Abstract
This paper reviews factors that contribute to excessive weight gain in children and outlines current knowledge regarding approaches for treating adolescent obesity. Adolescent obesity has been dramatically increasing over the past three decades, leading to increased risk of serious co-morbidities like type 2 diabetes, hyperlipidemia, hypertension, and sleep apnea as well as significant psychosocial consequences. India has also seen a huge increase in adolescent obesity, especially in urban and metropolitan cities. Metabolic syndrome is defined as a constellation of risk factors, including obesity, dyslipidemia, impaired glucose metabolism, and elevated blood pressure, all major predictors for cardiovascular disease. It has been seen that cardiometabolic risk factors frequently cluster in obese children and adolescents.

The treatment of overweight and obesity in children and adolescents requires a multidisciplinary approach with a holistic outlook. The care team should include a pediatrician, endocrinologist, dietician, psychologist, physiotherapist, and a bariatric surgeon. The components of overweight and obesity treatment include dietary management, physical activity, pharmacotherapy, and bariatric surgery.

Primary prevention is the best treatment. A synchronous effort by the society, government, and healthcare professionals is needed to tackle the ever-increasing menace of childhood obesity. This includes steps like influencing policy-makers and legislation, mobilizing communities, restructuring organizational practices, establishing coalitions and networks, empowering providers, imparting community education, and enriching and reinforcing individual knowledge and skills. Research and Indian data are desperately needed in this field to influence policy and make decisions. This should be given prime importance as actions now can save an entire generation from sufferings and ill health.

Key Words
• Adolescent obesity
• Pediatric obesity
• Childhood obesity
• Prevention of obesity
• Bariatric surgery

Introduction
Adolescent obesity presents a potentially increasing source of clinical and economic strain to healthcare providers. The dramatic increase in the prevalence of childhood obesity over the past three decades has been accompanied by a substantially increased risk of developing serious co-morbidities at an early age.
Such co-morbidities include type 2 diabetes, hyperlipidemia, hypertension, and sleep apnea as well as significant psychosocial consequences and the increased likelihood of becoming obese adults. Thus, the clinical, psychological, and economic consequences of adolescent obesity represent a significant challenge to healthcare systems across the world.

For children and adolescents, overweight and obesity are defined using age- and sex-specific normograms for body mass index (BMI). Children with BMI equal to or exceeding the age–gender-specific 95th percentile are defined obese. Those with a BMI equal to or exceeding the 85th but are below the 95th percentiles are defined as overweight and are at risk for obesity-related co-morbidities.

Asian countries are not immune to this phenomenon. For example, in China, the prevalence of overweight and obesity among children aged 7–9 yr increased from 1–2% in 1985 to 17% among girls and 25% among boys in 2000. In addition, obesity prevalence varies across the socio-economic strata. In developed countries, children of low socio-economic status are more affected than their affluent counterparts. The opposite is observed in developing countries: children of the upper socio-economic strata are more likely than poor children to be obese. Indian data regarding current trends in childhood obesity are emerging. A recent study conducted among 24,000 school children in South India showed that the proportion of overweight children increased from 4.94% of the total students in 2003 to 6.57% in 2005, demonstrating the time trend of this rapidly growing epidemic. Socio-economic trends in childhood obesity in India are also emerging. A study from northern India reported a childhood obesity prevalence of 5.59% in the higher socio-economic strata compared with 0.42% in the lower socio-economic strata.

**Co-morbidities related to obesity**

Obesity is associated with a number of co-morbidities in adolescents and children, as listed in Table 1.

<table>
<thead>
<tr>
<th>Cardiovascular</th>
<th>High blood pressure, early onset of atherosclerosis, and left ventricular hypertrophy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endocrine</td>
<td>Insulin resistance, type 2 diabetes mellitus, and polycystic ovarian syndrome</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Obstructive sleep apnea</td>
</tr>
<tr>
<td>Neurological</td>
<td>Pseudotumor cerebri</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Non-alcoholic steatohepatitis (NASH) and gallstones</td>
</tr>
<tr>
<td>Psychosocial issues</td>
<td>Depression; body image problems, lack of self-confidence, and adjustment problems</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>Osteoarthritis and tibia vara</td>
</tr>
</tbody>
</table>

**Metabolic syndrome**

Metabolic syndrome is defined as a constellation of risk factors, including obesity, dyslipidemia, impaired glucose metabolism, and elevated blood pressure, all major predictors for cardiovascular disease. It has been seen that cardiometabolic risk factors frequently cluster in obese children and adolescents.

The association of obesity with type 2 diabetes in adolescents and children is very strong and confirmed by various studies. Evidence entail that obesity-driven type 2 diabetes might become the most common form of newly diagnosed diabetes in adolescent youth within 10 yr. Obesity significantly contributes to morbidity and mortality from cardiovascular disease. Obesity may affect the heart through its influence on known risk factors such as dyslipidemia, hypertension, glucose intolerance, inflammatory markers, obstructive sleep apnea/hypoventilation, and the prothrombotic state, as well as through yet unrecognized mechanisms.

**Psychosocial abnormalities**

Psychosocial abnormalities are closely associated with obesity in children and adolescents. Obesity in adolescence may be associated with later depression in adulthood. In addition, abdominal obesity seems to be strongly associated with concomitant depression in children. The appearance-related teasing in obese kids is more frequent and upsetting, which leads to withdrawal from social life and poor performance at school.

**Treatment of obesity**

The treatment of overweight and obesity in children and adolescents requires a multidisciplinary approach with a holistic outlook. The care team should include a pediatrician, endocrinologist, dietician, psychologist, physiotherapist, and a bariatric surgeon. The immediate goal is to bring down the rate of weight gain, followed by a period of weight maintenance, and, finally, weight reduction to improve BMI. The long-term goal is to improve the quality of life and reduce morbidity and mortality associated with overweight and obesity.

**Components and phases of obesity treatment**

The components of overweight and obesity treatment include:

- Dietary management
- Physical activity
- Pharmacotherapy
- Bariatric surgery

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The various phases of obesity management in the ascending order of intensity include prevention-oriented approach, structured weight management, comprehensive multidisciplinary intervention, and tertiary care intervention. Each component goes through the various phases as required.

**Dietary management**

Dietary management should aim at weight maintenance or weight loss without compromising appropriate calorie intake and normal nutrition. Due emphasis should be given to initiate and maintain healthy eating patterns. Due emphasis should be given to reduction of eating out, planning for healthy snacks, balanced diet, adequate intake of fruits and vegetables, fiber content of diet, and avoidance of high-calorie/high-fat foods. A balanced diet should encompass salt reduction, restriction of sugar-rich beverages, and avoidance of trans fatty acids with the addition of proteins and adequate carbohydrates and fats.

**Physical activity**

Moderate-intensity regular physical activity is essential for the prevention of overweight and obesity as well as for the treatment of the same. Children and adolescents should engage in not less than 60 min of moderate to vigorous physical activity per day to achieve optimum cardiovascular health. Kids should be motivated to participate in sports activities of their liking, as it also helps improve their social skills. Family members can be the role models for the child to develop a healthy lifestyle. Regular exercise improves the endurance and helps improve the muscle mass.

The screen time of children should be restricted to less than 1 hour per day. This is increasingly becoming important in today’s world where gadgets are freely available and parents are happy while the kids are glued to these devices. More screen time leads to more unhealthy eating, snacking, and increase in obesity. Restriction of television time can be of prime importance in the normal development of a child.

**Pharmacological treatment**

Data supporting the use of pharmacological therapy for pediatric obesity are limited. Drugs should be reserved as a second-line therapy and started only when adequate lifestyle interventions have failed.

The drugs sibutramine, orlistat, and metformin are currently in use among obese children and adolescents with varying results. Sibutramine, a serotonin non-adrenaline reuptake inhibitor, enhances satiety and has been shown to be the most effective drug in treating adolescent obesity. This drug may be associated with side effects including increases in heart rate and blood pressure, limiting its use in obese adolescents with higher blood pressure. Orlistat, which is a pancreatic lipase inhibitor, acts by increasing fecal fat loss. It is associated with flatulence, diarrhea, gallbladder diseases, and malabsorptive stools, and requires fat-soluble vitamin supplementation and monitoring. Metformin is a valuable adjuvant to the treatment of obese adolescents with severe insulin resistance, impaired glucose tolerance, or polycystic ovarian syndrome.

**Bariatric surgery**

Severe adolescent obesity warrant aggressive approaches including surgical treatment. Adolescent candidates for bariatric surgery should be very severely obese (defined by a BMI of >40), should have attained a majority of skeletal maturity (generally >13 yr of age for girls and >15 yr of age for boys), and should have co-morbidities related to obesity that might be remedied with a durable weight loss. More severe elevation of BMI (>50 kg/m²) may be an indication for surgical treatment in the presence of less severe co-morbidities.

The bariatric procedures can be divided into restrictive (sleeve gastrectomy and gastric banding), malabsorptive (duodenal switch and mini-gastric bypass), and a combination of both (Roux-en-Y gastric bypass). Adolescents require a procedure that does not hamper their physical growth and allows them to safely move into adulthood. In case of females, the procedure should not adversely impact their capacity to bear children later in life. Taking these considerations in mind, sleeve gastrectomy is an attractive option for adolescents, as it is a restrictive procedure and has no malabsorptive component. It provides 60–80% excess weight loss over a 1-yr period. Roux-en-Y gastric bypass is the most extensively studied procedure in this age group, as it has been there for a longer duration of time. It provides excellent results too, but one has to be more careful about the protein malnutrition and micronutrient deficiencies because of the malabsorptive component. It can have late complications like small bowel obstruction, stomal ulcer, internal hernia, and gastro-gastric fistula. All these patients warrant meticulous, lifelong medical supervision. Current evidence suggests that after
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Bariatric surgery, adolescents lose significant weight and co-morbidities are appreciably reduced. Bariatric surgery performed in the adolescent period may be more effective treatment for childhood-onset extreme obesity than delaying surgery until adulthood.

We have treated many adolescents with severe obesity using sleeve gastrectomy. They have done very well in studies and social life, and have successfully raised families. It has provided them with a great opportunity to come out of the social stigma of obesity and perform well in their life.

Prevention and health policy

A synchronous effort by the society, government, and healthcare professionals is needed to tackle the ever-increasing menace of childhood obesity. This includes steps like influencing policy-makers and legislation, mobilizing communities, restructuring organizational practices, establishing coalitions and networks, empowering providers, imparting community education, and enriching and reinforcing individual knowledge and skills. Primary prevention is the best treatment. Parents should be the role models for their children. The screen time of kids should be restricted and they should be motivated to increase the physical activity. Schools, child care facilities, and primary healthcare centers are important settings for the implementation of policies and programs. Relevant attempts may involve specifying the nutrition composition of foods served in school canteens as well as other outlets, supporting requirements for physical education in schools, increasing the availability of physical activity options or the time available to utilize these options, implementing training programs to empower school teachers to provide nutrition or physical education, and providing financial as well as technical support for programs and services related to weight control. The advantage of setting-based approaches of this type includes the ability to work with a “captive audience” and to also influence social norms within the setting, with possible transfer to behavior outside of the setting. Of the possible setting-based interventions, there is sufficient evidence to recommend multi-component interventions aimed at diet, physical activity, and cognitive change, which makes the approach a holistic and efficient one with demonstrable results.

Research and Indian data are greatly needed in this field to influence policy and make decisions. This should be given prime importance, as actions now can save an entire generation from sufferings and ill health.

References


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