



Childhood predictors of adult obesity: a systematic review

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OBJECTIVE: To identify factors in childhood which might influence the development of obesity in adulthood.

BACKGROUND: The prevalence of obesity is increasing in the UK and other developed countries, in adults and children. The adverse health consequences of adult obesity are well documented, but are less certain for childhood obesity. An association between fatness in adolescence and undesirable socio-economic consequences, such as lower educational attainment and income, has been observed, particularly for women. Childhood factors implicated in the development of adult obesity therefore have far-reaching implications for costs to the health-services and economy.

SEARCH STRATEGY: In order to identify relevant studies, electronic databases—Medline, Embase, CAB abstracts, PsycLit and Sport Discus—were searched from the start date of the database to Spring 1998. The general search structure for electronic databases was (childhood or synonyms) AND (fatness or synonyms) AND (longitudinal or synonyms). Further studies were identified by citations in retrieved papers and by consultation with experts.

INCLUSION CRITERIA: Longitudinal observational studies of healthy children which included measurement of a risk factor in childhood (< 18 y), and outcome measure at least 1 y later. Any measure of fatness, leanness or change in fatness or leanness was accepted. Measures of fat distribution were not included. Only studies with participants from an industrialized country were considered, and those concerning minority or special groups, e.g. Pima Indians or children born preterm, were excluded.

FINDINGS:

- Risk factors for obesity included parental fatness, social factors, birth weight, timing or rate of maturation, physical activity, dietary factors and other behavioural or psychological factors.
- Offspring of obese parent(s) were consistently seen to be at increased risk of fatness, although few studies have looked at this relationship over longer periods of childhood and into adulthood. The relative contributions of genes and inherited lifestyle factors to the parent–child fatness association remain largely unknown.
- No clear relationship is reported between socio-economic status (SES) in early life and childhood fatness. However, a strong consistent relationship is observed between low SES in early life and increased fatness in adulthood. Studies investigating SES were generally large but very few considered confounding by parental fatness. Women who change social class (social mobility) show the prevalence of obesity of the class they join, an association which is not present in men. The influence of other social factors such as family size, number of parents at home and child-care have been little researched.
- There is good evidence from large and reasonably long-term studies for an apparently clear relationship for increased fatness with higher birth weight, but in studies which attempted to address potential confounding by gestational age, parental fatness, or social group, the relationship was less consistent.
- The relationship between earlier maturation and greater subsequent fatness was investigated in predominantly smaller, but also a few large studies. Again, this relationship appeared to be consistent, but in general, the studies had not investigated whether there was confounding by other factors, including parental fatness, SES, earlier fatness in childhood, or dietary or activity behaviours.
- Studies investigating the role of diet or activity were generally small, and included diverse methods of risk factor measurement. There was almost no evidence for an influence of activity in infancy on later fatness, and inconsistent but suggestive evidence for a protective effect of activity in childhood on later fatness. No clear evidence for an effect of infant feeding on later fatness emerged, but follow-up to adulthood was rare, with only one study measuring fatness after 7 y. Studies investigating diet in childhood were limited and inconclusive. Again, confounding variables were seldom accounted for.
- A few, diverse studies investigated associations between behaviour or psychological factors and fatness, but mechanisms through which energy balance might be influenced were rarely addressed.

CONCLUSIONS AND RESEARCH PRIORITIES: The major research gap identified by the current review is the lack of long-term follow-up data spanning the childhood to adulthood period. This gap could in part be filled by: (i) follow-up of existing groups on whom good quality baseline data have already been collected; and (ii) further exploitation of existing longitudinal datasets.

Many of the risk factors investigated are related, and may operate on the same causal pathways. Inherent problems in defining and measuring these risk factors make controlling for confounding, and attempts to disentangle relationships more difficult. A given risk factor may modify the effect of another, and cumulative effects on the development of obesity are likely, both over time for specific risks, or at any particular time over a range of risk factors. An additional approach to addressing these issues may be to use large samples on whom more basic measures of risk factors have been collected.

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Specific issues that remain unresolved include:

- the mechanism by which SES in early life influences obesity in adulthood;
- whether the relationships between birth weight and maturation and later obesity persist after accounting for confounding factors;
- whether any relationships between dietary factors and activity and later fatness are due to a direct effect, or to tracking in dietary or activity behaviour;
- how psychological factors and behaviours influence energy balance, and therefore fatness.

A further neglected area of research is the identification of factors predicting the maintenance of a healthy relative weight, which may or may not be the opposite of predictors of obesity.

The challenge to future research remains to discern which are the important and modifiable factors, or clustering of factors, and effects over time, on the causal pathway to the development of obesity.

Keywords: systematic review; obesity; child; adult; predictors

Introduction

Objective

The aim of this systematic review was to identify factors in childhood which might influence the development of obesity in adulthood.

Background

The prevalence of obesity is increasing in adults¹ and children in the UK;² British children are getting fatter.³ A similar rise in prevalence of obesity, related to increasing affluence, is reported from many developed countries throughout the world.⁴ The association between adult obesity and adverse health outcomes, including diabetes, coronary heart disease, cancer and respiratory problems, is well documented,⁴ but there is limited evidence for an association between adolescent obesity and increased risks of adult morbidity⁵ and mortality.⁶ More immediate effects of developing obesity include psychosocial outcomes, with social isolation and peer problems more common in fatter children.⁷ Overweight adolescent women have lower educational attainment, lower incomes and are less likely to marry than those not overweight.⁸ If these relationships are indeed causal, then they imply far-reaching consequences for costs to the health services, and the economy. The limited data available suggest the direct medical costs might amount to 4–5% of total health care.⁹ In the USA, an annual cost of US\$4 billion has been attributed to loss of productivity due to obesity.⁹ The relationship between relative weight and morbidity and mortality may not be linear, but J-shaped, with an increased risk of adverse health outcomes reported at the lower extremes of fatness in many studies.⁴ The extent is unclear to which this relationship between underweight and an increased risk of adverse outcome reflects reverse causality, whereby smoking and pre-existing disease cause both underweight and increased morbidity and mortality.⁴

So far treatment of established obesity has been largely ineffective and therefore prevention is preferable.^{10–12} Existing data suggest that children may be more responsive to prevention than adults,¹³ and that risk factors identified in children may be more amen-

able to change. Despite the attractiveness of prevention strategies aimed at children, a cautious approach is required to avoid the possibility of unforeseen adverse consequences, particularly in respect of interruption of normal growth pattern in early childhood and distorted body image, excessive dieting and anorexia in adolescence. For instance, the recommendation for children over the age of 2 y in the USA that total fat intake amount to 30% of total calories or less¹⁴ has in some observational studies been associated with a greater risk of inadequate intake of several vitamins.¹⁵

The childhood period is also important for adult obesity because tracking of overweight, albeit moderate, is observed between childhood and adulthood. This topic has recently been reviewed.^{5,16} The figures vary according to the definition of obesity and length of follow-up, but fat children have a high risk of going on to become fat adults; for example in the 1958 British birth cohort, 38% of boys and 44% of girls above the 95th BMI centile at age 7 were obese at age 33.¹⁷ Even so, only a small proportion of fat adults were fat in childhood. It is likely that there are factors operating in early adulthood which promote obesity, but there may also be factors operating in childhood that promote adult obesity. It is still a matter of debate whether there are particular stages in childhood, during which physiological alterations increase the risk of later obesity. These stages are termed critical periods, and may include the prenatal period, the adiposity rebound (second rise in adiposity occurring at about 6 y), and puberty.¹⁸

In addition to the observed tracking of adiposity from childhood to adulthood, it has been suggested that lifestyle habits such as diet and activity levels may also track during childhood and into adulthood. There is some evidence that such tracking occurs,^{19–21} although relationships are modest. If lifestyle patterns established in childhood persist into adulthood, childhood becomes a target period for modification of lifestyle factors with a view to preventing obesity.

Obesity is a multi-factorial condition with wide-ranging causes including genetic, social, cultural and behavioural factors, all of which may interact. The current review takes a public health perspective, and therefore focuses on potentially modifiable factors.