

The management of obesity in childhood and adolescence

Obesity can have a major effect on the life of a child or adolescent, from eliciting bullying to causing health problems such as premature heart disease. Areas of management that are targeted include diet, exercise and long-term behavioural changes.

SUSIE BURRELL

BNutrDiet(Hons), BSc(Psych)(Hons)

SHIRLEY ALEXANDER

MB ChB, MRCPCH, FRACP

LOUISE A. BAUR

MB BS(Hons), BSc(Med), PhD, FRACP

Ms Burrell is a Weight Management Dietitian at the Department of Nutrition and Dietetics, The Children's Hospital at Westmead. Dr Alexander is a Staff Specialist in Weight Management Services, The Children's Hospital at Westmead. Professor Baur is a Professor in the Discipline of Paediatrics and Child Health, University of Sydney, and Director, Weight Management Services, The Children's Hospital at Westmead, Westmead, NSW.

Obesity is now recognised by the World Health Organization as a major epidemic, with a prevalence that has increased dramatically over the past two to three decades in both adults and children.^{1,2} Obesity can be considered as both a disease, causing significant morbidity and mortality, and a risk factor for other noncommunicable diseases including type 2 diabetes and cardiovascular disease.

Overweight and obesity in children and adolescents are significant and increasingly prevalent conditions in Australia. According to nationally representative data, rates of combined overweight and obesity in Australian school-aged children have more than doubled over the past 20 years, with one in four now affected.³ However, the

prevalence of obesity alone in this age group has more than tripled, affecting 8 to 10%.^{4,5} Although the rate of increase appears to be slowing in some countries,⁶ available evidence suggests that total energy expenditure is continuing to decrease due to the impact of television, the internet and computer games. Coupled with increased energy intake from high-energy foods and drinks, it is likely that the prevalence of obesity will continue to increase.²

Obesity in childhood and adolescence is associated with a range of medical and psychosocial complications that can be present in childhood or may develop in the medium to long term (Table 1).^{2,7} Childhood obesity is also a major

IN SUMMARY

- **Obesity is a chronic disorder of energy imbalance. Management should focus on both sides of the energy equation: energy in and energy out.**
- **Body mass index (BMI) should be calculated and plotted on a BMI-for-age chart, with waist circumference also measured and recorded.**
- **A developmentally sensitive approach should be used. With children, focus on parents as the agents of change; with adolescents, provide the opportunity for the adolescent and parents to attend sessions separately.**
- **Long-term behavioural change is required, involving an increase in incidental physical activity, a reduction in sedentary behaviour (including television viewing and use of other forms of passive electronic entertainment) and a sustainable change to a lower energy intake.**
- **In prepubertal children, weight maintenance or reduction in the rate of weight gain are appropriate goals of therapy: after puberty, weight loss is generally appropriate.**
- **Vulnerable eating patterns include skipping breakfast; excessive consumption of soft drinks, cordials and fruit juices; large portion sizes and frequent snacking.**

risk factor for adult obesity, with all its attendant complications. For these reasons, early effective management of established overweight and obesity is vital.

GPs are in a powerful position to regularly monitor the weight status of children and adolescents and to develop appropriate management plans for those identified as being overweight or obese. The Australian National Health and Medical Research Council's *Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents* provide a practical summary for clinicians on how to treat this problem (see the flowchart on page 40).^{8,9}

Raising the issue of obesity with families or young people

Obesity is an extremely sensitive issue for children and adolescents and their families. GPs may feel uncomfortable raising the issue, particularly as the majority of consultations by families with overweight or obese children are not primarily for weight concerns.¹⁰ Such consultations, however, present the ideal opportunity to sensitively initiate



PHOTOLIBRARY

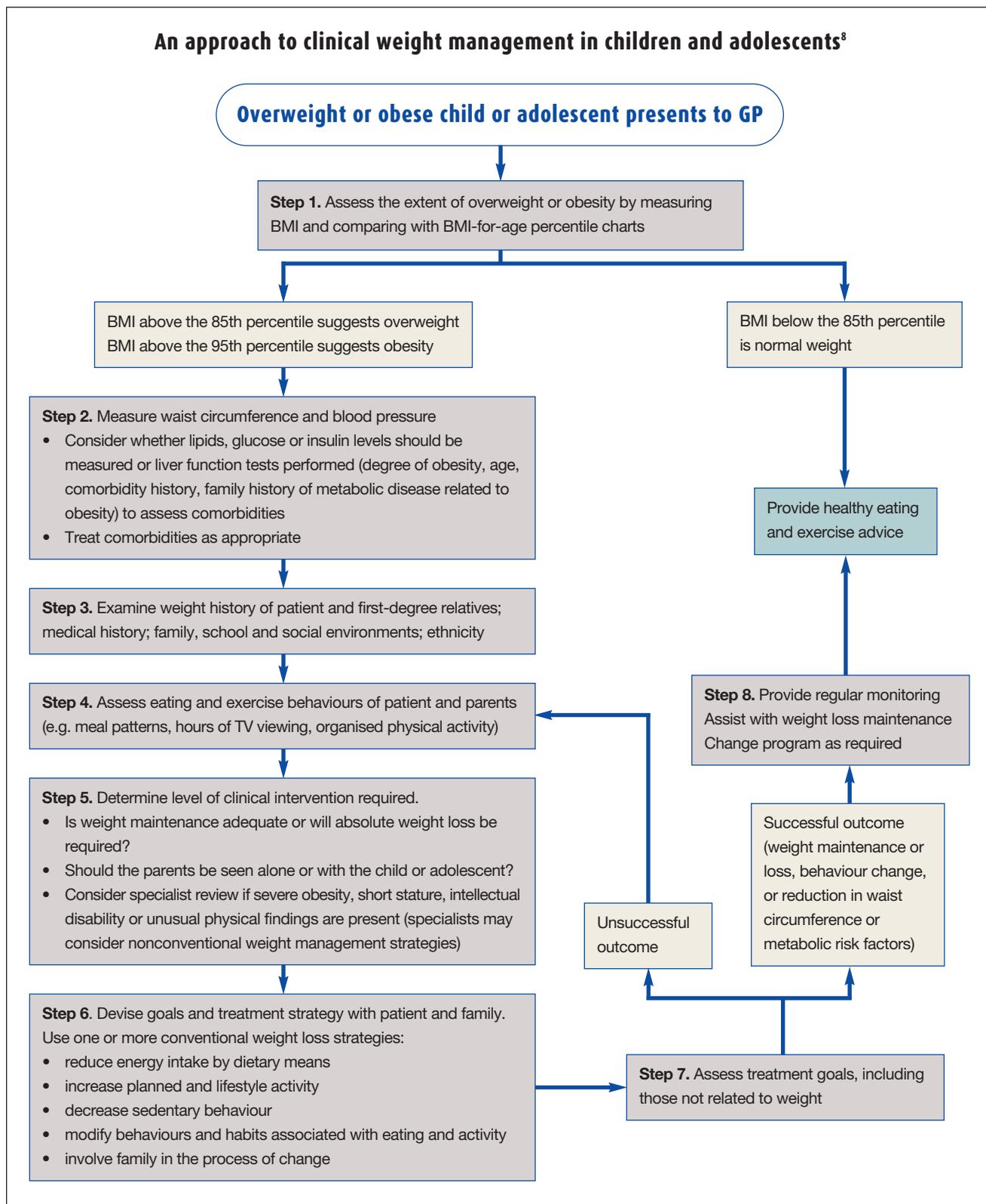
discussions on this health issue with the parents of preadolescent children or with young people themselves where appropriate.

Some families or young people will already be aware of a weight problem and will be ready

Table 1. Complications associated with obesity in childhood and adolescence

| System | Health problems |
|-------------------------|--|
| Psychosocial | Social isolation and discrimination, bullying, low self-esteem, body image disorder, bulimia In the medium to long term: poorer social and economic 'success', bulimia, depression |
| Respiratory | Obstructive sleep apnoea, asthma |
| Orthopaedic | Back pain, slipped femoral capital epiphyses, tibia vara, ankle sprain, flat feet |
| Gastrointestinal | Nonalcoholic fatty liver disease, gastro-oesophageal reflux, gastric emptying disturbances, constipation, gallstones |
| Genitourinary | Polycystic ovary disease, menstrual irregularities, nocturnal enuresis |
| Cardiovascular | Hypertension, adverse lipid profile (low high-density lipoprotein cholesterol, high triglycerides, high low-density lipoprotein cholesterol) In the medium to long term: increased risk of hypertension, adverse lipid profile and increased risk of coronary artery disease in adulthood |
| Endocrine and metabolic | Hyperinsulinaemia, insulin resistance, glucose intolerance, impaired fasting glucose, type 2 diabetes In the medium to long term: increased risk of type 2 diabetes in adulthood, increased risk of adult obesity |
| Neurological | Idiopathic intracranial hypertension |
| Skin | Acanthosis nigricans, striae, intertrigo |

continued



to make the necessary lifestyle changes. Others may need more time to consider the issues and decide whether or not they are ready to make lifestyle changes. In this situation, the GP is in a position to educate the family or young person about the medical and psychosocial issues associated with obesity in childhood and adolescence and offer future support when there is a decision to seek help at a later time.

Medical management of obesity

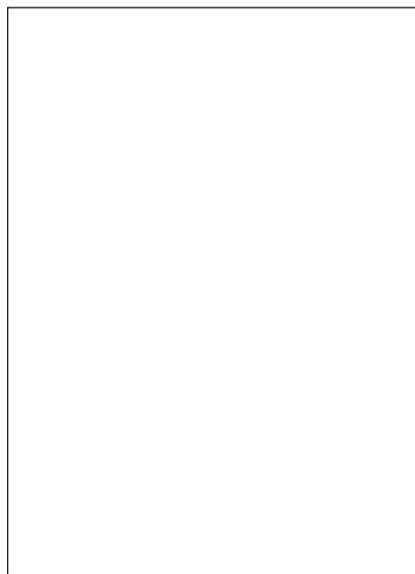
Obesity in children and adolescents has proven challenging to treat. However, a recent systematic review has shown that behavioural lifestyle interventions can produce significant and clinically meaningful reductions in the weight of obese children and adolescents.¹¹ Strategies used to treat obesity in children and adolescents include family support, a developmentally appropriate approach, behaviour modification, dietary change, increased physical activity and decreased sedentary behaviour (Table 2).

Clinical assessment

All obese children and adolescents should initially have a full history and physical examination performed. A general medical history should be obtained including details on the perinatal period (in particular if gestational diabetes was present), childhood development, weight-associated complications, medications taken, when concerns regarding weight first arose and any previous attempts at weight management (Table 1).

Detailed information should be sought on lifestyle, as well as the impact of obesity on the life of the child or young person and his or her family, including whether there has been bullying or teasing, or seemingly minor yet important problems such as difficulties with self-toileting or an inability to tie shoelaces because of the child's large waistline. A family history of obesity and disorders associated with insulin resistance (e.g. type 2 diabetes,

hypertension, dyslipidaemia, premature heart disease and obstructive sleep apnoea) should be obtained. Of particular importance is a detailed exploration of the factors influencing physical activity, sedentary behaviour and dietary intake. This history should help determine both why and how energy imbalance has occurred. In addition, the level of motivation to change should be assessed.



Height and weight should be accurately measured and body mass index (BMI) calculated as weight in kg divided by height in metres squared (kg/m^2) and then plotted on a gender appropriate BMI-for-age chart (Figure 1).¹² Waist circumference can be used as a proxy for abdominal obesity and, even in childhood and adolescence, is strongly correlated with markers for comorbidities such as adverse lipid and glucose profiles and hypertension.¹³ No specific cut-off points for waist circumference-for-age exist for categorising abdominal obesity in children and adolescents. It is reasonable to consider that a child whose waist circumference is of an adult at-risk value (men ≥ 94 cm, women ≥ 80 cm) is at substantial risk of complications of obesity. Another strong predictor of complications of obesity is the waist-to-height

Table 2. Behavioural management of obesity in childhood and adolescence

- Clarification of treatment outcomes
- Family involvement
- Developmentally appropriate approach
 - For preadolescent children, the focus should be on the parents
 - For adolescents, conduct separate sessions for the young person
- Long-term dietary change
 - Reduce energy intake
 - Choose low-fat food
 - Limit high-fat food
 - Eat breakfast regularly
 - Avoid sweetened drinks, including fruit juice, soft drink and cordial
- Increase in physical activity
 - Increase incidental activity
 - Use active transport options (such as walking or cycling)
 - Increase lifestyle activities
 - Take part in organised activities
- Decrease in sedentary behaviour
 - Limit use of television, computer and other electronic entertainment devices
 - Use alternatives to motorised transport

ratio: children or adolescents with a ratio greater than 0.5 are at increased risk of complications.¹⁴

BMI and waist circumference may be most useful in clinical assessment of the individual patient when measured serially and used to monitor change over time.

Complications that should be checked for on physical examination are outlined in Table 1. They include hypertension

continued

Table 3. Defining weight management outcomes

Improvement in complications or behaviour

- Resolution of medical complications – e.g. sleep apnoea, hypertension, insulin resistance, glucose intolerance, dyslipidaemia
- Improvement in self-esteem and psychosocial functioning
- Increase in healthy lifestyle behaviours (related to eating, physical activity)
- Increase in level of fitness or aerobic capacity
- Improvement in family functioning

Improvement in measures of body fatness

- Slowing in rate of weight gain, weight maintenance or weight loss
- Decrease in waist circumference

Aiming for a long-term result

Each child or adolescent and his or her family requires a thorough education on the nature of obesity management and should be helped to understand that ‘quick fix’ options such as low-carbohydrate diets, meal replacements or strict exercise regimens are not effective. It needs to be explained that a reduced energy intake coupled with increased amounts of both structured and incidental activity are the key to long-term weight management.

It is suggested that the child or adolescent and his or her family focus on making small, sustainable changes to their behaviour. Offering large amounts of information can be overwhelming for families and can make it difficult for them to concentrate on any one area of change. Examples of small changes that can be suggested include limiting the number of hours of television the child or adolescent watches each day and eating breakfast regularly.

Family involvement and a developmentally appropriate approach

When families are engaged in therapeutic interventions, the age and developmental level of the child or adolescent must be considered. There is good evidence to show that obesity management in pre-adolescent children is more effective when only parents are involved in therapeutic sessions.¹⁶ Parents are usually in a powerful position to effect change. In most cases they are the ones who purchase the food for the household, are able to facilitate an environment that is conducive to change, can support children by acknowledging and encouraging positive behaviours, and are generally the primary role models for all health-related behaviours. For situations in which grandparents or other family members are the child’s primary caregiver, they too need to be targeted in any intervention.

A slightly different approach is needed for managing adolescent obesity. There is little evidence available to show what the most effective management strategy is for overweight and obese adolescents. The few controlled studies available that have investigated the management of adolescent obesity suggest that the condition may be most effectively managed when the adolescent patient and his or her parents have the opportunity to attend some therapy sessions separately.

Table 4. ‘High-risk’ eating behaviours and diet checklist

| ‘High-risk’ eating behaviours | Healthy diet habits checklist |
|---|---|
| Skipping breakfast | Always eat breakfast |
| Having unstructured meal and mid-meal times ‘Grazing’ (frequent snacking) during the after-school period | Eat regular meals and in-between snacks and no other snacking |
| Eating on the sofa in front of the TV | Always sit at the table to eat with the TV off |
| Having large portion sizes | Limit portion sizes |
| Consuming fruit juice, cordial or soft drinks | Have no soft drinks, fruit juice or cordial Have water as the drink of choice |
| Consuming high-fat and/or high-glycaemic index foods (e.g. processed muesli bars, biscuits, potato chips and cakes) | Limit the consumption of high-fat and high-glycaemic index foods Eat wholegrain-based breads and cereals Eat low-fat dairy foods Include only one packaged snack food in the school lunchbox |
| Frequently consuming takeaway foods | Limit takeaway meals to once a week |

Key areas of dietary intervention

There are a number of food and food intake behaviours that have been shown to be helpful with regards to weight management in overweight and obese children (Table 4).

Breakfast

Several published studies have found a positive relation between eating breakfast and long-term weight control.¹⁷ Children who eat breakfast are less likely to snack on high-calorie foods during the day and also show improved memory and levels

of alertness at school compared with children who have not had breakfast. For this reason, a nutrient-rich breakfast of low-glycaemic index (GI) carbohydrates and proteins such as wholegrain breakfast cereal and low-fat milk or eggs on whole-grain toast is recommended.

No sugar-sweetened beverages

A high intake of sweetened beverages is associated with weight gain in children and adolescents in both the short and long term,¹⁸ and for this reason it is recommended that water be the main drink of choice for children. Sweetened beverages including fruit juice and cordial are recommended for consumption no more than twice each week to reduce the risk of weight issues developing in children long term.¹⁹

Low-glycaemic index diets

A recent Cochrane review has found an association between long-term weight control and low-GI diets.²⁰ In practical terms, this means that the bulk of carbohydrate-rich foods eaten, including bread and breakfast cereal, need to be low-GI choices such as wholegrain bread and low-fat dairy foods.

Snack food choice

Research published by Deakin University in 2006 found that school children in Australia have an average of three packaged snack foods in their lunch box each day, which is likely to be contributing a significant amount of energy into a child's daily intake.²¹ Encourage parents to limit the number of packaged snacks to just one choice each day and aim for whole-grain, low-fat choices that contain less than 400 kJ per serve.

Family eating patterns

It appears that the style of eating within families is also important. Long-term studies with adolescents have shown that families who sit down to eat meals together at least four times each week are

Strategies for parents to encourage positive food-related behaviour

- Consider giving children over the age of 2 years low-fat dairy products (see www.nhmrc.gov.au/publications/synopses/dietsyn.htm).
- Read food labels and purchase only healthy food choices that contain less than 10 g of fat per 100 g of food.
- Encourage children and adolescents to eat breakfast every day. Some easy 'breakfast-on-the-go' ideas include liquid meal drinks, malted chocolate powder with low-fat milk, fruit or yoghurt.
- Allow fruit juice, cordial and soft drinks on special occasions only. Water should be encouraged as the main drink.
- Choose low-glycaemic index cereal foods where possible. Examples include wholegrain bread, wholegrain breakfast cereal, stone and temperate fruit, low-fat dairy products and pasta. More information on the glycaemic index is available online at www.glycemicindex.com
- Promote set meal and mid-meal times to stop 'grazing' eating patterns that can often lead to overeating.
- Encourage food to be eaten only at the table, not in front of the television or while standing up in the kitchen.
- Aim for takeaway foods to be consumed no more than once per week.

significantly less likely to have adolescents with weight issues.²²

Some positive recommendations that GPs can make to families to promote more positive food-related behaviour are shown in the box on this page. It is important to emphasise that changes to food-related behaviours should be adopted by the whole family rather than targeting only the obese child or adolescent.

Encouraging physical activity

Making changes to a family's physical activity habits can be just as important as making dietary changes. The pervasiveness of computers, television, DVDs and hand-held computer equipment is no doubt related to the recent dramatic increases in sedentary behaviour and hence the increasing rates of child and adolescent obesity.

Individuals usually require a mix of structured activity (e.g. swimming lessons, soccer, netball, tennis) and unstructured or

incidental activity (e.g. household chores, walking to the shops or school, free play outside with friends) for weight control. Parents will sometimes overestimate the amount of time their children spend engaged in structured and incidental activity while underestimating the amount of time the child spends in sedentary activity such as playing the computer and watching television.²³

Obese children may find group-based activities intimidating, because their skills and performance levels may be below that of their leaner peers. Additionally, some may be embarrassed by the prospect of wearing sports clothes or swimsuits in public. In these cases, families can be encouraged to incorporate more activity into their everyday lifestyles. For all children and adolescents, incidental activity can be readily increased by choosing active transport options (e.g. walking, cycling, using public transport) over the routine use of the family car for local trips.

Ideas for parents to increase planned and incidental physical activity

- Walk to and from school or at least park the car further away from the school.
- Plan a regular, active family outing once a week such as a bushwalk, trip to the beach, bike riding or roller blading.
- Park the car further away from the shops when running errands.
- Involve children in 'fun' family chores such as washing the car or mowing the lawn.
- Set up a basketball hoop in the garden.
- Supply inexpensive activity-promoting equipment such as balls, skipping ropes or frisbees.
- Choose to use stairs and escalators, rather than lifts.
- Identify possible friends for children to play with.
- Locate safe parks and cycle ways in the local neighbourhood where children can play safely.
- Set a good example by engaging in regular activity such as walks after dinner or shooting basketball hoops on the weekend.
- Promote walking within the family by purchasing a pedometer, which counts the number of step an individual takes. It is recommended that adults take 10,000 steps per day and children take 7500 steps.
- Involve children in the daily household activities by encouraging them to have regular active jobs such as walking the dog, vacuuming and sweeping the leaves.

Some ideas for increasing the level of physical activity for a child or adolescent and his or her family are shown in the box on this page.

Decreasing sedentary behaviour

As previously mentioned, reducing the amount of sedentary behaviour a child or adolescent is engaged in is as important as increasing structured, unstructured and group-based activities. Ideally, a total of less than two hours each day should be spent using passive electronic entertainment such as television and computer games.

Some strategies to help families reduce the amount of television and computer use by children each day are shown in the box on this page.

When to refer

Due to a severe shortage of services for the management of child and adolescent obesity in the community, GPs can often be the only primary service providers to families with obese children. However, where services are available, GPs may be able to refer families or young people to paediatricians, paediatric dietitians, physiotherapists, exercise scientists or clinical psychologists. Such health professionals may also be able to work with family doctors to develop resource materials on management strategies that can be given to patients. For GPs working in remote areas, tertiary hospitals may have resource materials available for parents and adolescents on their websites, which may be downloadable.

Many overweight and obese children or adolescents can be managed in general practice. However, those patients with severe obesity, significant metabolic complications of obesity, growth failure or other signs of endocrine or genetic disease will need to be referred to a paediatrician or specialist clinic for management. It is important to be aware that some obese children and adolescents and their families will also present with significant

Strategies for targeting television and computer use

- Remove televisions from children's bedrooms.
- Ask the children or young people to plan in advance the television shows they would like to watch.
- Have specific television and non-television times in the household.
- Specifically target the afternoon period for a decrease in sedentary behaviour (e.g. tape afternoon TV programs to watch in the evening).
- Turn off the television when meals are served.
- Store the remote control in a drawer.

psychosocial disturbance. These cases warrant a referral to a specialist child and adolescent psychiatric service.

When to follow up

Regular follow up with a health professional is helpful in supporting families and young people to make long-term lifestyle changes. There is little evidence to guide decisions as to the exact frequency of follow up; hence, the time between follow-up appointments is largely up to the individual practitioner and patient. Some families who are already motivated need only one or two initial appointments to receive information and put it into practice. In these cases, general follow up every three to six months may be a reasonable goal. For families who find making changes more difficult, several frequent visits in the initial period (e.g. every two to four weeks) may be required in order to set goals, discuss progress and maintain motivation.

Nonconventional weight management strategies

Long-term behavioural weight management is the preferred treatment for the

continued

majority of obese children and adolescents. Very low calorie diets, drug therapy and bariatric surgery are generally not recommended in this age group and should only be considered under the supervision of a specialist in a tertiary centre in the context of a behavioural weight-management program.⁸ Under such circumstances, nonconventional therapies may be considered for adolescents when behavioural management has failed and there are significant obesity-associated complications.

Drug therapy

Large, randomised placebo-controlled trials in adults have shown that both the pancreatic lipase inhibitor orlistat and serotonin noradrenaline reuptake inhibitor sibutramine aid weight loss and limit weight regain. However, they are not recommended for treating paediatric obesity.

There is some evidence for the use of sibutramine and orlistat in adolescents where the addition of one of these drugs to a behavioural weight-management program resulted in increased weight loss compared with placebo. However, a few participants experienced side effects such as hypertension (with sibutramine) and gastrointestinal tract adverse events (with orlistat).¹¹

Metformin therapy should be considered in the obese adolescent with significant hyperinsulinaemia and a family history of diabetes. Short-term (two to six months) improvement in body composition and metabolic parameters has been demonstrated in obese adolescents with clinical evidence of insulin resistance. However, long-term studies are needed to determine the effect of metformin on BMI and cardiometabolic risk in adolescents.²⁴

Bariatric surgery

Bariatric surgery is recognised as an important form of therapy for adults with severe obesity, especially if medical therapy has failed. There are several case

reports and case series of bariatric surgery in adolescents, and recently the first randomised controlled trial comparing laparoscopic adjustable gastric banding with lifestyle intervention was published.²⁵ Bariatric surgery should only be considered when the young person has reached full adult height.

Australian guidelines for bariatric surgery in adolescents have recently been released by the Paediatrics & Child Health Division of the Royal Australasian College of Physicians.²⁶ They have been developed in conjunction with, and also endorsed by, the Australia and New Zealand Association of Paediatric Surgeons, and the Obesity Surgery Society of Australia and New Zealand. Recommendations include that bariatric surgery only be considered in adolescents aged 15 years and over, with a BMI above 35 kg/m² and who have had a range of complications from severe obesity, and who also have gone through puberty. If bariatric surgery is to be considered, such patients should be referred to centres with multidisciplinary weight-management teams, and surgery should be performed in highly experienced bariatric surgery units by surgeons with skills in laparoscopic gastric banding.

School-based strategies

It is not appropriate for schools to develop or deliver specific treatment or intervention programs geared towards overweight or obese children or adolescents. However, schools are extremely well positioned to provide an environment that encourages lifelong healthy lifestyle habits in the areas of nutrition and physical activity. A recent systematic review and meta-analysis concluded that the inclusion of nutrition and physical activity strategies in the school setting can be effective in achieving a healthier BMI in students.²⁷

Conclusion

Child and adolescent obesity is a significant and rapidly escalating problem in Australia. GPs are in a key position

to assess and manage obesity in this age group, as outlined in recent NHMRC Clinical Practice Guidelines. Obesity-associated complications should be sought on history and physical examination and may require specific therapy. BMI should be plotted on a gender appropriate BMI-for-age chart and waist circumference recorded. Long-term behavioural change is the cornerstone of effective management. This involves the following features:

- clarification of treatment outcomes
- a family-focused, developmentally sensitive approach
- dietary change to a sustainable, lower energy intake
- a decrease in sedentary behaviours
- an increase in physical activity (especially incidental activity).

Severe obesity may require the use of less conventional therapies. Other health professionals, where available, may be very useful in helping patients and their families achieve significant lifestyle change. **MT**

References

A list of references is available on request to the editorial office.

COMPETING INTERESTS: None.

Online CPD Journal Program



PHOTOLIBRARY

What are the potential health complications caused by obesity?

Review your knowledge of this topic and earn CPD/PDP points by taking part in Medicine Today's Online CPD Journal Program.

Log on to www.medicinetoday.com.au/cpd

The management of obesity in childhood and adolescence

SUSIE BURRELL BNutrDiet(Hons), BSc(psych)(Hons) **SHIRLEY ALEXANDER** MBChB, MRCPC, FRACP

LOUISE A. BAUR MB B5(Hons), BSc(Med), PhD, FRACP

References

1. World Health Organization. Global strategy on diet, physical activity and health. Obesity and overweight. Available online at: <http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/> (accessed March 2010).
2. Lobstein T, Baur L, Uauy R (eds). Obesity in children and young people: a crisis in public health. Report of the International Obesity TaskForce Childhood Obesity Working Group. *Obesity Reviews* 2004; 5(Suppl 1): 4-104.
3. Booth M, Okley AD, Denny-Wilson E, Hardy L, Yang B, Dobbins T. NSW Schools Physical Activity and Nutrition Survey (SPANS) 2004: summary report. Sydney: NSW Department of Health; 2006. Available online at: http://www.health.nsw.gov.au/pubs/2006/pdf/spans_report.pdf (accessed March 2010).
4. Australian Bureau of Statistics. 4102.0 Australian social trends. Children who are overweight or obese. <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features+20Sep+2009> (accessed March 2010).
5. Gill TP, Baur LA, Bauman AE, et al. Childhood obesity in Australia remains a widespread health concern that warrants population-wide prevention programs. *Med J Aust* 2009; 190: 146-148.
6. Sjöberg A, Lissner L, Albertsson-Wikland, Marild S. Recent anthropometric trends among Swedish school children: evidence for decreasing prevalence of overweight in girls. *Acta Paediatr* 2008; 97: 118-123.
7. Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public-health crisis, common sense cure. *Lancet* 2002; 360: 473-482.
8. National Health and Medical Research Council. Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents. Available online at: <http://www.health.gov.au/internet/main/publishing.nsf/Content/obesityguidelines-guidelines-children.htm> (accessed March 2010).
9. National Health and Medical Research Council. Clinical Practice Guidelines for the Management of Overweight and Obesity a Guide for General Practitioners. Available online at: http://www.health.gov.au/internet/main/publishing.nsf/Content/obesityguidelines-guidelines-gp_guide.htm (accessed March 2010).
10. Cretikos MA, Valenti L, Britt HC, Baur LA. General practice management of overweight and obesity in children and adolescents in Australia. *Med Care* 2008; 46: 1163-1169.
11. Oude Luttikhuis H, Baur L, Jansen H, et al. Interventions for treating obesity in children. *Cochrane Database Syst Rev* 2009; (1): CD001872.
12. Centers for Disease Control and Prevention, National Center for Health Statistics. CDC growth charts. Available online at: <http://www.cdc.gov/growthcharts> (accessed March 2010).
13. Garnett SP, Baur LA, Srinivasan S, Lee JW, Cowell CT. Body mass index and waist circumference in midchildhood and adverse cardiovascular disease risk clustering in adolescence. *Am J Clin Nutr* 2007; 86: 549-555.
14. Garnett SP, Baur LA, Cowell CT. Waist-to-height ratio: a simple option for determining excess central adiposity in young people. *Int J Obes* 2008; 32: 1028-1030.
15. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care* 2000; 23: 381-389.
16. Golan M, Weizman A, Apter A, Fainaru M. Parents as the exclusive agents of change in the treatment of childhood obesity. *Am J Clin Nutr* 1998; 67: 1130-1135.
17. Croezen S, Visscher TLS, Ter Bogt NCW, Veling ML, Haveman-Nies A. Skipping breakfast, alcohol consumption and physical inactivity as risk factors for overweight and obesity in adolescents: results of the E-MOVO project. *Euro J Clin Nutr* 2009; 63: 405-412.
18. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr* 2006; 84: 274-288.
19. Crawford PB, Woodward-Lopez G, Ritchie L, Webb K. How discretionary can we be with sweetened beverages for children. *J Am Diet*

Assoc 2008; 108: 1269.

20. Thomas DE, Elliott EJ, Baur L. Low glycaemic index or low glycaemic load diets for overweight and obesity. *Cochrane Database Syst Rev* 2007; (3): CD005105.
21. Sanigorski AM, Bell AC, Kremer PJ, Swinburn BA. Lunchbox contents of Australian schoolchildren: room for improvement. *Eur J Clin Nutr* 2005; 59: 1310-1316.
22. Cason K. Family mealtimes: more than just eating together. *J Am Diet Assoc* 2007; 106: 532-533.
23. Reilly JJ, Penpraze V, Hislop J, Davies G, Grant S, Payton JY. Objective measurement of physical activity and sedentary behaviour: review with new data. *Arch Dis Child* 2008; 93: 614-619.
24. Quinn SM, Baur LA, Garnett SP, Cowell CT. Treatment of clinical insulin

resistance in children: a systematic review. *Obesity Rev*. In press 2010.

25. O'Brien PE, Sawyer SM, Laurie C, et al. Laparoscopic adjustable gastric banding in severely obese adolescents: a randomized trial. *JAMA* 2010; 303: 519-526.
26. Recommendations for Bariatric Surgery in Adolescents in Australia and New Zealand. A position paper from the Australian and New Zealand Association of Paediatric Surgeons, the Obesity Surgery Society of Australia and New Zealand and the Paediatrics & Child Health Division of The Royal Australasian College of Physicians. Available online at: <http://www.racp.edu.au/page/policy-and-advocacy/paediatrics-and-child-health> (accessed March 2010).
27. Katz DL, O'Connell M, Njike VY, Yeh M-C, Nawaz H. Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis. *Int J Obes* 2008; 32: 1780-1789.