

An Overview of Childhood Obesity

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Abstract:

The prevalence of childhood obesity has increased greatly during the past two to three decades in developed countries. With industrialization and urbanization, obesity is now becoming widely prevalent in developing countries as well. Childhood obesity is the result of persistent adverse changes in food intake, life style and energy expenditure. Although less common, there may be some underlying pathological conditions as well. Obese children and adolescents are at increased risk of having type 2 diabetes or impaired glucose tolerance, mixed features of type 1 and type 2 diabetes, hypertension, dislipidaemia, fatty liver disease, metabolic syndrome, psychosocial complications, obstructive sleep

apnoea, orthopaedic problems, polycystic ovarian syndrome etc. Management of obesity need lifestyle intervention and the benefits are most likely to be achieved when diet and exercise programmes are coordinated with individual and family counseling and behaviour modification. A coordinated approach is needed involving families, school authorities, communities, healthcare providers and government to provide a continuum of population based interventions.

Key Words: Obesity, Children, Adolescent, Type 2 diabetes mellitus

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Introduction:

Worldwide prevalence of childhood obesity has increased greatly during the past two to three decades. The prevalence had increased in most industrialized countries, apart from Russia and Poland, and in several developing countries, especially in urban areas.¹ In the United States the rate of overweight and obesity among children and adolescents aged 6 to 18 years increased to more than 25% in the 1990s from 15% in the 1970s.¹ In China, the prevalence of overweight and obesity among children ages 7 to 9 years increased from 1-2% in 1985

to 17% in girls and 25% among boys in 2000.² The prevalence of overweight/obesity in urban children in Delhi has shown an increase from 16% in 2002 to about 24% in 2006-2007.³ In a study conducted in 1997 in a school and a maternal and child health clinic of Dhaka city among 316 children of 2-10 years of age, the prevalence of obesity was found to be 13%.⁴ In 2006, a study among 468 children and adolescents aged 3-18 years in a private school in Dhaka city was carried out. The prevalence of obesity was found to be 17.9% and that of overweight was 23.6%, obesity was more common in boys (19.9%) than in girls (15.3%)⁵

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The reason behind this global rise of obesity may include industrialization and urbanization with changes in the dietary habit, transformation of agricultural production, the restructuring of the food supply and distribution mechanisms, sedentary modes of work and leisure. Children residing in cities like Dhaka are often overburdened with studies with little time and space for outdoor games and activities. Obesity is associated with the development of a number of serious medical complications and increased morbidity and mortality in children and adults. Long term follow up indicates that obese children and adolescents tend to become obese adults.⁶ During the last few years, children with obesity has outnumbered other patients with various endocrine

problems attending our paediatric endocrine outpatient department in BIRDEM with high rate of complications including impaired glucose tolerance (16.9%), dislipidaemia (50.4%), hypertension (20.4%), metabolic syndrome (36.6%) and fatty liver disease (36%).⁷⁻⁹

Definition and measurement of Obesity

Obesity is arbitrarily defined as excess of adipose tissue. Accurate measurement of body fat content is possible through complicated, expensive techniques but there are more simple and practical ways for measuring body fat and defining obesity in children. These include:

BMI: BMI correlates with the amount of body fat both in children and adults.¹⁰ During childhood, level of body fat and body composition change with age, consequently overweight and obesity are defined using BMI percentiles for age and sex. Children >2 year old with a BMI \geq 95th percentile meet the criterion for obesity and those with a BMI between 85th and 95th percentile fall in the overweight range.¹¹ The U.S. Centers for Disease Control and prevention (CDC) 2000 growth charts for ages 2-19 year is widely used for classifying overweight and obesity in young people. Weight for length is used in the under two year age group where obesity is defined as greater than the 95th percentile for the weight for length.¹² The international obesity task force (IOTF) reference was published based on internationally pooled data to provide age and sex specific BMI centile curves that at the age of 18 year pass through the widely used cut-off points of 25 and 30 kg/m² for adult overweight and obesity and was recommended for global comparison of prevalence rates of overweight and obesity in children.¹³ There are also debates on use of population-specific references rather than international cut-off values.¹⁴

Skinfold thickness: Measurements more than 85th percentile for age and sex are suggestive of obesity. Triceps skinfold is correlated with fat mass, combined with BMI increases the sensitivity for the determination of percent body fat.¹⁵

Waist circumference and waist-hip ratio: These are indirect markers of intraabdominal adipose tissue. Waist circumference more than 90th percentile are more likely to have multiple risk factors.^{16,17} Waist-hip ratio is an excellent predictor of abnormalities of lipids and glucose metabolism in the adult population and similar correlation have been made for paediatric obesity.¹⁸ A ratio greater

than 0.8 in women and 0.9 in men is associated with an increased risk of insulin resistance and associated disease.¹⁹

There are some other techniques for assessment of body fat which are more expensive, require skill and mostly used for research purpose e.g. bioelectric impedance assay (BIA), dual-energy x-ray absorptiometry (DEXA), computed tomography and magnetic resonance imaging of abdomen, hydrodensitometry etc.

Determinants and risk Factors

Obesity is the result of the complex interplay among the genetically determined body habitus, appetite, nutritional intake, and physical activity. Simplistically, obesity results from an imbalance of calorie intake and energy expenditure. Following are some of the determinants or risk factors that are associated with childhood obesity:

Environmental factors:

Diet: Energy-dense foods, high fat and high sugar snacks, affordable and easily available fast foods have contributed immensely to the epidemic of obesity. Obese children tend to skip breakfast but consume a large amount of food at dinner.²⁰ In terms of dietary content, there is an inverse relationship between calcium intake and adiposity.²¹ The consumption of high-carbohydrate soft drink is a major contributing factor to high calorie count. Among formula or mixed-fed infants, the increase in energy intake has been associated with an increased risk of being overweight during childhood. In contrary, breast feeding has been shown to have some protective effects.^{22, 23}

Energy expenditure: Low levels of physical activity are associated with high risk of childhood obesity.²⁴

Television viewing: Television, computer and video games have contributed to more sedentary activities as well as increased snacking. Hours of television watching has positive correlation with obesity.²⁵

Sleep: Chronic partial sleep loss increases risk for weight gain and obesity.²⁶

Hereditary factors: parental obesity is an important predictor of childhood obesity, with greater prediction when both parents are obese. Parental obesity is related to early adiposity rebound.²⁷

Genetics: Most cases of obesity are likely the result of subtle interactions of several related genes with

environmental factors. There are, however, some recognizable conditions the clinician should consider seeing a child with severe obesity, rarely a single gene defect or some syndrome. They include Prader-Willy syndrome, Bardet-Biedl syndrome, Carpenter syndrome, Cohen Syndrome, Congenital leptin deficiency and leptin receptor deficiency, pro-opiomelanocortin defects, prohormone convertase 1 deficiency, human melanocortin receptor (MC4R) deficiency, cocaine-amphetamine related transcript deficiency and so on.²⁸

Endocrine disease: Although endocrine disease is not a common cause of obesity in children and adolescents but hypothyroidism, growth hormone deficiency or resistance, cortisol excess, pseudohypoparathyroidism are important endocrine diseases causing obesity as well as short stature.

Central Nervous System pathology: Congenital or acquired hypothalamic abnormalities have been associated with a severe form of childhood obesity. Obesity is a frequent complication in children surviving brain injury, brain tumours and/or cranial irradiation. The exact mechanisms are still unknown but reduced physical activity, alterations in hypothalamic neuropeptides²⁹ and enhanced activity of 11- β -hydroxysteroid dehydrogenase, converting cortisone to cortisol³⁰ have been implicated.

Intrauterine environment:

Gestational diabetes: In populations at high risk of obesity and diabetes (eg. Pima Indians), exposure to gestational diabetes is associated with increased risk of childhood and early adult obesity in offspring.³¹

Maternal obesity: Intrauterine exposure to high maternal adiposity has also shown to have increased risk of obesity in offspring.³²

Birthweight: High birth weight is associated with increased risk of childhood obesity. On the other hand, small- for -gestational age babies who show catch up growth are at risk of childhood obesity and later development of cardiovascular complications and type 2 diabetes.^{33,34}

Early adiposity rebound: The age of adiposity rebound refers to the age after infancy at which the individual's BMI is lowest and after which starts to rise to adult levels. Early age of adiposity rebound is associated with greater risk of obesity and type 2 diabetes.³⁵

Ethnic origin: Some ethnic groups e.g. Hispanic and south Asian have a higher magnitude of adiposity, abdominal obesity for any proposed value of BMI than white Caucasians.³⁶

Medications: Some of the anticonvulsants and antipsychotic, high dose chronic glucocorticoid treatment can cause obesity.

The consequences of obesity and associated comorbidities. Obese children and adolescents are at increased risk of having type 2 diabetes mellitus (type 2 DM) or impaired glucose tolerance, mixed features of type 1 and type 2 diabetes mellitus, hypertension, dislipidaemia, fatty liver disease, metabolic syndrome and psychosocial complications.^{37,38} Pulmonary comorbidities include obstructive sleep apnoea and reactive airway disease. Orthopaedic complications are: Blount disease (tibia vara), slipped capital femoral epiphysis and various musculoskeletal problems. Obesity is also a risk factor for hyperandrogenemia,³⁹ polycystic ovarian syndrome,⁴⁰ acceleration in timing of puberty in girls, pubertal advancement in boys and advanced skeletal maturation,⁴¹⁻⁴³ although in obese boys delayed onset of sexual maturation has also been reported.⁴⁴ Obesity is associated with idiopathic intracranial hypertension or pseudotumour cerebri. Specific nutritional deficiencies often accompany childhood obesity e.g. low vitamin D concentrations⁴⁵ and iron deficiency.⁴⁶

Evaluation

The parents and child should be interviewed at length with emphasis on: antenatal and perinatal history (e.g. birth weight, SGA, gestational diabetes,) feeding and weight gain history in infancy and childhood, family eating and nutritional and activity patterns (e.g. habits of walking, exercise, active recreation, television watching etc.) It is useful to request a 24 hour dietary recall. A family history of obesity, diabetes, hypertension cardiovascular disease should be sought for.

A thorough examination include: looking for dysmorphic feature, cognitive impairment, vision and hearing abnormalities as found in genetic disorders, recording and charting of height, weight and BMI, blood pressure, waist-hip ratio, triceps and subscapular thickness where available, examination of skin e.g. acanthosis nigricans suggesting insulin resistance, examination of genitalia and Tanner staging. Short stature warrant further

evaluation as children who consume excessive amounts of calorie tend to experience accelerated growth.

Laboratory investigations for fasting plasma glucose or oral glucose tolerance test with insulin level, lipid profile, thyroid and liver function tests are recommended as part of initial evaluation. Other investigations should be guided by history or physical examination finding.

Management strategies

Management of obesity need lifestyle intervention and the benefits are most likely to be achieved when diet and exercise programmes are coordinated with individual and family counseling and behaviour modification. The goal in growing children is stabilization of weight with slow reduction in BMI.

Dietary approaches: It is important to begin with clear recommendation with appropriate calorie intake. Working with a dietician and planning a family meal is important. Mild calorie restriction can be done. A balanced diet containing vegetables, fruits, whole grains, nuts, fiber, lean meat and low fat dairy products should be encouraged. An example of such a programme is the "traffic light" diet⁴⁷ where food is grouped into: i. Foods that can be consumed without any limitations (green)-low calorie, high fibre, low-fat, nutrient-dense foods (e.g. fruits and vegetables). ii. Foods that can be taken in moderation (yellow)-nutrient dense but higher in calories and fat (e.g. lean meats, dairy, starches, grains). iii. Foods that should be avoided -high in calories, sugar and fat (e.g. fatty meats, sugar and fried foods).

Some patient with severe obesity may need very low calorie diets for a limited time because of severe comorbidities. These should be carried out under medical supervision.

Increasing physical activity: It decrease risk of cardiovascular disease, improves well being and contributes to weight loss. Exercise should be fun, age-specific, and tailored to the child's fitness level and ability. Activities like walking, cycling, aerobics, outdoor sports should be encouraged to replace more sedentary activities. The American Academy of Pediatrics recommends that screen time to be restricted to not more than 2 hours/day for children >2 year old and that children <2 year old should not be encouraged to watch television.

Pharmacotherapy: Role of pharmacotherapy is limited in childhood obesity. It may be considered for obesity

with major comorbidities (e.g. glucose intolerance, hypertension, dislipidaemia, sleep apnoea etc) if lifestyle intervention fails. Orlistat, an intestinal lipase inhibitor is sometimes used as an adjunctive therapy to lifestyle modification in obese adolescents. The anorectic agent Sibutramine, a nonepinephrine and serotonin reuptake inhibitor has been recently withdrawn from the market for its adverse cardiovascular affects. Metformin reduces fasting and post-prandial insulin concentration and results in weight loss and can be used in treating obese adolescents with severe insulin resistance or glucose intolerance although currently it is approved by FDA for treatment of Type 2 DM only. Leptin has been used in children with genetic leptin deficiency.⁴⁸

Bariatric surgery: The American Pediatric Surgical Association Guidelines recommends that surgery can be considered only in children with complete or near complete skeletal maturity, a BMIe⁴⁰, in the presence of comorbidities after failing a six months of multidisciplinary weight management programme. Surgical approaches include: Roux-en-Y and the adjustable gastric band.

Prevention

A team approach with involvement of families, school authorities, health care providers and government bodies is needed for ensuring and improving the health of the community. The National institute of health (NIH) and Centers for Disease Control and Prevention (CDC) recommend a variety of initiatives to combat the current obesigenic environment, including promotion of breast feeding, access to fruits and vegetables, walkable communities, and a 60 minute/day of activity for children.

Conclusion

Childhood is a critical period for onset of obesity and therefore the ideal time for beginning prevention programmes, thereby reducing the incidence and comorbidities associated with obesity.

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