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2/15

Socioeconomic disadvantage and childhood growth: A review of the literature focusing on the mediatory roles of birth weight, maternal age and parity

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Abstract

In this paper we review the literature on the relationship between maternal social disadvantage and childhood growth. We focus particularly on the potential mediatory roles played by birth weight, maternal age, and parity, and on studies of UK populations. We find convincing evidence of social inequalities of growth, both in terms of stature (height) and adiposity/overweight. Maternal age, parity and, particularly, birth weight are plausible mediators of the association between socioeconomic disadvantage and growth due to the acknowledged relationships between each of these factors. However, few studies have considered such mediation explicitly. Further work is required in this area.

Introduction

In this paper we review the literature on the relationship between maternal social disadvantage and childhood growth, both in terms of stature (height) and adiposity/overweight. We focus particularly on the potential mediatory roles played by birth weight, maternal age, and parity, and on studies of UK populations.

Search strategy

The following databases were searched during the period 3 November to 14 November 2014: EMBASE, MEDLINE, PubMed, Scopus, Web of Science. The literature search was designed based on the following terms: “Socio-economic status” combined with “height”, “overweight”, “obesity” and “childhood” – synonyms and closely related words were used, including specific well-known measures of each concept, for example, “Index of Multiple Deprivation”, “DEXA scan”. The current study focused on research conducted in the UK (England, Scotland, Wales, and Northern Ireland). Further studies were identified by examining the reference lists of all relevant articles.

Increased prevalence of childhood obesity and links to health issues in adulthood

The existence of social inequalities in health is well established. However, calls have been made for greater focus on infancy and childhood due to the growing body of evidence suggesting that the early years of development are critical for the creation of socioeconomic health inequalities which are maintained into adulthood (Li et al., 2009; Keating and Hertzman, 1999). Socioeconomic inequalities in child health have been demonstrated using a range of health indicators, including growth and obesity. The growing rate of obesity globally is recognised as a major public health issue; the World Health Organization (WHO) estimates that by 2025 the number of overweight and obese infants and young children will have increased to 70 million (WHO, 2014).

Several surveys in Britain have found that the prevalence of childhood obesity increased throughout the 1990s – and though there is evidence of a plateau in overall prevalence in the 2000s, the rate of obesity continues to rise among children from poorer communities (Stamatakis et al., 2005; Stamatakis et al., 2010; Smith et al., 2013). Beyond the impact of childhood overweight and obesity on the quality of life of young people (Williams et al., 2005), adiposity in childhood is associated with adiposity in adulthood (Power et al., 1997; Baird et al. 2005) and is a risk factor for diabetes (Morrison et al., 2008), cancer (Biro and Wien, 2010), and cardiovascular disease (Gunnell et al., 1998).

Height is also associated with childhood socioeconomic inequality, though the relationship between height and adult poor health seems to vary. While evidence has been found for an inverse association between height and cardiovascular disease, research also suggests that increased stature is associated with greater risk of developing of certain types of cancer (Batty et al., 2009; Gunnell et al., 2001).

Socioeconomic status and obesity/height

A systematic review of cross-sectional studies conducted between 1990 and 2005 in high-income countries found that in 42% of studies socioeconomic status (SES) was inversely associated with

adiposity, in 27% there was no association between SES and adiposity, and in the remainder there was a mixture of no associations and inverse associations across subgroups. Parental education level was the indicator of SES most consistently associated with childhood adiposity (Shrewsbury and Wardle, 2008).

More recent research conducted across Britain has also found that the rate of childhood overweight and obesity is higher among children of lower SES, as indicated by area-level indicators of deprivation (Smith et al., 2013; Townsend et al., 2012; Emerson, 2009; Kinra et al., 2000; Conrad and Capewell, 2012; Samani-Radia and McCarthy, 2011; Simkiss, 2014; Cecil et al., 2005), household income (Jebb et al., 2004; Stamatakis et al., 2005), parental occupation (Ness et al., 2006; Stamatakis et al., 2010) and education (Brophy et al., 2009).

Social inequalities in growth are also reflected in height differences – UK studies have found that lower childhood height is associated with paternal unemployment (Rona et al., 1978; Rona et al., 1991), lower maternal education (Galobrades et al., 2012; Howe et al., 2012), and area-level deprivation (Samani-Radia and McCarthy, 2011; Cecil et al., 2005). However, a study by Li et al. (2004), which compared the SES height differentials of a 1958 British birth cohort with those of their offspring, found evidence suggesting that inequalities in height may be narrowing due to a greater height gain among offspring from manual classes over time.

The role of birth weight

Relatively few studies have specifically examined the role of birth weight in these associations. A recent meta-analysis of UK studies identified that low birth weight was consistently associated with greater area-level deprivation and lower parental social class (Weightman et al., 2012), a study of more than 10,000 UK children found that higher maternal educational level at 32 weeks gestation was predictive of greater length at birth (which is correlated with birth weight) (Howe et al., 2012), and a study of birth registration data from Scotland found a positive social class gradient in mean birth weight (Fairley, 2005). Furthermore, greater weight at birth has been shown to be predictive of increased height (Rona et al., 1978; Finch and Beck., 2011) and BMI (Hawkins et al., 2009; Brophy et al., 2009) in childhood. Therefore, it is conceivable that birth weight might play a mediatory role in the associations observed between SES and childhood obesity and height – accounting for birth weight may potentially attenuate the association with height, while strengthening the association with overweight/obesity.

UK studies accounting for birth weight

Only Armstrong et al. (2003) present analyses allowing assessment of how the association between SES and growth differs when adjustments are made for effect of birth weight. Other studies generally present analyses adjusted for birth weight and a range of other factors – so it is not possible to identify the specific effect of birth weight on this association.

Armstrong et al's (2003) study used data from the Scottish National Preschool Child Health Surveillance System (NCHS-P) and analysed health records of 74,500 children aged 3-4 years in 1998/99. The authors calculated odds ratios for both underweight and severe obesity – in comparing the most deprived (based on area-level Carstairs Deprivation Category) with least deprived, the odds ratio for obesity was 1.30 (95% confidence interval (CI): 1.05, 1.60), and when adjusting for birth weight the adjusted odds ratio increased to 1.43 (95% CI: 1.16, 1.77).

Hawkins et al (2009) used data from the Millennium Cohort Study to identify the risk factors for childhood overweight and obesity among 3 year olds living in the UK. In unadjusted analyses, birth weight was significantly and positively associated with overweight, while the associations between overweight status and maternal social class (based on occupation), maternal education, and household income were borderline significant ($p = 0.11-0.15$) – and therefore, these variables were not entered into the multivariate regression analyses which included adjustment for birth weight – so it is possible that they missed an association which might have emerged on controlling for birth weight. Living in a ‘disadvantaged’ ward was associated with increased obesity (OR: 1.13, 95% CI: 1.02, 1.26) relative to living in an ‘advantaged’ ward. In an adjusted model accounting for birth weight and a range of other variables (including ethnicity, breastfeeding, parental weight and others) ward type was no longer associated with childhood obesity.

Kinra et al. (2005) analysed data from 1335 school children in Plymouth in order to assess whether prenatal, early postnatal, and late postnatal growth was predictive of obesity at age 7. Area level deprivation (based on the Townsend score – dichotomised into the most deprived quarter versus least deprived 75%) was associated with BMI at age 7 with an unadjusted coefficient of 0.13 (95% CI: 0.00, 0.26). When adjusted for birth weight and early and late weight gains, the association between deprivation and obesity increased slightly to an adjusted coefficient of 0.17 (95% CI: 0.05-0.29).

Brophy et al. (2009) explored factors associated with obesity at 5 years old using data from the Millennium Cohort Study ($n = 17,561$). No crude odds ratios were presented (so we cannot assess the change in association on adjustment for birth weight), though in the adjusted model (including birth weight, ethnicity, mother pre-pregnancy weight and others) lower maternal education and lower household income were both still independently associated with increased obesity at age 5.

Using data from the National Study of Health and Growth (1987-1988), Gulliford et al. (1991), assessed the factors associated with the height of 5-11 year old school children in England and Scotland ($n = 8491$). There was evidence of a significant positive gradient in child height with parental social class, however this disappeared once several biological variables (parental heights, length of pregnancy, birth weight, and ethnic group) were adjusted for.

The role of maternal age and parity

Maternal age and parity could also conceivably play a mediatory role in the association between lower maternal SES and childhood height. Women of higher SES are more likely to delay childbearing until older ages (Rindfuss et al., 1983; Ekert-Jaffe et al., 2002), and to have fewer children (Jones, 1982; Rindfuss et al., 1983). Several UK studies have found an association between increased maternal age and childhood height, and a negative association between parity and childhood height (Gulliford et al., 1991; Rona et al., 1978; Galobardes et al., 2012). The evidence for a relationship between maternal age at birth, parity, and overweight/obesity in childhood is more equivocal; two studies conducted in the UK found no evidence of such an association (Hawkins et al., 2009; Reilly et al., 2005), though a US study found that first-born children were at increased risk of overweight status at age 7 (Stettler et al., 2002).

Conclusions

In this paper we reviewed the literature on the relationship between maternal social disadvantage and childhood growth. We focused particularly on the potential mediatory roles played by birth weight, maternal age, and parity, and on studies of UK populations.

There is convincing evidence that adiposity levels are higher and overweight prevalence is greater in children of lower SES. Social inequalities in growth are also reflected in height differences, with lower childhood height associated with lower SES.

Although relatively few studies have specifically examined the mediatory role of birth weight in these associations, lower birth weight has been consistently found to be associated with socioeconomic disadvantage, and greater weight at birth has been shown to be predictive of increased height and BMI, making it a plausible mediator. The only study we located which considered birth weight in isolation found the association between area-level deprivation and severe obesity to strengthen markedly on adjustment for birth weight, suggesting a mediatory role.

Maternal age and parity could also conceivably play a mediatory role in the association between lower SES and childhood growth (particularly height). Women of higher SES are more likely to delay childbearing until older ages and to have fewer children, and associations between increased maternal age and greater childhood height, and between lower parity and greater childhood height, have been observed.

Socioeconomic inequalities in growth remain an important issue in the UK. Whilst a reduction in socioeconomic inequality itself would be one obvious solution to reducing the resultant differences in growth, better elucidation of mediatory pathways could suggest alternative interventions. Further work is required in this area.

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