

APPROACH TO CHILDHOOD AND ADOLESCENT OBESITY

Dr Chew Shu Shan Elaine, Dr Chin Xinyi

ABSTRACT

The prevalence of child and adolescent obesity is increasing both globally and in Singapore and primary care providers play an important role in stemming this rise. Accurate measurement of Body Mass Index (BMI) and monitoring of growth across time can enable early diagnosis and intervention. Addressing childhood and adolescent obesity and its consequences should be done in a sensitive and non-judgemental manner. Childhood and adolescent obesity have adverse medical and psychosocial consequences and early screening for these complications is important in assessment. Adopting a family-based approach for healthier lifestyle changes is important in the prevention of childhood and adolescent obesity. Pharmacotherapy may be considered as an adjunct to lifestyle changes in selected cases.

Keywords: childhood obesity, adolescent obesity, obesity prevention, body mass index

SFP2024; 50(11): 47-53

INTRODUCTION**Epidemiology and Causes of Childhood and Adolescent Obesity**

According to the World Health Organisation (WHO), the prevalence of overweight and obesity among children and adolescents aged 5-19 has increased from 4 percent in 1975 to 18 percent in 2016.¹ Similarly in Singapore, obesity among children aged 6-18 rose from 11 percent in 2013 to 16 percent in 2021,² exacerbated by the COVID-19 pandemic. A study conducted by Health Promotion Board found that 70 percent of children who were overweight at age seven continued to be overweight as adults.³

Obesity is a complex disease with numerous contributory factors. Genetic, behavioural, environmental, and social factors all contribute to obesity.⁴

DR CHEW CHU SHAN ELAINE
MRCPC(HK), MMED(Paed), MCI
Adolescent Medicine Service, Department of Paediatrics, KK
Women's and Children's Hospital, Singapore

DR CHIN XINYI, MRCPC(HK)
Paediatric Endocrinology Service, Department of Paediatrics,
KK Women's and Children's Hospital, Singapore

ROLE OF PRIMARY HEALTHCARE PROVIDERS

Children and adolescents with obesity present to clinical services more frequently than their healthy weight peers.⁵ However, overweight is seldom addressed due to barriers such as lack of recognition of overweight status and lack of training to address the issue of obesity.⁶ The frequent touchpoints to primary care such as well-child visits and acute conditions provide the opportunities to discuss a child's growth, identify weight issues early, and provide anticipatory guidance.

Addressing childhood and adolescent obesity can be a sensitive situation for families as the need for intervention to address the complications intersects with the social determinants of obesity and the normal development of adolescents. This can result in an emotionally sensitive situation for families in a healthcare setting. An overweight child may be viewed as acceptable and reflective of the caregiver's caregiving abilities. On the other hand, adolescents with obesity commonly experience criticism about their weight and lifestyle habits from their families; bringing up health consequences of obesity can lead to emotionally charged situations where the adolescents are blamed for the issue.⁷ Broaching the topic of obesity will thus need to be done in a sensitive, non-judgmental, and non-stigmatising manner, while highlighting the risks of future health consequences. Having a family-based approach is important so that the child/adolescent will not feel targeted and other family members can also benefit from healthier lifestyle changes. This is especially important as obesity is an intergenerational condition and primary care providers commonly care for the family. They are thus well-positioned to address the health needs of the family and to provide family-based guidance across their life course.

ASSESSMENT OF OBESITY

Visual assessment of the weight status of children is known to be inaccurate, hence objective measures are important for growth assessment.⁸ Accurate weight and height measurement using well-calibrated instruments and proper measurement techniques as recommended by WHO is important to calculate Body Mass Index (BMI).⁹ Careful plotting of BMI on age- and gender-appropriate BMI percentile charts is important in diagnosing obesity and for monitoring of changes in obesity status longitudinally. For children in Singapore aged 6-18 years, the Health Promotion Board (HPB) defines a BMI of more than the 90th percentile as overweight, while a BMI of more than the 97th percentile is considered severely overweight (obesity equivalent).¹⁰

After assessing that the child/adolescent’s BMI is in the overweight/obesity range, family history of obesity and obesity-related diseases, dietary habits, and physical activity should also be assessed to evaluate the risk factors for obesity (refer to **Table I**). History and physical examination should also look out for possible secondary causes of obesity such as genetic, endocrine abnormalities, or medication use that can lead to weight gain and assess for potential obesity related co-morbidities¹¹ (refer to **Table II**).

Table I: Assessment of risk factors and health behaviours

Risk factors
<ul style="list-style-type: none"> • Obesity in parents and first-degree relatives • History of metabolic diseases in first- and second-degree relatives • Maternal history of diabetes or gestational diabetes • Small for gestational age
Diet
<ul style="list-style-type: none"> • Main caregiver for child • Consumption of sweetened beverages, fruits, and vegetables • Frequency of eating out and family meals
Activities
<ul style="list-style-type: none"> • School-based activities and after-school physical activities • Screen time use and duration • Sleep time and duration

Table II: Systems review of child/adolescent with obesity

System	Symptoms or signs	Possible causes
General inspection	Dysmorphic features or developmental delay	Genetic syndromes such as Prader-Willi
	Cushingoid	Hypocortisolism or use of glucocorticoids
	Presenting affect	Depression or anxiety
	Height and Weight	Assess severity of overweight
	Binge-eating, purging or use of laxatives	Eating disorder
	School-avoidance or anxiety or low mood	Depression or anxiety
Skin	Acanthosis nigricans (especially on neck, axilla, and antecubital fossa)	Type 2 Diabetes Mellitus
	Acne and hirsutism (females)	Polycystic Ovarian Syndrome
	Skin folds infection (especially in lower abdomen and genital area)	Intertrigo Hyperhidrosis
Eye	Papilloedema	Pseudotumour cerebri
	Recurrent headaches	Pseudotumour cerebri
Oral	Tonsillar hypertrophy	Obstructive sleep apnoea
	Dental hygiene	Dental caries
	Snoring and daytime somnolence	Obstructive sleep apnoea
Neck	Thyroid enlargement	Hypothyroidism
Respiratory	Dyspnoea and wheezing	Asthma (which may lead to exercise intolerance)
	Poor exercise tolerance	Asthma or lack of physical conditioning
Cardiometabolic	Blood pressure	Hypertension
	Urinary frequency, polydipsia and polyuria, and recent weight loss	Type 2 Diabetes Mellitus

Gastrointestinal system	Abdominal pain or tenderness	Gastro-oesophageal reflux or cholelithiasis or functional abdominal disorders
	Hepatomegaly	Non-alcoholic fatty liver disease
Musculoskeletal	Abnormal gait	Slipped capital femoral epiphysis or joint strain
	Bowing of tibia	Blount disease
	Foot pain	Pes planus
Reproductive system	Tanner staging	Altered onset of puberty
	Breast development (in males)	To evaluate height potential
	Irregular periods or amenorrhoea	Gynaecomastia
		Polycystic Ovarian Syndrome

COMPLICATIONS OF CHILDHOOD AND ADOLESCENT OBESITY

Childhood and adolescent obesity can adversely affect almost every organ of the body¹² as discussed in **Tables I and II**. In the audit of our paediatric weight management clinic, 68 percent of those enrolled had already developed at least one obesity-related co-morbidity at presentation. The most common obesity-related co-morbidity was dyslipidaemia followed by hypertension.¹³

Child and adolescent obesity also increase the risk of adult obesity with development of obesity-related co-morbidities and increased cardiovascular mortality.¹⁴ Early prevention and management of childhood obesity is thus important to avoid these complications.

Initial tests to consider include fasting lipids, glycated haemoglobin, and alanine amino transferase (+/- liver function tests) as recommended by various international expert guidelines.¹⁵⁻¹⁷ Risk factors for Type 2 diabetes include a maternal history of diabetes (including gestational diabetes), type 2 diabetes in a first-degree relative, clinical signs of insulin resistance – acanthosis nigricans, other conditions associated with obesity – hypertension, dyslipidaemia, fatty liver disease, polycystic ovary syndrome, small for gestational age, and use of psychotropic medications.¹⁸ As with all investigations, it is important to consider the various risk factors and whether testing will alter the course of treatment.

MANAGEMENT OF CHILDHOOD AND ADOLESCENT OBESITY

Lifestyle Management

Comprehensive dietary and physical assessments are impractical in a busy clinical setting, hence it is generally recommended to focus on common dietary and physical activity behaviours that have the strongest evidence and more are easily modifiable as a family.¹⁵ These recommendations are in line with the 24-hour activity guidelines for children and adolescents and suitable for healthy children and adolescents (refer to **Table III**).¹⁹ These guidelines can also support parents in making family-wide changes, especially if they have both overweight and normal weight children

to avoid stigmatising the overweight children. These health behaviours are helpful in both the reduction of obesity and the promotion of other health benefits to promote the holistic physical and psychosocial development of healthy children and adolescents. Other healthcare providers such as dietitians or nurses, trained in child health, can also help to assess and monitor health behaviours.

Comprehensive, intensive behavioural interventions with at least 26 contact hours or more that include supervised physical activity sessions for up to 1-year result are effective for weight loss in children and adolescents with improvements in cardiometabolic risk factors. These behavioural interventions commonly consist of multiple components and include sessions for both parent and child (separately, together, or both) and sessions may be group or individual session.³¹ While such comprehensive and intensive behavioural interventions are available mostly in a hospital setting,³² identifying and addressing high BMI are important steps in helping children and families get the support they need.

Use of a patient-centric communication technique, such as motivational interviewing, has been found to be effective in behaviour change.²⁰ Motivational interviewing takes into consideration patients’ readiness to change, use of non-judgemental questions, and reflective listening to understand one’s beliefs and values. This can help patients formulate a plan that is consistent with their values rather than physicians imposing their plans, reducing the stigma associated with obesity.

Providing a close follow-up in the subsequent few weeks or months after the initial visit will be important in monitoring changes in weight and health behaviours and providing the required support for families.¹⁵ While weight management does not lower self-esteem or increase the risk of eating disorder, it is important to note that children and adolescents with obesity are at risk of eating disorder.³¹ Thus it is important to follow up on the child’s growth to ensure that dietary changes aren’t too drastic, which can lead to excessive weight loss affecting normal growth or the early onset of eating disorder.

Table III: Recommended health behaviours for children and adolescents

Dietary
<ul style="list-style-type: none"> • Avoid sugar-sweetened beverages inclusive of fruit juices and malt drinks. These can reduce the risk of obesity and formation of dental caries. • Consume two servings of fruits and vegetables per day. Fruits and vegetables contain vitamins, minerals and fibre which are important for healthy growth and development and prevention of chronic diseases. Fibre can also keep children fuller for longer time. • Encourage regular family mealtimes. Parents are important role models for healthy eating habits and family meals allow parents to influence the portions and quality of the meals for their children.
Physical Activity
<ul style="list-style-type: none"> • Achieve at least 60 minutes of moderate-to vigorous activity per day. All types of activities, active and outdoor play should be encouraged to promote sports participation and achievement of health benefits. • Engage in a variety of light activity throughout the day. These include taking the stairs or walking to destinations rather than taking transportation. • Build in regular breaks throughout the day. Prolonged sedentary behaviour is also harmful to health and building in breaks is important to improve concentration.
Sleep
<ul style="list-style-type: none"> • Regular, continuous sleep of at least 9 hours (for 7-13 years old), at least 8 hours (for 14-17 years old) and at least 7 hours (for 18 years old). Insufficient sleep duration is associated with obesity, hypertension, diabetes, poorer mental health and cognitive functioning.
Screen time
<ul style="list-style-type: none"> • Limit recreational screen time as much as possible. Recreational screen time such as phone or device use of more than 2 hours per day is associated with the most adverse health outcomes such as increased adiposity and poorer psychosocial health. Screen time during meals is also discouraged to enable child to self-regulate during mealtimes.

Pharmacotherapy

Pharmacotherapy, though very limited, may be considered as an adjunct to lifestyle interventions in selected children with extreme obesity, especially if they face significant physical or psychological comorbidities.

Orlistat, for more than a decade and up till recently, was the only licensed drug by the FDA for the treatment of obesity in adolescent patients over 12 years of age. It is an intestinal lipase inhibitor, thereby decreasing hydrolysis of ingested triglycerides and reducing gastrointestinal absorption of fat. A series of randomised trials demonstrated that orlistat reduced BMI by 0.5-4.2 kg/m² compared to placebo.²¹ The side effects include diarrhoea, flatulence, and abdominal pain. These understandably can result in a high discontinuation rate; reportedly 75 percent by the end of three months.²² As orlistat reduces adsorption of dietary fat-soluble vitamins, supplementation of vitamins A, D, E, and K is recommended.²³

Glucagon-like peptide-1 analogues (GLP-1) is a gut peptide that increases the postprandial insulin level in a glucose-dependent manner, reduces glucagon secretion, slows gut motility, and suppresses appetite. Subcutaneous Liraglutide is approved by the Health Science Authority (HSA) for paediatric patient with Type 2 Diabetes Mellitus (T2DM) above age of 10 years old (maximum dose 1.8 mg) and has expanded to the treatment of obesity in patients above 12 years of age (maximum dose of 3 mg). Over a 3-month period, one study showed that patients' BMI dropped by 2.1 kg/m²,²⁴ and another showed that half lost

5-10 percent of their body weight and one-quarter lost >10 percent.²⁵ There was also significant improvement of other metabolic indices.²⁵ After a trial of liraglutide for 12 weeks, if patients have not lost at least 4 percent of their BMI or BMI z score on the 3.0 mg/day or maximum tolerated dose, it should be discontinued. Kelly et al²⁶ demonstrated that after discontinuation of liraglutide after one year of administration, weight gain ensued, suggesting that longer-term treatment may be required as part of management of obesity as a chronic disease. A recent publication on the use of subcutaneous Liraglutide (maximum dose of 3 mg) in patients aged six to less than 12 years old had found similar improvement in BMI percentage of 7.4 percent compared to placebo, and 46 percent of participants on liraglutide had at least 5 percent reduction in BMI.³³ Further trials on long-term effects of liraglutide on children and adolescents are awaited.

Topiramate/Phentermine combination therapy has recently been approved by the FDA for treatment of obesity in adolescents above 12 years of age. The treatment is however associated with suicidal behaviours and impulsivity, hence further trials examining long-term safety profile and efficacy are needed.

Metformin is an attractive drug of choice given its various desirable effects on insulin resistance and cardiovascular risk profile. Unfortunately, its effect on weight reduction is consistently statistically insignificant.²⁷ As such, its licensed use is limited to the treatment of children with T2DM from 10 years of age.

Setmelanotide (melanocortin 4 receptor agonist) and Metreleptin (a synthetic recombinant leptin analogue) are approved for specific monogenic obesity conditions (refer to **Table IV**).

Table IV: Summary of medications approved for the treatment of childhood obesity

Medication	Mechanism of action	FDA- and EMA-approved indications and age	Dose	Adverse effect(s)
Orlistat	Lipase inhibitor, blocks intestinal fat absorption	Obesity >12years	PO 60-120 mg TDS	GI
Liraglutide	GLP-1 agonist	Obesity >12 years T2DM >10 years	SC 0.6-3 mg OD SC 0.6-1.8 mg OD	GI, hypoglycaemia, pancreatitis, renal failure
Setmelanotide	MC4R agonist	POMC, PCSK1, or LEPR deficiency in >6 years	SC 1-2 mg OD	GI, hyperpigmentation
Metreleptin	Recombinant analogue of leptin	congenital leptin deficiency and generalised lipodystrophy	SC Max 0.13 mg/kg OD	Fatigue, hypoglycaemia
Phentermine	TAAR1 agonist	FDA approved >16 years Not approved by EMA	PO 15-30 mg OD	Tachycardia, GI, dizziness, insomnia
Topiramate	Carbonic anhydrase inhibitor, appetite suppressant	Phentermine/topiramate FDA approved >12 years	PO P3.75 mg/T23 mg-P15 mg/T92 mg OD	Mood changes, memory issues, paraesthesia
Metformin	Inhibits gluconeogenesis, improves insulin sensitivity	T2DM >10 years *not approved for weight loss	PO 500-2,000 mg a day in divided doses	GI

Abbreviations:

FDA = Food and Drug Administration
 EMA = European Medicines Agency
 GI = gastrointestinal
 POMC = proopiomelanocortin
 PCSK1 = proprotein convertase subtilisin/kexin type 1
 LEPR = leptin receptor

T2DM = type 2 diabetes mellitus
 OD = once daily
 TDS = three times a day
 PO = oral
 SC = subcutaneous

Note: *Drugs in Italics are available in Singapore.*

Bariatric Surgery

Current international guidelines suggest that bariatric surgery should be considered in post-pubertal adolescents with BMI >40kg/m² or a BMI >35 kg/m² with significant comorbidities and have failed a formal, intensive lifestyle modification programme.²⁸ Short- and mid-term results have been encouraging. BMI reduction at 1-year follow-up was -13.5 kg/m²²⁹ and weight loss being maintained at a 5-year follow-up.³⁰ In addition, the reduction or even resolution of comorbidities after surgery is also significant. This procedure should be undertaken by an experienced multidisciplinary specialist team with expertise in the care of adolescents with obesity.

INDICATIONS FOR REFERRAL TO TERTIARY CARE

Primary care providers play an important role in the early identification of overweight and to provide brief intervention. However, primary care providers should provide follow-up for these patients and refer to a tertiary centre for further investigation or specialist management in the following situations:

- Increase in weight with slowing height growth
- Suspected secondary cause of obesity
- Severe obesity, especially if associated with obesity-related co-morbidities
- Rapid weight loss of more than 2 kg per month or concerns about eating disorder
- Failure of primary care management after a 6-month trial

CONCLUSION

Paediatric obesity remains an ongoing serious health concern, with an increasing local prevalence that echoes the global trend. It results in both physical and psychosocial complications, and if allowed to continue into adulthood, endangers their adult health and longevity. Hence the prevention of obesity would be more relevant and cost-effective than to treat its complications. Primary care physicians are pivotal in this combat as they monitor growth and development of the child from birth. Each visit should provide an opportunity to provide anticipatory guidance throughout childhood and accord early preventive measures for at-risk children. Pharmacotherapy and bariatric surgery serve only to fill in the treatment gap for patients who are refractory to lifestyle modifications or have morbid obesity. Whilst they do show promising short-term effects, research is still ongoing to evaluate the long-term effects of these treatment modalities.

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LEARNING POINTS

- **Accurate weight and height should be taken at each visit to opportunistically screen for obesity. BMI-for-age should be monitored over time for early identification of young children at risk of being overweight or obese.**
 - **Primary care providers can provide anticipatory guidance for caregivers of young children with up-trending or persistently high BMI-for-age (i.e., >90th percentile). This begins with early identification of at-risk children and education of caregivers on the potential long-term implications of childhood obesity.**
 - **Primary care providers can provide preliminary assessment and management to address modifiable risk factors, such as adopting healthy nutrition and physical activity habits, to prevent childhood obesity.**
 - **Management strategies to prevent obesity should be family-based (rather than focused on the child) and centred around long-term healthy behavioural and lifestyle changes.**
 - **Pharmacotherapy and, to a smaller extent, bariatric surgery may be considered for children and adolescents with obesity only after a formal intensive lifestyle modification programme has failed to limit weight gain or ameliorate comorbidities. This should be done by clinicians experienced with the use of such medications under close supervision and done in conjunction with concomitant lifestyle modification programmes.**
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