Indian Academy of Pediatrics Revised Guidelines on Evaluation, Prevention and Management of Childhood Obesity

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Justification: The last guidelines for pediatric obesity were released in 2004 by Indian Academy of Pediatrics (IAP). Since then, there has been an alarming increase in prevalence and a significant shift in our understanding in the pathogenesis, risk factors, evaluation, and management of pediatric obesity and its complications. Thus, it was decided to revise and update the previous recommendations.

Objectives: To review the existing literature on the burden of childhood obesity and its underlying etiology and risk factors. To recommend evaluation of childhood obesity and suggest optimum prevention and management strategies of childhood obesity.

Process: The following IAP chapters (Pediatric and Adolescent Endocrinology, Infant and Young Child feeding, Nutrition, Non-Communicable Disease and Adolescent Health Academy) were invited to nominate members to become part of the writing committee. The Committee held discussions on various aspects of childhood obesity through online meetings between February and August, 2023. Recommendations were then formulated, which were analyzed, revised and approved by all members of the Committee.

Recommendations: Exogenous or primary obesity accounts for the majority of cases of childhood obesity. It is important to differentiate it from endogenous or secondary obesity as evaluation and management changes depending on the cause. In Indian, in children under 5 years of age, weight for length/height using WHO charts, and in children 5-18 years, BMI using IAP 2015 charts is used to diagnose overweight and obesity. Waist circumference should be routinely measured in all overweight and obese children and plotted on India specific charts, as it is a key measure of cardio-metabolic risk. Routine evaluation for endocrine causes is not recommended, except in short and obese children with additional diagnostic clues. All obese children more than ten years old should be evaluated for comorbidities like hypertension, dyslipidemia, hyperglycemia and non-alcoholic fatty liver disease/metabolic dysfunction associated steatotic liver disease (NAFLD/ MASLD). Prevention and management of childhood obesity mainly involves healthy diet practices, daily moderate to vigorous physical activity and reduced screen time. Pharmacotherapy may be offered as an addition to lifestyle interventions only in cases of class 3 obesity or if there are any life-threatening comorbidities. Finally, surgical management may be offered in children older than 12 years of age with class 2 obesity and associated comorbidities or class 3 obesity with/without comorbidities, only after failure of a proper trial of intense lifestyle modifications and pharmacotherapy for at least 6 months.

Keywords: *Comorbidities, Overweight, Metabolic syndrome.*

Childhood obesity has emerged as an important public health problem in India as well as other countries in the world. In 2017, it was estimated that more than 14.4 million children in India were obese, the second highest rate in the world, only behind China [1]. In addition to the prevalence, the severity of obesity is also showing an alarming rise, which was significantly worsened by the restrictions implemented during the COVID-19 pandemic.

PROCESS

In February, 2023, the executive board of Indian Academy of Pediatrics (IAP) established a writing committee chaired by the president of IAP to formulate recommendations on obesity in Indian children. The following IAP chapters (Pediatric and Adolescent Endocrinology, Infant and Young Child Feeding, Nutrition, Non-Communicable Disease and Adolescent Health Academy) contributed to the guidelines, as members of these chapters are routinely involved in the care of children with obesity. Five sub-committees were assembled to carry out a detailed review of literature. These sub-committees then prepared the first draft of recommendations by June, 2023. These recommendations were then deliberated upon and revised by the sub-committee members. The second draft was put together, based on all the suggestions, and resent to all members. A National Consultative meeting was held on July 14, 2023 on digital platform (Zoom) where all the reviews were discussed, and the deliberations among experts provided the direction to frame the recommendations. Evidence was assessed and graded following the method used by the American Academy of Pediatrics (AAP) guidelines [2]. The final document was put together by the Writing Committee after a number of revisions and was approved by the Executive Board of IAP.

RECOMMENDATIONS

1. Recognition of Childhood Obesity as a Chronic Disease and Need for Updated Guidelines for Indian Children and Adolescents

The issue of pediatric obesity, once considered a problem in only high-income countries, has now reached epidemic proportions even in middle and low-income countries, including urban slums and rural areas. In the last few years, various reputed medical bodies, including the American Association of Clinical Endocrinology (AACE), Pediatric Endocrine Society (PES) and very recently, the American Academy of Pediatrics (AAP) and the Endocrine Society of India (ESI) have recognized obesity as a chronic disease [3-6]. There is now enough proof that childhood obesity tracks into adulthood, negatively affecting physical and psychological health [7]. Hence, pediatricians and health care providers (HCPs) in India should recognize and treat pediatric obesity as "a chronic disease characterized by excess or dysfunctional body fat (adiposity) which impairs health leading to long term morbidity and even early mortality." Hence, a need was felt to revise and update the previous guidelines [8].

Recommendation 1.0

Pediatricians and HCPs should recognize and treat pediatric obesity as a chronic disease characterized by excess or dysfunctional body fat (adiposity), which impairs health, leading to long-term morbidity and early mortality. (*Evidence level B, Recommendation level moderate*).

2. Prevalence of Childhood Obesity

Prevalence of infantile obesity: Data on prevalence of infantile obesity is scarce in world literature, because the focus on association of early life factors with later obesity is relatively recent. National Family Health Survey 5 (NFHS 5) data from India reported 3.4% of children below five years to be overweight (4.2% in urban areas) with an increase of almost 50% from 2.1% in NFHS 4 [9]. In the United States (US), the prevalence of obesity was found to be 16% during infancy [10]

Prevalence of childhood and adolescent obesity: The prevalence of childhood obesity quoted in various studies is as high as 40% to up to 24 times rise in the past 2-3 decades [11].The prevalence varies with the definitions and criteria selected for evaluation [12]. With a global prevalence of 18%, about 200 million school children are estimated to be overweight/obese worldwide [13].

The prevalence of overweight in the comprehensive national nutrition survey (CNNS) of 2016-18, in children between 5-9 years of age and adolescents, was 4% and 5%, respectively. In the same survey, the prevalence of obesity in children aged 5-9 years and adolescents was only 1% [14]. This is in contrast to studies conducted across various parts of India that report a prevalence of 3% to 24.7% for overweight and 1.5% to 14% for obesity among adolescents; this difference could be due to the varying socioeconomic class in studies across India. Pooled data from a meta-analysis of 52 Indian studies reveals that the combined prevalence of overweight and obesity has increased from 16.3% (2001-2005) to 19.3% (after 2010). In the meta-analysis, a higher incidence of overweight/obesity was seen among boys, urban population, higher socioeconomic strata and North Indian population [13].

Recommendation 2.0

The rising prevalence of infantile, childhood and adolescent obesity in India (including the rural population) needs to be addressed urgently by all the stakeholders (HCPs, school

authorities, national medical bodies and policy makers) involved in the management and prevention of pediatric obesity.
(*Evidence level A, Recommendation level strong*)

3. Etiology and Risk Factors of Childhood Obesity

Infantile Obesity

Maternal factors

Maternal preconception BMI ≥30 kg/m^2, excessive gestational weight gain, and gestational diabetes mellitus increase the risk of infantile obesity. Small for gestational age infants at birth, due to maternal factors like tobacco use, gestational hypertension (PIH) and insufficient maternal weight gain often show an inappropriate rapid catch up weight gain in the postnatal period or for the first 2 years of life and are also at higher risk for obesity in childhood [15].

Nutritional factors

These arise mainly from faulty feeding patterns which includes overfeeding, bottle feeding, exposure to formula feeds with added sugars, junk food, etc. Parental eating behaviour is a crucial determinant of the infant feeding practices [16]. Early addition of sugar sweetened beverages and fruit juices leads to four- to fivefold higher odds of obesity even in infants exclusively breastfed till 6 months of age. If the duration of exclusive breastfeeding is less than 6 months, the risk of obesity is 6- to 12-fold higher [15,17].

Genetic factors

Genetic obesity must be suspected in any infant and child under 5 years of age with severe obesity [4]. Genetic obesity can be polygenic, monogenic or syndromic.

Childhood and Adolescent Obesity

Obesity in children and adolescents is multifactorial and usually involves an interplay of factors such as genetic predisposition, behavioural and cultural practices and environmental influences causing an imbalance where energy intake exceeds expenditure [5].

Family and home factors

- Eating practices**:** Eating habits like high-energy diets, eating fewer fruits and vegetables, eating a lot of meat, frequent dining out, eating fast foods and ultra-processed foods, snacking, and consuming beverages with added sugar and eating quickly has a positive correlation with the development of obesity and overweight [18].
- Screen time: Children who are involved in sedentary activities, such as watching television, playing video games and using computers or mobile phones are at higher risk of developing obesity [19].

Environmental factors

Obesogenic environment refers to a setting, such as a home, school and community, "that encourages weight gain and is not supportive of weight loss." [20]. Physical environment indicators (residential density, access to green spaces, public transport, cycle lanes in urban areas, and sidewalks) and food environmental factors (like access to convenience stores, grocery stores, fast-food restaurants, online food delivery apps and fruit and vegetable markets) have evidence of association with obesity [21].

Policy level factors

- Online and T.V advertising of HFSS (High in Fat, Salt and Sugar) foods aimed at children promotes short-term consumption of energy-dense and nutrient-poor foods leading to childhood obesity [22].
- Food labeling policies - There is enough evidence to support that good and responsible food labeling can reduce the burden of childhood obesity by guiding the customers to buy the right/healthy foods by influencing consumer behaviors [23].

Individual factors

These could be prenatal, lifestyle related, endocrine related, genetic or due to other factors as enumerated in **Box I.**

A practical way to classify childhood obesity is exogenous/primary/lifestyle obesity and secondary/endogenous obesity. Exogenous obesity accounts for the majority of the cases of childhood obesity (>90%), whereas secondary causes account for <10% of the cases (endocrine causes account for <1% of all cases) [24,25].

Recommendation 3.0

Exogenous or primary obesity accounts for the majority of cases of childhood obesity. It is important to differentiate it from endogenous or secondary obesity as evaluation and management changes depending on the cause. (*Evidence level X, recommendation strong*)

4. Evaluation of Childhood Obesity

A. Clinical Evaluation (history and physical examination)

A detailed history and examination are essential to identify the etiology of obesity, associated comorbidities and to plan supporting laboratory evaluation and structured management strategies for sustained weight loss [4,25] (**Table I** and **Box II**). Red flags in identifying pathological or secondary causes of childhood obesity are enumerated in **Box III.**

Recommendation 4.0

4.1 Every overweight and obese child should have a detailed

Box I Causes of Childhood Obesity

Exogenous or primary obesity (>90%)

- Parental factors (The chance of obesity in a child if only one parent is obese is 40% and this increases to 80% chance if both parents are obese)
- Prenatal factors (Maternal nutrition or body mass index, maternal gestational diabetes mellitus, excessive weight gain in pregnancy, placental dysfunction and intrauterine growth restriction)
- Lifestyle factors (physical inactivity, poor sleep hygiene and excess screen time)
- Dietary factors (Parental eating behaviour, overfeeding, exposure to formula feeds, prolonged bottle-feeding, excess quantity of processed or packaged foods, trans fats, JUNCS food, carbonated or sweet beverages, nocturnal snacking)
- Environmental and policy level factors (easy accessibility to supermarkets, paucity of public grounds and gardens, commercials for HFSS (High in Fat, Salt and Sugar) foods

Endogenous or secondary causes of childhood obesity (<10%)

Endocrine (Hypothyroidism, Cushing syndrome, Growth hormone deficiency, Pseudohypoparathyroidism)

Monogenic disorders (Melanocortin-4 receptor haploinsufficiency, Leptin or leptin-receptor deficiency, Proopriomelanocortin deficiency, Prohormone Convertase-1 deficiency, etc)

Syndromes (Prader–Willi, Bardet–Biedl, Alstrom, Cohen, etc)

Neurological/hypothalamic causes (Space occupying lesions including craniopharyngioma, glioma, hamartoma, histiocytosis; infective causes comprising tuberculosis or meningo-encephalitis; brain surgery or radiotherapy; trauma; ROHHAD {Rapid onset obesity, hypothalamic dysregulation, hypoventilation, and autonomic dysregulation})

Drug induced (Glucocorticoids, Antiepileptics, Antipsychotics, Sulfonylureas)

Psychological (Depressive disorders, eating disorders such as binge eating)

Miscellaneous causes: Emotional deprivation, neglect or abuse, single overprotective parent; children and young people with special health care needs (developmental and physical disabilities); children with autism spectrum disorder / attention deficit hyperactivity disorder)

M*odified from Khadilkar V, et al. Evaluation of children and adolescents with obesity. Indian J Pediatr. 2021;88:1214-1221)*

Table I Clinical Examination of an Overweight or Obese Child

Parameters	*Etiology/comorbidity*
Anthropometry	Weight, height, body mass index, mid-parental height, watch for changing centiles upwards Plot on growth chart
Body fat distribution	Waist circumference
Pubertal staging (sexual maturity rating)	
Lipomastia and buried penis	Simple obesity
Micropenis (hypogonadism), undescended testis	Prader-Willi syndrome
Delayed/precocious puberty	Hypothalamic/pituitary lesions
Moon facies, buffalo hump	Cushing syndrome (exogenous or endogenous)
Blood pressure	Compare with age/sex/height appropriate references
Skin examination	Acanthosis nigricans - insulin resistance acne, hirsutism - PCOS
	Violaceous stria - Cushing syndrome
	Xanthelasma, skin tags - dyslipidemia
	Intertrigo
Hair	Dry, brittle- hypothyroidism
	Red hair – monogenic (POMC mutation)
Genetic syndromes (dysmorphism)	
Small hands and feet	Albright hereditary osteodystrophy
Polydactyly, retinitis pigmentosa	Bardet-Biedl syndrome
Skeletal complaints like bowing of legs, limp, of hip motion	Slipped capital femoral epiphysis, genu valgum, tibia vara, limited range fractures
Hepatomegaly	Non alcoholic fatty liver disease

Box II Evaluation of an Overweight or Obese Child Based on History and Possible Etiology/Comorbidity

Dietary history

Diet rich in carbohydrate/ fat/ energy dense foods

Lack of breastfeeding and early introduction of complementary feed

Increased consumption of JUNCS (junk foods, ultra-processed foods- nova Classification 4, Nutritionally inappropriate foods, caffeinated/ colored/ carbonated foods/ beverages and sugar-sweetened food and beverages)

Large portion size, snacking

Physical activity

Decreased physical activity or sedentary habits

Increased non- academic screen time

Irregular sleep duration

Birth history

Birth weight, intrauterine growth restriction, post-natal events

Antenatal

Maternal pregnancy overweight/gestational diabetes/hypertension

Menstrual history

Menstrual irregularity and hirsutism- Polycystic ovarian syndrome

Family history

Obesity and associated complications like hypertension, heart disease/eating habits/behavioral pattern

Development history

Attainment of milestones/ current school performance/ developmental disabilities (chromosomal/genetic syndromes)

Drug intake: Corticosteroids, Olanzapine, risperidone, antiepileptics like valproate, gabapentin

Psychological assessment

Eating disorder, anxiety, depression, self-esteem, readiness and ability for behavior change, peer relationship, bullying

Hypothalamic obesity- CNS infection, trauma, radiation, mass

Headache, vomiting, visual disturbances

Shortness of breath, exercise intolerance: Asthma

Acne and hirsutism: Polycystic ovarian syndrome

Snoring, sleep disruption, morning headaches, day-time somnolence: Obstructive sleep apnea

Hip, knee or back pain: Slipped capital femoral epiphyses

Abdominal pain: Gastroesophageal reflux, constipation, gall bladder disease, non-alcoholic fatty liver disease

Recurrent headache: Pseudotumor cerebri

history and physical examination including specific measurements such as BMI, waist circumference and blood pressure, to identify etiology and associated comorbidities. (*Evidence level B, Recommendation level strong*)

Box III Red Flags for Pathological Obesity

Early onset obesity - very rapid gain in weight in first few years

Short stature for age or mid parental height/ poor linear growth

Hyperphagia–non-discriminatory

Dysmorphism

Associated features, e.g., developmental delay, vision abnormalities, behavioral problems

History of steroid intake

Hypogonadism

B. Defining overweight and obesity using BMI (5-18 year old) and weight for length/height (under 5 year old) on age appropriate growth charts

BMI is the most used tool in clinical practice for screening, diagnosing and grading overweight and obesity. It is easy to use, inexpensive and in most cases, strongly correlates with the standard methods of measuring body fat such as Dual-energy *X*-ray absorptiometry (DXA) [26]. The advantage of BMI is that it is not only used for classifying weight status and associated health risk, but it is also useful to follow a child or adolescent's weight trajectory over time, particularly in response to individualized treatment or public health measures [27].

Traditionally, the BMI cut-offs used by Centre for Disease control (CDC) and WHO for overweight and

obesity in children 5-18 years are ≥85th percentile (≥ +1SD) and ≥95th percentile (≥+2 SD), respectively [4,5,28]. These cut-offs coincide with the adult cut-offs for overweight and obesity of BMI 25 kg/m^2 and 30 kg/m^2, respectively. The Asian population tends to have adiposity and increased cardio-metabolic risk at lower BMI, hence the International Obesity Task Force (IOTF) and WHO have suggested lower cut-offs to define overweight and obesity in Asian children [29,30]. The IAP charts for BMI devised in 2015 follow the WHO and IOTF suggested cutoffs, where the 23 adult equivalent is used to define overweight and 27 adult equivalent is used to define obesity [31]. Numerous studies have demonstrated the advantages and utility of IAP charts as compared to the WHO charts in Indian children [32].

In the recently released PES as well as the AAP guidelines for childhood obesity, the classes of severe obesity have been redefined as follows [4,5]: Class 2 obesity: ≥120% to < 140% of 95th percentile or BMI ≥35 kg/m2 to < 40kg/m2 whichever is lower based on age and gender; and, Class 3 obesity: ≥140% of the 95th percentile or BMI ≥40 kg/m2 whichever is lower based on age and gender.

Web Table I and **II** and **Web Fig. 1** and **2** show the percentiles for extended IAP BMI charts including class 2 and 3 obesity based on 120% and 140% of the IAP obesity cutoff values of 27 adult equivalent, respectively. These extended charts need further validation but may be useful in deciding treatment options and monitoring response to therapy.

In a busy pediatric outpatient department (OPD), BMI calculation takes time and often gets looked over. To overcome this, IAP has recently published the pediatrician-friendly growth charts which contain a quick screening BMI tool for 8 -18 year old children, embedded in the growth chart itself [33]. This tool eliminates the need for calculation as weight can be plotted against the height directly on the tool. The drawback of this tool is that a child at the extreme ends of height-for-age could be incorrectly classified. Hence, if a child is found to be abnormal on the BMI tool, his/ her BMI should be verified on IAP BMI charts.

In children between 2-5 years of age, country specific BMI charts are used to diagnose overweight and obesity [4,5]. However, IAP growth charts are not available for children under 5 years of age. Hence, in children under 5 years of age, IAP recommends WHO weight for height/length charts to diagnose overweight and obesity. Overweight is defined as weight-for-length/height ≥2 standard deviation (SD) (≥97th percentile) but less than + 3 SD (<99.9th percentile) and obesity as values ≥3 SD (≥ 99.9th percentile) on the WHO charts [34].

In children under 5 years, growth monitoring should be done at every vaccine visit (or at least 6 monthly after first birthday). In children greater than 5 years, BMI calculation and plotting should be done at least annually [35].

Recommendation 4.0

4.2 In 5-18 years old Indian children, BMI should be used to diagnose overweight and obesity. The IAP 2015 BMI charts should be used for plotting the BMI in Indian children. (*Evidence level B, Recommendation level moderate*)

4.3 BMI cutoffs (on IAP 2015 BMI charts) of 23rd adult equivalent should be used to define overweight and 27th adult equivalent should be used to define obesity in Indian children and adolescents aged 5-18 years.
(*Evidence level B, Recommendation level moderate*)

4.4 In Indian children under 5 years of age, weight for length/ height using WHO charts should be usedto diagnose overweight and obesity. A child whose weight-for-length/height ≥+2 SD (≥97th percentile) but less than + 3 SD (<99.9th percentile) is diagnosed as overweight and value ≥3 SD (≥99.9th percentile) is diagnosed as obese.
(*Evidence level B, Recommendation level moderate*)

4.5 In children under 5 years weight for length/ height plotting should be done at every vaccine visit or at least 6 monthly (after 1st birthday). In children greater than 5 years, BMI plotting should be at least annually.
(*Evidence level X, Recommendation level strong*)

C. Utility of emerging measures of adiposity in overweight and obese children

The BMI, although useful, has some limitations. BMI does not directly assess body composition (and hence fat content) and therefore has low sensitivity for detecting excess adiposity (around 50%). BMI is not equally valid across gender, age groups (hence the use of Z-scores in children) and race or ethnicities [36]. BMI cannot differentiate between lean and fat mass. BMI alone is an insufficient marker of abdominal adiposity and hence can fail to fully detect cardio-metabolic risk [37]. In fact, in 25% of cases, normal BMI is compatible with excess body fat, which is very commonly seen in the Asian population [31]. In such individuals, waist circumference (WC) is a simple measure of adiposity which is not difficult to standardize and apply clinically. The combination of BMI and WC, thus identifies a high-risk obesity phenotype superior to either parameter alone [37].

WC is an important predictor of visceral adiposity. It is strongly associated with metabolic syndrome, all-cause and cardiovascular morbidity and mortality with or without adjustment for BMI [38,39]. WC is measured horizontally in a standing child just above the lateral border of the right ileum with a stretch-resistant tape at the end of normal

expiration [40]. Like BMI, country-specific growth charts should be used for plotting WC. Traditionally, WC above the 90th percentile is used as a cut-off for identifying central adiposity and children who are at risk of developing metabolic syndrome [41]. A multicentre, large-scale trial has shown that a WC cut-off above the 70th centile may be more suitable in screening and identifying Indian children at risk for metabolic syndrome [42]. However, more Indian studies are required to validate these WC cutoffs.

In a busy clinical setting, it is sometimes difficult to measure WC, as the physical landmarks for measurement of WC are not always clear in overweight and obese children. Recently, measures such as wrist circumference are being used to identify children with metabolic risk as they are easier to measure and more socially acceptable. India-specific wrist circumference percentiles have been published in the past and like WC, 70th percentile is used as the cutoff to screen hypertension [43]. However, more Indian studies on overweight and obese children are necessary to validate the cutoffs.

Among the various methods used for analysis of body composition, dual-energy *X*-ray absorptiometry (DXA) has the highest sensitivity and specificity in detecting body fat in the pediatric population [44]. Due to its accuracy, speed, low radiation dose and ease of use, DXA has now become one of the most commonly used standards for measuring body composition in the children. However, due to it being expensive, requirement of trained operators and lack of standardization due to different machines and software available, its current use is limited more for research purposes in the Indian scenario. Bioelectrical impedance analysis (BIA) although less accurate than DXA is routinely used for body composition analysis in the field/ clinical settings due to ease of use, portability, easy availability and relatively low cost [45].

Recommendation 4.0

4.6 Waist circumference should be routinely measured in all overweight and obese children and plotted on India specific charts, as it is a key measure of cardio-metabolic risk. (*Evidence level B, Recommendation level strong*)

4.7 In Indian children, waist circumference greater than 70th percentile can be used as a cutoff for identifying children with central adiposity who are at a risk of developing metabolic syndrome.
(*Evidence level C, Recommendation level weak*)

D. Laboratory evaluation in childhood obesity

The goal of laboratory evaluation is to screen for associated comorbidities and MS. Since exogenous obesity is the most prevalent type of pediatric obesity, testing for secondary causes should only be done in presence of clues on the history and examination.

Endocrine disorders are suspected in children with obesity who also have short stature or poor growth velocity and the presence of additional diagnostic clues [4,5] (**Box IV**). In obese children, thyroid function tests should be carefully interpreted. Mild elevation of TSH with normal or mildly elevated free T3, T4 does not indicate hypothyroidism. The mild TSH elevation is due to peripheral resistance to thyroid hormone as well as due to increased hypothalamic TRH drive caused by increased leptin levels [46].

In south-east Asia, due to the increased prevalence of consanguineous marriages, genetic disorders could be the etiology in 30% of morbidly obese individuals [47]. They present with early or rapid onset obesity with hyperphagia as the defining symptom. Genetic diagnosis is important for prognosis, therapeutic management and counseling. The threshold for genetic testing should be lower in the presence of consanguinity, early-onset obesity (<5 years of age), dysmorphism, developmental delay, growth retardation, congenital abnormalities, vision abnormalities and hormone deficiencies [48].

Recommendation 4.0

4.8 The committee recommends against routine evaluation for endocrine cause except in short and obese children with additional diagnostic clues.

(*Evidence level C, Recommendation level moderate*)

4.9 Genetic testing should be only recommended for early or rapid onset obesity (<5 years of age) with hyperphagia, clinical pointers and/or family history of suspected syndromic obesity.
(*Evidence level B, Recommendation level moderate*)

Box IV Suspected Etiology and Laboratory Evaluation of Pediatric Obesity

Exogenous obesity: Fasting lipid profile, alanine aminotransferase (ALT), renal function tests, fasting blood glucose, oral glucose tolerance test, glycosylated hemoglobin (if indicated)

Hypothyroidism: TSH, free thyroxine

Cushing syndrome: Serum or salivary cortisol (11 PM), dexamethasone suppression test, 24-hour urine-free cortisol test

Growth hormone deficiency: Bone age, Insulin-like growth factor-1, Insulin-like growth factor binding protein-3, growth hormone stimulation test

Pseudohypoparathyroidism: Calcium, phosphorus, parathyroid hormone, *X*-ray hand

Genetic or monogenic obesity: Specific genetic test (advised by a specialist)

Hypothalamic and pituitary disease: Magnetic resonance imaging (MRI) of brain

E. Metabolic syndrome in Indian children

MS in adults is diagnosed by the presence of at least 3 out of the 5 risk factors: central adiposity, elevated blood pressure, hyperglycemia, elevated triglycerides and reduced high-density lipoprotein cholesterol (HDL-C). But there is still no consensus for the definition for MS in children [49,50]. The prevalence of MS is 13.6% in overweight and 46.4% in obese Indian children aged 10-18 years [51].

As per International Diabetes Federation (IDF), MS can be diagnosed in children aged 10-16 years with the following criteria: presence of abdominal obesity (defined by waist circumference (WC) ≥90th centile for age, gender and ethnicity) with ≥2 of the following: Triglycerides ≥150 mg/dl, HDL-cholesterol ≥40 mg/dl, fasting blood glucose ≥ 100 mg/dl and systolic blood pressure ≥130 mm of Hg; Diastolic blood pressure ≤85 mm of Hg (≥95th centile adjusted for age, height and gender) [52].

This definition fails to define MS in children <10 years of age (screening advised if WC ≥90th centile for age, gender and ethnicity). IDF advocates the use of adult cut-offs for adolescents >16 years of age. As discussed earlier, it is important to note that Indian population is likely to develop MS at lower BMI and WC; thus ≥70th percentile for screening may be more appropriate [42].

F. Comorbidity screening

Pediatric obesity is associated with an increased prevalence of dyslipidemia. Due to high prevalence, NHLBI (National Heart, Lung and Blood Institute) and AHA (American Heart Association) recommend universal screening for dyslipidemia at 9-11 years of age and then at 17-21 years of age with a non-fasting lipid sample which if abnormal will need confirmation on a fasting lipid sample [41,53] (**Table II**). Due to the higher prevalence of dyslipidemia in overweight and obese children, a fasting lipid sample is recommended for screening [41].

Obesity is an independent risk factor for the development of pre-diabetes and type 2 diabetes (T2D), which is being increasingly seen in children younger than 10 years. ADA recommends screening for diabetes in children at 10 years of age or pubertal onset, whichever is earlier, in the presence of risk factors and earlier in the presence of symptoms [54]. It is evaluated by fasting blood glucose or oral glucose challenge test. In the absence of unequivocal hyperglycemia, the diagnosis is confirmed if 2 different tests are above threshold or a single test is above the threshold on 2 separate occasions. Pre-diabetes is defined as fasting plasma glucose between 100-125 mg/dL or 2 hour plasma glucose on oral glucose tolerance test (OGTT) between 140-199 mg/dL. Diabetes is defined as fasting plasma glucose ≥126 mg/dL or 2 hour plasma glucose on OGTT ≥200 mg/dL. HbA1c is not commonly recommended for the diagnosis of T2D in children due to racial-ethnic variations [55]. Measurement of insulin to detect insulin resistance is not recommended due to lack of standardized assay and increased variability of the results in non-obese and obese children [4,56].

Non-alcoholic fatty liver disease (NAFLD) also known as metabolic dysfunction associated steatotic liver disease (MASLD) is the most common chronic liver disease with prevalence as high as 34% in obese children [57]. The risk factors for MASLD include Asian ethnicity, male gender, > 10 years of age, positive family history, pre-diabetes or DM, OSA and dyslipidemia. Alanine aminotransferase (ALT) is the screening test (normal <26 U/L in males and <22 U/L in females as per liver SAFETY (Screening ALT for Elevation in Today's Youth) study even though it correlates poorly with disease severity [58]. It is recommended to evaluate for other liver pathology in the presence of ALT >2 times the sex-specific upper limit of normal. Additional diagnostic evaluation of the liver (ultrasonography, FibroScan, MRI) may be needed if ALT >80 U/L. It is recommended to screen all obese and overweight children ≥9 years of age with risk factors for MASLD [59].

Children and adolescents with obesity are at a higher risk for hypertension with a prevalence of 5-30%.The 2017, AAP guidelines on childhood hypertension recommend screening of all children from 3 years of age [60]. Elevated BP is defined as BP percentile ≥90th to < 95th for age and gender, stage 1 hypertension is defined as ≥95th to <95th percentile +12mmHg or 130/80 to 139/89 mm Hg (whichever is lower) and stage 2 hypertension is defined as ≥95th percentile +12mm Hg or ≥140/90 mm Hg (whichever is lower). Indian children's blood pressure reference percentiles are available and should be used for evaluation [61].

Table II Cutoffs for Lipid Levels Among Children

Serum lipids	*Acceptable, mg/dL*	*Borderline, mg/dL*	*Abnormal, mg/dL*
Total cholesterol	<170	170-199	≥200
LDL cholesterol	<110	110-129	≥130
Non-HDL cholesterol	<120	120-144	≥145
Triglycerides			
0-9 y	<75	75-99	≥100
10-19 y	<90	90-129	≥130
HDL cholesterol	>45	40-45	<40

LDL: low-density lipoprotein; HDL: high-density lipoprotein. Modified from Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung, and Blood Institute. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report. Pediatrics. 2011;128 Suppl 5:S213-56.

There is an increased prevalence of obstructive sleep apnea (OSA) in obese children (45% in obese children vs 9% in non-obese children) [62]. It is to be screened using a polysomnogram (gold standard diagnostic test) based on presence of supporting history and examination.

Obese adolescent girls are at increased risk of developing PCOS with prevalence of 3-11% [63]. It is difficult to diagnose during the first three post-menarcheal years due to lack of consensus on diagnostic criteria and presence of physiological menstrual abnormalities and mild hyperandrogenism. The diagnosis of PCOS in an adolescent girl should be made based on the presence of clinical and/or biochemical evidence of hyperandrogenism (after exclusion of other pathologies) in the presence of irregular menstrual cycles along with dysfunction of ovulation [64]. Polycystic ovarian morphology on ultrasound alone is not reliable to diagnose adolescents because multifollicular ovaries are a feature of normal puberty that subsides with the onset of regular menstrual cycles.

There is 32% more risk of developing depression in obese children as compared to non-obese children and it has a significant impact on obesity management [65].It is also important to evaluate musculoskeletal disorders due to their high association with obesity [66]. Idiopathic intracranial hypertension is commonly associated with obesity, especially in adolescent girls (3.5 times the risk than non-obese population) and presents with headaches, tinnitus or visual changes [67].

Recommendation 4.0

4.10 All obese children ≥10 years (irrespective of risk factors) and obese children aged 2-10 years (if risk factors like positive family history of obesity, dyslipidemia, premature coronary artery disease, diabetes or hypertension are present), or waist circumference greater than 70th percentile, should be evaluated for hypertension, dyslipidemia, hyperglycemia, MASLD and other comorbidities.
(*Evidence level B, Recommendation level moderate*)

4.11 All overweight children ≥10 years of age should be evaluated for hypertension, dyslipidemia, hyperglycemia, MASLD and other comorbidities in presence of risk factors or waist circumference greater than 70th percentile. (*Evidence level B, Recommendation level moderate*)

5. Prevention of Childhood Obesity

A. Dietary role in the prevention of childhood obesity

Preventive strategies in infancy [68]:

- Promotion of healthy maternal nutrition and weight status at reproductive age and during pregnancy
- Optimal infant feeding practices
  - Exclusive breastfeeding till six months of age.
  - Continue breastfeeding till 2 years and beyond.
  - Avoid formula feed. If mother's milk is not available, pasteurised donor human milk (if available) is better than formula
  - Fresh home-made complementary foods starting at 6 months
  - Avoid extra sugar (first two years of life) and low salt (first year)
  - Avoid sugar-sweetened beverages (SSB) and packed fruit juices.
  - Avoid packaged food.
  - Avoid forced feeding, promote responsive feeding
  - No bottle feeding
- Careful, regular monitoring of infant growth to detect early excessive weight gain.

Preventive strategies in children and adolescents: Parents/ caregivers should provide a healthy eating environment, set meal timings and routine for the child. The diet should be a blend of diverse food groups to provide sufficient energy, protein, fats, micronutrients and vitamins in optimal proportions [69]. Use of recommended dietary allowances (RDA) and the estimated average requirements (EAR) including the Tolerable Upper Limits, published by National Institute of Nutrition, ICMR, 2020 for macro-nutrients and micronutrients is recommended [70]. Children with obesity are more prone to develop iron deficiency with or without anemia. Therefore, active screening and treatment of anemia is recommended in obese children. Many children are likely to have other deficiencies, like vitamin B 12, zinc, vitamin D, etc.,which need to be addressed.

Foods should routinely be prepared with low salt, little or no added solid fats/trans-fat and free sugars should be restricted to <5% of total energy intake, especially in beverages [71]. Beyond 2 years, adequate consumption of dietary fiber is encouraged by eating a variety of fiber-rich fruits, vegetables, cereals, and whole-grain products. The consumption of JUNCS (Junk foods- high in fat, high in salt, high in sugar with very low nutrients, ultra-processed foods-Nova Classification 4, nutritionally inappropriate foods, caffeinated/colored/carbonated foods/beverages, and sugar-sweetened food and beverages) should be avoided in children and adolescents [72]. Whole fruit intake should be encouraged over fruit juice as the latter has high sugar content, lacks fiber and provides no nutritional advantage. Freshly cooked home food is preferred over packaged/ processed foods as the latter results in higher consumption of

calories, salt, free sugar and saturated fats. The habit of liberal water intake should be cultivated over colas, sugar-sweetened beverages, fruit juices/drinks at home and school.

Parents should adopt an authoritative (i.e., by setting examples) rather than authoritarian approach towards development of healthy eating habits among children. They should recognize and respond to the child's hunger and satiety cues and avoid overfeeding and forced-feeding. Children are encouraged to develop self-regulation of over-feeding skills to regulate their meal intake (portion size) [73,74]. They can involve children in food shopping and meal preparation and entrust them with the responsibility for healthy cooking and eating practices as they get older. Threatening, bribing or forceful attempts to make children eat and finish their meals makes them insensitive to hunger and satiety cues, thereby resulting in overeating. The intake of food and beverages while watching TV/ screen should be strongly discouraged. Food should never be a part of reward or punishment to a child.

Schools are viewed as an essential setting for intervening in children's obesity-related behavior. Teaching staff can significantly facilitate and contribute to delivery of the intervention, increasing its sustainability. School events/ fetes/programs should not be sponsored by manufacturers of unhealthy foods/drinks.

The AAP Clinical Decision Support 10 chart recommends the pneumonic '5-2-1-0' rule for prevention of obesity among children. This '5-2-1-0' rule translates to consumption of at least 5 servings of fruits and vegetables each day, limit screen time < 2 hours per day, participation in 1 hour of physical activity every day (moderate to vigorous physical exercise every day) and no intake or 0 intake of sugar-sweetened beverages daily [75].

Recommendation 5.0

5.1 Prevention of childhood obesity should start by promoting healthy maternal weight in the prenatal period, smoking cessation before pregnancy, appropriate gestational weight gain and diet, exclusive breastfeeding in the first 6 months, ensuring appropriate weight gain in infancy and transition to balanced home-made complementary foods, avoid salt (first year of life) and extra sugar (first two years of life), avoiding packaged foods and forced feeding. (*Evidence level B, Recommendation level strong*)

5.2 Childhood nutrition should have a balanced diet, healthy eating pattern and behaviour. Child's diet should be a blend of diverse food groups to provide sufficient energy, protein, fats, micronutrients and vitamins in optimal proportions. (*Evidence level A, Recommendation level strozng*)

5.3 Appropriate portion sizes should be offered to children depending upon the child's age and the energy density of the food. (*Evidence level C, Recommendation level moderate*).

5.4 It is recommended to avoid the consumption of JUNCS food and beverages in children and adolescents. (*Evidence level B, Recommendation level strong*)

B. Role of physical activity/exercise in prevention of pediatric obesity

Physical activity and or exercise is an essential conjunct to a healthy diet for the prevention of obesity in children. Exercise reduces visceral adipose tissue, promotes increased muscle mass, independently reduces the risk for cardio-metabolic complications, improves motor and cognitive development, psychosocial well-being, skeletal health and overall risk of mortality [76].

Infants are encouraged to remain active throughout the day through activities like reaching and grasping, pulling and pushing, and floor play (including crawling) in a safe and supervised environment. Favorable health outcomes are associated with 30 minutes/day of prone position (tummy time) in young infants. Toddlers and preschoolers should engage in varied physical activities as per their developmental age, that is spread across the day (at least 180 minutes a day). They should not be restrained for more than 1 hour (e.g., in prams/strollers, high chairs, or strapped on a caregiver's back) [77].

Older children and adolescents should regularly engage in both aerobic and anaerobic exercises to maintain good health and strengthen their muscles and bones. An average of at least 60 minutes of moderate to vigorous physical activity spread throughout the day is recommended for children and adolescents (5-17 years) [78]. High-intensity interval training/ resistance exercises (20 minutes in a day) should be incorporated at least 3 times a week to strengthen their muscles and bones [79]. Besides planned exercise, children should actively participate in daily chores, sports, recreational work, and team play. The activities should be age-appropriate, enjoyable, sustainable, and well-aligned with family dynamics and the child's daily routine. Safe play areas should be identified in all communities for children, especially for those belonging to low socioeconomic strata. The school curriculum should also incorporate 30 minutes of exercise schedule every day.

There is evidence to support an association of inadequate and poor-quality sleep with the risk of overweight and obesity in children. Recommended sleep duration by age is: 0-5 years – at least 11 hours, 5-10 years – at least 10 hours, 10 years and above – at least 9 hours [80].

Recommendation 5.0

5.5 Age-appropriate, moderate to vigorous physical activity for at least 60 minutes per day, should be recommended for

the prevention of obesity in older children and adolescents (5-17 years).
(*Evidence level B, Recommendation level moderate*)

5.6 Infants, toddlers and preschoolers should be encouraged to remain active throughout the day through age-appropriate activities and play.
(*Evidence level B, Recommendation level moderate*)

5.7 Sleep hygiene should be followed for getting recommended age-appropriate good quality sleep to decrease likelihood of developing childhood obesity.
(*Evidence level B, Recommendation level moderate*)

C. Role of screen time in the prevention of pediatric obesity

Sedentary behavior, which comprises predominantly recreational screen time (time spent watching television, computer and smart phone usage) in children is likely to track from preschool years to preadolescent age and to young adulthood and is positively associated with obesity. The combined effect of reducing recreational screen time (<2 hours) and increasing moderate to vigorous physical activity (>60 minutes) per day, brings down the odds of being overweight/obese by three to fourfold [81]. A review of 13 studies found moderately strong evidence for associations between screen time and adiposity. The effects of increasing screen time go beyond physical morbidities and affect development, mental health and quality of life [19].

As a part of its strategy on Ending Childhood Obesity WHO released its recommendations on screen time for under 5 children in 2019 [82]. It recommends no screen time for children under 1 year of age and not more than 1 hour for under 5 years of age. The Indian Academy of Pediatrics has published comprehensive recommendations on 'Screen Time and Digital Wellness in Infants, Children and Adolescents' as well as Parental Guidelines on screen time [83]. The recommended screen time is zero up to 2 years, maximum 1 hour from 2-5 years and 2 hours from 5-10 years, the lesser the better. Children in the 10-18 age group is advised to balance screen time with other age-specific developmental goals. This includes recreational screen time as well as time spent on screen to complete educational assignments at home or school. Screen time should be mainly for the purpose of education and studying. Recreational screen time should be kept to bare minimum.

Recommendation 5.0

5.8 The recommended screen time is no screen time up to 2 years, maximum 1 hour from 1-5 years and 2 hours from 5-10 years, the lesser the better. The 10-18 age group is advised to balance screen time with other age specific developmental goals.
(*Evidence level A, Recommendation strong*)

6. Management of Childhood Obesity

A. Principles of management of pediatric obesity

The goals of treating childhood and adolescent obesity are to decrease adiposity, alleviate related physical and psychosocial comorbidities, halt the progression to chronic illnesses and support longterm weight maintenance. The management should have a multimodal approach that includes various healthy lifestyle modifications like dietary advice, regular physical activities, behavioral interventions aiming at modifying eating behaviors, decreasing sedentary behaviors and encouraging sleep routines, medications, and surgical options (only if indicated) [4,5,74].

To effectively treat obesity, behavioral support programs must be family-centered and developmentally appropriate. For instance, treatment for children may be primarily parent-based, whereas teenagers may need more self-direction [84]. Studies have shown that family-based therapies were helpful in reducing child weight by a moderate to large effect. Furthermore, family-based interventions that resulted in both short- and long-term weight loss in children were more likely to focus on both parental and family weight management in addition to the children [85].

Motivational interviewing (MI) is a patient-centered counseling strategy, which acknowledges and attends to a patient's needs [86]. This strategy encourages a patient's personal motivation for development, in contrast to the more conventional model in which a clinician prescribes behavior adjustment. Prospective studies on MI have revealed that the technique improves weight status as compared to control systems. The findings revealed a greater decrease in BMI percentile or BMI *Z* score and a lesser increase in BMI [87].

The American Academy of Pediatrics (AAP) previously had suggested a stage-based approach for pediatric weight management to tackle obesity at different ages with varying levels of severity [75,88].

Recommendation 6.0

6.1 The initial management of pediatric obesity is lifestyle modification at the primary HCP level. If this fails to produce results after 6 months, the management is transferred to a multidisciplinary team for multimodal approach. This will involve caregivers including parents, family and school, HCPs or pediatricians, pediatric specialists for comorbidities like endocrinologists/pulmonologists, psychologists or counselors and dieticians in the prevention, management and follow-up care of overweight and obese children.
(*Evidence level X, Recommendation level strong*)

B. Dietary management of obesity

Dietary management in infantile obesity: It is important to strike a delicate balance between allowing the infant's

nutrient needs for optimal growth and development while at the same time not allowing excessive weight gain. This can be achieved as follows- Premature initiation of complementary foods is linked with increased BMI and hence complementary feeding must be started only after 6 months of exclusive breastfeeding. Standard infant feeding recommendations of IAP must be followed with special emphasis on avoiding sugar-sweetened beverages and junk food [68,72]. In contrast, in genetic (monogenic and syndromic) obesity, the physiological hunger-satiety feedback is not intact. Hence standard nutritional counseling may not be effective. The energy intake in such cases will have to be individualized based on activity level and behavior.

Ensure responsive feeding wherein the caregiver recognizes the hunger cues, engages, and encourages self-feeding in an age-appropriate manner. Forced-feeding must be avoided at all ages. In genetic obesity, due to hyperphagia, the management must focus on controlling access to food and reducing food preoccupation. Caregivers must be counseled that this may lead to temper tantrums, outbursts etc.

Dietary management in obese children and adolescents: The goal is towards weight maintenance rather than weight loss in children; unless in severe obesity where gradual weight loss is recommended [89]. Calorie restriction is not usually recommended before 6 years of age and increasing physical activity and weight maintenance are more rewarding.

Weight maintenance for 1-2 years will reduce excess weight-for-height (approx. 20%) in a growing child. A healthy diet based on the Traffic Light/Stop Light diet is an acceptable, feasible and sustainable intervention for weight management in overweight and obese children [90]. An alternative approach towards a healthy and balanced diet is based on the principles of MyPlate (USDA *choose-myplate.gov/* ICMR-NIN My plate) which can be adapted to different food cultures and ethnicities.

For the management of children with severe obesity and/or those with comorbidities or complications, a gradual weight loss is recommended (0.5 kg per month for 2-5 years and 1 kg per week for older children and adolescents) [91]. Intervention trials using varied dietary strategies for intensive weight management in children or youth/adults with severe obesity have yielded inconsistent results in reducing BMI. These dietary strategies were based on modifying the macronutrient content [92,93] and/or the quality of carbohydrate [94,95] or caloric restriction like very low energy diets (VLED) [96,97], protein-sparing modified fast [98,99] or a low-carbohydrate diet [101,102]. Though there is sufficient evidence to support safety of energy-restricted diets, it should be prescribed only under close supervision and intensive monitoring [98,99]. Potential risk for disordered eating behaviours, growth impairment, loss of lean body mass and micronutrient deficiency remains a concern in adopting these strategies.

There is no 'one size fits all' approach. Therefore, the diet plan should be individualised taking into consideration the age, pubertal status, rate of growth, BMI percentile, associated comorbidities, family preferences and socio-economic status.

Recommendation 6.0

6.2 Interventions for children and adolescents with obesity should aim at weight maintenance initially using healthy dietary practices and behaviors that are culturally acceptable, affordable, and ensure long-term compliance.
(*Evidence level B, Recommendation level strong*)

6.3 Children with severe obesity and or with comorbidities can be considered for energy-restricted supervised intensive dietary interventions (e.g., very low- carbohydrate diets, very low-energy diets and lower glycemic index diets) to achieve gradual weight loss.
(*Evidence level C, Recommendation level weak*)

6.4 Dietary intervention should be an individualised family-based approach on individual needs, preferences, and medical conditions which optimises outcomes for children and adolescents with severe obesity and or cardiometabolic complications.
(*Evidence level B, Recommendation level strong*)

C. Role of physical activity/exercise in the management of pediatric obesity

Exercise intervention in overweight and obese children should be tailored to the age, gender, preference, socio-economic status and fitness level of a child. Barriers that limit the participation of children in physical activities should also be identified and addressed adequately before any intervention. A quick evaluation of the child for any disability, which may hinder the physical activity e.g., slipped capital femoral epiphyses (SCFE) should be done, before guiding the physical activity.

Moderate to vigorous aerobic activity at least 60 min per day along with resistance exercise (at least 20 min over 3 days/week) are effective interventions for decreasing body weight, body mass index, and fat mass in children with obesity [102]. The combination of aerobic exercise and strength training has synergistic effects. A goal setting approach is suggested to gradually build up the child's physical activity to recommended level. Goals should be individualized for each child.

Non-weight-bearing activities like recumbent and stationary cycling, rowing ergometry and swimming are

recommended for children with severe obesity. Gradually, focus is shifted towards activities that promote core stability, posture, gait and cardiorespiratory endurance. Bone-strengthening activities like jumping and skipping are introduced later and continued at least three times per week. A targeted and gradual increase in time and intensity of activities is recommended in a stepwise fashion.

Recommendation 6.0

6.5 Exercise intervention in obese children should be tailored as per the age, gender, preference, socioeconomic status and disability or fitness level of a child. A combination of aerobic and strength training exercises is recommended for the management of children with obesity.
(*Evidence level B, Recommendation level moderate*)

D. Pharmacological management of childhood obesity

Pharmacotherapy options are offered only in adolescents over the age of 12 years, after a significant well focused lifestyle modification program has not yielded results or when an associated comorbidity warrants it [5]. Drugs approved for children are very limited and lack long-term safety and efficacy data (**Table III**) [103]. The drug therapy is termed ineffective if it fails to safely reduce BMI by 5% over 12 weeks of consistent use [4]. As the drugs have a differential effect on different comorbidities, the choice often depends on the associated comorbidity profile. They are not recommended as monotherapy and are always prescribed along with a comprehensive lifestyle modification program. A systematic review evaluating weight loss medications in adolescents found a modest weight reduction with pharmacotherapy with short or no post-intervention follow-up [103,104].

Glucagon-like peptide-1 (GLP-1) analogues have been recently approved by the Food and Drug administration for long-term treatment of obesity in children aged ≥12 years. In recently published data, Liraglutide showed a modest weight loss as compared to placebo and lifestyle therapy alone (absolute change in weight was -4.50 kg [95% CI -7.17 to -1.84] at end of 56 weeks, mean (SD) starting weight in liraglutide group being 99.3 (19.7) kg [105,106]. Its use may be limited by the need for daily subcutaneous injections and the rebound weight gain after stopping therapy. Another GLP-1 analogue, Semaglutide, resulted in significant weight loss as compared to placebo and lifestyle modification alone (absolute change in weight was -17.7 kg [95% CI -21.8 to -13.7] at end of 68 weeks, mean starting weight being 107.5 (24.5) kg [107]. It is used as a once-a-week subcutaneous injection. Orlistat produces a modest weight loss (reduces BMI by 0.5-1.5 kg/m2) with significant gastrointestinal side effects with increased discontinuation rates. A recent study showed improvement in dyslipidemia but with minimal benefit on BMI reduction and hypertension [108]. Metformin produced <5% weight loss when used along with lifestyle modification. Due to this, it may be used in obese adolescents who are diabetic or prediabetic [109]

Recommendation 6.0

6.6 Adjunct use of pharmacotherapy to a comprehensive lifestyle modification program may be recommended in adolescents ≥12 years of age having class 2 obesity with immediate or life-threatening comorbidities or class 3 obesity with or without comorbidities.
(*Grade B, Moderate recommendation*)

E. Surgical management of pediatric obesity

Severe obesity (class 2 and 3 obesity) presents with a significant risk of comorbidities and early mortality. Due to the significantly lesser success of intensive lifestyle and medical management in weight reduction, surgical weight loss options are being increasingly used.

It may be offered to children older than 12 with [5,110] Class 2 obesity with significant comorbidities (T2DM, MASLD, OSA, Blount disease, slipped capital femoral epiphyses, gastro-esophageal reflux disease, idiopathic intracranial hypertension, dyslipidemia, hypertension, disease-associated depression, etc.), and Class 3 obesity with or without comorbidities.

Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are the most used procedures. Minor complications (up-to 15%) and a few major complications (up to 8%) may be seen in the postoperative period. Nearly 25% may need a follow-up procedure [111,112]. SG is the more commonly used simpler procedure and is associated with fewer complications. RYGB is associated with an increased risk of anastomotic leakage, small bowel obstruction, cholelithiasis and micronutrient deficiency. Teen-LABS study has shown comparable outcomes of SG and RYGB with significant improvement in BMI and cardiovascular risk factors [113-115].

Micronutrient supplementation and adherence to comprehensive lifestyle changes post-surgery are needed for sustained long-term effects. All patients need to undergo a psychological assessment before surgery. It is contraindicated in the presence of a treatable cause of obesity, substance abuse, chronic medical illness, psychiatric illness, cognitive state that impairs compliance to post-operative regimens and inability to comprehend the risk/ benefits of the surgery. Completion of puberty or growth is no longer a contraindication to bariatric surgery. It is to be preferably done in a centre of excellence with facilities for post-operative management [110,111].

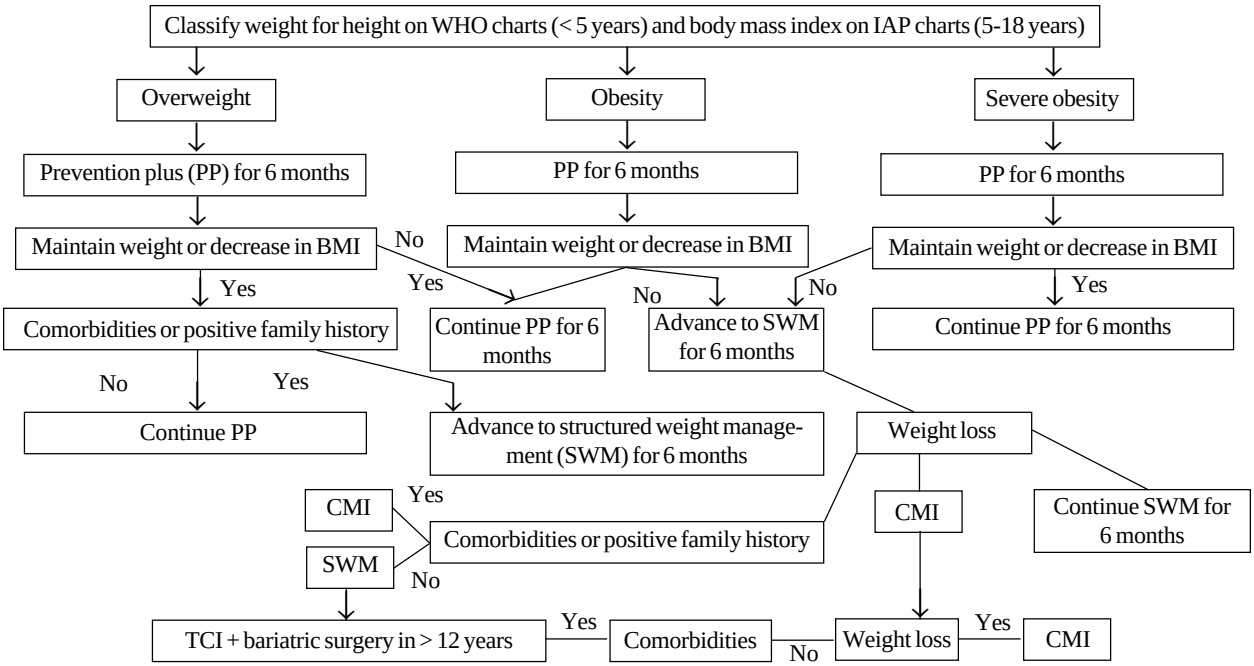
Table III Drugs Used for Treatment of Obesity

Drug and dosage	*Approval*	*Mechanism of action*	*Side effects*
Orlistat (120 mg PO TID)	FDA approved for obesity in ≥12 y of age	Gastrointestinal lipase inhibitor	Steatorrhea, abdominal cramps, fecal incontinence, flatulence, fat soluble vitamins deficiency
Liraglutide (2.4-3 mg/d SC)	FDA approved for obesity with or without type 2 diabetes in children ≥12 y of age	Glucagon like peptide-1 analogue which decreases gastric emptying, appetite suppressant	Vomiting, Nausea, abdominal Pain, diarrhea, constipation, dyspepsia, increased risk of medullary cell thyroid carcinoma (family history of MEN2 positive)
Semaglutide (2.4 mg/week, SC)	FDA approved for obesity in children ≥12 y of age	Glucagon like peptide-1 which decreases gastric emptying, appetite suppressant	Headache, abdominal pain, nausea, vomisting, diarrhea, gall stones, low blood pressure, rash
Phentermine (7.5mg-37.5mg PO)	FDA approved for short term use (12 weeks) in ≥16 y of age	Nor-epinephrine reuptake inhibitor	Hypertension, dizziness, headache, tremor, dry mouth, stomach-ache,Insomnia, tachycardia, constipation, diarrhea, vomiting, anxiety, restless
Topiramate (25-100 mg PO BID)	FDA approved for binge eating disorder ≥18y of age	Carbonic anhydrase inhibitor and suppress appetite centrally	Cognitive slowingTeratogenic
Metformin (250-1000 mg PO BD)	Not approved for treatment of obesity. Approved for ≥10 y of age for treatment of Type 2 diabetes. Adjunct use to prevent weight gain in girls with polycysctic ovarian syndrome and on antipsychotic medication	Reduces hepatic glucose production, decreases intestinal absorption of glucose & increases peripheral insulin sensitivity	GI complaints, nausea/vomiting, vitamin B12, diarrhea, bloating deficiency, lactic acidosis (rare)
Octreotide (5-15 ug/kg/day SC (divided in TID)	Not approved for treatment of obesity. Used in hypothalamic obesity		Gallstones, diarrhea, edema, abdominal cramps, nausea, bloating, reduction in thyroxine concentration Decreased growth hormone with normal IGF1
Leptin (Titration of doses to serum levels, SC)	Not approved Used only for leptin deficiency		Local reactions, headache, abdominal pain
Growth hormone (1-3 mg/m2 SC daily)	Not approved for obesity. FDA approved only in Prader Willi syndrome for linear growth		Edema, carpal tunnel syndrome
Melanocortin 4 Receptor agonist (Setmelanotide) (1-3 mg daily SC)	FDA approved in ≥6-year-olds with POMC deficiency, pro-protein subtilisin or kexin type 1 deficiency. and leptin receptor deficiency		Injection site reaction, nausea
Lisdexamfetamine	Not approved for treatment of obesity Used in binge eating disorder		Dry mouth, insomnia, tachycardia, constipation, anxiety

Recommendation 6.0

6.7 Surgical management may be offered in children older than 12 years of age with class 2 obesity and associated comorbidities or class 3 obesity with/without comorbidities only after failure of a proper trial of intense lifestyle modifications and pharmacotherapy for at least 6 months. (*Grade C, Moderate recommendation*)

A simplified algorithm in the management of childhood exogenous overweight and obesity (accounting for > 90% of cases) has been illustrated in **Fig. 1**.



CMI: Comprehensive multidisciplinary intervention. TCI: Tertiary care intervention.

Fig.1 Simplified algorithm for management of childhood exogenous overweight and obesity.

CONCLUSION

Pediatricians should recognize and treat pediatric obesity as a chronic disease. Exogenous or primary obesity is responsible for the majority of cases of childhood obesity. In Indian children under 5 years of age, weight for length/height using WHO charts and in children 5-18 years, BMI using IAP 2015 charts is used to diagnose overweight and obesity. Cutoffs for class 2 and class 3 obesity have been defined based on the IAP BMI charts. Waist circumference should be routinely measured in all overweight and obese children as it is a key measure of cardiometabolic risk. Routine evaluation for endocrine cause is only recommended in short and obese children with additional diagnostic clues. All obese children ≥10 years should be evaluated for comorbidities like hypertension, dyslipidemia, hyperglycemia and NAFLD (MASLD). Prevention and management of childhood obesity is primarily based on healthy diet, physical exercise and reduction in screen time. The prevention and management of pediatric obesity requires a multimodal staged approach involving caregivers including parents, family and school, HCPs or pediatricians, pediatric specialists, psychologists, counselors and nutritionists.

Contributors: All authors were part of the National Consultative Committee that formulated these guidelines. VK, NS and UK conceived the design and prepared the agenda. AB, SG, AG, KS and PS reviewed the literature for each section in detail and wrote the first draft of the respective sections. AA, SB, SC, JC, KE, RK, SM, HS, AS and ST moderated the draft recommendations of each respective section and provided critical inputs. RH was the invited expert who provided critical inputs for revision and participated in discussions VK, NS, UK and VS provided their inputs in the guidelines, participated in discussions and manuscript editing. All authors approved the final version

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Web Table I Extended Indian Academy of Pediatrics (IAP) Body Mass Index (BMI) Chart Percentiles for Girls Aged 5-18 Years

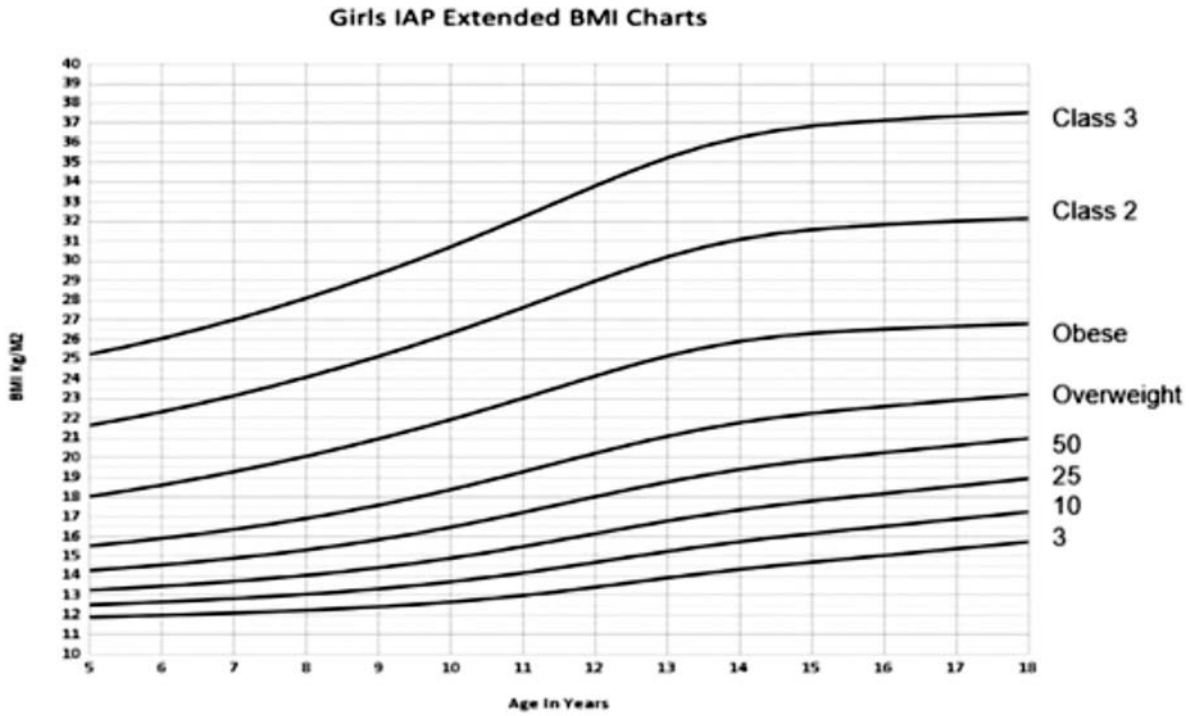
Age (y)	*3rd*	*10th*	*25th*	*50th*	*Overweight (23 adult equivalent)*	*Obesity (27 adult equivalent)*	*Class 2 obesity (≥120% to <140% of 27 adult equivalent)*	*Class 3 obesity (≥140% of 27 adult equivalent)*
5	11.9	12.5	13.3	14.3	15.5	18.0	21.6	25.2
5.5	11.9	12.6	13.4	14.4	15.7	18.3	22.0	25.6
6	12.0	12.7	13.5	14.5	15.9	18.6	22.3	26.1
6.5	12.1	12.8	13.6	14.7	16.1	18.9	22.7	26.5
7	12.1	12.8	13.7	14.9	16.4	19.3	23.1	27.0
7.5	12.2	12.9	13.9	15.1	16.6	19.7	23.6	27.5
8	12.3	13.1	14.0	15.3	16.9	20.1	24.1	28.1
8.5	12.3	13.2	14.2	15.6	17.2	20.5	24.6	28.7
9	12.4	13.3	14.4	15.8	17.6	21.0	25.1	29.3
9.5	12.5	13.5	14.6	16.1	18.0	21.4	25.7	30.0
10	12.7	13.7	14.9	16.5	18.4	21.9	26.3	30.7
10.5	12.8	13.9	15.2	16.8	18.8	22.5	27.0	31.5
11	13.0	14.1	15.5	17.2	19.3	23.0	27.6	32.2
11.5	13.2	14.4	15.8	17.6	19.8	23.6	28.3	33.0
12	13.4	14.7	16.1	18.0	20.2	24.1	29.0	33.8
12.5	13.7	15.0	16.5	18.4	20.7	24.7	29.6	34.6
13	13.9	15.2	16.8	18.8	21.1	25.2	30.2	35.2
13.5	14.1	15.5	17.1	19.1	21.5	25.6	30.7	35.8
14	14.3	15.7	17.3	19.4	21.8	25.9	31.1	36.3
14.5	14.5	16.0	17.6	19.7	22.0	26.2	31.4	36.6
15	14.7	16.1	17.8	19.9	22.3	26.3	31.6	36.8
15.5	14.9	16.3	18.0	20.1	22.4	26.4	31.7	37.0
16	15.0	16.5	18.2	20.3	22.6	26.5	31.8	37.1
16.5	15.2	16.7	18.4	20.4	22.8	26.6	31.9	37.3
17	15.4	16.9	18.6	20.6	22.9	26.7	32.0	37.3
17.5	15.5	17.1	18.7	20.8	23.1	26.7	32.1	37.4
18	15.7	17.3	18.9	21.0	23.2	26.8	32.2	37.5

Unpublished data.

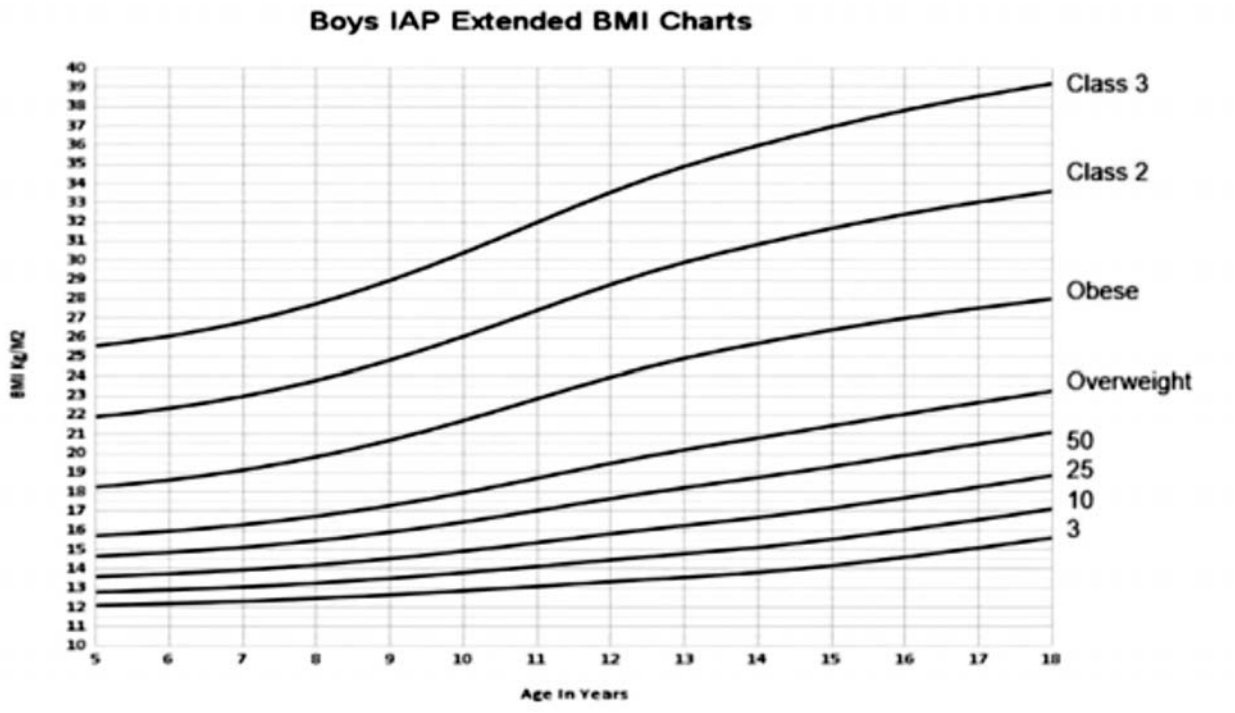
Web Table II Extended Indian Academy of Pediatrics (IAP) Body Mass Index (BMI) Chart Percentiles for Boys Aged 5-18 Years

Age (y)	*3rd*	*10th*	*25th*	*50th*	*Overweight (23 adult equivalent)*	*Obesity (27 adult equivalent)*	*Class 2 obesity (≥120% to <140% of 27 adult equivalent)*	*Class 3 obesity (≥140% of 27 adult equivalent)*
5	12.1	12.8	13.6	14.7	15.7	18.3	21.9	25.6
5.5	12.2	12.9	13.7	14.8	15.8	18.4	22.1	25.8
6	12.2	12.9	13.7	14.9	16.0	18.6	22.3	26.1
6.5	12.3	13.0	13.8	15.0	16.1	18.9	22.6	26.4
7	12.3	13.1	13.9	15.1	16.3	19.1	23.0	26.8
7.5	12.4	13.2	14.1	15.3	16.5	19.5	23.3	27.2
8	12.5	13.3	14.2	15.5	16.7	19.8	23.8	27.8
8.5	12.6	13.4	14.4	15.7	17.0	20.2	24.3	28.3
9	12.7	13.5	14.5	15.9	17.3	20.7	24.8	29.0
9.5	12.8	13.7	14.7	16.2	17.6	21.2	25.4	29.7
10	12.9	13.8	14.9	16.4	18.0	21.7	26.1	30.4
10.5	13.0	14.0	15.1	16.7	18.3	22.3	26.7	31.2
11	13.1	14.1	15.4	17.0	18.7	22.8	27.4	32.0
11.5	13.2	14.3	15.6	17.3	19.1	23.4	28.1	32.8
12	13.3	14.5	15.8	17.7	19.5	24.0	28.7	33.5
12.5	13.5	14.6	16.0	17.9	19.8	24.5	29.4	34.2
13	13.6	14.8	16.3	18.2	20.2	24.9	29.9	34.9
13.5	13.7	14.9	16.5	18.5	20.5	25.3	30.4	35.5
14	13.8	15.1	16.7	18.7	20.8	25.7	30.8	36.0
14.5	14.0	15.3	16.9	19.0	21.1	26.0	31.3	36.5
15	14.2	15.5	17.2	19.3	21.4	26.4	31.7	36.9
15.5	14.4	15.8	17.4	19.6	21.7	26.7	32.0	37.4
16	14.6	16.0	17.7	19.9	22.0	27.0	32.4	37.8
16.5	14.9	16.3	18.0	20.2	22.4	27.3	32.7	38.2
17	15.1	16.6	18.3	20.5	22.6	27.5	33.0	38.5
17.5	15.4	16.8	18.6	20.8	22.9	27.8	33.3	38.9
18	15.6	17.1	18.9	21.1	23.2	28.0	33.6	39.2

Unpublished data.



Web Fig. 1 Extended Indian Academy of Pediatrics (IAP) body mass index (BMI) chart for 5-18 years girls.



Web Fig.2 Extended Indian Academy of Pediatrics (IAP) body mass index (BMI) chart for 5-18 years boys.