

Obesity in adolescence

John R Reilly

Introduction

An epidemic of child and adolescent obesity has recently affected both the developed and developing world (Reilly and Dorosty, 1999). Obesity is now the most common health problem for adolescents in the developed world (Ebbeling et al, 2002). This article summarises the aetiology, prevalence, consequences and treatment of obesity in adolescence, focusing particularly on diabetes as a condition caused by obesity.

Obesity is the result of a chronic energy imbalance: when energy intake exceeds energy output over a period of months or years, leading to the accumulation of excess body fat and lean body mass. This energy imbalance can come about as a result of an increased food intake, or a decreased energy expenditure (reduced physical activity) or a combination of both. Most of the evidence suggests that the main societal change which brought about the obesity epidemic was a decline in physical activity (Reilly and Dorosty, 1999; Prentice and Jebb, 1995). Almost all cases of obesity have a lifestyle origin and pathological causes are extremely rare. Once an individual has become obese their energy requirements are unusually high, not low as often reported by patients and families. In order to remain obese an individual must therefore consume an unusually large amount of energy (food).

Diagnosis

The only simple and accurate means of diagnosing overweight and obesity in adolescents is to use the body mass index (BMI) percentile. The BMI is calculated as weight (kg)/height² (m²). This value should then be plotted on the UK 1990 percentile charts (Child Growth Foundation London; Harlow Printing, South Shields UK). These describe the BMI distribution of the UK population in 1990. A BMI above the 91st percentile on the UK 1990 chart indicates overweight; a BMI above the 98th

percentile indicates obesity (Reilly et al, 2002; SIGN, 2003). These definitions are moderately sensitive and highly specific for obesity, i.e. false negative rates are low. We can be confident that an adolescent with a BMI of >98th percentile really has a high level of body fatness (Reilly et al, 2000).

Alternative methods for diagnosing obesity are unsuitable and 'eyeballing' the child as a means of diagnosis is inaccurate and too subjective. Use of adult values to interpret BMI (such as BMI >30 to diagnose obesity) are inappropriate since BMI values are generally much lower in childhood and adolescence than in adulthood.

Health consequences of adolescent obesity

There is still a widespread belief among adolescents, their parents and healthcare professionals that obesity is a relatively minor health problem, or even a largely cosmetic problem with no significant health impact. In fact, there is a rapidly accumulating body of evidence that obesity in adolescents will have major health consequences in the short term (for the adolescent) and the longer term (for the adult who was an obese adolescent as can be seen in *Figure 1*).

Short term health risks

The main impacts on health as a consequence of obesity in adolescence are an increasing risk of psychosocial problems

ARTICLE POINTS

1 Adolescent obesity has reached epidemic levels in the UK.

2 Obesity in adolescence has many serious adverse effects, including increased risk of type 2 diabetes.

3 Obesity should be diagnosed using the BMI percentile, plotted on a chart.

4 Management of obesity in adolescence should focus on:

- Excluding underlying pathological causes of obesity
- Identifying and treating co-morbid conditions if present
- Weight maintenance, (not weight loss) in most cases
- Encouragement of small but sustainable lifestyle changes
- Encouragement of patient self-monitoring of lifestyle

KEY WORDS

- Paediatrics
- Type 2 diabetes
- Risk factors
- Coronary heart disease

Dr John J Reilly is a Reader in Paediatric Energy Balance, University of Glasgow, Division of Developmental Medicine, Yorkhill Hospital, Glasgow

Health consequences of adolescent obesity

Short term clinical consequences:

- Psychological ill health (e.g. low self-esteem, social isolation)
- Increased risk of asthma, exacerbation of existing asthma
- Diabetes (type 2 and possibly also type 1)
- Various orthopaedic problems
- Chronic systemic inflammation

Cardiovascular risk factors in adolescence:

- High blood pressure
- Dyslipidaemia
- Abnormalities in left ventricular mass and function
- Abnormalities in endothelial function
- Hyperinsulinaemia/insulin resistance
- ‘Clustering’ or aggregation of these risk factors

Long term consequences:

- Obesity persistence
- Socioeconomic disadvantage
- Persistence of cardiovascular risk
- Greater adult morbidity
- Increased risk of premature mortality

type 2 diabetes in hospital diabetes clinics now accounts for over one third of new cases (Pinhias-Hamiel et al, 1996). Incidence of type 2 diabetes in adolescents in the UK appears to be on the increase (Drake et al, 2002) in the wake of the obesity epidemic. Impaired glucose tolerance may now be common among obese adolescents in the UK, as it is in the US (Sinha et al, 2002). Recent evidence suggests that obesity in adolescents increases cardiovascular risk factors, including impaired glucose tolerance, in much the same way as in adults (Slyper, 1998).

Longer-term consequences

For the adult who was obese as an adolescent ‘social success’ in adult life is adversely affected. This includes outcomes such as lower educational attainment, poorer socio-economic prospects and greater risk of social isolation (Gortmaker et al, 1993; Sargent and Blanchflower, 1994). Adolescent obesity also has a strong tendency to persist – at least 75% of contemporary obese teenagers will become obese adults. The cardiovascular risk factors associated with adolescent obesity also tend to persist or even amplify over time.

The high and increasing prevalence of adolescent obesity, combined with its strong association with all of the major cardiovascular risk factors, presents a major challenge to public health and to healthcare systems. A substantial increase in future adult cardiovascular morbidity and premature mortality is likely as the new generation of obese adolescents grows up (Ebbelling et al, 2002).

Prevalence of adolescent obesity

In the UK the paediatric obesity epidemic began in the mid-late 1980s and prevalence is now high and increasing as can be seen in Figure 2. In 1996, for example, 17% of English 15 year olds were obese. As well as becoming substantially fatter, modern adolescents have a more central fat distribution than those in the recent past – waist circumference has increased in the adolescent population at an even greater rate than the increase in BMI (McCarthy et al, 2003).

Figure 1. The health consequences of obesity in adolescence

(Dietz, 1998), presence and clustering of cardiovascular risk factors and increasing risks of type 1 (Hypponen et al, 2000) and type 2 diabetes, asthma and a variety of less common conditions (Reilly et al, 2003).

In the US, the paediatric obesity epidemic has been accompanied by an epidemic of type 2 diabetes in adolescents and young adults. Incidence of type 2 diabetes has risen ten-fold in some states so that

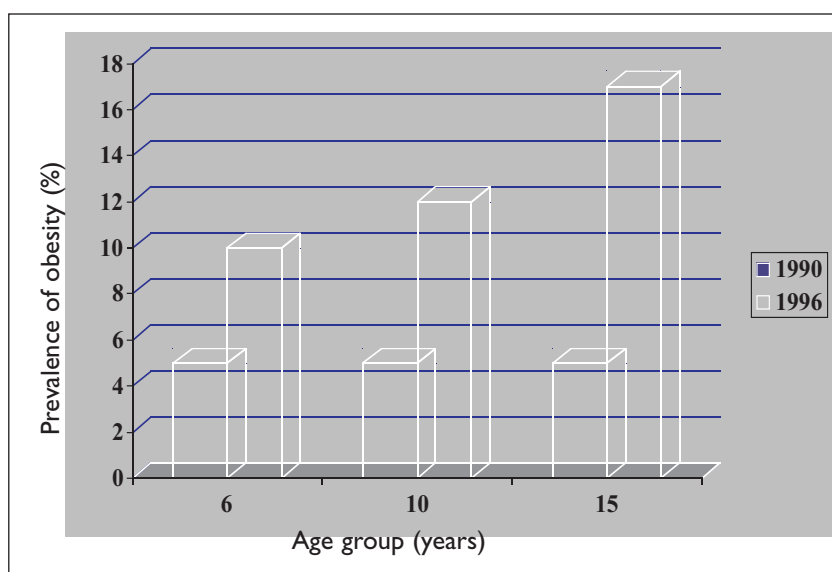


Figure 2. The prevalence of childhood obesity (BMI > 95th percentile) in nationally representative samples of English children in 1990 and 1996.

Evidence about treatment

High quality, long-term randomised controlled trials in paediatric obesity treatment are almost non-existent (Reilly et al, 2002; Summerbell et al, 2003) and there is a dearth of evidence on treatment of adolescents. As a result there are no treatment models which are currently evidence-based and generalisable to the UK. No high quality, long-term, evidence exists for residential treatment ('fat camps'), or for pharmacotherapy (Reilly et al, 2002). However, pharmacotherapy for obese adolescents who have co-morbidities of obesity such as glucose intolerance is of great interest in view of the increasing numbers of such patients. A promising short-term trial of pharmacotherapy combined with lifestyle change in obese adolescents in the US was published recently (Berkowitz et al, 2003) and use of pharmacotherapy for obese adolescents will increase in the future.

In the absence of a clearly successful and generalisable treatment regimen which we can all adopt, a number of authors have tried to summarise the most promising features of child and adolescent obesity treatment. More intensive treatment (longer appointments and more of them) seems more successful than the traditional small number of short appointments; targeting sedentary behaviour (particularly TV viewing) is a useful addition to dietary treatment. Attempting to change the family environment and not simply treat the adolescent in isolation seems worthwhile.

Guidance on management of the obese adolescent

In the absence of high quality evidence on the ideal method of management of adolescents with obesity, consensus reports (see web-based management guidelines below) provide useful guidance on the basic management principles. There are three components to this guidance:

- Who should be referred from primary care?
- Who should be treated ?
- What should treatment aim for?

Figure 3 summarises the best evidence-based guidance on these three questions. For most patients referred from primary

Guidance on management

Who should be referred from primary care?

- Patients with serious co-morbidity of obesity requiring treatment
- Patients with suspected underlying medical cause of obesity (e.g. obese children who are short for their age)
- All children with BMI >99.6th percentile

Who should be treated?

- Patients confirmed as obese (BMI >98th percentile)
- Patients/families who perceive obesity as being a problem
- Patients/families judged to be willing/motivated to undertake the necessary lifestyle changes

What should treatment aim for?

- Weight maintenance in most cases, not weight loss
- Small sustained lifestyle changes
- Better monitoring of eating and sedentary behaviour
- Reduced sedentary behaviour
- Healthier eating
- Increasing physical activity to at least 30 minutes a day of moderate to vigorous physical activity (e.g. brisk walking)

Figure 3. Guidance on management of adolescents with type 2 diabetes

care the underlying pathological causes of obesity will have been excluded at the referral, and patients can be discharged to be managed in the primary care setting.

The treatment that can be offered at present is based on lifestyle changes and should probably only be offered to those adolescents who are actually obese (BMI >98th percentile) and who perceive obesity as a problem and/or appear willing to make the necessary lifestyle changes. Small, sustainable changes to eating behaviour, sedentary behaviour (particularly TV viewing) and physical activity will be required. These are unlikely to be successful if the adolescent and/or their family are unwilling to attempt to make the changes. For most children and adolescents who are obese, weight maintenance over a period of 6–12 months is a successful outcome, and continued growth will help many patients 'grow into their weight' to some degree. For patients who have achieved weight maintenance for 6–12 months and who have co-morbidities which require weight loss, a modest weight loss target of 0.5 kg/month is appropriate. For the adolescent who is 'overweight'

PAGE POINTS

1 High quality, long-term randomised controlled trials in paediatric obesity treatment are almost non-existent and there is a dearth of evidence on treatment of adolescents.

2 The treatment that can be offered at present is based on lifestyle changes and should probably only be offered to adolescents who are obese and who perceive obesity as a problem and/or appear willing to make the necessary lifestyle changes.

3 Small, sustainable changes to eating behaviour, sedentary behaviour (particularly TV viewing) and physical activity will be required.

PAGE POINTS

1 Adolescent obesity is common and increasing in prevalence.

2 Evidence-based guidelines are now available for the management of adolescent obesity.

3 Targeting management towards more receptive patients and families is helpful and a number of new management strategies are very promising.

4 Encouraging greater self-monitoring of lifestyle by the patient and reducing sedentary behaviour such as TV viewing may be both practical and effective in primary care.

(BMI > 91st percentile but < 98th percentile) annual monitoring of BMI percentile in the primary care setting is probably adequate.

Useful web-based obesity management resources

Three useful web-based resources are currently available. The only evidence-based management guideline at present is SIGN 69 (www.sign.ac.uk). SIGN 69 and the recent Royal College of Paediatrics and Child Health guidelines for primary care (www.rcpch.ac.uk/publications/clinical_docs.html) drew heavily on the US Academy of Pediatrics Statement (www.pediatrics.org/cgi/content/full/102/3/e29). The US Academy of Pediatrics is a comprehensive and helpful guide to management of obesity.

Conclusion

In the past, child and adolescent obesity was relatively uncommon and the perception was that health risks associated with obesity before adulthood were small. It is now clear that adolescent obesity is common and increasing in prevalence. It is extremely persistent and causes a number of health problems in both the short and long term. Of particular note is the increased risk of cardiovascular risk factors and type 2 diabetes. Evidence-based guidelines are now available for the management of adolescent obesity. Management is challenging and often unsuccessful. Targeting management towards more receptive patients and families is helpful and a number of new management strategies are very promising. In particular, encouraging greater self-monitoring of lifestyle by the patient and reducing sedentary behaviour such as TV viewing may be both practical and effective in primary care. ■

Berkowitz RI, Wadden TA, Tershakovec AM, Cronquist JL (2003) Behaviour therapy and sibutramine for adolescent obesity: a randomised controlled trial. *Journal of the American Medical Association* **289**: 11805–12

Dietz WH (1998). Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* **101**: 518–25

Drake AJ, Smith A, Betts PR, Crowne EC, Shield JP (2002) Type 2 diabetes in obese white children. *Archives of Disease in Childhood* **86**: 207–08

Ebbeling CB, Pawlak DB, Ludwig DS (2002) Childhood obesity: public-health crisis, common sense cure *Lancet* **362**: 473–82

Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH (1993) Social and economic consequences of overweight in adolescence and young adulthood. *New England Journal of Medicine* **329**: 1008–12

Hypponen E, Vitanen SM, Kenward MG, Knip M, Akerblom HK (2000) Obesity, increased linear growth, and risk of type 1 diabetes in children. *Diabetes Care* **23**: 1755–60

Pinhas-Hamiel O, Dolan LM, Daniels SR (1996) Increased incidence of non-insulin dependent diabetes mellitus among adolescents. *Journal of Pediatrics* **128**: 608–15

Prentice AM, Jebb S (1995) Obesity in Britain: gluttony or sloth? *British Medical Journal* **311**: 437–39

McCarthy DH, Ellis SM, Cole TJ (2003) Central overweight and obesity in British youth aged 11–16 years: cross-sectional surveys of waist circumference. *British Medical Journal* **326**: 624–28

Reilly JJ, Dorosty AR (1999) Epidemic of obesity in UK children. *Lancet* **354**: 1874–75

Reilly JJ, Dorosty AR, Emmett PM (2000) Identification of the obese child: adequacy of the BMI for clinical practice and epidemiology. *International Journal of Obesity* **24**: 1623–27

Reilly JJ, Wilson M, Summerbell CD, Wilson D (2002) Obesity diagnosis prevention, and treatment: evidence-based answers to common questions. *Archives of Disease in Childhood* **86**: 392–95

Reilly JJ, Kelnar CJ, Alexander DW et al (2003) Health consequences of obesity. *Archives of Disease in Childhood* **88**: 748–52

Sargent JD, Blanchflower DG (1994). Obesity and stature in adolescence and earnings in young adulthood. *Archives Pediatrics and Adolescent Medicine* **148**: 681–87

SIGN (2003) *Management of obesity in children and young people: a national clinical guideline*. Scottish Intercollegiate Guidelines Network (www.sign.ac.uk)

Sinha R, Fisch G, Teague B et al (2002) Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. *New England Journal of Medicine* **346**: 802–10

Slyper AH (1998). Childhood obesity, adipose tissue distribution, and the pediatric practitioner. *Pediatrics* **102**: e4

Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly J, Waters E (2003). *Interventions for treating obesity in children*. Cochrane Library Issue 3, Oxford: update software