficient explanation for obesity levels. Whilst manual work associated with employment has been shown to be an important component of physical activity for some men, the steady decline in occupations requiring heavy manual work suggests this will play a decreasing role over time.

Differences in levels of obesity between Black Caribbean and Black African men and women remain unexplained and require more work to establish the various roles of life-style and eating patterns, occupation or body-image preferences.

The very low levels of obesity for Chinese men and women – with no indication of an increase amongst younger generations - is not readily explained by levels of physical activity and, again, needs research in more depth to identify whether diet plays a major role or whether additional factors are at play. Similarly, the low levels of physical activity amongst Pakistani and Bangladeshi women *and men* cannot be simply explained by cultural barriers for women.

Obesity is much more complicated than just trying to tell people to eat more healthily and exercise more! Much more detailed work is needed to understand the range of different factors that explain the ethnic and gender differences observed here.

Figure 1: Percentage meeting physical activity guidelines by age group by ethnic group – males aged 16+

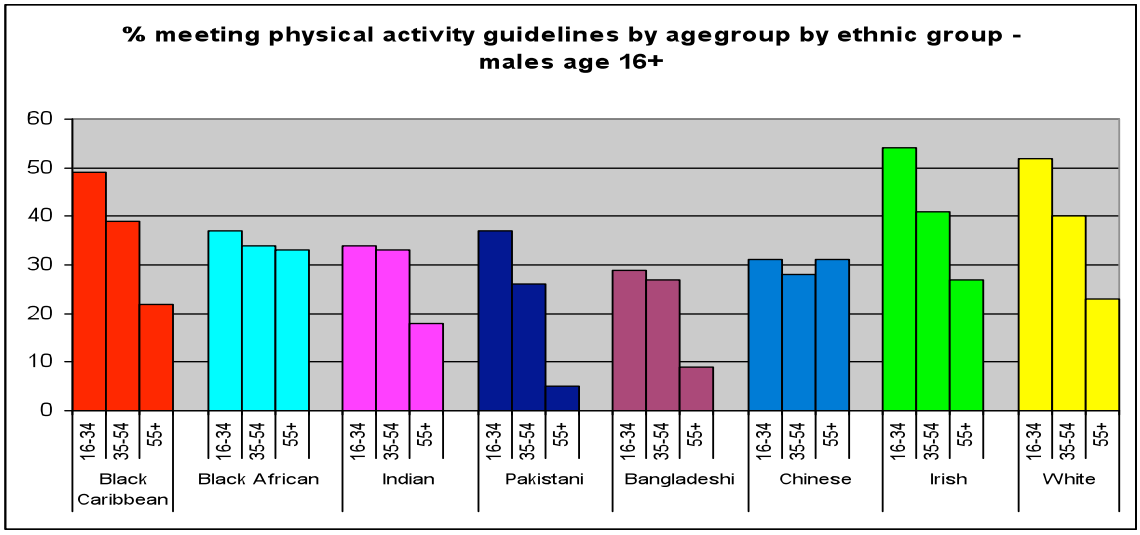


Figure 2: Percentage meeting physical activity guidelines by age group by ethnic group – females aged 16+

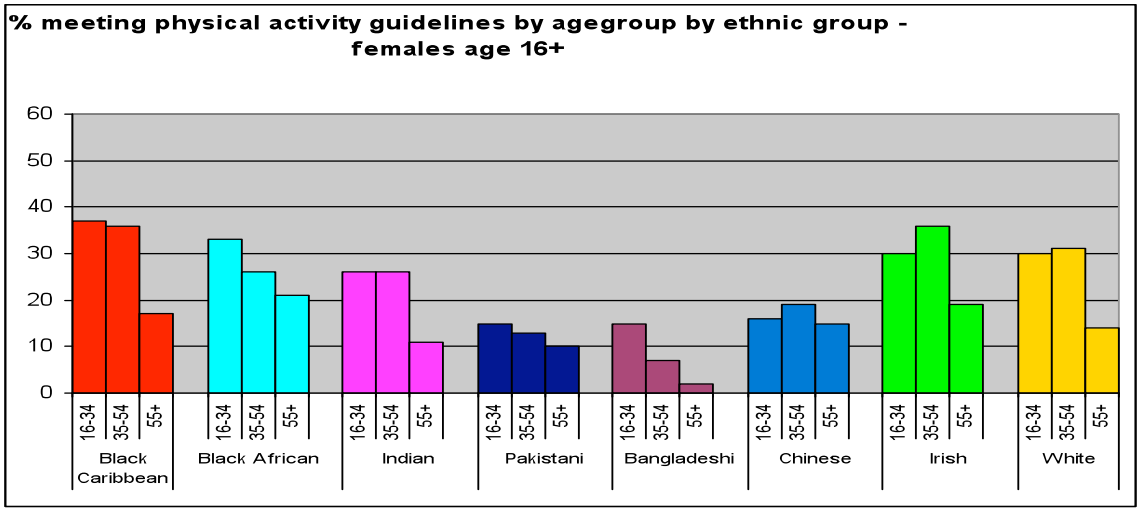


Figure 3: Percentage obese by age group by ethnic group – males age 16+

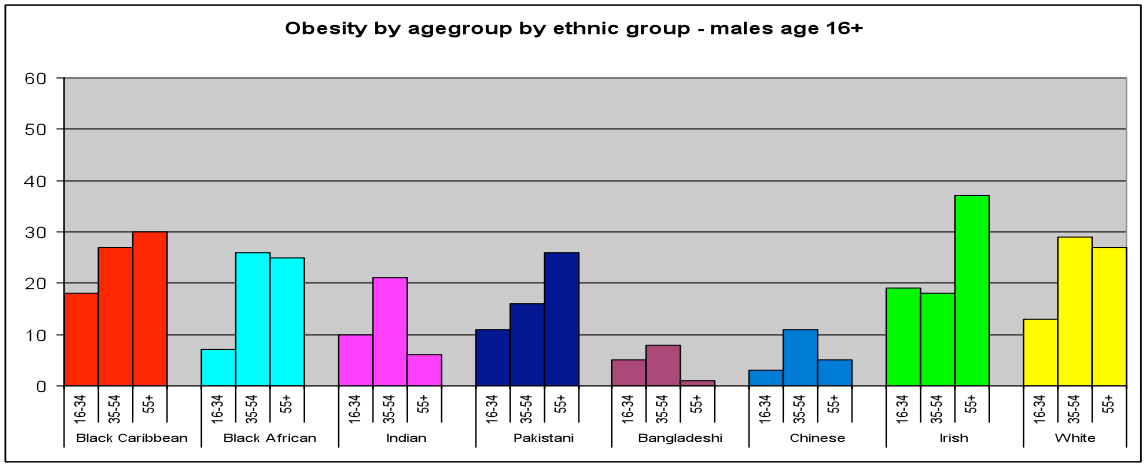
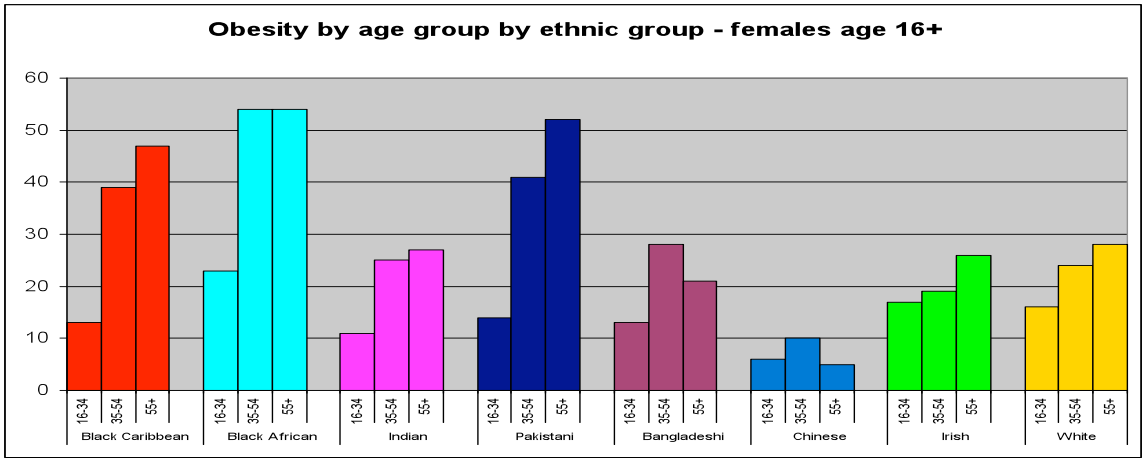


Figure 4: Percentage obese by age group by ethnic group – females age 16+



Appendix Table 1: Percentage of respondents meeting physical activity guidelines by ethnic group by age by sex			
Ethnic group	Age	Sex	
		Men	Women
Black Caribbean	16-34	49	37
	35-54	39	36
	55+	22	17
	All (n=weighted base)	37 (n=477)	31 (n=673)
Black African	16-34	37	33
	35-54	34	26
	55+	33	21
	All (n=weighted base)	35 (n=373)	29 (n=472)
Indian	16-34	34	26
	35-54	33	26
	55+	18	11
	All (n=weighted base)	30 (n=901)	23 (n=1067)
Pakistani	16-34	37	15
	35-54	26	13
	55+	5	10
	All (n=weighted base)	28 (n=420)	14 (n=499)
Bangladeshi	16-34	29	15
	35-54	27	7
	55+	9	2
	All (n=weighted base)	26 (n=177)	11 (n=207)
Chinese	16-34	31	16
	35-54	28	19
	55+	31	15
	All (n=weighted base)	30 (n=151)	17 (n=163)
Irish	16-34	54	30
	35-54	41	36
	55+	27	19
	All (n=weighted base)	39 (n=1776)	29 (n=2369)
White	16-34	52	30
	35-54	40	31
	55+	23	14
	All (n=weighted base)	38 (n=39756)	24 (n=41623)

Unweighted bases less than 30
Unweighted bases less than 50

Appendix Table 2: Percentage of respondents who are BMI obese by ethnic group by age by sex

Ethnic group	Age	Sex	
		Men	Women
Black Caribbean	16-34	18	13
	35-54	27	39
	55+	30	47
	All (n=weighted base)	25 (n=380)	32 (n=500)
Black African	16-34	7	23
	35-54	26	54
	55+	25	54
	All (n=weighted base)	17 (n=291)	17 (n=344)
Indian	16-34	10	11
	35-54	21	25
	55+	6	27
	All (n=weighted base)	14 (n=798)	14 (n=921)
Pakistani	16-34	11	14
	35-54	16	41
	55+	26	52
	All (n=weighted base)	15 (n=336)	15 (n=387)
Bangladeshi	16-34	5	13
	35-54	8	28
	55+	1	21
	All (n=weighted base)	6 (n=143)	6 (n=153)
Chinese	16-34	3	6
	35-54	11	10
	55+	5	5
	All (n=weighted base)	6 (n=135)	6 (n=136)
Irish	16-34	19	17
	35-54	18	19
	55+	37	26
	All (n=weighted base)	25 (n=1574)	25 (n=2008)
White	16-34	13	16
	35-54	29	24
	55+	27	28
	All (n=weighted base)	23 (n=33887)	23 (n=34170)

Unweighted bases less than 30
Unweighted bases less than 50

Appendix Table 3: Logistic regression (odds ratios) – physical activity				
	Model 1		*Model 2*	
	Males	*Females*	*Males*	*Females*
Age (single years)	1.02	**1.08**	**0.97**	**1.07**
Age squared	**0.999**	**0.998**	1.00	**1.00**
Ethnic group				
White	1.00	1.00	1.00	1.00
Black Caribbean	0.92	1.24	1.08	1.31
Black African	**0.65**	0.95	0.91	0.82
Indian	**0.61**	**0.75**	0.77	**0.65**
Pakistani	**0.50**	**0.38**	**0.55**	**0.48**
Bangladeshi	**0.43**	**0.31**	**0.49**	**0.48**
Chinese	**0.56**	**0.50**	0.82	**0.35**
Irish	1.09	1.18	1.20	0.99
Migrant status				
GB born			1.00	1.00
Adult migrant			0.74	1.21
Child migrant			0.95	1.30
Highest qualification				
Degree			1.00	1.00
Higher education below degree			**1.59**	1.22
A-level equiv			**1.73**	1.28
O-level/CSE/Foreign/Other equiv			**1.79**	1.02
No Qualifications			**2.25**	1.03
Economic status				
In employment			1.00	1.00
Unemployed			**0.50**	1.28
Retired/other economically inactive			**0.32**	**0.70**
Equivalised household income tertiles				
Highest income tertile			1.00	1.00
Middle income tertile			0.96	0.87
Lowest income tertile			1.05	0.86
Urban indicator				
Urban			1.00	1.00
Suburban			0.91	0.96
Rural			1.12	0.99
IMD quintiles				
IMD (1) – Least deprived quintile			1.00	1.00
IMD (2)			1.17	1.07
IMD (3)			1.36	1.04
IMD (4)			1.25	0.94
IMD (5) – Most deprived quintile			1.41	0.92
Good leisure facilities in area				
Agree			1.00	1.00
Disagree			1.16	1.19
Good local transport in area				
Agree			1.00	1.00
Disagree			0.83	1.06
Unweighted number of cases	*5540*	*7068*	*3832*	*4863*

P <0.05

Appendix Table 4: Logistic regression (odds ratios) – obesity				
	Model 1		*Model 2*	
	Males	*Females*	*Males*	*Females*
Age (single years)	**1.16**	**1.10**	**1.19**	**1.11**
Age squared	**1.00**	**1.00**	**1.00**	**1.00**
Ethnic group				
White	1.00	1.00	1.00	1.00
Black Caribbean	1.10	**1.68**	0.91	**2.03**
Black African	0.76	**2.64**	0.70	**3.18**
Indian	**0.53**	0.87	**0.47**	0.93
Pakistani	**0.65**	**1.59**	**0.54**	1.47
Bangladeshi	**0.23**	0.92	**0.12**	0.68
Chinese	**0.24**	**0.29**	**0.25**	**0.36**
Irish	0.99	0.82	0.75	0.92
Migrant status				
GB born			1.00	1.00
Adult migrant			0.87	0.72
Child migrant			1.04	0.85
Highest qualification				
Degree			1.00	1.00
Higher education below degree			1.21	1.38
A-level equiv			1.28	**1.54**
O-level/CSE/Foreign/Other equiv			**1.41**	**1.65**
No Qualifications			**1.51**	**2.08**
Economic status				
In employment			1.00	1.00
Unemployed			1.09	0.76
Retired/other economically inactive			0.99	0.92
Equivalised household income tertiles				
Highest income tertile			1.00	1.00
Middle income tertile			1.13	**1.35**
Lowest income tertile			1.28	**1.36**
Urban indicator				
Urban			1.00	1.00
Suburban			0.94	0.87
Rural			1.00	0.84
IMD quintiles				
IMD (1) – Least deprived quintile			1.00	1.00
IMD (2)			0.91	0.96
IMD (3)			1.01	1.05
IMD (4)			1.11	1.30
IMD (5) – Most deprived quintile			0.97	1.14
Good leisure facilities in area				
Agree			1.00	1.00
Disagree			**0.75**	0.98
Good local transport in area				
Agree			1.00	1.00
Disagree			1.07	**0.75**
Ease of getting to supermarket				
Easy			1.00	1.00

Difficult			0.68	1.01
Meeting physical activity guidelines				
No			1.00	1.00
Yes			**0.72**	**0.65**
Eating 5 day				
No			1.00	1.00
Yes			1.17	1.16
Unweighted number of cases	*4638*	*5661*	*3470*	*4200*

P <0.05

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