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Socio-economic position and coronary heart disease risk factors in children and young people

Evidence from UK epidemiological studies

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Background: Coronary heart disease (CHD) is a condition with its origin in early life. In adults, CHD and its risk factors show clear socio-economic gradients. The aim of the present review is to collate published evidence to assess if these risk factor gradients are also apparent in young people in the UK. Methods: Pertinent publications were identified in four ways: i) a systematic search of PUBMED from its inception in January 1966 until October 2000; ii) scanning the reference sections of identified publications; iii) searching the authors' own files; and iv) contacting experts in the field. Results: Of eleven CHD risk factors, consistent evidence concerning the association in child- and early adulthood with socio-economic position was evident for cigarette smoking, birth weight, adiposity (in young adults), height, and some aspects of diet, particularly fat and fibre consumption. As in UK adults, the most favourable levels of these risk factors were seen in young people from socially advantaged backgrounds. For the other variables associated with CHD – physical inactivity/low cardiorespiratory fitness, blood pressure, blood cholesterol, adiposity (in children), and some emerging risk factors (C-reactive protein, homocysteine, fibrinogen) – there was little evidence of any clear association with socio-economic level. Conclusions: While social variation is seen in some CHD risk factors in young people, further data are needed to fully explore if this is also the case for others. This issue could be addressed by analysing some existing but unutilized survey data from the UK.

Keywords: CHD, risk factors, socio-economic position, young people

Despite the declining incidence of coronary heart disease (CHD) in the latter half of the twentieth century, it remains one of the leading causes of death in the UK.[1] Clinically, it is a condition of middle- and old-age with few cases diagnosed earlier than the fourth decade of life. Following the Framingham study in the 1940s,[2] a series of population-based surveys of middle-aged men and women conducted in diverse populations have identified several physiological and behavioural risk factors for CHD which include obesity, elevated blood pressure, elevated HDL and low HDL, elevated blood glucose, tobacco consumption, smoking, physical inactivity or low cardiorespiratory fitness, high fat and low fibre diets, and high levels of alcohol consumption.[3,4] Although the cohort studies of middle-aged men and women on which these observations have been based are numerous, far fewer studies have been conducted to examine whether these coronary risk factors when measured in childhood and early adult life are associated with later disease. This evidence has recently been reviewed;[5] in summary, data from studies using a range of research designs do implicate infancy, childhood, and early adult life in the development of coronary heart disease. Firstly, there is evidence from a small number of cohort studies that some CHD risk factors measured in childhood and early adulthood are predictive of subsequent CHD events. These include raised blood pressure,[6,7] adverse lipid profiles,[6,8] overweight/obesity,[9,10] short stature,[11] low birth weight,[12] cigarette smoking[6,13] and physical inactivity.[14] Secondly, from childhood into early adult life several of these risk factors seem to 'track', such that there is a tendency for levels in childhood to be correlated with levels in later life.[15] Thirdly, there are convincing data from autopsy investigations that the natural history of atherosclerosis extends back into teenage years[16,17] and even to the *in utero* period.[18]

Given that the evidence suggests that unfavourable levels of certain variables in pre- and early adult life may increase the risk of CHD, if successful preventative measures are to be implemented during this period it is necessary to understand their determinants. Socio-economic position – as measured most commonly by occupational social class but also income and educational attainment – have generally been shown to be related to CHD risk factors in a graded fashion in adult men and women from the UK[19–22] and elsewhere in Europe.[23,24] We examine if this is also the case for children and young adults by reviewing UK-based studies that have related socio-economic

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factors to cigarette smoking, birth weight, height, adiposity, dietary characteristics, physical activity/cardiorespiratory fitness, blood pressure, blood cholesterol, and emerging risk factors for CHD (i.e., C-reactive protein, homocysteine, fibrinogen).

METHODS

A systematic search of PUBMED was conducted from its inception in January 1966 until October 2000 using the following terms for exposure: 'socio-economic', 'socioeconomic'; and outcome: 'blood pressure', 'cholesterol', 'obesity', 'smoking', 'activity', 'fitness', 'height', 'fat', and 'fibre'. All searches incorporated the term 'child'. A total of 75 publications were so identified. The reference sections of identified papers were then examined for additional publications (33 publications identified), our own files were searched (5 publications), and some researchers in the field were contacted for further information (12 publications). To be included in the review, publications had to i) present information on the socio-economic distribution of one or more of the CHD risk factors listed above; and ii) describe data on people in the UK aged 24 years or less as consistent with the World Health Organisation's definition of the period spanning childhood, adolescence and youth.[25] It should be noted that associations between socio-economic position and CHD risk factors in earlier decades are not necessarily a reliable guide as to what may prevail today and in this regard we elected not to review in detail publications reporting data collected before 1950, although earlier papers are sometimes cited in order to place more contemporary work in context.

The published sources reviewed use a wide range of different measures of socio-economic position of the child/young person including the Registrar General's occupational social class schema, income, educational attainment and aspirations, family size, receipt of state benefits, and housing tenure. Except in surveys of young adults who were employed, these measures relate to parental or household characteristics rather than those of the children themselves. While these different measures can be regarded as interrelated dimensions of socio-economic position, it is beyond the scope of this review to determine whether any one (or more) particular dimension underlies the reported gradients.

RESULTS AND DISCUSSION

Table 1 summarizes each of the 31 publications that met the inclusion criteria, including information on the study on which each publication is based, the study sample and the period of measurement. An expanded version of this table and those for individual CHD risk factors in their relation to socio-economic position are available at: http://www.lshtm.ac.uk/eph/public/child_chd_sep.htm.

Smoking status

Studies from the 1960s[26–30] (see Bewley[31]) and the 1970s,[32,33] report an inconsistent association between occupational social class of the parent or income and cigarette smoking in schoolchildren. These surveys were, however, of convenience samples and a further eight reports[34–41] of representative groups of schoolchildren and young adults from the UK relevant to this area were identified. The first such survey took place in 1966[41] and, because pilot study results indicated a low prevalence of smoking in schoolgirls, comprised teenage boys only. An association between prevalence of smoking and parental occupational social class was seen that broke down in social groups IV and V, possibly due to low numbers in these categories. The study investigators also assessed academic performance, as a marker of socio-economic position, in terms of a vocabulary test,[42] headteacher's perception of pupil's academic ability and the pupil's self-rating in relation to classroom peers. For all indicators, smoking was less ubiquitous amongst those who achieved academically or perceived that they did.

More recently, on aggregating data for children and young adults from the Health Survey for England carried out over three years between 1995 and 1997, Prescott-Clarke and Primatesta[36] found a relation between the occupational social class of the carer and self-reported smoking prevalence, whereby the prevalence of smoking was lowest in both males and females from social class I relative to those in the lower social classes. The same observations have been made elsewhere.[37,40,43]

By measuring cotinine levels – a biological marker of exposure to tobacco smoke – in 4–24-year-olds in the 1996 and 1997 phases of data collection in the Health Survey for England, the investigators were able to objectively assess both direct and passive exposure, with a continine level of 15 ng ml^{-1} or more indicative of a child who smokes regularly *and* inhales. Cotinine levels were measured in either the saliva or serum of the research participants depending on the age group in question and the survey year. An association between social class and cotinine levels in both children (4–15 years) and young people (16–24 years) was seen that was steepest in the older group *(figure 1)*; this gradient was also evident when housing tenure was the socio-economic indicator of interest *(figure 2)*. Enquiries about income were only introduced in 1997 when the sample of 16–24-year-olds was markedly smaller than in the preceding two years; thus, no data on the income–cotinine relation are available. In the younger age group, however, there were sufficient numbers and a less pronounced income–cotinine association was seen than for the other markers of socio-economic position.

An insight into why these social gradients in smoking prevalence exist has been provided by De Vries[44] who also reported similar social class patterning in a survey of Dutch adolescents. In this study the understanding of the deleterious health effects of smoking were greatest, and the perception of the peer pressure to smoke were least acute, in children in the higher social strata relative to the lowest.

Table 1 Overview of publications from UK studies relating indicators of socio-economic position in children and young adults to CHD risk factors according to period of data collection

Study name and reference	Description[a]	Year at risk factor measurement	Age at risk factor measurement (years)
Conducted 1990–1999			
Scottish Health Survey[77]	Nationally representative sample of 3892 schoolchildren from Scotland	1998	2–15
Health Survey for England[78]	Nationally representative sample of 3409 schoolchildren from England	1998	2–15
National Diet and Nutrition Survey[63,118]	Nationally representative sample of 2672 young adults from UK	1997	4–18
Department of Health Ninth National Survey of Smoking in Secondary School Children[34]	Nationally representative sample of 2854 secondary schoolchildren from England and Scotland	1996	11–15
Health Education Authority National Survey of Smoking in Secondary School Children[35]	Nationally representative sample of 3657 secondary schoolchildren from England	1996	11–15
Health Survey for England[36]	Aggregated data from three nationally representative surveys of 19,708 children and young adults from England	1995/97	2–24
Ten Towns Study[95]	Random sample of 2650 primary schoolchildren from ten towns in England and Wales with disparate adult CVD mortality rates	1994	8–11
National Study of Health and Growth[103]	Random sample of 1987 schoolchildren from England and Wales	1992/93	8–9
National Diet and Nutrition Survey[64]	Nationally representative sample of 1859 pre-schoolchildren from Britain	1992/93	1.5–4.5
National Study of Health and Growth[98]	Sample of 581 Caucasian children drawn from a survey of a nationally representative sample of schoolchildren from England and Scotland	1992	8–9
National Fitness Survey[99]	Random sample of 1308 adults from England	1990	16–34
Ten Towns Study[104]	Random sample of 3360 primary schoolchildren from ten towns in England and Wales with disparate adult CVD mortality rates	1990	5–7
Ten Towns Study[46]	Random sample of 3842 primary schoolchildren from ten towns in England and Wales with disparate adult CVD mortality rates	1990	5–7.5
Conducted 1981–1989			
Young Hearts Project[38]	Random sample of 509 schoolchildren from Northern Ireland	1989/90 1992/93 (follow-up)	12
Young People's Leisure and Lifestyles Project[37]	Random sample of 2393 young adults from Scottish secondary school catchments. Mixed longitudinal study	1987 and 1989	16–18 20–22
Nine Towns Study[65]	Random sample of 5006 primary schoolchildren from nine towns in England and Wales	1987/1988	5–7.5
Department of Health Survey[39]	Random sample of 4165 secondary schoolchildren from England and Wales. Longitudinal study	1986/1987/1988	11–15
Department of Health Survey of School Children[66]	Representative sample of 2678 schoolchildren from England, Scotland and Wales	1983	10–11 and 14–15
Ministry of Agriculture Fisheries and Foods Dietary Survey[40]	'Quota' sample of approx. 1000 young adults from Scotland and Wales	1982	15–25
National Child Development Study (1958 birth cohort)[84]	12,274 adults based on all births in England, Scotland and Wales in early March 1958. Longitudinal study	1981	23
Conducted ≤1980			
Department of Health and Social Security Survey of British adults[67]	Representative sample of 1121 English, Scottish and Welsh adults	1980	16–24
Child Health and Education Study (1970 birth cohort)[94]	Approx. 15,000 schoolchildren based on all births in England, Scotland and Wales in April 1970	1980	10
National Study of Health and Growth[79]	Random sample of 9815 schoolchildren from England and Scotland. Mixed longitudinal study	1972	5–11
National Study of Health and Growth[68]	Random sample of 9815 schoolchildren from England and Scotland. Mixed longitudinal study	1972	5–11.5

Table continued

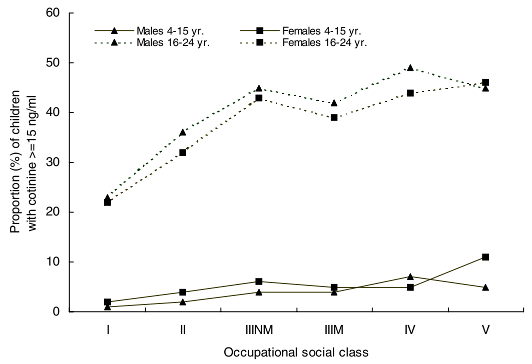

Figure 1 Proportion (%) of children (4–15-years) and young adults (16–24-years) with cotinine[a] levels ≥15 ng ml^{-1} by the occupational social class of the head of the household/subject in the Health Survey for England in 1995/7.[36]

a: Cotinine levels were measured in saliva or serum depending on the age of the participants and the survey year. To provide a level for all research participants serum levels were converted to saliva levels.

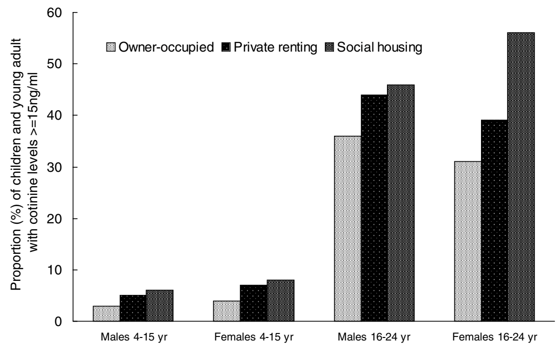

Figure 2 Proportion (%) of children (4–15-years) and young adults (16–24-years) with cotinine[a] levels ≥15 ng ml^{-1} by accommodation tenure in the Health Survey for England in 1995–97.[36]

a: Cotinine levels were measured in saliva or serum depending on the age of the participants and the survey year. To provide a level for all research participants serum levels were converted to saliva levels.

Anthropometry

▪ Birth weight

Routinely collected data on over two million live births between 1991 and 1995 in England and Wales[45] show a social class gradient for birth weight, with the distribution of live births shifting towards the higher birth weights as one moves from social class V to social class I. This association has been demonstrated repeatedly over the last two decades in the UK[46,47] and we will therefore not describe individual studies. The role of this socio-economic gradient in birth weight in generating either past, current or future socio-economic gradients in CHD is unknown. What is clear, however, is that a negative socio-economic gradient in birth weight has been observed for as long as records have been available – certainly back to the early part of the 20th century. This consistency in the social class gradient of birth weight is in contrast to the evidence that the current negative

Table 1 continued Overview of publications from UK studies relating indicators of socio-economic position in children and young adults to CHD risk factors according to period of data collection

Study name and reference	Description[a]	Year at risk factor measurement	Age at risk factor measurement (years)
Government Social Survey[41]	Random sample of 5601 secondary schoolboys from England and Wales	1966	11–15
National Diet and Nutrition Survey of Pre-school Children[69]	Nationally representative sample of 1321 British pre-schoolchildren	1967/68	0.5–4.5
National Child Development Study (1958 birth cohort)[70]	13,127 children based on all births in England, Scotland and Wales in early March 1958. Longitudinal study	1965	7
National Survey of Health and Development (1946 birth cohort)[71]	3026 children based on a social class stratified sample of single, legitimate births in England, Scotland and Wales in early March 1946. Longitudinal study	1953/1957/1961	7, 11, 15
National Survey of Health & Development (1946 birth cohort) and National Child Development Study (1958 birth cohort) combined[72]	Children born in England, Scotland and Wales in early March of 1946 (stratified sample) and 1958 (full sample). Longitudinal studies (sample size varies according to study and period of follow-up)	1953/1957 (1946 cohort) 1965/1969 (1958 cohort)	7, 11
National Survey of Health & Development (1946 birth cohort) and National Child Development Study (1958 birth cohort) combined[80]	Children born in England, Scotland and Wales in early March of 1946 (stratified sample) and 1958 (full sample). Longitudinal studies (sample size varies according to study and period of follow-up)	1953/1957/1962 (1946 cohort) 1965/1969/1974 (1958 cohort)	7, 11, 16
National Survey of Health and Development (1946 birth cohort)[93]	4599 children based on a social class stratified sample of single, legitimate births in England, Scotland and Wales in early March 1946. Longitudinal study	1950	4

a: Study design is cross-sectional unless otherwise stated. For studies where more than one risk factor was measured, the reported sample size may vary by risk factor.

socio-economic gradient in coronary heart disease in adults has not always been apparent in the past,[48] although this observation has been disputed.[49]

■ Height

Childhood height is determined by genetic and environmental factors.[50] In terms of the latter, height may be regarded as an indicator of, amongst other antecedents, nutritional status, well-being, psychological stress, or social background . The study of the relationship between social background and childhood growth has a long research pedigree,[51] with strong evidence to suggest that the social class differentials in height evident in the early part of the last century still persist today. For example, in Aberdeen in 1910 all primary school children aged 5–14 years entering educational institutions underwent a medical examination during which their height was recorded.[52] These data were classified according to the cleanliness of the school which can be used as a group level indicator of socio-economic position. For both sexes there was evidence of a graded association with children from the 'poor' schools of consistently shorter stature in comparison to those from schools that were classified as 'well-to-do'. Later surveys which also assessed deprivation at the group level report similar findings.[53–57]

Similarly consistent patterns of association of height with a range of indicators of social position at the level of the individual are also evident, including family size[58–60] and parental occupational social class.[60,61] Notably, in a longitudinal study of South Walian children from birth,[62] parental occupational social class differences in height were apparent from as young as two years of age.

More recently, a number of representative national surveys of children and young adults have compared height with individual socio-economic position.[38,40,46,63–72] One of the most notable of these is the National Study of Health and Growth[73,74] which was established to detect what changes in growth, if any, were evident as a result of the abolition of the free school milk programme in UK schools by the then Conservative government. Using data collected in 1972,[68] Rona and colleagues reported an association between social class and height that is consistent with what that found in children in the 1946 and 1958 British birth cohort studies[72] and in the Nine[65] and Ten Towns Studies[46] *(figure 3)*. Statistically significant relationships between height and a range of other markers of socio-economic position have also been reported.

Gunnell and colleagues,[75] in a re-analysis of data from a cross-sectional study of children examined across Britain in the late 1930s,[76] indicate that of the two components of overall stature – leg length and trunk length – the main source of social variation lies in the former. This finding is in keeping with other observations made in Britain during a similar period[56] and subsequent to it.[61] The authors conclude that leg length may, therefore, be a more sensitive marker of childhood environment than the traditionally used overall stature.

To summarize, irrespective of the period of data collection, the unit of analysis (i.e., person or group), and the indicator of socio-economic position used, a socio-economic gradient in height is evident in children of all ages. The reason for these height differences is not well understood but it may be in part attributable to differentials in dietary characteristics across the social groups and this association will be examined in a subsequent section.

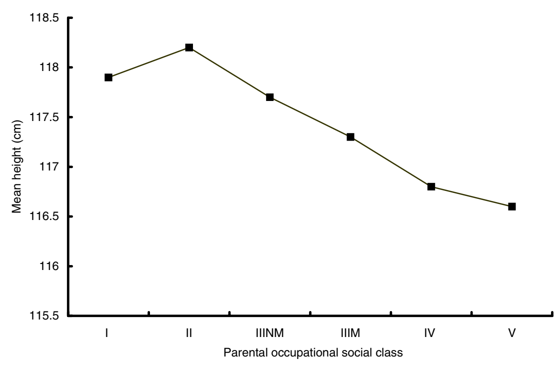

Figure 3 Mean height[a] (cm) of children (5–7.5 years) by parental occupational social class in the Ten Towns Study in 1990.[46]
a: Data are age- and sex-adjusted. P-value for heterogeneity <0.0001

■ Adiposity

In studies of the anthropometry of children, investigators have typically measured adiposity in terms of body mass index (BMI)[64,67,77–80] or, less commonly, skinfold thickness.[38,79] On occasion, waste-to-hip ratio[63] has been used to assess fat distribution. In several early small-scale studies skinfold thickness was related to social class with inconsistent results: on aggregating data from five cohorts of children examined between 1950 and 1953 from mixed social backgrounds Hammond[81] reported no association between skinfold thickness and social class. Subsequent surveys of schoolchildren from Glasgow in the 1960s[82] and London during a similar period,[83] did not clarify the relationship.

Several studies drawing on nationally representative samples of UK children and young adults were identified.[36,38,63–65,67,77–80,84] In cross-sectional studies that relate current childhood measures of socio-economic position – most commonly parental occupational social class – to markers of adiposity there is little evidence of an association. For example, in 2–15-year-olds in the Scottish Health Survey,[77] in 5–11-year-olds in National Study of Health and Growth,[79] in pre-schoolers in the National Diet and Nutrition Survey,[64] in 5–7.5-year-olds in the Ten Towns Study,[46] in 7-year-olds in the National Child Development Study (1958 birth cohort)[84] and in 2–15-year-olds in the 1995/7[36] and the 1998[78] Health Surveys for England *(figure 4)* there were no consistent social class differences in the markers of overweight or obesity used. Despite the increasing secular trends in childhood obesity, particularly in recent years,[85] there is still little evidence of a socio-economic gradient in obesity in childhood. However, in contrast, in early adulthood, a social class gradient is apparent in some studies,

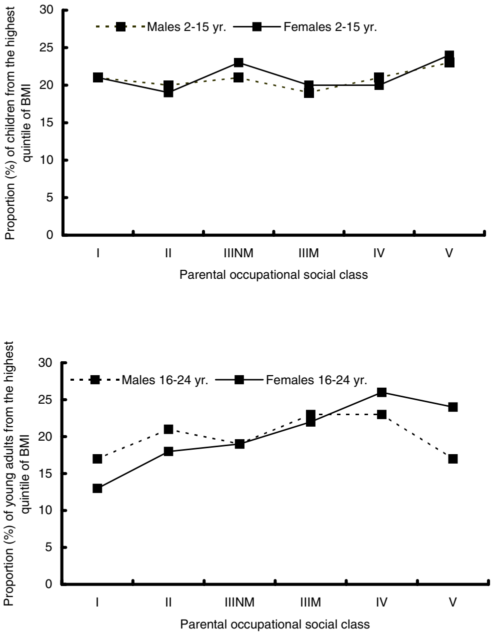

Figure 4 Proportion (%) of children (2–15 years) and young adults (16–24 years) from the highest quintile of body mass index (BMI) by parental/subject's occupational social class in the Health Survey for England in 1995/7.[36]

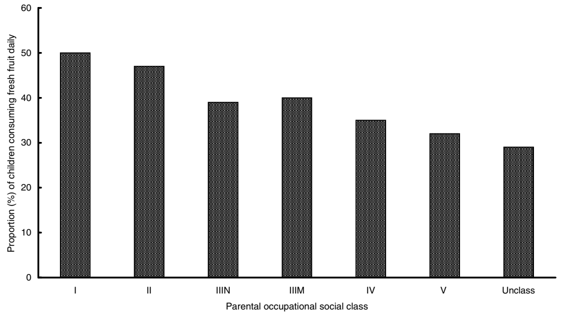

Figure 5 Proportion (%) of daily fresh fruit consumption in children (8–11-years) according to parental occupational social class in the Ten Towns Study in 1994

Figure supplied by Peter Whincup based on further analyses[43] of data from a report of the Ten Towns Study.[95]

including 23-year-olds in the National Child Development Study (1958 birth cohort)[84] and 16–24-year-olds in the Health Survey for England[36] *(figure 4)*. There is also growing evidence from UK cohort studies[80,84,86] that low childhood social class predicts adult obesity. This finding has been supported in a recent comprehensive review of these and other non-UK studies.[87]

Although being born into the low social classes would not in itself 'cause' obesity, the characteristics of this group in terms of their material circumstances and the knowledge that informs behaviours such as food intake and physical activity probably do.[87] The relation of socio-economic position to each of these behaviours will be discussed next.

Dietary characteristics

While detailed but modestly sized dietary studies of schoolchildren from Kent,[88,89] the West of Scotland,[90] and Edinburgh[91,92] have been conducted, it is possible to draw on the findings of several large scale representative surveys of 1.5–4.5-year-olds,[64,69,93] schoolchildren,[36,38,63,66,77,94,94,95] and young people[36,40,63] carried out over the last 50 years in the UK.

In 1967/68 a survey of the dietary habits of 1,938 preschool children aged 6 months to 4.5 years was conducted by the Department of Health.[69] This study was repeated 25 years later in 1992/93 in a different cohort of similar size and age range.[64] Despite a lower overall level of fat consumption in the most recent survey in comparison to the 1967/68 study, a relation with social class was apparent in both studies with the highest levels of fat consumption seen in children from households where the head was in manual employment. Other indicators of socio-economic position – receipt of state benefits, employment status of the head of the household and educational attainment of the mother – as measured in 1992/93[64] showed similar patterns of association.

In an older group of children, Golding and others[94] reported on the dietary habits of 10-year-olds in the national Child Health and Education Study (1970 birth cohort study). Although the enquiries were limited to a small number of questions, it was evident that the proportion of children whose carers were in the lowest social groups consumed twice the amount of confectionery to those in social class I. Similar observations were made in the Health Survey for England[36] where, in 2–15-year-olds, there was an increase from social classes I and II (combined) to IV and V (combined) in the prevalence of children consuming sweet foods, soft drinks and crisps. In keeping with this observation, Whincup and colleagues,[43] in reporting on further analyses of data from the Ten Towns Study,[95] found that children from the lower social groups in England and Wales are less likely to favour fruit and vegetables *(figure 5)*.

Physical activity and cardiorespiratory fitness

Like food consumption, physical activity is a multidimensional behaviour, the accurate assessment of which is problematic in all age groups, particularly children.[96] It has become increasingly common, therefore, for investigators to use previously validated physical activity questionnaires – of which there are several[97] – when surveying the physical activity levels of child populations. However, in the seven studies identified herein.[36,38,40,63,67,77,98,99] a validated questionnaire was not employed; the findings should, therefore, be regarded with some caution.

No consistent pattern of association between socioeconomic position and indices of physical activity was apparent.[36,38,40,63,77,99] Moreover, the direction of these relationships do not seem to depend on age at measurement. In young adults (16–24 years) in the Health Survey for England,[36] for example, there was no evidence of a relationship between social class and physical activity, whereas in the National Fitness Survey[99] a clear invers socio-economice gradient was observed in a similar age group.

The issue of inaccuracy of self-reported physical activity data has been addressed by Kikuchi et al.[98] in the National Study of Health and Growth (NSHG) and Van Lenthe in the Young Hearts Study[38] where cardiorespiratory fitness – a physiological outcome of frequent physical activity and therefore an objective marker of this behaviour – was assessed in primary and secondary school children, respectively. Notably, no association with socio-economic position – measured in terms of father's occupation and mother's educational attainment (NSHG only) – was evident.

Blood pressure

While both blood pressure and parental occupational social class were recorded in a survey of adolescents drawn from Nottinghamshire and Derbyshire general practice registries[100] – one of the first UK studies, along with the Brompton Longitudinal Study,[101] to measure CHD risk factors in children – their relationship was not explored. Despite a recent review[102] of the socio-economic position–blood pressure relation reporting an absence of any data from the UK for children, we were able to identify six relevant studies[36,38,63,77,103,104] which draw on nationally representative UK samples and a further three[105–107] which were based on convenience samples.

In children, height is strongly correlated with blood pressure such that tall children have higher blood pressure than those of shorter stature.[108] Because taller children come from more affluent social backgrounds (see earlier section), one would expect higher levels of blood pressure in the higher social class groups.[102] In most,[38,63,77,104] but not all studies,[103] however, there was little evidence of any association between the given marker of socio-economic position (i.e. occupational social class of the parent, household income, receipt of benefits, or parental educational attainment) and the measure of blood pressure employed (i.e. systolic, diastolic or mean). This was supported in some[105] but not all[106,107] of the studies using non-representative samples of schoolchildren. The balance of evidence, therefore, suggests little evidence of an association between socio-economic position indices and blood pressure levels in children and young people.

Blood cholesterol

Only three[38,63,103] published studies relating occupational social class of the parent to blood cholesterol in a representative sample of UK children were located. These studies generally reported no relationship[63,103] and this observation was also made in preliminary analyses of data from the Ten Towns study (Peter Whincup – personal communication). The observation of differing associations of occupational social class of the parent and total and HDL cholesterol seen in some age groups in the Young Hearts Project[38] may be limited by the small sample size.

Emerging CHD risk factors

Although high levels of some physiological variables such as C-reactive protein,[109] homocysteine,[110] and fibrinogen[111] when measured in adults appear to be associated with subsequent CHD, their relation to adult CHD when assessed in childhood is unknown. This notwithstanding, some studies have explored the relation of these emerging risk factors with parental occupational social class in children. In the Ten Towns study, Cook and others found that both C-reactive protein,[112] and fibrinogen[113] were unrelated to the occupational social class of the head of the household. Although no UK study exploring the possibility of social gradients in homocysteine was identified, a survey of Norwegian schoolchildren reported no relationship.[114]

CONCLUSIONS

The aim of this review was to explore the relation of socio-economic position to CHD risk factors in children and young adults. The main finding was that, of the eleven risk factors examined, associations with markers of socio-economic position were evident for cigarette smoking, birth weight, indices of adiposity (in young adults only), height, and some aspects of diet, specifically fat and fibre consumption. The same relationships have been demonstrated in adults from the UK and elsewhere. For the other variables, that is physical activity/ cardiorespiratory fitness, indices of adiposity (in children only), blood pressure, blood cholesterol, and some emerging risk factors, no clear association was seen. Notably, obesity does not appear to show a social gradient in children under approximately 15 years of age, although a negative relation seems to emerge in studies of young adults.

At present, there is an interest in addressing inequalities in health by focusing on 'poor' or 'socially excluded' children and young people. However, the findings of our review indicate that, for several modifiable CHD risk factors, there is an incremental gradient across the socio-economic spectrum. To this extent, policies aimed at reducing inequalities may need to have a broader reach.

It is clear from this review that there is a relative paucity of published data on which to make a comprehensive assessment of socio-economic gradients in several CHD risk factors in childhood and early adulthood in the UK. There is, however, scope to undertake analyses of existing databases (e.g., General Household Survey,[115] which includes young adults in its sample, and the Avon Longitudinal Study of Pregnancy and Childhood Study[116]) which would go beyond what is already in the public domain. Although the practice of investigators on the national health surveys to include samples of children in their studies is increasing, the recently published report *Health in England 1998: investigating the links between social* *inequalities and health*[117] was notable in not collecting data on individuals under the age of 16 years.

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