Socioeconomic disparities in cancer-risk behaviors in adolescence: baseline results from the Health and Behaviour in Teenagers Study (HABITS)


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Abstract

Background. This study explores the association between socioeconomic deprivation and five factors associated with long-term risk of cancer, in adolescents.

Methods. BMI, fat intake, fruit and vegetable intake, smoking, and exercise were assessed in 4320 students ages 11 to 12, from 36 schools, in the first year of a 5-year longitudinal study of the development of health behaviors (HABITS study). Neighborhood socioeconomic deprivation for each student’s area of residence was matched to their postcode (zip code). We used multiple logistic regression analyses to investigate the relationship between risky behaviors and socioeconomic circumstances.

Results. Univariate analyses showed boys and girls from more deprived neighborhoods were more likely to have tried smoking, to eat a high fat diet, and to be overweight. Girls living in more deprived areas were also less likely to eat five servings of fruit and vegetables or to exercise at the weekend. Most differences persisted after controlling for ethnicity. A clear deprivation gradient emerged for each risk factor, indicating the linear nature of the relationship.

Conclusions. This study demonstrates the influence of deprivation on engaging in cancer-risk health behaviors. These patterns may set young people from more socioeconomically deprived social environments on a trajectory leading to increased cancer mortality in adult life.

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Keywords: Adolescence; Child; Socioeconomic status; Smoking; Diet; Exercise; Obesity

Introduction

The burden of cancer is distributed unequally in almost all developed countries, with cancer deaths being higher in groups from deprived socioeconomic backgrounds [1]. There is increasing interest in understanding the roots of these inequalities, with a view to finding better ways to minimize the loss of life to cancer across all sectors of the community. Many processes are likely to contribute to disparities in cancer mortality, including differences in medical care, environmental exposures, reproductive patterns, chronic infections, health behaviors, and utilization of screening. In terms of attributable risk in the population as a whole, tobacco smoking, diet, body weight, and alcohol consumption are estimated to account for the largest fractions of the avoidable risks for cancer [2].

Socioeconomic differentials have been established in many of the contributory behavioral risk factors, supporting the idea that health behavior differences are important influences on the gradient in cancer mortality [3]. Since the hazardous effects of smoking were publicized in the 1950s, dramatic differences in smoking rates between higher and lower socioeconomic status (SES) groups have emerged in most industrialized countries. In the United Kingdom, 15% of men with professional occupations are smokers rising to 44% in unskilled manual men [4]. Similar patterns can be seen in the United States [5] and other European countries [6]. Fresh fruit and vegetables are consumed less among the poor than the rich in many parts of the world. In Britain,
intake of fruit and vegetables is almost one and one-half times as high in the highest compared with the lowest income groups [7], and similar associations can be seen with income and education in the United States [8]. Obesity, once confined mainly to the wealthy, has become one of the hallmarks of poverty in industrialized countries. Adult obesity prevalence in Britain is less than 15% in women from professional groups, but rises to 28.1% in women in unskilled jobs [9]. SES patterning in overall physical activity is complex, reflecting lower levels of occupational physical activity, but higher levels of leisure-time physical activity in more affluent groups [10]. However, with progressively fewer jobs involving significant physical activity, an active lifestyle will increasingly depend on leisure-time physical activity throughout the population [11].

These observations highlight the importance of understanding the development of socioeconomic gradients in the behaviors that affect cancer risk, many of which emerge in adolescence. Most smokers take up the habit in their teenage years [4]. Dietary choices move from being primarily determined by family eating patterns in childhood, to being increasingly peer-led or independently determined behaviors in the teenage years [12]. Physical activity, which is part of active play in childhood, becomes one of many competing leisure options in adolescence. Particularly for girls, this is often a time when active pastimes are dropped in favor of more sedentary pursuits [13,14]. Adolescence is also one of the key times for weight gain, with recent data suggesting that over 17% of 15-year-old girls have a BMI that puts them at risk of obesity in adulthood [15].

Adolescence therefore appears to be a life stage at which important behavioral choices are emerging and trajectories for adult life may be set, and so it may well be a time when socioeconomic differentials in behavior appear. Adolescents become increasingly independent in decision-making, and take progressively more responsibility for social activities, leisure activities, and lifestyle. They also begin to assume responsibility for their own health-related choices, and must develop an understanding of how to promote and protect health.

Research into socioeconomic inequalities in health behaviors during adolescence has produced a mixed picture, and few studies have examined the full range of behaviors under scrutiny in this study. In addition, some studies have used ethnicity as a proxy for socioeconomic deprivation, which has added to the uncertainty of what effect, if any, socioeconomic deprivation has at this formative age. Adolescent smoking has been the focus of many investigations, and although some studies have found no relationship [16–18], many other studies in the United States, Europe, and Australia observe SES differences [19–23]. Studies of diet have provided a fairly consistent picture of higher fat intake in more deprived young people [24–26]. A similar picture has emerged in relation to exercise studies [17,27–29]. The findings, however, are again mixed when examining fruit and vegetable intake [30,31] and obesity rates [32].

The Health and Behaviour in Teenagers Study (HABITS) was set up to produce some more definitive answers with respect to the adoption, development, and change in health behaviors which are related to adult cancer risk. The cohort of adolescents is being assessed annually over 5 years to investigate tracking and clustering of health behaviors as well as psychosocial predictors. The present report examines SES differences in health behaviors in the baseline year of the study (1999). The sample was drawn to be socioeconomically diverse, in order to maximize the power to examine SES differences in the development of health behaviors. We aimed to examine the extent of the SES differences in health behavior engagement, looking for a gradient of effect and not just comparing affluent and deprived young people. We also included a range of health behaviors, to allow us to determine whether socioeconomic deprivation has a similar association with each behavior.

Methods

The HABITS study is a 5-year longitudinal study that began in 1999 and will be completed in 2003. It is a school-based survey, encompassing 36 secondary (high) schools that are visited annually by a team of researchers. The target sample in the baseline year was all students in Year 7 (ages 11 to 12) registered in the 36 schools (n = 5120). Students complete an extensive questionnaire annually, as well as being weighed and measured and providing a saliva sample for cotinine assay.

School sampling frame

The sampling frame included both state-funded (public) and independently funded (private) schools. Schools were sampled from inner and outer London to maximize the variation in economic circumstances. The catchment zone for inner London state schools includes areas of high deprivation, whereas more affluent suburbs typify the outer London area. This sampling process also ensured that ethnic minorities were well represented. In the 1991 census 38% of young people ages 5–15 in inner London were not White, compared with 14% in outer London boroughs [33]. Schools were also sampled by gender of pupils attending the school (boys only/girls only/mixed), since all these school types are common in the British educational system.

The sampling frame consisted of nine cells created by crossing school setting (independent, inner London state, and outer London state schools) and gender mix (boys, girls, and mixed). A list was compiled of all secondary schools in the South London boroughs taking students from ages 11 to 16, and the schools were categorized according to school setting and gender mix. Four schools were then drawn at random from each school type list and, each selected school was approached. If a school declined to take part, a substitute was drawn from the list until all cells contained four
schools. Seven independent schools, 2 inner London schools, and 16 outer London schools declined participation. These were predominantly girls (13) or mixed (10) schools, and all cited pressures on staff time or recent staff turnover as a reason for nonparticipation.

Recruitment of pupils

All students in the first secondary school year of the participating schools were eligible for inclusion in the study, which took place in the Spring and Autumn terms. Consent letters were sent to parents, informing them of the study and giving them the option to exclude their child from the project. Each student was also given a written consent form, and was informed of their right to withdraw from the study. The study protocol was approved by the University College London/University College London Hospital Medical Ethics Committee.

Procedure in classroom

School visits took place during lesson time and were carried out with whole classes of students. In each class, a researcher explained the purpose and procedures of the study. Pupils were asked to complete a separate sheet, with a unique identifier, detailing their name, address, postcode (zip code), and school, confirming their consent to participate. This sheet was stored separately, and used to track students throughout the study. Students then completed a questionnaire with the researchers present to provide assistance. Students were individually weighed and measured out of sight of the class and saliva samples were taken for cotinine assay.

Measures

Socioeconomic deprivation

An area-based measure of socioeconomic deprivation was obtained by matching students’ reported residential postcode to census information available at enumeration district level. A neighborhood-based SES index was used because of evidence for a socioeconomic bias in completion of data on family socioeconomic characteristics such as parental education, in younger adolescents [34]. The area deprivation index therefore acts as a proxy for SES, and is easily obtainable, as most (97.5%) of the students knew where they lived. The deprivation measure used was the Townsend index, which is based on levels of car ownership, housing tenure, unemployment, and overcrowded living conditions, of the district [35]. Scores on these measures have been standardized across the United Kingdom, so that each enumeration district receives a score dependent on its relative levels of deprivation. A score of zero represents the national average, negative values represent below-average levels of deprivation, and positive values represent higher than average deprivation. This measure has been found to provide a good representation of material deprivation, and is associated with variation in health outcomes [36]. Among those students who gave data on individual measures of material affluence (over 86% of responders), there was reasonable concordance between the Townsend index and housing tenure, car ownership, and dishwasher ownership (correlation with combined affluence scores for these items $r = -0.49$, $P < 0.001$). For categorical analyses, scores were divided into quintiles to reflect the range of levels of deprivation.

Ethnicity

Ethnicity was assessed with responses to the question “would you say you are . . . “White,” “Black,” “Asian,” “mixed,” or “other.” This measure was simplified because of the age of the students involved, but included the three main ethnic groups represented in the 1991 U.K. census [33]. A fourth, heterogeneous group was also identified (mixed/other); this included all those with parents of different ethnic backgrounds and any student whose ethnicity did not fall into one of the three categories above.

Anthropometric measures

Students were individually weighed in indoor clothes, without shoes, using Soehnle calibrated solar scales. Height was measured using a Leicester height measure. Overweight status was defined using international cut-off points for children, defined at 6-month intervals, to form a curve, which passes through a BMI of 25 at 18 years of age [37].

Smoking status

Smoking status was assessed by asking students to tick one of six response categories: “I have never smoked”; “I have only tried smoking once”; “I used to smoke sometimes but never smoke cigarettes now”; “I sometimes smoke cigarettes now but I don’t smoke as many as one a week”; “I usually smoke between one and six cigarettes a week”; “I usually smoke more than six cigarettes a week” [38]. Students who indicated that they had never smoked were asked a further check question: “Just to check, tick the box next to the statement which best describes you: I have never tried smoking a cigarette, not even a puff or two/I did once have a puff or two of a cigarette, but I never smoke now/I do sometimes smoke cigarettes.” Very few students in this age group reported current smoking (2.5%). This was confirmed by cotinine assay, with less than 1% of students having a cotinine concentration indicative of having smoked in the last few days (over 14.7 ng/ml [39]). Because of the low levels of smoking, the cotinine measure was not used in the analysis. For the purposes of the present analyses, students were classified as experimental smokers (“tried smoking”) if they reported ever having tried a cigarette on either question.
Exercise

Current exercise rates were assessed by asking about weekend physical activities “Do you usually take part in any sport or other physical activities on Saturdays/Sundays—yes/no.” Measuring weekend exercise removes the influence of interschool variation in the frequency of physical education lessons. For the logistic regression analysis, students were classified as engaging in weekend exercise (one or both days) or not engaging in weekend exercise.

Fat intake

Frequency of high-fat food intake was assessed using a scale adapted from The Foods That You Eat scale [30]. Eight items (crisps (potato chips), sweets/chocolate (candy), cakes, other puddings/deserts, biscuits, chips (French fries), sausages/burgers, and tinned meat) that provide proportionately high levels of fat were identified. Frequency of consumption was reported on a 6-point scale (“never”/“less than once a week”/“once or twice a week”/“most days”/“once a day”/“more than once a day”). Students who reported eating three or more of these items most days or more often were considered to be consuming a relatively high level of fat. This dichotomy was based on that used in the Youth Risk Behavior Survey [40], although the items reflected foods high in fat in a typical British diet.

Fruit and vegetable consumption

Fruit and vegetable consumption was assessed using the two questions: (“About how many servings of vegetables do you usually eat in a day?” “About how many servings of fruit do you usually eat in a day?”), from the Dietary Instrument for Nutrition Education (DINE) [41], and developed in previous studies [42]. These measures were qualified by stating that estimates of servings should include fresh, frozen, or tinned vegetables, but not potatoes. Examples of a handful of carrots or a small bowl of salad indicated the size of one serving. Fruit portions were defined in a similar way, giving an apple or bowl of fruit salad as an example. Response categories to these questions were “less than 1 serving a day/1 serving a day/2 servings a day/3 servings a day/4 servings a day/5 or more servings a day.” Students were divided into those who reported eating fewer than five fruit and vegetable servings a day, and those eating five or more servings.

Statistical methodology

For descriptive analyses, risk behaviors were dichotomized, and chi-square analyses were used to determine the significance of group differences. Multiple logistic regression was used to examine the relationship between deprivation and risk behaviors, controlling for age and ethnicity in boys and girls separately. School attended was entered as a clustering variable to adjust for any variation due to school-level factors. To determine whether the association between the behaviors and deprivation was linear, polynomial contrasts were calculated to test the linear trend of the relationship of the behaviors with the quintiles of deprivation. Interaction terms (ethnicity by deprivation) were included in a final step, but these were not significant and are not reported here. Univariate analyses were conducted using SPSS Version 9. Regression analyses were carried out in STATA Version 6 to adjust for school as a clustering variable.

Results

Description of sample

Students (5120) were registered in Year 7 (U.S. Grade 6) at the 36 participating schools. The achieved sample comprised 4320 adolescents (1742 girls, 2578 boys), representing an 84% coverage rate; 515 (10%) were absent from the class on the day of the visit and 285 (5.5%) opted out of the study, either by parental or self-exclusion. Numbers in each analysis vary slightly due to missing data on that item.

Students (1617) (1040 boys, 577 girls) came from mixed-sex schools, and 2702 (1536 boys, 1166 girls) from single-sex schools. The sociodemographic characteristics of the participants are shown in Table 1. The majority of the students described themselves as White (56.4%), with 17.3% Black, 7.7% Asian, and 10% from a mixed ethnic origin or “other,” 8.5% did not complete this question. Slightly more girls than boys were Black ($\chi^2(4) = 48.8, P < 0.001$). The mean age of students was 11.8 years and girls were marginally older than boys ($F(1,4146) = 8.82, P = 0.003$).

The mean deprivation score for the areas of residence of the sample was 1.65 (SD 3.7), representing a sample that was slightly more deprived than the U.K. population average (0.0) (a higher score indicates a higher level of deprivation). The girls were slightly more deprived (1.96, SD 3.9) than the boys (1.45, SD 3.5) ($F(1,4212) = 19.7, P < 0.001$).

The average height of the students was 150.7 cm (SD 7.52) and weight was 44.4 kg (SD 10.76). The mean BMI was 19.41 (SD 3.6). Girls were taller ($F(1,4288) = 86.8, P < 0.001$), heavier ($F(1,4273) = 109.7, P < 0.001$), and had a higher BMI ($F(1,4271) = 74.5, P < 0.001$) than the boys.

Health risk behaviors

Rates of reporting each of the health behaviors are reported in Table 2 and show a high prevalence of behaviors that have been linked with cancer risk. More than one in five of these young students had tried smoking (22.8%) and almost a quarter (24.2%) were overweight or obese. Even higher proportions took no weekend exercise (28%), ate insufficient amounts of fruit and vegetables (59%), or ate a high-fat diet (67%).

Regular smoking was infrequent in either sex at this young age (only 13 girls and 15 boys reported smoking once
a week or more), but trying smoking was common. Boys were more likely to have tried smoking than girls ($P < 0.001$). Girls were more likely than boys to be overweight or obese ($P < 0.001$), with almost 22.5% of girls classified as overweight and a further 6.4% classified as obese on age- and gender-adjusted curves [37], compared with 16.7% of boys being overweight and a further 4.4% obese. Boys reported significantly higher levels of weekend exercise than girls. There was no gender difference in the proportion eating five servings of fruit and vegetables a day, but boys were more likely to report frequent high-fat food intake. In the light of the gender differences, the remaining analyses have been conducted separately for boys and girls.

**Associations between deprivation and risk behaviors**

Univariate associations between socioeconomic deprivation and cancer risk factors are shown in Table 3. Overall

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### Table 1

**Distribution of demographic and anthropometric factors by gender**

<table>
<thead>
<tr>
<th></th>
<th>Full sample $(n = 4320)$</th>
<th>Boys $(n = 2578)$</th>
<th>Girls $(n = 1742)$</th>
<th>Test of sex difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD):</td>
<td>11.82 (0.35)</td>
<td>11.81 (0.37)</td>
<td>11.85 (0.32)</td>
<td>$t = 2.71$ (4297) $P = 0.07$</td>
</tr>
<tr>
<td>Ethnicity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>56.5</td>
<td>57.7</td>
<td>54.6</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>17.3</td>
<td>15.3</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>7.7</td>
<td>8.0</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>Mixed/other</td>
<td>10</td>
<td>8.8</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>Data missing</td>
<td>8.5</td>
<td>10.2</td>
<td>6</td>
<td>$\chi^2 = 48.78$ (4) $P &lt; 0.001$</td>
</tr>
<tr>
<td>Townsend quintile (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Least deprived (–5.45–2.03)</td>
<td>19.5</td>
<td>19.3</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td>2.00 (–2.031–0.218)</td>
<td>19.5</td>
<td>20.4</td>
<td>18.1</td>
<td></td>
</tr>
<tr>
<td>3.00 (0.219–2.631)</td>
<td>19.5</td>
<td>20.7</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>4.00 (2.632–5.258)</td>
<td>19.5</td>
<td>20.8</td>
<td>17.6</td>
<td></td>
</tr>
<tr>
<td>Most deprived (5.269–11.08)</td>
<td>19.5</td>
<td>16.0</td>
<td>24.7</td>
<td></td>
</tr>
<tr>
<td>Data missing</td>
<td>2.5</td>
<td>2.8</td>
<td>2</td>
<td>$\chi^2 = 55.96$ (5) $P &lt; 0.001$</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>150.67 (7.52)</td>
<td>149.80 (7.40)</td>
<td>151.96 (7.51)</td>
<td>$t = 9.31$ (4287) $P &lt; 0.001$</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>44.45 (10.76)</td>
<td>43.05 (10.13)</td>
<td>46.52 (11.32)</td>
<td>$t = 10.46$ (4272) $P &lt; 0.001$</td>
</tr>
<tr>
<td>Body mass index (kg/m$^2$)</td>
<td>19.41 (3.59)</td>
<td>19.03 (3.37)</td>
<td>19.98 (3.82)</td>
<td>$t = 8.61$ (4270) $P &lt; 0.001$</td>
</tr>
</tbody>
</table>

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### Table 2

**Distribution of health behaviors by gender**

<table>
<thead>
<tr>
<th></th>
<th>Full sample $(n = 4320)$</th>
<th>Boys $(n = 2578)$</th>
<th>Girls $(n = 1742)$</th>
<th>Test of sex difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever tried smoking (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22.8</td>
<td>24.8</td>
<td>19.1</td>
<td>$\chi^2 = 20.45$ (1), $P &lt; 0.001$</td>
</tr>
<tr>
<td>No</td>
<td>77.2</td>
<td>75.2</td>
<td>80.9</td>
<td></td>
</tr>
<tr>
<td>Overweight category (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>5.2</td>
<td>4.4</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>19.0</td>
<td>16.7</td>
<td>22.5</td>
<td></td>
</tr>
<tr>
<td>Normal weight</td>
<td>70.0</td>
<td>73.5</td>
<td>64.7</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>5.8</td>
<td>5.4</td>
<td>6.3</td>
<td>$\chi^2 = 39.33$ (3), $P &lt; 0.001$</td>
</tr>
<tr>
<td>Exercise (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually exercise at weekend</td>
<td>72.0</td>
<td>76.7</td>
<td>65.1</td>
<td></td>
</tr>
<tr>
<td>Not usually exercise at weekend</td>
<td>28.0</td>
<td>23.3</td>
<td>34.9</td>
<td>$\chi^2 = 68.65$ (1), $P &lt; 0.001$</td>
</tr>
<tr>
<td>High-fat diet (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than two items high-fat foods most days</td>
<td>66.9</td>
<td>70.7</td>
<td>61.6</td>
<td>$\chi^2 = 36.03$ (1), $P &lt; 0.001$</td>
</tr>
<tr>
<td>Two or fewer items high-fat foods most days</td>
<td>33.1</td>
<td>29.3</td>
<td>38.1</td>
<td></td>
</tr>
<tr>
<td>Fruit and vegetable servings (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fewer than 5 per day</td>
<td>58.7</td>
<td>59.6</td>
<td>57.6</td>
<td>$\chi^2 = 1.65$ (1), $P = 0.2$</td>
</tr>
<tr>
<td>5 or more per day</td>
<td>41.3</td>
<td>40.4</td>
<td>42.4</td>
<td></td>
</tr>
</tbody>
</table>
there were very consistent trends in the association between behavior and deprivation. Boys and girls living in deprived areas were more likely to have tried smoking, more likely to eat a high-fat diet, and more likely to be overweight or obese. There was little association between deprivation level and engagement in physical activities at the weekend among boys, but girls were least likely to exercise regularly at the weekend if they lived in deprived neighborhoods. Reported fruit and vegetable consumption did not vary by deprivation level in boys, but girls from the more deprived areas were less likely to report eating at least five portions of fruit and vegetables a day.

**Multivariate analyses**

Associations between SES and the risk behaviors were assessed using multiple logistic regression, controlling for age, ethnicity, and school clustering effects. Tests were carried out for trends using polynomial contrasts. In each case the line of best fit was linear and other models are not reported.

There was a very clear relationship between trying smoking and deprivation in both sexes, with the most deprived boys having odds of trying smoking 1.9 times higher than the least deprived group. The odds of girls from deprived areas trying smoking were 3.2 times higher than girls from the most affluent areas. Among both boys and girls there was a significant linear association with deprivation ($P = 0.030$ and $P < 0.001$, respectively).

The odds of the most deprived group of boys being overweight were 1.7 times higher than the least deprived boys. There was a linear trend also in this relationship ($P = 0.003$). Among the girls, the trend for being overweight in relation to deprivation appeared similar, but was not significant ($P = 0.164$).

Among boys, the pattern of participation in weekend exercise suggested less exercise in those from more deprived areas, but the differences were not statistically significant. Among girls there was a significant linear gradient of exercise from less to more deprived areas ($P = 0.018$).

Eating a high fat diet was strongly associated with deprivation. Both boys and girls from the most deprived areas had twice the odds of eating a high-fat diet compared to the least deprived group (OR 1.8 in both boys and girls), with a linear effect across Townsend quintiles (boys: $P = 0.019$, girls: $P = 0.013$).

In the boys there was no association between fruit and vegetable consumption and deprivation, $P = 0.719$. Although in the girls none of the quintiles were significantly different to the reference group, there was an overall linear trend ($P = 0.037$), with girls living in the most deprived area being less likely to eat the recommended five portions a day than the most affluent girls (Table 4).

**Discussion**

The link between socioeconomic deprivation and cancer is now well established, as are the inequalities in cancer-risk factors in adults [3]. The stage in the life course at which these inequalities emerge is less clear. The present analyses examine evidence for a deprivation gradient in cancer risk factors in early adolescence (11–12 years old); a stage when young people take increasing control over their lifestyle. The data reported here are from the first wave of a large longitudinal study cohort recruited from an ethnically and economically diverse sample.

The results of the univariate analyses showed that students living in deprived areas were more likely to engage in unhealthy behaviors than young people from more affluent areas.
Tried smoking

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Least deprived</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Most deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1.00</td>
<td>1.50 (1.01–2.23)</td>
<td>1.40 (0.86–2.26)</td>
<td>1.70 (0.96–3.01)</td>
<td>1.87 (1.11–3.17)</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
<td>1.29 (0.94–1.78)</td>
<td>1.65 (0.96–2.81)</td>
<td>2.75 (1.66–4.54)</td>
<td>3.23 (1.89–5.50)</td>
</tr>
</tbody>
</table>

Overweight or obese

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Least deprived</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Most deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1.00</td>
<td>0.93 (0.69–1.25)</td>
<td>1.20 (0.94–1.53)</td>
<td>1.26 (0.86–1.86)</td>
<td>1.70 (1.18–2.44)</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
<td>0.93 (0.70–1.25)</td>
<td>0.98 (0.73–1.32)</td>
<td>1.09 (0.77–1.56)</td>
<td>1.26 (0.85–1.86)</td>
</tr>
</tbody>
</table>

Exercise at weekend

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Least deprived</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Most deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1.00</td>
<td>0.95 (0.65–1.39)</td>
<td>0.96 (0.60–1.52)</td>
<td>0.76 (0.49–1.20)</td>
<td>0.75 (0.48–1.15)</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
<td>0.75 (0.55–1.01)</td>
<td>0.68 (0.48–0.96)</td>
<td>0.60 (0.42–0.87)</td>
<td>0.61 (0.39–0.96)</td>
</tr>
</tbody>
</table>

Eat more than two high-fat foods most days

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Least deprived</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Most deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1.00</td>
<td>1.31 (1.02–1.69)</td>
<td>1.30 (0.86–1.95)</td>
<td>1.48 (0.98–2.23)</td>
<td>1.78 (1.16–2.75)</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
<td>0.99 (0.71–1.36)</td>
<td>1.08 (0.72–1.62)</td>
<td>1.53 (0.98–2.40)</td>
<td>1.76 (1.02–3.06)</td>
</tr>
</tbody>
</table>

Eat five or more fruit and vegetables/day

<table>
<thead>
<tr>
<th>Townsend quintile</th>
<th>Least deprived</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Most deprived</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>1.00</td>
<td>0.87 (0.68–1.12)</td>
<td>1.02 (0.78–1.33)</td>
<td>0.87 (0.64–1.20)</td>
<td>0.93 (0.69–1.26)</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00</td>
<td>1.02 (0.66–1.58)</td>
<td>0.80 (0.51–1.25)</td>
<td>0.73 (0.46–1.16)</td>
<td>0.71 (0.45–1.12)</td>
</tr>
</tbody>
</table>

Significance of linear trend (P)

- Townsend quintile: Least deprived, Second, Third, Fourth, Most deprived
- Least deprived: 1.00
- Second: 1.50 (1.01–2.23)
- Third: 1.40 (0.86–2.26)
- Fourth: 1.70 (0.96–3.01)
- Most deprived: 1.87 (1.11–3.17)

- Least deprived: 1.00
- Second: 1.29 (0.94–1.78)
- Third: 1.65 (0.96–2.81)
- Fourth: 2.75 (1.66–4.54)
- Most deprived: 3.23 (1.89–5.50)

- Least deprived: 1.00
- Second: 0.93 (0.69–1.25)
- Third: 1.20 (0.94–1.53)
- Fourth: 1.26 (0.86–1.86)
- Most deprived: 1.70 (1.18–2.44)

- Least deprived: 1.00
- Second: 0.93 (0.70–1.25)
- Third: 0.98 (0.73–1.32)
- Fourth: 1.09 (0.77–1.56)
- Most deprived: 1.26 (0.85–1.86)

- Least deprived: 1.00
- Second: 0.95 (0.65–1.39)
- Third: 0.96 (0.60–1.52)
- Fourth: 0.76 (0.49–1.20)
- Most deprived: 0.75 (0.48–1.15)

- Least deprived: 1.00
- Second: 0.75 (0.55–1.01)
- Third: 0.68 (0.48–0.96)
- Fourth: 0.60 (0.42–0.87)
- Most deprived: 0.61 (0.39–0.96)

- Least deprived: 1.00
- Second: 1.31 (1.02–1.69)
- Third: 1.30 (0.86–1.95)
- Fourth: 1.48 (0.98–2.23)
- Most deprived: 1.78 (1.16–2.75)

- Least deprived: 1.00
- Second: 0.99 (0.71–1.36)
- Third: 1.08 (0.72–1.62)
- Fourth: 1.53 (0.98–2.40)
- Most deprived: 1.76 (1.02–3.06)

- Least deprived: 1.00
- Second: 0.87 (0.68–1.12)
- Third: 1.02 (0.78–1.33)
- Fourth: 0.87 (0.64–1.20)
- Most deprived: 0.93 (0.69–1.26)

- Least deprived: 1.00
- Second: 1.02 (0.66–1.58)
- Third: 0.80 (0.51–1.25)
- Fourth: 0.73 (0.46–1.16)
- Most deprived: 0.71 (0.45–1.12)

areas. Furthermore, the relationships are predominantly linear, with increasing deprivation having an increasingly detrimental effect on the chance of students engaging in healthy behaviors. Among girls this relationship was seen in all the five outcome variables: girls living in lower SES areas were more likely to have tried smoking, eat a high-fat diet, to be inactive, to be overweight, and to eat too few vegetables and fruit. Among boys there was a significant gradient in smoking, high-fat diet, and overweight, but less so for exercise or fruit and vegetable intake.

In the United Kingdom, as in many Western countries, ethnic minorities are overrepresented in more deprived areas [33], and may also have different behavioral norms. For example traditional Indian diets contain more fat than other diets. Therefore it is important to control for ethnicity to identify independent effects of socioeconomic status. We found that most differences in risk behaviors persisted after controlling for ethnic differences, indicating that deprivation has an effect above and beyond any ethnic variation. The exception to this was being overweight among girls. In this case ethnicity and age moderated the relationship between deprivation and behavior that had been evident in the univariate analyses. An association between ethnicity and overweight has been observed in other studies [43], with Black women more likely to be overweight than White women, although the results have been less conclusive in young adolescents [44].

This study has overcome some of the difficulties experienced in previous studies, which have either recruited very few ethnic minorities [45], or have only measured ethnicity and not socioeconomic deprivation [40]. In comparison to some previous research [18–23,26,28,31], we have investigated a wider range of behaviors, all of which show an unfavorable pattern in relation to SES. The large number of participants, the diverse socioeconomic backgrounds, the adjustment for ethnicity, and the high completion rates for the SES measure mean we can be confident that SES has a detrimental effect on health behaviors among this age group, consistent with the extensive findings in adult health behaviors [3].

For two behaviors (being overweight in girls and fruit and vegetable consumption in boys) the associations with deprivation were weaker in the multivariate analyses. As previous research has also produced inconclusive findings [30–32], this suggests that these behaviors may be weakly linked with deprivation in this age group. Alternatively a clearer gradient may emerge later on in adolescence. The lack of a significant association between deprivation and exercise rates among boys may be attributable to a high rate of exercising overall in boys, giving a ceiling effect. If exercise rates decrease with age as we expect, a gradient may emerge in later waves bringing our results into line with other research [17,27–29]. Data from the baseline of the HABITS study has not resolved all the inconsistencies in the relationship between SES and health behaviors, but subsequent longitudinal analyses should allow us to take a dynamic perspective reflecting the emergence of deprivation gradients.

One of the important questions raised by this and other studies is whether the SES patterning observed here reflects a continuation of childhood patterns, what Chen et al. [46] call the “childhood persistence pattern,” or emerges in adolescence, the “adolescent emergent pattern.” Chen et al. identify an adolescent emergent model for physical activity, which appears to show little variation by SES in younger children. Interestingly the social gradient in the present sample was less for boys than girls, which might reflect a mixture of gender-specific lifestyle choices as well as the greater social maturation of girls. If exercise were an adolescent emergent trait, as proposed by Chen et al., then we would expect a deprivation gradient in rates of exercise for
boys to become stronger in future years. Smoking is, almost by definition an adolescent-emergent behavior, and “trying smoking” showed up clearly as a behavior that was taken up earlier by the lower SES students. In relation to the emergence of dietary differences, by age 11 young people are choosing their food at school, often having money to buy snacks on the way to and from school, and increasingly making their own choices for meals in the home. Studies of fruit and vegetable intake in 1½- to 4-year-olds show a strong association with maternal education [47]. The pattern in the present study was inconsistent for girls and boys. More affluent boys were no more likely to eat fruit and vegetables than their less affluent peers, but there was still evidence of an SES gradient in this behavior among girls. This again may be an adolescent emergent trait like exercise; however, it is too early to speculate about how this behavior will change in relation to SES over the next 5 years. Fat intakes show relatively modest SES patterns in adults in the United Kingdom, although at the level of individual food choices, so-called junk foods show a stronger social gradient [48]. Both boys and girls in this sample showed a strong gradient in their choice of foods. This may reflect a change in the diet of British young people over recent years toward more high-fat foods, which may be particularly noticeable in adolescents from more deprived backgrounds whose parents perhaps exert less control over their children’s diet [49,50]. In Britain and the United States, obesity tends not to be strongly graded by socioeconomic status in childhood, but becomes so, especially among women, by adulthood. The SES gradient in obesity therefore appears to show an adolescent emergent pattern—whether as a consequence of diet and activity choices or as a reflection of earlier life course effects. Many of these issues will be further illuminated with a longitudinal perspective, reexamining the gradient as the adolescents become older.

Some potential limitations of this study need to be considered. Deprivation was measured using an area-based, rather than an individually based, measure. The residential area-level index was used in the present study because data were available for most of the students (97.5%), and it also provides an objective way of establishing deprivation. However, area-based measures do not actually characterize the individuals, but rather the community in which they live. It is possible that a higher social class person may live in a deprived area, and vice versa. Census districts do not always represent geographical boundaries, and may include diverse housing stock, although the enumeration district level used in this study (approximately 700 people) indicates that the measure is likely to be fairly representative. These issues mean that it is not possible to fully untangle whether the differences observed in these analyses reflect the level of deprivation of the young person or of their immediate community. Other studies have used schools themselves as indicators of deprivation [51]; however, this approach means that deprivation is observed only at a few levels, and if the school has an heterogeneous intake, the average for the school may not be representative of many pupils. Additionally, there may be factors other than deprivation operating at a school level, such as availability of unhealthy food at the canteen or frequency of physical education lessons. As the students mature and become more able to answer questions on SES, it may be possible to determine how individual and neighborhood levels of deprivation independently influence these cancer-risk behaviors.

A second limitation was that diet and exercise were assessed only by self-report measures. However, the use of questionnaire measures with this age group is consistent with most other large-scale surveys (e.g., Adolescent Health and Lifestyle Survey [52], West of Scotland 11 to 16 Study [45], Health Behaviour in School-aged Children [53]), and is a practical way of gathering such data. The students were assured of the confidentiality of the study, and the importance of giving honest answers. Despite this, there may be an effect of social desirability or the participants may have had difficulty recalling their dietary habits, exercise participation, or smoking status. The subjectivity is likely to have increased the error, which may explain why there are fewer differences in the behaviors which were only self-report (food intake and exercise) compared with weight, for which an objective measure was available.

There is inevitably a limit to the generalizability of these findings beyond this sample. The students were sampled to ensure socioeconomic and ethnic variation, and the average deprivation was slightly higher than that found in the United Kingdom as a whole. The sample also contained a higher proportion of ethnic minorities than the United Kingdom as a whole. Additionally the students were predominantly in urban areas, inner city and suburban locations, and there might be some differences for young people living in more rural locations.

The advantages of the study included the fact that the large sample size gave sufficient power to detect even a small effect of socioeconomic deprivation. The diversity of the sample meant that there was representation from every ethnic group at every level of deprivation, so it was possible to control for ethnicity when considering the influence of deprivation. The use of a range of health behaviors allowed us to see whether there were consistent patterns across behaviors.

The results demonstrate that the precursors to major adult diseases are already strongly associated with living in more deprived areas among adolescents. Effective preventive interventions need to be developed at the societal, familial, and individual level, and implemented early in the adolescent years to reduce the social toll of growing disparities in health outcomes.

Acknowledgments

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References


