

## Adult socioeconomic, educational, social, and psychological outcomes of childhood obesity: a national birth cohort study

Russell M Viner, Tim J Cole

Editorial by Lean  
and pp 1357, 1360

Department of  
Paediatrics, Royal  
Free and University  
College Medical  
School, University  
College London,  
London NW3 2PF  
Russell M Viner  
*honorary senior  
lecturer*

Centre for  
Paediatric  
Epidemiology and  
Biostatistics,  
Institute of Child  
Health, University  
College London,  
London  
WC1N 1EH  
Tim J Cole  
*professor*

Correspondence to:  
R M Viner  
R.Viner@ich.ucl.ac.uk

BMJ 2005;330:1354-7

### Abstract

**Objectives** To assess adult socioeconomic, educational, social, and psychological outcomes of childhood obesity by using nationally representative data.

**Design** 1970 British birth cohort.

**Participants** 16 567 babies born in Great Britain 5-11 April 1970 and followed up at 5, 10, and 29-30 years.

**Main outcome measures** Obesity at age 10 and 30 years. Self reported socioeconomic, educational, psychological, and social outcomes at 30 years. Odds ratios were calculated for the risk of each adult outcome associated with obesity in childhood only, obesity in adulthood only, and persistent child and adult obesity, compared with those obese at neither period.

**Results** Of the 8490 participants with data on body mass index at 10 and 30 years, 4.3% were obese at 10 years and 16.3% at 30 years. Obesity in childhood only was not associated with adult social class, income, years of schooling, educational attainment, relationships, or psychological morbidity in either sex after adjustment for confounding factors. Persistent obesity was not associated with any adverse adult outcomes in men, though it was associated among women with a higher risk of never having been gainfully employed (odds ratio 1.9, 95% confidence interval 1.1 to 3.3) and not having a current partner (2.0, 1.3 to 3.3).

**Conclusions** Obesity limited to childhood has little impact on adult outcomes. Persistent obesity in women is associated with poorer employment and relationship outcomes. Efforts to reduce the socioeconomic and psychosocial burden of obesity in adult life should focus on prevention of the persistence of obesity from childhood into adulthood.

### Introduction

Little is known about social, socioeconomic, and psychological consequences of childhood obesity in adult life. A recent systematic review found no longitudinal studies on the outcomes of childhood obesity other than physical health outcomes<sup>1</sup> and only two longitudinal studies of socioeconomic effects of obesity in adolescence<sup>2,3</sup> (see [bmj.com](http://bmj.com)). Identifying outcomes related to obesity confined to childhood is important

in determining whether people who are obese in childhood and who later lose weight remain at risk for adult adversity and inequalities.

We used longitudinal data from the 1970 British birth cohort to examine the adult socioeconomic, educational, social, and psychological outcomes of childhood obesity. We hypothesised that obesity limited to childhood has fewer adverse adult outcomes than obesity that persists into adult life.

### Methods

#### Participants

The 1970 British cohort study is a continuing, multidisciplinary longitudinal study of all people living in Great Britain who were born 5-11 April 1970. A total of 16 567 babies were enrolled and have been followed up at 5, 10, 16, 26, and 29-30 years.<sup>4</sup>

At 10 years of age (in 1980), 15 995 cohort members were traced and invited to participate, and data were obtained on 14 875. In 2000, when participants were aged 29-30, 14 087 of an estimated 16 695 cohort members were traced and invited to participate, of whom 11 261 (68%) underwent interview.<sup>4</sup> See [bmj.com](http://bmj.com) for details of response bias at 10 years and 29-30 years.

#### Childhood data

Height was measured at 10 years of age by school medical staff and recorded to the nearest 0.1 cm (or 0.25 inch). Weight was measured and recorded to the nearest 0.1 kg (or 0.25 pound). Body mass index z score at 10 years was calculated from height and weight with the revised UK 1990 growth reference. Obesity at 10 years was defined as body mass index  $\geq 95$ th centile. Height and weight of parents were measured or self reported at parental interview in the 10 year survey. Body mass index z scores for parents were calculated from cohort mean and standard deviation. Birth weight was recorded in the original birth survey. Socioeconomic status in childhood was defined by paternal occupation and maternal educational status at 10 years. Cognitive ability was assessed at 10 years.



This is the abridged version of an article that was posted on [bmj.com](http://bmj.com) on 17 May 2005: <http://bmj.com/cgi/doi/10.1136/bmj.38453.422049.E0>

### Adult data

Outcomes in adult life were obtained by completion of an interview on computer or self report as part of the 1999-2000 survey of the cohort when participants were aged 29-30. Height and weight were obtained by self report. As under-reporting of weight in obese individuals and over-reporting of height may underestimate BMI,<sup>5,6</sup> we chose to define self reported obesity as BMI  $\geq 28.5$  rather than the standard definition of  $\geq 30$ .

Data on other adult outcomes included occupational status, annual net income, employment history, educational and vocational achievements, marital and relationship history, and the presence of a longstanding illness ( $\geq 6$  months' duration) significantly limiting home or work activities. Mental health was assessed by confidential completion of the Rutter malaise inventory: scores  $\geq 7$  suggested psychiatric morbidity.

### Analysis

We divided participants into four categories of obesity: not obese in childhood or adulthood, obese in childhood only, obese in adulthood only, and obese in childhood and adulthood (persistent obesity). Frequency differences between groups were investigated. For each adult outcome we then constructed multivariable models using logistic regression to calculate odds ratios for the risk of that outcome conferred by childhood and adult obesity. We did this in two ways and in both sets of analyses we adjusted for confounding factors (see [bmj.com](http://bmj.com) for details).

### Results

Our sample comprised 8490 participants for whom we knew body mass index at 10 and 30 years (forming 75% of participants at 30 years). See [bmj.com](http://bmj.com) for details of the participants at 10 and 30 years. Overall, 362 (4.3%) people were obese at 10 years and 1380 (16.3%) were obese at 30, with about 52% of those

obese in childhood also obese at 30 years. One hundred and seventy three (2.0%) were obese in childhood only, 1191 (14%) in adulthood only, and 189 (2.2%) had persistent obesity. Childhood obesity increased the risk of adult obesity in men (odds ratio 4.8, 95% confidence interval 3.3 to 6.8;  $P < 0.0001$ ) and women (4.7, 3.2 to 6.9;  $P < 0.0001$ ) after adjustment for social class and maternal education in childhood, parental BMI z scores, height, and adult social class. Follow-up at 30 years of those with valid BMI at 10 years showed similar loss to follow-up to that reported for the entire cohort, with a higher loss of men and those from lower social classes. Obesity at 10 years was not associated with loss to follow-up at 30 years.

Analysis of the prevalence of adverse adult outcomes in the four categories of obesity for men and women show that for men, there were significant differences between groups for educational and social outcomes, social class, and longstanding illness. For women, there were significant differences in all outcomes apart from unemployment and long-standing illnesses (see [bmj.com](http://bmj.com)).

Mean annual net income was significantly lower in women who were obese in childhood and persistently obese compared with those not obese at either period. These differences, however, were not significant when they were adjusted for childhood socioeconomic status and parental BMI z scores. Mean annual net income was not associated with obesity category in men.

The table shows adjusted odds ratios for the risk of each adult outcome posed by the four obesity categories. In these analyses, obesity limited to childhood was not significantly associated with any adult outcomes measured in either sex. Persistent obesity in men was not significantly associated with any adverse adult outcomes measured, while in women, persistent obesity predicted higher risk of never having

Adjusted odds ratios\* (95% confidence intervals) for the associations of child, adult, and persistent obesity with adverse adult outcomes

	Childhood only	Adulthood only	Childhood and adulthood	P value
<b>Men</b>				
Unskilled occupation (social class IV or V)	1.4 (0.8 to 2.5)	0.9 (0.7 to 1.2)	1.2 (0.7 to 0.2)	0.9
Never gainfully employed	1.1 (0.6 to 1.9)	0.9 (0.7 to 1.2)	1.4 (0.9 to 2.3)	0.9
Currently unemployed and seeking work	0.8 (0.2 to 3.2)	1.4 (0.9 to 2.2)	1.4 (0.5 to 3.7)	0.2
Left school $\leq 16$	0.9 (0.5 to 1.5)	1.2 (1.0 to 1.5)	1.0 (0.6 to 1.6)	0.3
Left school with no qualifications	0.8 (0.4 to 1.4)	1.4 (1.1 to 1.7)	1.2 (0.7 to 1.8)	0.01
Never married	0.9 (0.6 to 1.4)	0.7 (0.5 to 0.8)	0.8 (0.5 to 1.2)	<0.0001
Has no current partner	1.1 (0.7 to 1.7)	0.6 (0.5 to 0.8)	0.8 (0.5 to 1.3)	<0.0001
Psychological morbidity (malaise inventory score $\geq 7$ )	0.6 (0.3 to 1.5)	1.1 (0.8 to 1.5)	1.5 (0.9 to 2.6)	0.3
Limiting longstanding illness	0.8 (0.4 to 1.9)	1.5 (1.1 to 2.0)	0.4 (0.2 to 1.2)	0.2
<b>Women</b>				
Unskilled occupation (social class IV or V)	0.9 (0.5 to 1.6)	1.2 (0.9 to 1.5)	1.3 (0.7 to 2.1)	0.14
Never gainfully employed	1.6 (0.9 to 2.9)	1.1 (0.8 to 1.5)	1.9 (1.1 to 3.3)	0.06
Currently unemployed and seeking work	0.6 (0.1 to 5.4)	1.4 (0.7 to 2.8)	0.8 (0.1 to 5.8)	0.6
Left school $\leq 16$	1.2 (0.7 to 2.0)	0.9 (0.7 to 1.1)	0.9 (0.5 to 1.4)	0.18
Left school with no qualifications	1.0 (0.6 to 1.7)	1.0 (0.8 to 1.2)	0.7 (0.4 to 1.3)	0.5
Never married	0.7 (0.4 to 1.1)	0.9 (0.7 to 1.1)	1.3 (0.8 to 2.1)	0.7
Has no current partner	1.2 (0.8 to 2.1)	1.0 (0.8 to 1.2)	2.0 (1.3 to 3.3)	0.2
Psychological morbidity (malaise inventory score $\geq 7$ )	1.0 (0.6 to 1.9)	1.3 (1.1 to 1.7)	1.5 (0.9 to 2.5)	0.02
Limiting longstanding illness	1.5 (0.8 to 3.0)	1.5 (1.1 to 2.1)	1.4 (0.7 to 2.8)	0.005

\*Adjusted for maternal education, social class in childhood and adulthood, maternal and paternal BMI, and height at 10 and 30 years (analyses for unskilled occupation were not controlled for adult social class).

†Reference category was no obesity in childhood or adulthood.

‡P values for the adjusted regression model for each adult outcome.

### What is already known on this topic

Some studies have linked childhood obesity with poorer quality of life, low self esteem, depression, and poor academic achievement within childhood and adolescence

Longitudinal studies of obese adolescents suggest they have poorer socioeconomic and financial outcome in adult life

Research has not separated the effects of childhood obesity from that of persistent child and adult or adult onset obesity, and poorer socioeconomic and educational outcomes may actually reflect confounding by adult obesity

### What this study adds

Obesity limited to childhood has little impact on socioeconomic, educational, social, and psychological outcomes in adult life.

Persistent child to adult obesity is associated with somewhat poorer employment and relationship outcomes in women only

Health inequalities and social adversity related to obesity probably develop after childhood

been gainfully employed and not having a current partner. In men, obesity limited to adulthood was associated with a higher risk of longstanding illness and leaving school with no qualifications but with a lower risk of never having married or not having a current partner. In women, obesity limited to adulthood was associated with higher risk of psychological disorder and longstanding illness.

### Discussion

We found that childhood obesity per se did not seem to influence any adult outcomes measured in either sex when we adjusted for a range of potential confounding factors, and only half of those obese in childhood in 1980 remained obese in adulthood in 2000. In contrast, persistent obesity through childhood and adulthood was associated with increased adversity, although only in women, who were half as likely to have ever been gainfully employed or ever married compared with those not obese at either time point.

Adult obesity was associated with higher risk of psychological morbidity in women, poor educational achievement in men, and limiting longstanding illness in both sexes, but also with positive social (marriage and relationship) outcomes in men, when we adjusted for confounding factors. These associations in adult life, however, were cross sectional and may represent factors contributing to adult obesity rather than outcomes resulting from it.

### Strengths and limitations

We used data from a large national birth cohort, with data on body mass index that were representative for 10 year old children in Great Britain in 1980. The prevalence of childhood obesity in our sample was identical to that in the whole cohort at 10 years (4.3%) and was appropriate for the period. There was no additional loss to follow-up at 30 years of participants who were obese at 10 years. We controlled our analyses for potential confounding factors. As our analyses of obesity in four groups may have introduced bias due to

dichotomisation of obesity variables,<sup>7</sup> we repeated analyses entering childhood and adult obesity as main effects in the regression equations, adjusting for the interaction between child and adult obesity. The results were not materially different to those achieved with the four obesity categories.

Weaknesses of this study include the use of self reported height and weight in adulthood. To reduce such bias, we used a lower threshold of BMI 28.5 to define adult obesity. The prevalence of obesity in our sample with this definition was similar to that reported in the health survey for England 1999 ([www.statistics.gov.uk](http://www.statistics.gov.uk)). Findings were not materially changed when we repeated analyses using BMI 30 to define obesity.

### Comparison with literature

Longitudinal cohort studies from the 1980s in the UK<sup>3</sup> and US<sup>2</sup> have reported that obesity in adolescence and young adulthood has important social and economic consequences for women. While we found that persistent obesity in women was associated with a lower likelihood of having ever found gainful employment, we identified no association of childhood or persistent obesity with annual net income, current unemployment, and social class in either sex.

We could not confirm previous reports that men<sup>2</sup> and women<sup>8</sup> who were obese in adolescence were less likely to get married. We found that women who were persistently obese were less likely to have a current partner, and men who were obese only in adulthood were more likely to have been married and more likely to have a current partner. These findings are cross sectional and causality cannot be inferred.

We identified no significant impact of obesity limited to childhood or persistent obesity on educational attainment in our sample when we adjusted for confounding factors, contrary to three cohort studies that reported that women who were overweight or obese in adolescence completed fewer years of school.<sup>2 3 8</sup> We found that men who were obese only in adulthood were more likely to have left school without any qualifications, although again this finding was cross sectional and causality cannot be inferred. Our findings were not materially changed when we controlled for cognitive ability at 10 years.

We found that childhood and persistent obesity were not associated with later psychological morbidity. Despite evidence of an association between psychological distress and obesity in childhood<sup>9</sup> and adolescence,<sup>10</sup> we are unaware of other longitudinal studies of adult psychological outcomes of childhood obesity. We found that obesity only in adulthood was cross sectionally associated with psychological morbidity in women but not men, consistent with previous reports.<sup>11</sup>

We did not find that obesity limited to childhood or persistent obesity increased the risk of having a limiting longstanding illness. While the tracking of childhood obesity into adulthood is strongly associated with increased cardiovascular risk and mortality from multiple causes it remains unclear whether cardiovascular risk is higher in those whose obesity is limited to childhood.<sup>12 13</sup>

The adult outcomes of obesity limited to childhood and persistent obesity were less adverse in this cohort than reported by a previous longitudinal analysis.<sup>2 3</sup> There are several possible explanations including the

fact that previous studies evaluated the outcome of adolescent rather than childhood obesity, they evaluated young adults in the 1980s, and assessed outcomes at 21<sup>2</sup> and 23,<sup>3</sup> whereas we assessed outcome at 30 years (see [bmj.com](http://bmj.com)).

### Conclusions

These data suggest that the long term social and psychological impact of the apparent epidemic of childhood obesity less than previously thought, particularly in those in whom obesity resolves after childhood. Efforts to reduce the socioeconomic and psychosocial burden of obesity in adult life should focus on prevention of the persistence of obesity from childhood into adulthood.

Contributors: See [bmj.com](http://bmj.com)

Funding: RMV is funded by the NHS with part funding by a fellowship from the Health Foundation, UK. TJC is funded by the Medical Research Council.

Competing interests: None declared.

Ethical approval: Not required.

- 1 Reilly JJ, Methven E, McDowell ZC, Hacking B, Alexander D, Stewart L, et al. Health consequences of obesity. *Arch Dis Child* 2003;88:748-52.
- 2 Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. *N Engl J Med* 1993;329:1008-12.

- 3 Sargent JD, Blanchflower DG. Obesity and stature in adolescence and earnings in young adulthood. Analysis of a British birth cohort. *Arch Pediatr Adolesc Med* 1994;148:681-7.
- 4 Bynner J, Butler N, Ferri E, Shepherd P, and Smith K. *The design and conduct of the 1999-2000 surveys of the national child development study and the 1970 British birth cohort study*. UK data archive. London: Centre for Longitudinal Studies, Institute of Education, 2002. (CLS Cohort Studies Working Paper 1)
- 5 Spencer EA, Appleby PN, Davey GK, Key TJ. Validity of self-reported height and weight in 4808 EPIC-Oxford participants. *Public Health Nutr* 2002;5:561-5.
- 6 Crawley HF, Portides G. Self-reported versus measured height, weight and body mass index amongst 16-17 year old British teenagers. *Int J Obes Relat Metab Disord* 1995;19:579-84.
- 7 Maxwell SE, Delaney HD. Bivariate median splits and spurious statistical significance. *Psychol Bull* 1993;113:181-90.
- 8 Laitinen J, Power C, Ek E, Sovio U, Jarvelin MR. Unemployment and obesity among young adults in a northern Finland 1966 birth cohort. *Int J Obes Relat Metab Disord* 2002;26:1329-38.
- 9 Mustillo S, Worthman C, Erkanli A, Keeler G, Angold A, Costello EJ. Obesity and psychiatric disorder: developmental trajectories. *Pediatrics* 2003;111:851-9.
- 10 Goodman E, Whitaker RC. A prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics* 2002;109:497-504.
- 11 Onyike CU, Crum RM, Lee HB, Lyketsos CG, Eaton WW. Is obesity associated with major depression? Results from the third national health and nutrition examination survey. *Am J Epidemiol* 2003;158:1139-47.
- 12 Ferraro KE, Thorpe RJ Jr, Wilkinson JA. The life course of severe obesity: does childhood overweight matter? *J Gerontol B Psychol Sci Soc Sci* 2003;58:S110-9.
- 13 Wright CM, Parker L, Lamont D, Craft AW. Implications of childhood obesity for adult health: findings from thousand families cohort study. *BMJ* 2001;323:1280-4. (Accepted 6 April 2005)

doi 10.1136/bmj.38453.422049.E0

## Early life risk factors for obesity in childhood: cohort study

John J Reilly, Julie Armstrong, Ahmad R Dorosty, Pauline M Emmett, A Ness, I Rogers, Colin Steer, Andrea Sherriff for the Avon Longitudinal Study of Parents and Children Study Team

### Abstract

**Objective** To identify risk factors in early life (up to 3 years of age) for obesity in children in the United Kingdom.

**Design** Prospective cohort study.

**Setting** Avon longitudinal study of parents and children, United Kingdom.

**Participants** 8234 children in cohort aged 7 years and a subsample of 909 children (children in focus) with data on additional early growth related risk factors for obesity.

**Main outcome measures** Obesity at age 7 years, defined as a body mass index  $\geq$ 95th centile relative to reference data for the UK population in 1990.

**Results** Eight of 25 putative risk factors were associated with a risk of obesity in the final models: parental obesity (both parents: adjusted odds ratio, 10.44, 95% confidence interval 5.11 to 21.32), very early (by 43 months) body mass index or adiposity rebound (15.00, 5.32 to 42.30), more than eight hours spent watching television per week at age 3 years (1.55, 1.13 to 2.12), catch-up growth (2.60, 1.09 to 6.16), standard deviation score for weight at age 8 months (3.13, 1.43 to 6.85) and 18 months (2.65, 1.25 to 5.59); weight gain in first year (1.06, 1.02 to 1.10 per 100 g increase); birth weight, per 100 g (1.05, 1.03

to 1.07); and short (<10.5 hours) sleep duration at age 3 years (1.45, 1.10 to 1.89).

**Conclusion** Eight factors in early life are associated with an increased risk of obesity in childhood.

### Introduction

Evidence on risk factors for obesity in childhood is limited.<sup>1 2</sup> We identified and quantified risk factors for obesity at age 7 years in children who were participating in the Avon longitudinal study of parents and children (ALSPAC), in which confounding variables are being considered and potential risk factors are being tested simultaneously. For our study, we took into account only risk factors supported by a priori hypotheses.

### Methods

The Avon longitudinal study of parents and children is described in detail elsewhere.<sup>3</sup> Briefly, 14 541 pregnant women with an expected date of delivery between April 1991 and December 1992 were enrolled, and 13 971 children formed the original cohort. Data have been

Editorial by Lean and pp 1354, 1360

University of Glasgow Division of Developmental Medicine, Yorkhill Hospitals, Glasgow G3 8SJ

John J Reilly reader in paediatric energy metabolism  
Julie Armstrong senior lecturer in nutrition

continued over

BMJ 2005;330:1357-9



This is the abridged version of an article that was posted on [bmj.com](http://bmj.com) on 20 May 2005: <http://bmj.com/cgi/doi/10.1136/bmj.38470.670903.E0>