

# ESI Clinical Practice Guidelines for the Evaluation and Management of Obesity In India

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 (on behalf of Endocrine Society of India)

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## Preamble

Obesity is a major health problem that increases the risk of multiple non communicable diseases such as diabetes, hypertension, and cardiovascular diseases. In India, as well as globally, the prevalence of obesity has been increasing rapidly. The management of obesity is complex and often unrewarding with respect to long-term weight loss. The management of obesity requires proper knowledge and training on the part of the health care providers. However, most health care providers either lack the required knowledge or do not feel confident in managing obesity. Considering the severity of the health problem, the Endocrine Society of India (ESI) has come up with clinical practice guidelines to provide guidance to doctors as well as paramedical staff who are interested in managing obesity in their patients.

## Methodology

The Executive Committee of the Endocrine Society of India appointed a writing committee for framing the guidelines. The members of the committee were chosen from endocrinologists involved in research as well as clinical care of obesity and related disorders. The writing committee was chaired by the Editor-in-Chief, *Indian Journal of Endocrinology and Metabolism*. The writing committee met on several occasions and came up with 14 sub-sections under which the guidelines would be formulated. Each member was then allotted one or more subsections in order to search the literature, including all existing literature, and suggest recommendations for that subsection. Each recommendation had two options: (a) Recommended care as the primary recommendation and (b) limited care recommendation for resource-limited settings. The recommendations are numbered as 1.1, 1.2, etc., where the first number indicates the subsection while the second denotes the serial number of the recommendation. The limited care recommendations are denoted by (L) after the recommendation number (such as 1.1 (L)). An abridged version of the document for primary care providers was also made. Once the members had completed the literature search and formulated the recommendations, all the subsections were compiled together and circulated amongst the committee members for their comments. Any corrections or suggestions by the other

committee members were incorporated into the document. The chairman of the writing committee approved this draft and forwarded it to the Executive Committee of the ESI. The members of the Executive Committee, consisting of national experts in the field of endocrinology, vetted the document and gave their inputs. After incorporation of these inputs, the draft was uploaded on the official website of ESI and inputs or suggestions were sought from all members of the ESI or any other stakeholder. The inputs were considered for inclusion as per their merit and relevance; the draft was then finalized for publication in the *Indian Journal of Endocrinology and Metabolism*.

## 1. INTRODUCTION

### 1a. Recognition of obesity as a chronic disease

One of the basic challenges to the successful management of obesity is the failure to consider obesity as a disease or chronic disease and as a challenge to modern medicine.

- First, the concept of obesity as a disease remains controversial, including among many health care workers
- Once the motivated person with obesity seeks care, expert facilities may not be available in their community.
  - Most physicians in primary care are ill-equipped to deliver the established high-intensity lifestyle treatments that can lead to lasting weight loss and improved health

#### Defining Obesity:

Obesity is a chronic, relapsing progressive disease defined by excessive adiposity that may impair health.<sup>[1]</sup>

Abundance of food, low physical activity, and genetics or environmental factors result in a positive energy balance. This excess energy is stored as fat.

American Association of Clinical Endocrinology (AACE) has coined a new term for obesity, i.e., ABCD or Adiposity-Based Chronic Disease, to underline the need to recognize it as a chronic disease.

The management of obesity should follow the approach that is followed for any chronic disease, viz., we need to initiate interventions (medical nutrition therapy, lifestyle changes and

behavior modification) and keep titrating these with time in order to achieve our treatment goals.

### **1b. Need for these clinical practice guidelines in the Indian setting**

Several studies have demonstrated a rising prevalence of overweight and obesity in our country over the last one or two decades. More importantly, the prevalence of abdominal obesity rates is also very high and is significant even in those with a normal body mass index (BMI). This thin-fat Indian phenotype is unique to India, which is associated with a higher insulin resistance and a greater risk of cardiometabolic abnormalities. Indians are also genetically predisposed to the metabolic consequences of obesity.

Childhood obesity has also shown a significant rise during this period which is a primary driver of obesity later in adulthood, adding to the already high burden of diabetes and cardiovascular diseases in our country. Also, obesity and overweight rates have varied widely across different states and regions within India. What has been consistently demonstrated has been the largely sedentary nature of Indians, with physical inactivity being highly prevalent in urban areas and among women.

India is a large country and, aside from the rural–urban divide, it is diverse in its lifestyle. There is a significant variation in dietary and physical activity patterns as well as cultural and religious beliefs that can have a huge impact on obesity management.

Obesity management in our country has been a neglected area and has remained unstructured and is, therefore, largely unsuccessful and frustrating to the patient and the physician alike.

Clearly, there is an urgent need for concerted efforts to tackle obesity in our country, if we have to significantly halt the rising burden of cardiometabolic disorders. Thus, there is also an urgent need for structured and evidence-based clinical practice guidelines for the management of obesity that addresses the specific needs of the Indian context, as summarized above, and that can see the emergence of focused obesity care in our country.

**Recommendations:**

1.1 Obesity should be considered as a chronic disease and not a risk factor.

**Limited care recommendations:**

1.1(L) Obesity should be considered as a chronic disease and not a risk factor.

## **2. PREVALENCE OF OBESITY IN INDIA**

### **2a. National data: Prevalence in different states and regions**

Overweight and obesity are some of the biggest challenges that are faced by modern medicine today. The prevalence of people

living with either overweight or obesity worldwide has almost tripled from 1975 to 2016.<sup>[2]</sup> In 2016, globally, more than a third of adults were overweight and about 12% obese.<sup>[3]</sup> This translates to 1.9 billion adults in this age group with overweight and over 650 million with obesity. Childhood and adolescent obesity are also on the rise.

Prevalence of generalized obesity as well as of abdominal obesity were reported to be 20% and 23.7%, respectively, in India by the INDIAB-ICMR investigators in 2015.<sup>[4]</sup> Obesity rates a decade earlier were 16.5% for men and 14.5% for women,<sup>[2]</sup> suggesting a 25% increase in this period. The INDIAB-ICMR study also showed that 54.5% of Indians were physically inactive, with those from urban areas (60%) more inactive than their rural (50%) counterparts and women more than men.<sup>[5]</sup>

More recent studies from different parts of India have reported similar or higher prevalence of obesity and abdominal obesity. The Delhi Urban Diabetes Survey (DUDS) in 2018<sup>[6]</sup> found alarmingly high rates of both overweight or generalized obesity (79.5%) and abdominal obesity (71%) in a middle-class urban metro city. Another study from Delhi also detected significantly high rates of overweight or obesity (approximately 60%) and central obesity (70%) among women, while corresponding figures among nurses were over 80%.<sup>[7]</sup>

A secondary data analysis of the National Family Health Surveys (NHFS) in India using Asia-specific cutoffs found that 34.4% of men and 36.2% of women over the age of 18 years were living with overweight or obesity as of 2015–16.<sup>[8]</sup> It also documented the rising prevalence of obesity in India from what was observed in NHFS III earlier in 2005–6, both in urban as well as rural areas. Older age, higher education, richest wealth quintile, and living in urban areas were the strongest predictors of being overweight or obese. Factors such as unhealthy diet pattern, sedentary lifestyle, odd and prolonged working hours and stress add to the risk in urban areas. In an earlier study, prevalence rates were shown to increase with age, decreasing physical activity, and higher socioeconomic status.<sup>[9]</sup>

### ***Regional variation within India***

There is significant regional variation within India, and prevalence for generalized and abdominal obesity<sup>[4]</sup> varies from 11.5% and 16.5% in Jharkhand to 31.5% and 37% in Chandigarh, with Maharashtra (15.6% and 17.3%) and Tamil Nadu (24% and 25.5%) in between. The NHFS IV data also showed considerable regional variation<sup>[8]</sup>: prevalence of overweight and obesity was highest at over 50%–55% in Kerala, Punjab, Goa, Delhi, Tamil Nadu and Sikkim, while it was the lowest in Jharkhand, Bihar, Chhattisgarh and Madhya Pradesh at 23%–27% in the mainland states and in Assam and Meghalaya in the North East at about 27%–30%.

### ***Obesity prevalence in rural India***

Two studies from rural India<sup>[10,11]</sup> show clearly that the prevalence of obesity and central obesity is high even in these

communities. Rural parts of western India were reported in 2020 to have a 16.5% prevalence of overweight and 24.6% prevalence of obesity. Abdominal obesity was over 30% in both men and women.<sup>[10]</sup> Obesity (BMI >25 kg/m<sup>2</sup>) was found in over 50% of adults in rural Kerala,<sup>[11]</sup> a third of whom had normal weight obesity.

## **2b. Prevalence across different age groups: Children, adults, and the elderly**

### *Obesity in children*

At least 30% of obesity begins in childhood. Conversely, 50%–80% of obese children become obese adults. The older a child when they remain overweight, the greater is the likelihood that it will persist in adulthood. Hence it is very important to identify and manage childhood obesity.<sup>[12]</sup>

Childhood obesity has been on the rise in the last three decades. Most studies among schoolchildren between 1990 and 2010 reported a prevalence of obesity of less than 10% and overweight of 12%–22%. This was regardless of whether the children were from Delhi<sup>[13–16]</sup> or Chandigarh<sup>[17]</sup> in the north, Chennai in the south,<sup>[19]</sup> Pune<sup>[18]</sup> in the west or Bengal in the east.<sup>[19]</sup>

More recent studies on childhood obesity clearly show a continuing trend of a rising prevalence of obesity in children. The high burden of obesity and abdominal obesity in urban Indian schoolchildren was confirmed in a large multi-center study from different parts of India<sup>[20]</sup> and was found to be higher in girls and among adolescents.<sup>[21]</sup>

Factors implicated in the rise of childhood obesity in India include lifestyle factors such as unhealthy eating patterns, sedentary habits of children, such as watching TV, internet surfing, videogaming and restricted playtime, as well as genetic and constitutional factors, such as early life programming, high rates of Gestational diabetes mellitus (GDM) and familial patterns of eating and exercising behaviors.<sup>[12]</sup>

### *Obesity among pre-adolescents and adolescents in India*

In Chandigarh in 2020,<sup>[22]</sup> 9.3% and 4.9% of adolescent schoolchildren were found to be overweight and obese, respectively, but abdominal obesity was far higher at 39.3%. Higher levels of obesity and abdominal obesity are associated with hyperinsulinemia and insulin resistance in Asian Indian children and adolescents.<sup>[23,24]</sup>

### *Obesity in women in the reproductive age group and after menopause*

An analysis of females of reproductive age observed that 22.6% of women were overweight and 10.7% were obese.<sup>[25]</sup> Obesity rates reported recently in menopausal women aged 40–60 years<sup>[26]</sup> showed that these were high even in rural areas at about 35.5% overall, of which 26% were overweight and 9.5% obese.

### *Conclusions*

The prevalence of obesity and abdominal obesity is rising to alarming levels, particularly in urban India with rural

India fast catching up. High obesity rates among children and adolescents are particularly disturbing and highlight the need for focused attention in this group. The wide variation in prevalence of obesity and overweight across different states of India with a higher potential for obesity-related comorbidities suggest that at a national level particular attention must be paid to these states from a public health point of view.

### Recommendations:

- 2.1 A rapid increase in the prevalence of obesity in India warrants urgent attention of all involved stakeholders to work together toward the prevention and management of obesity.

### Limited care recommendations:

- 2.1 (L) A rapid increase in the prevalence of obesity in India warrants urgent attention of all involved stakeholders to work together toward the prevention and management of obesity.

## **3. UNIQUE INDIAN THIN–FAT PHENOTYPE**

South Asian ethnicity is known to have a unique phenotype known as the thin–fat obesity, wherein individuals have a significantly higher fat content despite an apparently smaller body frame.<sup>[27,28]</sup> This was first depicted in the famous lancet paper called “The Y-Y Paradox” wherein Dr Yajnik, a physician of Indian origin, had almost double the body fat percentage as compared to Dr Yudkin, a physician of Caucasian origin, who had the exact same BMI.<sup>[29]</sup> This has been shown in several other studies from India and has been called by different names, such as normal weight obesity, metabolic obesity, skinny fat and thin–fat phenotype. The prevalence of normal weight obesity has been found to be about 15% in Chennai and about 16% in Mumbai.<sup>[30,31]</sup> In another recent study from Kerala, the prevalence among high diabetes risk individuals was found to be about 30% of the population.<sup>[11]</sup> But the prevalence of diabetes, hypertension and dyslipidemia in individuals with normal weight obesity was found to be similar to those with overt obesity and significantly higher than individuals with normal weight and normal body fat. There is emerging evidence on the impact of lifestyle and other interventions in people with obesity. At present, limited literature is available which suggests that individuals with normal weight obesity are more resistant to improvement but do improve following lifestyle interventions.<sup>[32]</sup> Emerging data from randomized clinical trials using GLP-1 analogues seem to be effective in reducing weight and improving glycemic control in the subset of patients from the South East Asian region.<sup>[33]</sup>

### Recommendations:

- 3.1 A significant population in the South Asian setting is noted to have normal weight obesity.
- 3.2 The cardiometabolic risk in individuals with normal weight obesity is at par with those with an overt phenotype of obesity

3.3 Emerging literature suggests slow but a favorable response to lifestyle intervention in people with normal weight obesity

Limited care recommendations:

- 3.1 (L) A significant population in the South Asian setting is noted to have normal weight obesity.
- 3.2 (L) The cardiometabolic risk in individuals with normal weight obesity is at par with those with an overt phenotype of obesity
- 3.3(L) Emerging literature suggests slow but a favorable response to lifestyle intervention in people with normal weight obesity

## 4. DIAGNOSIS OF OBESITY: IDENTIFICATION AND CLASSIFICATION

### 4a. Classification of obesity in adults and children

Several definitions [Table 1] and classifications [Table 2] have been proposed to define obesity in the Indian population.<sup>[34]</sup>

Beyond the above-mentioned conventionally used obesity indicators, several others like waist–height ratio, neck circumference, wrist circumference, etc., have also been proposed or used in the Indian setting. In a study on over 500 subjects from New Delhi, waist circumference and waist–height ratio (WHtR) were the best predictors of metabolic disorders in the north Indian population.<sup>[35]</sup> WHtR also appeared to be the best predictor of hypertension in both genders, particularly in women. In another population-based study from southern India, waist circumference, waist–height ratio and waist–hip ratio stood as the best predictors of underlying diabetes as opposed to other indicators.<sup>[36]</sup> Neck circumference of ≥37 cm in males and ≥34 cm in females and the ratio of neck circumference and height has also

been shown to be a good predictor of metabolic syndrome in the Indian population.<sup>[37]</sup> Other studies in India have also validated the use of surrogate measures like Metabolic Score for Visceral Fat (METS-VF) to assess visceral adipose tissue. A METS-VF value of 7.3 was found to have a good sensitivity and reasonable specificity in predicting elevated Visceral adipose tissue (VAT) in this population.<sup>[38]</sup>

### 4b Assessment of obesity beyond numbers

Despite, several cut-points, noted for different obesity indicators across several ethnicities, the evaluation of obesity is currently moving away from just evaluating it on the basis of numbers and cut points, but towards incorporating all comorbidities as well. Edmonton Obesity Staging System is an example of such a clinical staging system.<sup>[38]</sup> This incorporates each of the medical, functional and psychological aspects in the evaluation of obesity and has been endorsed by the recently published clinical practice guidelines by the Canadian Obesity Network.<sup>[39]</sup> The advantage of using this system against the conventional use of BMI is that it can not only predict mortality in a much efficient way, but can also be used to suggest a plan for management of obesity as well.<sup>[40]</sup> In the Indian setting, data from a tertiary care centre suggests that 68% of the patient population belongs to the stage 3 and 4.<sup>[38]</sup> [Table 3].

Recommendations:

- 4.1 We recommend the use of body fat measurement, when feasible, in addition to other anthropometric parameters (like waist circumference, neck circumference, wrist circumference and BMI) for assessment and follow-up of patients seeking obesity management.
- 4.2 We recommend the use of more comprehensive clinical staging systems like the Edmonton Obesity Staging System for clinical staging, assessment and management of obesity in current day practice.

Limited care recommendations:

- 4.1(L) Body mass index (BMI), though convenient, is not the best way to assess obesity in the Indian setting. Centripetal assessment with parameters using waist circumference and waist–hip ratio have been validated and shown to be better predictors in the Indian setting. In limited care settings, if BMI is used, we recommend the use of lower cutoffs of BMI, as mentioned in Table 2, to be used in the Indian setting. Novel methods of obesity assessment like neck circumference, wrist circumference, and body fat assessment are being validated in the Indian settings and could be used if available.
- 4.2(L) We recommend the use of more comprehensive clinical staging systems like the Edmonton Obesity Staging System for clinical staging, assessment and management of obesity in current day practice.

## 5. ETIOLOGICAL EVALUATION OF OBESITY

As adapted from the Canadian Obesity Network guidelines, the root cause of obesity needs to be identified in each patient,

**Table 1: Obesity indicators used to define obesity**

Parameter studied	Criteria for overweight/obesity
Body mass index	≥23 kg/m <sup>2</sup> (over weight); ≥25 kg/m <sup>2</sup> (obesity)
Waist circumference	>90 cm in men and >80 cm in women
Waist-hip ratio	0.9 in men and 0.8 in women
Body fat percentage*	>25% in men and >30% in women

\* As measured by dual-energy X-ray absorptiometry (DXA)

**Table 2: Criteria for using body mass index (BMI) as a measure of obesity in children and adults**

Category	Children		Adults	
	BMI	Percentile	BMI	kg/m <sup>2</sup>
Underweight	BMI <5 <sup>th</sup> percentile of age		<18.5	kg/m <sup>2</sup>
Normal weight	BMI ≥5 <sup>th</sup> to 85 <sup>th</sup> percentile of age		18.5-22.9	kg/m <sup>2</sup>
Overweight	BMI ≥85 <sup>th</sup> to 95 <sup>th</sup> percentile of age		23-24.9	kg/m <sup>2</sup>
Obesity	BMI ≥95 <sup>th</sup> percentile of age		Obesity grade 1 Obesity grade 2 Obesity grade 3	25-29.9 kg/m <sup>2</sup> 30-34.9 kg/m <sup>2</sup> >35 kg/m <sup>2</sup>

**Table 3: The utility of Edmonton Obesity Staging System in therapeutic decision-making**

Stage	Description	Level of Prevention	Management
0	No apparent obesity-related risk factors, physical symptoms, psychopathology, functional limitations and/or impairment of well-being.	Primordial/No intervention	Identification of risk factors for weight gain and encouraging healthy eating and physical activity.
1	Subclinical obesity risk factors (including biochemical), physical symptoms, psychopathology, functional limitations and/or well-being mildly impaired.	Primordial	Identification and correction of risk factors and encouraging healthy eating and physical activity.
2	Established obesity and related chronic diseases, moderate limitations in activities of daily living and/or well-being	Primary	Behavioral therapy with supportive medication therapy for biochemical abnormalities and comorbidities
3	Established end-organ damage, significant psychopathology, significant functional limitations, and/or well-being impairment	Secondary	Medical therapy/bariatric surgery
4	Severe (potentially end-stage) disabilities from obesity-related chronic diseases, disabling psychopathology, functional limitations, and/or well-being impairment	Tertiary	Bariatric surgery

as only once it is assessed appropriately that it will become possible to target that particular aspect, and thereby not only help weight loss but more importantly, attain long-term weight maintenance.<sup>[39]</sup>

The three domains that need to be assessed for the etiological evaluation of obesity include causes of slow metabolism, increased dietary intake and limited physical activity. These have been summarized in Table 4.

Though exogenous obesity is common, globally, about 5% of patients with obesity may have an underlying genetic component significantly contributing to obesity. This is likely to be more common in the South Asian region as we still have large pockets of consanguineous marriages that happen in India.<sup>[41]</sup> In other South Asian countries only three monogenic causes (LEP, LEPR and MC4R mutations) could be attributed to 30% of children with obesity in the presence of consanguinity.<sup>[42]</sup> The key indications for doing a genetic test in individuals with severe obesity are summarized in Table 5.

The treating physician should also rule out secondary causes of obesity and associated endocrinopathies.<sup>[43]</sup> These have been summarized in the Table 6.

#### Recommendations:

- 5.1 The key cause of weight gain should be identified in each individual seeking evaluation for obesity. These could be screened under the domains of slow metabolism, limited physical activity and increased caloric intake.
- 5.2 The endocrinopathies and underlying genetic testing should be asked if indicated.

#### Limited care recommendations:

- 5.1 (L) The key cause of weight gain should be identified in each individual seeking evaluation for obesity. These could be screened under the domains of slow metabolism, limited physical activity and increased caloric intake.

**Table 4: Etiological evaluation of obesity**

Pathophysiology of weight gain	Possible factors contributing to weight gain in a given patient
Slow metabolic rate	Age, ethnicity, medications, endocrinopathies, sarcopenia, recent weight loss, genetic makeup
Increased caloric intake	Sociocultural environment, emotional eating, psychological disorders, medications, poor knowledge of high caloric foods, poor food preparation techniques, non-timely eating pattern
Decreased physical activity	Sociocultural environment, surrounding environment, emotional factors, physical limitations, medications

**Table 5: Indications of performing a genetic test in a patient with obesity**

- 1) Age of onset of obesity <10 years of age
- 2) Presence of morbid obesity
- 3) Family history of consanguinity
- 4) Family history of young onset obesity
- 5) History of hyperphagia
- 6) Mild or moderate developmental delay
- 7) Clinically evident visual impairment or hearing defects
- 8) Macrocephaly

## 6. ASSESSMENT OF COMORBIDITIES

A patient with obesity should be assessed both clinically and biochemically for different comorbidities associated with obesity [Table 7]. These should not be just limited to the metabolic comorbidities but could encompass mechanical and psychological associations as well.<sup>[39]</sup> These have been summarized in the table. Based on several studies from the Indian subcontinent, these comorbidities are often found equal to or even in more frequency than the western counterparts.

The key investigations that should be considered while evaluating a patient with obesity are summarized in Table 8. These are only suggested investigations to be chosen from case-to-case basis and not all tests are required for all patients with obesity.

**Table 6: Endocrine evaluation in a patient with obesity**

Gland	Prevalence in obesity	When to assess	First diagnostic procedure	Other mandatory workup in obesity	Not recommended in obesity
Thyroid	Severe hypothyroidism is rare but subclinical hypothyroidism is common	Thyroid function should be tested in all patients with clinical suspicion of hypothyroidism, those having resistant obesity, and those undergoing procedures for weight loss	TSH	Free T4 and antibodies (anti-TPO) should be measured only if TSH is elevated	Routine FT3 in patients with elevated TSH; Routine ultrasound of the thyroid gland (irrespective of thyroid function)
Adrenal	Cushing's disease or Cushing's syndrome is rare	Central obesity; Hypertension; Classic striae; Facial plethora; Proximal myopathy; Purpura	1 mg ODST	24-hr urine cortisol or late-night salivary cortisol in patients with positive 1 mg overnight dexamethasone suppression test; Imaging (find the cause/source) and ACTH in patients with confirmed hypercortisolism	Routine testing for hypercortisolism
	Drug-induced adrenal dysfunction (e.g., glucocorticoids) is common	Biochemical testing should be performed in patients with clinical suspicion of hypercortisolism; those undergoing bariatric surgery, or having psychiatric disorders	8 am cortisol		Testing for hypercortisolism in patients using corticosteroids
Male gonad	Androgen deficiency is common	Severe obesity; Symptoms and signs of hypogonadism	LH, FSH, fasting morning testosterone	Total and free testosterone (or calculated), SHBG in patients with clinical features of hypogonadism	Routine biochemical testing for hypogonadism unless key clinical symptoms or signs of hypogonadism
Female gonad	Androgen excess is common	Central obesity; Irregular menses; Hirsutism; Acanthosis nigricans chronic anovulation/infertility	LH, FSH, estradiol, testosterone	Total testosterone, SHBG, $\Delta$ 4androstenedione, 17-hydroxyprogesterone and prolactin in patients with menstrual irregularities (assess in early follicular phase if menstrual cycle is predictable); Ovarian morphology	Routine testing for gonadal dysfunction
Pituitary	GH deficiency is rare	Clinical features of PCOS	Total testosterone, free T, $\Delta$ 4androstenedion, SHBG and blood glucose	IGF1/GH using a dynamic test only in patients with suspected hypopituitarism	Routine testing for IGF1/GH
	Hypopituitarism is rare	Hypothalamic or pituitary disease, pituitary or hypothalamic surgery or radiation therapy	FT4 TSH LH FSH (testosterone or estradiol); GH IGF-1 PRL; ACTH stimulation test; GH stimulation test		
	Acquired hypothalamic obesity (hypothalamic lesions or, tumors) is rare	Severe hyperphagia; Possible multiple endocrine abnormalities	Brain CT/MRI		

Contd...

**Table 6: Contd...**

Gland	Prevalence in obesity	When to assess	First diagnostic procedure	Other mandatory workup in obesity	Not recommended in obesity
Parathyroid	Pseudohypoparathyroidism type 1a (Albright hereditary osteodystrophy) is rare	Short stature, short fourth metacarpal bones, obesity, s.c. calcifications, developmental delay	PTH↑calcium↓phosphate ↑		Routine testing for hyperparathyroidism or Vitamin D deficiency
Syndromic obesity	Hypothalamic obesity associated with Genetic Syndromes is very rare	Hypogonadism (hypogonadism or hypergonadotropic) or variable gonadal function; dysmorphic syndrome, mental and grow retardation	Leptin (leptin resistance); genetic testing	Routine testing of hormones such as leptin and ghrelin in patients with suspicion of syndromic obesity	

Abbreviations: ACTH, Adrenocorticotrophic hormone; FSH, Follicle-stimulating hormone; FT4, Free thyroxine; GH, Growth hormone; IGF, Insulin-like growth factor; LH, Luteinizing hormone; MC4R, Melanocortin receptor 4; ODST, Overnight dexamethasone suppression test; PCSK, Proprotein convertase subtilisin/kexin; PTH, Parathyroid hormone; TSH, Thyroid-stimulating hormone

**Table 7: Comorbidity assessment in a patient with obesity**

Metabolic comorbidities	Type 2 diabetes mellitus, hypertension, dyslipidemia, hyperuricemia, non-alcoholic fatty liver disease, cholelithiasis and polycystic ovary syndrome
Mechanical impact	Osteoarthritis, obstructive sleep apnea, venous stasis, acid reflux, bladder incontinence and plantar fasciitis
Psychological impact	Depression, eating disorders, addictions, psychosis, attention deficit, insomnia, posttraumatic stress disorder.

**Table 8: Proposed set of investigations in a patient with obesity**

Fasting, Post prandial blood glucose, HbA1c, Creatinine, Fasting lipid profile, TSH, Assessment of cortisol axis, Liver function tests, Serum electrolytes,
Uric acid
Chest X-ray, ECG*
Body composition analysis (using DXA scan)*
Ultrasound abdomen/Upper GI endoscopy*
Sleep apnea assessment*
If diabetic, assessment of its complications*

\*In selected patients

#### Recommendations:

- 6.1 A comprehensive assessment of obesity-related comorbidities should be done, including metabolic, mechanical and psychological assessments [Table 7].
- 6.2 The investigations for a patient with obesity should be customized for a given patient and decided by clinical and social parameters [Table 8].

#### Limited care recommendations:

- 6.1(L) A comprehensive clinical assessment of obesity-related comorbidities should be done, including metabolic, mechanical and psychological assessments [Table 7]
- 6.2(L) Fasting and post prandial blood glucose, creatinine, low density lipoprotein and serum glutamic pyruvic

transaminase (SGPT) should be tested in all patients with obesity.

## 7. TREATMENT OF OBESITY

### 7a. Realistic goal setting

The realistic goals of weight management should be aimed at

- Preventing further weight gain
- Reducing bodyweight
  - Short-term goal: 5–10%, or 0.5 to 1 kg per week of weight loss.
  - Interim goal: Maintenance of reduced weight
  - Long-term goal: Additional weight loss, if desired.
- Maintenance: The achieved lower bodyweight over long term

The goals and weight loss targets are summarized in Tables 9 and 10. Weight management strategies need to be customized based on patient-centric cut-points [Table 11]. Moreover, in certain populations (such as those with eating disorders, pregnancy, organ failures and those receiving chemotherapy) the targets need to be individualized.<sup>[44]</sup>

### 7b. Dietary changes reduction in energy intake

#### Definition

Medical nutrition therapy (MNT) is defined as a process and provision of nutritional assessment, counselling, advice (dietary, nutritional and culinary) and follow-up for prevention and/or management of obesity by a qualified or trained health care provider.<sup>[34]</sup>

Challenges of providing medical nutrition therapy in India<sup>[49]</sup>:

- In India, MNT is pay from pocket and is not covered by insurance.
- Lack of Individualized MNT for obesity (mostly MNT is provided as pre-printed diet charts)
- Lack of awareness among physicians about the importance of MNT.
- Less number of trained and registered nutritionists.

**Recommendations:**

- 7.1 The three steps for an effective, individualized and patient-centric MNT for obesity include [Figure 1]<sup>[34]</sup>
- A) Understanding the current dietary practices of the individual and family
  - B) Individualized dietary planning
  - C) Careful follow-up
- 7.2 For better adherence and compliance by the patient, MNT should follow the 7As principles. It should be appropriate, accurate as per the patient's requirement, easily absorbed, and should be affordable, easily accessible, acceptable and attractive for the patient [Figure 2].<sup>[49,50]</sup>
- 7.3 MNT should be appealing to all five human senses (vision, smell, taste, touch, and hearing) as per the 'Degustation Pentad' [Figure 3] proposed by Dr Kalra and colleagues.<sup>[51]</sup>
- 7.4 A hypo-caloric diet with reduced portion size is

**Table 9: Goals for obesity management**

The goals of obesity management are to keep the patient metabolically healthy, managing the comorbidities, restoring self-esteem, positive body image and avoiding stigmatization.

Weight loss should not be the only goal for comprehensive obesity management.

Weight loss is targeted toward reducing cardiometabolic risk factors and associated comorbidities.

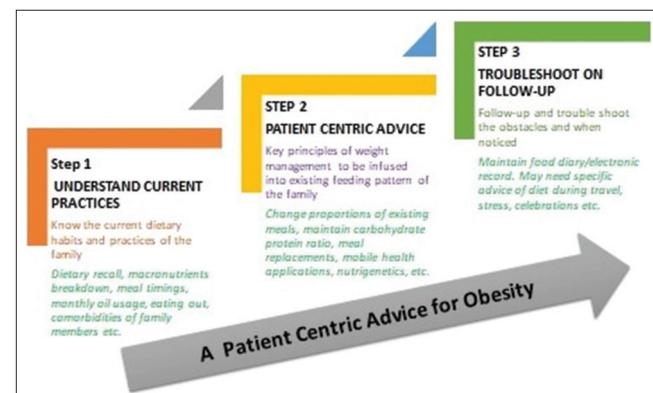
Shared decision-making, realistic and individualized targets for weight loss of 5%-15% in medium- and long-term should be the goal.

The final weight targets should be SMART (specific, measurable, achievable, rewarding and timely)

**Table 10: Weight loss targets based on comorbidities<sup>[45]</sup>**

Disease	Weight loss in %	Expected outcome
Type 2 diabetes mellitus	5-15	Reduction in HbA1c, reduction in drugs, reversal of diabetes
Metabolic syndrome	7-10	Prevention of diabetes
NAFLD	7-10	Reduction in intrahepatocyte fat and NASH resolution (64%-90%) <sup>[46]</sup>
PCOS	5-15	Ovulation, reduction in insulin resistance and hirsutism
Dyslipidemia	5-15	Reduction in triglyceride and LDL, rise in HDL
Hypertension	5-15	Lower blood pressure and decreased medications
Sleep apnea	7-11	Decrease in apnea and hypopnea index

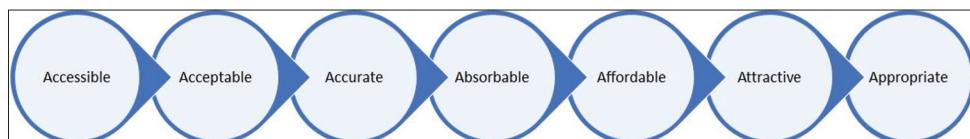
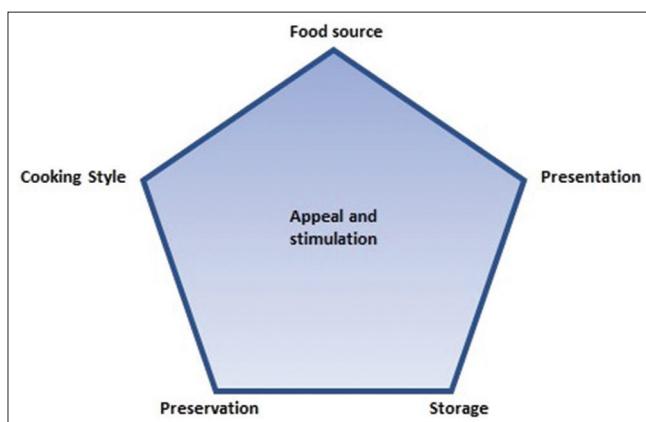
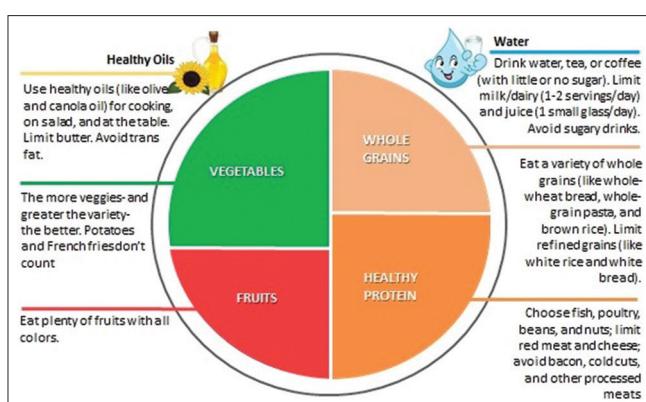
- recommended for people living with overweight or obesity.
- 7.5 MNT should have the "biomedical triplet" or macro-nutrient (carbohydrate, protein and fat) balance correct and should have recommended micronutrients. The nutrient composition of MNT for weight management has been depicted in Table 12. The plate model can be used to control portion size of different major macronutrients [Figure 4].
- 7.6 Culinary diversity, economic status and food preferences of the person should be kept in mind.
- 7.7 Mindful and slow eating, eating only in response to sensation of hunger and avoidance of frequent snacking and skipping of meals are recommended.
- 7.8 Patients should be encouraged to maintain food diaries and journals. This helps understand food patterns, emotional eating patterns, and patients' perceptions and behaviors toward food.
- 7.9 Any eating disorders should be identified and treated on priority through proper education, counselling and pharmacotherapy.
- 7.10 The prescribed nutrition therapy should be compatible with other comorbidities like diabetes, dyslipidemia, chronic kidney disease, celiac disease and hyperuricemia.
- 7.11 Indications for formula MNT are limited. However, they can be prescribed in the following circumstances:
- Patients who have a busy lifestyle, or who are not willing to adhere to a strict diet regime.
  - Macronutrient imbalance in available diet.
  - Limited access to healthy cooking.

**Figure 1: A step-wise approach to effective MNT****Table 11: BMI cutoffs for management of obesity in South Asians<sup>[47,48]</sup>**

BMI of Asian in kg/m <sup>2</sup>	23-24.9 Overweight	25-26.9 Grade I	27-29.9 Grade I	30-34.9 Grade II	≥37.5 Grade III
Therapy					
Diet, exercise, behavioral therapy	✓	✓	✓	✓	✓
Pharmacotherapy		✓	✓	✓	✓
		If comorbidities			
Bariatric surgery				✓	✓
				If comorbidities	

**Table 12: Nutrient distribution in MNT for weight management**

Carbohydrates	Protein	Fats	Micronutrients
Carbohydrate content of the food should be 50%-60% Current carbohydrate intake to be reduced by 10-15% High-fiber and low-glycemic index diet Complex carbohydrates should be preferred over simple carbohydrates. Food choices should have low GI. High-fiber diet should be consumed (15-40 gm/day). Simple sugars are to be avoided.	Adequate protein intake should be ensured as most of the Indian diets have less than the daily recommended allowance of protein. Try to increase the current protein intake by 10% to a maximum of 1 gm/kg bodyweight/day. Typically 15-20% of total energy in individuals	20%-25% total daily calories. Restricted intake of saturated fats: <7% total daily calories. Minimal intake of trans fats (hydrogenated vegetable fats). Restricted intake of dietary cholesterol: <300 mg/day. Fatty foods should be reduced, especially saturated fats. Selection of correct oils (PUFA and MUFA) and cooking methods (steaming, baking, shallow-fat frying, low-fat cooking, etc.) should be advised.	Ensure adequate micronutrient intake through diet and exogenous sources. Restricted intake of dietary salt: ≤6 g/day. Moderate alcohol consumption; cessation of any form of tobacco use

**Figure 2:** An approach for MNT**Figure 3:** Degustation entad**Figure 4:** The plate model

- Those who have difficulty in calculating calories.
- Those having chewing, swallowing or dextromotor limitations and high glycemic variability

#### Limited care recommendations:

- 7.1 (L) The three steps for an effective, individualized and patient-centric MNT for obesity include [Figure 1]<sup>[34]</sup>
- A) Understanding the current dietary practices of the individual and family
  - B) Individualized dietary planning
  - C) Careful follow-up.
- 7.2 (L) For better adherence and compliance by the patient, MNT should follow the 7As principle. It should be appropriate, accurate as per the patient's requirement, easily absorbed, and should be affordable, easily accessible, acceptable and attractive for the patient [Figure 2].<sup>[49,50]</sup>
- 7.3 (L) MNT should be appealing to all five human senses (vision, smell, taste, touch, and hearing) as per the 'Degustation Pentad' [Figure 3] proposed by Dr Kalra and colleagues.<sup>[51]</sup>
- 7.4 (L) A hypo-caloric diet with reduced portion size is recommended for people living with overweight or obesity.
- 7.5 (L) MNT should have the correct balance of the "biomedical triplet" or macronutrients (carbohydrate, protein and fat) and should have the recommended micronutrients. The nutrient composition of MNT for weight management has been depicted in Table 12. The plate model can be used to control portion size of different major macronutrients [Figure 4].
- 7.6 (L) Culinary diversity, economic status and food preferences of the person should be kept in mind.
- 7.7(L) Mindful and slow eating, eating only in response to the sensation of hunger and avoidance of frequent snacking and skipping of meals are recommended.

- 7.8 (L) Patients should be encouraged to maintain food diaries and journals. This helps understand food patterns, emotional eating patterns, and patients' perceptions and behaviors toward food.
- 7.9 (L) Any eating disorders should be identified and treated on priority through proper education, counseling and pharmacotherapy.
- 7.10 (L) The prescribed nutrition therapy should be compatible with other comorbidities like diabetes, dyslipidemia, chronic kidney disease, celiac disease and hyperuricemia.

### **7c. Increasing physical activity and life style interventions**

#### *Definition*

Physical activity is defined as any body movement produced by the skeletal muscles that results in energy expenditure beyond resting energy expenditure.

Exercise is referred to as a physical activity that is planned, structured, repetitive and purposeful, aimed at improving or maintaining physical fitness.

Aims of physical activity and exercise<sup>[50]</sup>:

- Causes modest weight reduction
- Preserving fat-free mass and maintaining weight
- Promotes cardio-respiratory fitness and reduces cardiovascular risk

Recommendations<sup>[39,51,52]</sup>:

- 7.12 Physical activity counselling should be an integral part of obesity management. This should include advice on building physical activity in everyday life and supervised, structured exercise program under the guidance of an expert.
- 7.13 Physical activity must be individualized on the basis of the person's abilities and comorbidities.
- 7.14 Structured exercise levels should be gradually stepped up to levels that are safe for the patient.
- 7.15 Pre-participation medical consultation is recommended for those with chronic conditions or those who are symptomatic.
- 7.16 Aerobic physical activity (30–60 minutes of moderate to vigorous intensity on most days of the week) will help in
  - Modest amounts of bodyweight and fat loss
  - Reduction in visceral fat and ectopic fat even in the absence of weight loss<sup>[51]</sup>
  - Weight maintenance and fat-free mass after weight loss
  - Increase cardiorespiratory fitness and mobility
- 7.17 There is a dose-response relationship between physical activity and health. High-intensity interval training can help increase cardio respiratory fitness, and achieve fat-free muscle mass.
- 7.18 Adults can increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity, or 150 minutes a week of vigorous-intensity aerobic physical activity.
- 7.19 Resistance training may promote weight maintenance or modest increases in muscle mass or fat-free mass and mobility.

- 7.20 Regular physical activity can improve health-related quality of life, mood disorders (i.e., depression, anxiety) and body image in adults living with overweight or obesity.
- 7.21 Physical activity can be accumulated throughout the day in blocks as short as 10 minutes. Work-related activity should be encouraged wherever possible.
- 7.22 Action is needed at the individual, community and societal level to help Indians become more physically active.

Limited care recommendations:

- 7.11 (L) Physical activity counselling should be an integral part of obesity management. This should include advice on building physical activity in everyday life and supervised, structured exercise program under the guidance of an expert.
- 7.12 (L) Physical activity must be individualized on the basis of the person's abilities and comorbidities.
- 7.13 (L) Structured exercise levels should be gradually stepped up to levels that are safe for the patient.
- 7.14 (L) Pre-participation medical consultation is recommended for those with chronic conditions or those who are symptomatic.
- 7.15 (L) Aerobic physical activity (30–60 minutes of moderate to vigorous intensity on most days of the week) will help in
  - Modest amounts of bodyweight and fat loss
  - Reduction in visceral fat and ectopic fat even in the absence of weight loss<sup>[51]</sup>
  - Weight maintenance and fat free mass after weight loss
  - Increase cardiorespiratory fitness and mobility
- 7.16 (L) There is a dose-response relationship between physical activity and health. High-intensity interval training can help increase cardio respiratory fitness, and achieve fat-free muscle mass.
- 7.17 (L) Adults can increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity, or 150 minutes a week of vigorous-intensity aerobic physical activity.
- 7.18 (L) Resistance training may promote weight maintenance or modest increases in muscle mass or fat-free mass and mobility.
- 7.19 (L) Regular physical activity can improve health-related quality of life, mood disorders (i.e., depression, anxiety) and body image in adults living with overweight or obesity.
- 7.20 (L) Physical activity can be accumulated throughout the day in blocks as short as 10 minutes. Work-related activity should be encouraged wherever possible.
- 7.21 (L) Action is needed at the individual, community and societal level to help Indians become more physically active.

### **7d. Medications**

Recommendations<sup>[39,51,52]</sup>:

- 7.23 Indications: In Asian Indians, pharmacotherapy should be initiated along with lifestyle modifications

in individuals with a BMI >27 kg/m<sup>2</sup> or in individuals with a BMI >25 kg/m<sup>2</sup> with at least one associated comorbid medical condition such as hypertension, dyslipidemia, type 2 diabetes (T2DM), and obstructive sleep apnea. A higher cutoff of BMI >30 kg/m<sup>2</sup> or >27 kg/m<sup>2</sup> with comorbidities are endorsed by western guidelines.

7.24 Pharmacotherapy is indicated at a lower BMI cutoff in individuals who are unable to exercise. It can increase adherence to behavior change and may improve physical functioning to enhance physical activity.

7.25 Monitoring for weight loss and adverse events of drugs should be done at least monthly for the first three months, then at least every three months.

7.26 Effective response to a pharmacotherapeutic agent has been defined as weight loss of <5% of bodyweight at three months and which can be safely achieved. If found ineffective (i.e., weight loss <5% at three months) or if there are safety or tolerability issues, the medication can be discontinued and alternative medications or treatment approaches may be tried.

7.27 Orlistat is the only approved and available pharmacotherapeutic agent for obesity management in India at present. It is to be used at a dose of 120 mg thrice a day before major meals depending on the tolerance. The various drugs used for obesity management and their approval status in India have been listed in Table 13.

7.28 For management of comorbidities or associated illnesses in a person living with obesity, it is prudent to avoid drugs that can increase weight. Rather, one can preferably choose medications which are weight safe (weight neutral or reducing) [Table 14].

Limited care recommendations:

7.22 (L) For management of comorbidities or associated illnesses in a person living with obesity, it is prudent to avoid drugs that can increase weight. Rather, one can preferably choose medications which are weight safe (weight neutral or reducing) [Table 14].

## 7e. Bariatric surgery and intragastric devices

The indications and contraindications have been quoted in Table 15. As per western guidelines, bariatric surgery is

**Table 13: Pharmacological options for weight management**

Medication	Orlistat	Liraglutide (3 mg)	Semaglutide 2.4 mg	Naltrexone/bupropion	Phentermine/topiramate 3.75 mg/23 mg and 15 mg/92 mg
Mechanism of action	Lipase inhibitor	GLP1 receptor agonist	GLP1 receptor agonist	Naltrexone: opioid antagonist; Bupropion: dopamine and norepinephrine reuptake inhibitors	Phenteramine: noradrenergic sympathomimetic drug; Topiramate: GABA receptor modulation
Weight loss percentage of change (from baseline to 1 year)	4-8.8	6.2-8 7.4% Placebo 3.0%	4.8-13.8 16.9% Placebo 2.4%	6-6.5 5.4%/8.1%* Placebo: 1.3%/4.9%*	5-14.4 5.1%/10.9%† Placebo 1.6%
CV effects	Improvements in CV risk factors: blood pressure and serum lipid levels	Safety data from Liraglutide 1.2 and 1.8 mg CVOT LEADER has been added to label	Safety data from SUSTAIN 6 and PIONEER 6 has established CV safety	Not established	Not established
Dosing	Thrice daily	Daily injection	Weekly once injection Oral semaglutide 3 mg, 7 mg and 14 mg are currently available in India for management of type-2 diabetes mellitus. However oral semaglutide is not approved for obesity management.	Twice daily, oral	Once daily, oral
Common AEs	Oily spotting, flatus with discharge, fecal urgency, fatty/oily stool, oily evacuation, increased defecation and fecal incontinence	Nausea, hypoglycemia, diarrhea, constipation, vomiting, headache, dyspepsia, fatigue, dizziness, abdominal pain	Nausea, diarrhea, vomiting, constipation, abdominal pain, headache, fatigue, dyspepsia, dizziness, abdominal distension	Nausea, constipation, headache, vomiting, dizziness, insomnia, dry mouth, diarrhea	Paresthesia, dizziness, dysgeusia, insomnia, constipation, dry mouth
Approval status in India	Approved	Not approved for obesity indication	Injectable semaglutide (2021)	Not approved	Not approved

**Table 14: Selection of drugs for management of associated comorbidities in obesity<sup>[53]</sup>**

Comorbidities	Drugs that can potentially lead to weight gain (to be avoided)	Drugs that are weight neutral or weight reducing (to be used)
Diabetes	Sulfonylureas, pioglitazone, insulin	SGLT2 inhibitors, GLP1 RA, metformin, DPP4i
Hypertension	Beta-blockers (Metoprolol) Atenolol Propranolol	ACEIs, ARBs, calcium channel blockers, diuretics
Antidepressants	SSRIs (sertraline, citalopram, escitalopram, fluoxetine) MAOIs (e.g., phenelzine) TCAs (e.g., amitriptyline, clomipramine, doxepin, imipramine, nortriptyline, protriptyline)	Desvenlafaxine Bupropion Venlafaxine
Drugs used for neuropathy and anti-epileptic drugs	Gabapentin Pregabalin Carbamazepine Divalproex Lithium Valproic acid Vigabatrin	Topiramate Lamotrigine Zonisamide
Anti-psychotics	Quetiapine Clozapine Olanzapine Risperidone Thioridazine	Aripiprazole Haloperidol Ziprasidone
Rheumatologic disorders	Prednisone Hydrocortisone Methyl-prednisolone	Alternatives for rheumatologic disorders: NSAIDs Biologics/DMARDs Nontraditional therapies
Hormonal agents	Progesterins (e.g., medroxyprogesterone or megestrol acetate)	For contraception, consider alternative methods (e.g., barrier methods, copper IUD)

**Table 15: Indications met for metabolic surgery**

BMI of greater than 37.5 kg/m <sup>2</sup>
BMI of greater than 32.5 kg/m <sup>2</sup> in combination with high-risk comorbid conditions, such as sleep apnea, diabetes mellitus, or degenerative joint disease.
Acceptable operative risk
Failure of non-surgical weight loss programs
Psychologically stable with realistic expectations
Well-informed and motivated patient with support from family/social
Contraindications to bariatric surgery
Reduced life expectancy (untreated schizophrenia, active substance abuse, noncompliance with previous medical care)

reserved for patients if conventional treatment is not viable and if BMI is: >40 kg/m<sup>2</sup>; or >35 kg/m<sup>2</sup> with comorbidities; or BMI >30 kg/m<sup>2</sup> if the patient has comorbid T2DM.<sup>[54]</sup>

Bariatric surgery involves modification of the digestive system by either decreasing the gastric volume (restriction) or altering the path of the alimentary tract, causing nutrient mal-absorption.<sup>[55,56]</sup>

There are various surgical procedures.

- Restrictive procedures: Adjustable gastric banding (LAGB) and sleeve gastrectomy,
- Combined procedures: Roux-en-Y Gastric Bypass (RYGBP),
- Malabsorptive procedures: Bilio-pancreatic diversions (BPD),

- Experimental procedures: Ileal interposition and duodeno-jejunal bypass, various implantable pulse generators.

The most common types of bariatric surgeries currently practiced are gastric bypass, adjustable gastric band, and sleeve gastrectomy. The difference between these procedures are mentioned below in Table 16.

#### Recommendations:

7.29 For Asian Indians, bariatric surgery is indicated if BMI is >32.5 kg/m<sup>2</sup> with comorbidity, and BMI is >37.5 kg/m<sup>2</sup> without comorbidity. The indications and contraindications have been quoted in Table 15.

#### Limited care recommendations:

7.23 (L) For Asian Indians bariatric, surgery is indicated if BMI is >32.5 kg/m<sup>2</sup> with comorbidity, and BMI is >37.5 kg/m<sup>2</sup> without comorbidity. The indications and contraindications have been quoted in Table 15. The patients should utilize health insurance coverage for bariatric surgery.

## 8. COMMUNICATION IN OBESITY MANAGEMENT

### Background and evidences

Communication is a fundamental initial step in obesity management. Obtaining consent before starting a discussion on obesity, avoiding stigmatization and

**Table 16: Various surgical procedures with merits and demerits<sup>[55,56]</sup>**

Gastric bypass	Gastric band (adjustable)	Sleeve gastrectomy
Very long technical experience	Three decades of experience	One decade of experience
Stomach and small intestine bypassed and stomach reduced to a very small pouch size	Band placed around upper part of the stomach (adjustable externally)	Stomach restricted vertically (80% removed)
Massive weight loss expected (14-20 units of BMI)	Significant weight loss expected (8-12 units of BMI)	Very significant weight loss expected (10-18 units of BMI)
Partly reversible procedure	Fully reversible procedure	Irreversible procedure

motivational interviewing are three components of effective communication.

Health care professionals (HCPs) should not assume that all patients living with obesity will essentially seek consultation for obesity management. A prior consent from the patient is a must for each member of the health care team before initiating a discussion on obesity and weight management issues.<sup>[39]</sup>

Stigmatization has been noted in different settings for individuals with obesity, starting from the work place, family, friends and public, and also in the media. It is also prevalent among HCPs. Weight bias in the health care set up and public can lead not only to poor compliance and discontinuation of therapy but also various complications like poor self-image, eating disorders, depression and suicidal tendencies. Weight bias can be minimized by self-assessment of health care team by certain tools, like the Implicit Association Test for weight bias.<sup>[57-59]</sup>

Motivational interviewing (MI) is a powerful tool for engaging the patient and the HCPs in a productive conversation for a collaborative goal setting and management strategy.<sup>[60,61]</sup> The core components of MI have been listed below:

- Respecting autonomy
- Understanding the patient's own motivations
- Active listening
- Improving confidence of the patient with empathy
- Open-ended questions, affirmations, reflections, and summaries (OARS).

#### Recommendations:

- 8.1 Welcoming the patient without negative judgment and bias.
- 8.2 Taking consent and asking the patient whether they are ready to discuss about weight-related issues.
- 8.3 Recognizing obesity as a complex condition with multifactorial etiology and avoiding blaming or stigmatization.

- 8.4 Avoiding language that may be hurtful to the person with obesity.
- 8.5 Being empathetic throughout the conversation to maintain a positive, constructive and helpful relationship with the patient.
- 8.6 Using MI which is a collaborative and non-judgmental discussion method allowing strengthening of the patient's own motivation and stimulating their involvement toward a behavioral change.

#### Limited care recommendations:

- 8.1 (L) Welcoming the patient without negative judgment and bias.
- 8.2 (L) Obtaining consent and asking the patient whether they are ready to discuss weight-related issues.
- 8.3 (L) Recognizing obesity as a complex condition with multifactorial etiology and avoiding blaming or stigmatization.
- 8.4 (L) Avoiding language that may be hurtful to the person with obesity.
- 8.5 (L) Being empathetic throughout the conversation to maintain a positive, constructive and helpful relationship with the patient.
- 8.6 (L) Using MI which is a collaborative and non-judgmental discussion method allowing the strengthening of the patient's own motivation and stimulating their involvement toward a behavioral change.
- 8.7 (L) Time constraint is a major challenge.

## 9. FOLLOW-UP OF A PATIENT WITH OBESITY

### Strategies to prevent weight gain

Obesity is considered to be a chronic condition with a propensity for relapses.<sup>[62]</sup> Despite initial success in weight reduction, weight regain is common.<sup>[63]</sup> Greater than 50% of weight lost is regained within two years of follow-up.<sup>[64]</sup>

A multidisciplinary team targeting diet, exercise and pharmacotherapy has shown to be effective in preventing weight regain.<sup>[65]</sup> Adherence to a healthy diet with consumption of planned meals, regulation of portion sizes, avoidance of fast food, increased intake of fruit and vegetables has been noted in individuals who manage to sustain weight loss.<sup>[66,67]</sup> Frequent physical activity, especially brisk walking, has also been associated with weight loss maintenance.<sup>[68,69]</sup> As compared to short-term treatments, prolonged follow-up with health care providers, whether individually or as group sessions, has shown superior results in weight-loss maintenance.<sup>[70]</sup> Frequent self-weighing is associated with beneficial effects on weight-loss maintenance, irrespective of the underlying weight-loss intervention.<sup>[63,71]</sup> The average weight loss expected with diet, physical activity and behavioral therapy is around 5%-10%, which may be much lower than what patients or physicians expect to see.<sup>[72,73]</sup> Education about the same may help to prevent disappointment with outcomes which are reasonably good. A comparison between the weight loss already achieved by the patient and that documented with

similar treatments in literature may improve patient satisfaction with their results. Modest weight loss in the range of 6%–7% bodyweight has been associated with numerous health benefits including reduced risk of diabetes, improvement in cardiovascular risk factors, reduced need for antihypertensive and lipid lowering medications, as well as reduction in hospitalizations.<sup>[74,75]</sup> These health benefits can motivate the patient to continue weight loss efforts despite not seeing major changes in bodyweight. Awareness about the high likelihood of weight regain in obese patients who lose weight can enable the patient to anticipate and make efforts to prevent weight regain.

Relapse prevention training and problem-solving training are behavioral interventions which enable the patient to anticipate high-risk situations, help them identify and counter the lapses and prevent them from giving up.<sup>[76]</sup>

Recent clinical trials suggest that the GLP-1 agonists may help in long-term weight-loss maintenance when added to the ongoing lifestyle modifications.<sup>[77,78]</sup>

#### Recommendations:

- 9.1 A multidisciplinary team that integrates diet, exercise and pharmacotherapy should be involved in follow-up care.
- 9.2 Patients who have been able to lose weight should be informed that weight regain during follow-up is common.
- 9.3 Ongoing interaction with the HCP (s) in the period following initial weight loss should be maintained.
- 9.4 Frequent weighing should be advised in the follow-up period.
- 9.5 Counselling for long-term weight-loss maintenance should be provided with emphasis on the following points:
  - Realistic expectation for weight loss should be promoted to avoid demoralization and promote adherence.
  - Efforts should be made to enhance patient satisfaction with already achieved outcomes.
  - Health benefits and reduction of disease risk factors with modest weight loss should be emphasized.
  - Cognitive modifications targeting behavioral fatigue and adoption of realistic behavioral goals is advisable.
- 9.6 Relapse prevention training and/or problem-solving training should be provided whenever feasible.
- 9.7 Pharmacotherapy, especially GLP-1 agonists, may be initiated for weight-loss maintenance.

#### Limited care recommendations:

- 9.1 (L) The treating physician should reinforce the role of diet and physical activity in weight-loss maintenance.
- 9.2 (L) Patients who have been able to lose weight should be informed that weight regain during follow-up is common.
- 9.3 (L) Follow-up visits should be scheduled every three months, if feasible, and should include weight measurement.
- 9.4 (L) Counseling for long-term weight-loss maintenance should be provided with emphasis on the following points:

- Realistic expectation for weight loss should be promoted to avoid demoralization and promote adherence.
- Efforts should be made to enhance patient satisfaction with already achieved outcomes.
- Health benefits and reduction of disease risk factors with modest weight loss should be emphasized.

## 10. MANAGEMENT IN SPECIFIC CONDITIONS

### 10a. Obesity in children

Healthy eating habits as mentioned in Table 17 are essential in reducing ingested calories and, hence, beneficial in prevention as well as treatment of obesity. Sugar sweetened beverages, fast foods, high-fructose corn syrup, added sugars and foods rich in fats are associated with obesity.<sup>[79-81]</sup> Similar data has been reported from studies in India, including those from rural areas in Sikkim and Himachal Pradesh.<sup>[82,83]</sup> Skipping breakfast was associated with overweight and obesity in children in Delhi.<sup>[84]</sup> Self-reported physical activity has shown an association with obesity in 10–14-year-old children in a study from North India.<sup>[85]</sup> In children, one hour of physical activity has been recommended.<sup>[86]</sup> Television watching has been associated with obesity in a study from West Bengal.<sup>[87]</sup> More than two hours of screen time is associated with obesity in both children and parents.<sup>[88]</sup> Children with obesity may suffer from low self-esteem and report poor quality of life.<sup>[89]</sup> Adolescents are more likely to suffer from low self-esteem. Lack of support from family and bullying or teasing by peers contributes to low self-esteem and poor quality of life.<sup>[90]</sup> Depression, anxiety and eating disorders are common and should be addressed concurrently.<sup>[91]</sup>

Pharmacotherapy should be considered only if a formal lifestyle intervention program has not been able to reduce weight gain. Orlistat has been used on obese adolescents, but long-term compliance rates have been poor.<sup>[92]</sup> Metformin has been used in some studies, but the weight loss has been modest.<sup>[93]</sup> Liraglutide has shown reduction in BMI when used in obese adolescents in addition to lifestyle intervention.<sup>[94]</sup> In a small study, liraglutide showed reduction in weight, glycemic parameters and blood pressure in Indian adolescents.<sup>[95]</sup> Data on other drugs are scanty.

Bariatric surgery is offered to adolescents with BMI >40 kg/m<sup>2</sup> or >35 kg/m<sup>2</sup> with significant comorbidities, after formal intensive lifestyle modification with or without pharmacotherapy has failed. Other conditions mentioned in Table 18 must also be met. Both vertical sleeve gastrectomy and Roux-en-Y gastric bypass have been performed on adolescents and the weight reduction seems to be comparable.<sup>[96]</sup> A multidisciplinary team including a surgeon, a pediatric endocrinologist, a nutritionist and a mental health professional should be involved in such cases. Psychological complications can emerge postoperatively.<sup>[97]</sup> Long-term follow-up for management of nutritional deficiencies and other post-surgical complications is required.<sup>[98]</sup>

**Table 17: Healthy eating habits recommended for children with obesity**

- Regular meals at appropriate time; avoidance of frequent snacking
- Regular breakfast consumption
- Elimination of sugar sweetened beverages
- Reduced intake of fast foods, table sugar, high-fructose corn syrup
- Reduced intake of foods rich in high-fructose corn syrup, fats, sodium or sugar
- Ensuring portion control to prevent overeating
- Ensuring adequate intake of fruits (in preference to fruit juice), vegetables and dietary fiber
- Identification of eating cues such as screen time, loneliness, boredom or stress

**Table 18: Criteria to be fulfilled prior to considering bariatric surgery in children**

- Tanner stage 4 or 5 along with adult or near adult height
- BMI  $\geq 40 \text{ kg/m}^2$  or  $\geq 35 \text{ kg/m}^2$  with significant comorbidities
- Failure to respond to a formal intensive lifestyle modification with or without pharmacotherapy
- Absence of untreated psychiatric illness
- Presence of a stable family unit is required

#### Recommendations:

- 10.1 Formal dietary advice should be provided, taking into account the caloric requirement of the patient. Healthy eating habits should be encouraged [Table 17].
- 10.2 Children should engage in a minimum of 20 minutes of moderate-to-vigorous physical activity daily, with a target of achieving 60 minutes of such activity.
- 10.3 Non-academic screen time should be restricted to 1–2 hours per day. Healthy sleeping patterns should be encouraged.
- 10.4 Parents should be educated about the need to develop a conducive atmosphere for weight loss by providing emotional support and avoiding negative comments which may lower self-esteem
- 10.5 Psychosocial comorbidities should be identified and treated.
- 10.6 Pharmacotherapy should be initiated only if a trial of formal intensive lifestyle modification including diet and physical activity have not been able to reduce weight gain. Only physicians experienced with the use of such medications in children should prescribe such treatments.
- 10.7 Bariatric surgery should only be reserved for patients in who fulfill the criteria mentioned in Table 17.

#### Limited care recommendations:

- 10.1 (L) Formal dietary advice should be provided taking into account the caloric requirement of the patient. Healthy eating habits should be encouraged [Table 17].
- 10.2 (L) Children should engage in a minimum of 20 minutes of moderate-to-vigorous physical activity daily with a target of achieving 60 minutes of such activity.

- 10.3 (L) Non-academic screen time should be restricted to 1–2 hours per day. Healthy sleeping patterns should be encouraged.
- 10.4 (L) Parents should be educated about the need to develop a conducive atmosphere for weight loss by providing emotional support and avoiding negative comments which may lower self-esteem of the child.
- 10.5 (L) Psychosocial comorbidities should be identified and treated.
- 10.6 (L) Patients not improving despite lifestyle measures should be referred to higher centers.

### **10b. Obesity during pregnancy**

Obesity during pregnancy is associated with adverse outcomes for both the mother and the fetus.<sup>[99]</sup> Wherever feasible, obesity should be diagnosed before conception is planned, and attempts should be made to achieve weight loss prior to conception. Obese women are prone to both folic acid deficiency and neural tube defects in the fetus.<sup>[100]</sup> Hence, folic acid supplementation should be initiated before conception or as early as possible in the pregnancy.<sup>[101]</sup> Vitamin D supplementation has been advocated by some guidelines. At the first antenatal visit, height, weight and BMI should be recorded.<sup>[102]</sup> Weight should be measured subsequently at each antenatal visit. It is currently recommended that gestational weight gain should be limited to 5–9 kilograms.<sup>[103]</sup> Vaccination for H1N1 has been recommended as H1N1 pneumonia in obese pregnant women is more likely to lead to adverse outcomes.<sup>[104]</sup>

Nutritional advice to limit gestational weight gain has to be individualized according to the BMI, physical activity and age of the patient.<sup>[105]</sup> Physical activity is beneficial in limiting gestational weight gain but attention to risk of injury from falls or other accidents is essential.<sup>[106]</sup> Obese women are at risk of both pregestational as well as gestational diabetes mellitus. Hence, screening with 75 gm Oral glucose tolerance test (OGTT) should be done in early pregnancy as well as at 24–28 weeks of gestation. The International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria should be used for diagnosing gestational diabetes mellitus while the ADA/WHO criteria for diabetes mellitus in non-pregnant adults should be used in the first trimester.<sup>[107,108]</sup> Obese women are at an increased risk of pregnancy-induced hypertension, venous thromboembolism and obstructive sleep apnea.<sup>[109]</sup> Screening for these complications and appropriate management is necessary. Adverse fetal outcomes should be anticipated and managed accordingly.<sup>[110]</sup> Depression and anxiety are common in obese women with pregnancy and require treatment by a mental health professional.<sup>[111]</sup>

#### Recommendations:

- 10.8 Obesity should be diagnosed wherever possible prior to conception, and advice regarding weight reduction should be provided.
- 10.9 Before conception, folic acid supplementation should be considered to prevent neural tube defects.

**Table 19: Risks associated with obesity and pregnancy**

<b>Maternal</b>	<b>Fetal</b>
Gestational diabetes mellitus	Spontaneous abortion
Hypertensive disorders of pregnancy	Still birth
Sepsis	Infant death
Venous thromboembolism	Preterm delivery
Obstructive sleep apnea	Macrosomia
	Congenital anomalies
	Neonatal mechanical ventilation
	Neonatal ICU admission
	Childhood obesity

- 10.10 Height and weight should be recorded at first antenatal visit. BMI should be calculated and these parameters should be documented. Weight should be recorded at each antenatal visit.
- 10.11 Patients with obesity should be advised to limit gestational weight gain to 5–9 kilograms.
- 10.12 The risks associated with obesity in pregnancy should be explained to the patient [Table 19].
- 10.13 Vaccination for H1N1 should be offered to pregnant women with obesity.
- 10.14 Formal diet advice to limit gestational weight gain along with general information regarding healthy diet should be provided to all patients.
- 10.15 Moderate physical activity should be prescribed while avoiding risk of fall or injury.
- 10.16 Screening for gestational diabetes should be conducted in all pregnant women with obesity at the first antenatal visit, and again at 24–28 weeks.
- 10.17 Screening and appropriate management of complications mentioned in Table 19 should be done as appropriate.
- 10.18 Mental health problems such as depression and anxiety should be looked for and treated, if present.

#### Limited care recommendations:

- 10.7 (L) Obesity should be diagnosed wherever possible prior to conception, and advice regarding weight reduction should be provided.
- 10.8(L) Before conception, folic acid supplementation should be considered to prevent neural tube defects.
- 10.9(L) Height and weight should be recorded at first antenatal visit. BMI should be calculated and these parameters should be documented. Weight should be recorded at each antenatal visit.
- 10.10(L) Patients with obesity should be advised to limit gestational weight gain to 5–9 kilograms.
- 10.11(L) The risks associated with obesity in pregnancy should be explained to the patient [Table 19].
- 10.12(L) Vaccination for H1N1 should be offered to pregnant women with obesity.
- 10.13(L) Formal diet advice to limit gestational weight gain along with general information regarding healthy diet should be provided to all patients

- 10.14(L) Moderate physical activity should be prescribed while avoiding risk of fall or injury.
- 10.15(L) Screening for gestational diabetes should be conducted in all pregnant women with obesity at the first antenatal visit and again at 24–28 weeks.
- 10.16(L) Screening and appropriate management of complications mentioned in Table 19 should be done as appropriate.
- 10.17(L) Mental health problems such as depression and anxiety should be looked for and treated, if present.

### 10c. Sarcopenic obesity

Sarcopenic obesity refers to the coexistence of obesity with reduced muscle mass and muscle function.<sup>[112,113]</sup> This is seen more commonly in elderly individuals.<sup>[114,115]</sup> Nutritional intervention and physical activity is the mainstay of treatment. Intentional weight loss along with exercise improve physical function in sarcopenic obese adults.<sup>[116]</sup> Both aerobic activity as well as resistance training should be undertaken. Resistance training causes greater improvement in functional status probably by stimulating muscle growth.<sup>[116,117]</sup> Calorie restriction is essential to induce weight loss, and chronic calorie restriction does not lead to muscle loss, provided physical activity including resistance training is continued.<sup>[118]</sup> The daily protein requirement in the elderly has been a matter of debate: while 1.0–1.2 grams of protein per kg bodyweight has been recommended, some data suggest that 0.8 g/kg per day protein is enough to maintain lean body mass and muscle function.<sup>[119,120]</sup> At present, there is inadequate data to support the use of pharmacotherapy and bariatric surgery in sarcopenic obesity.<sup>[113]</sup> Testosterone is not recommended for use in view of lack of evidence of benefit and risk of adverse effects.<sup>[121]</sup> There are several novel therapies which are undergoing evaluation, but, at present, data is scanty.

#### Recommendations:

- 10.19 Both nutritional intervention as well as physical activity should be employed in the management of sarcopenic obesity.
- 10.20 The diet should contain adequate amount of protein.
- 10.21 Physical activity should include resistance training to maintain muscle mass.
- 10.22 The use of testosterone for sarcopenic obesity is not recommended in the absence of clinical and biochemical evidence of hypogonadism.
- 10.23 The use of novel therapies like ghrelin analogues, selective androgen receptor modulators, myostatin inhibitors, vitamin K and stem cell therapy is still investigational and is not recommended for clinical use.

#### Limited care recommendations:

- 10.18(L) Both nutritional intervention as well as physical activity should be employed in the management of sarcopenic obesity.
- 10.19 (L) The diet should contain adequate amount of protein.

- 10.20 (L) Physical activity should include resistance training to maintain muscle mass.
- 10.21 (L) The use of testosterone for sarcopenic obesity is not recommended in the absence of clinical and biochemical evidence of hypogonadism.

#### **10d. Diabesity**

Diabesity refers to the coexistence of T2DM with obesity. The management of diabesity centers on medical nutrition therapy and physical activity. The Indian diet is often rich in carbohydrates and fats, while poor in proteins. It is recommended that a reduction of current carbohydrate intake by 10%–15% along with an increase in current protein intake by 10% (with a maximum of 1 g/kg per day) should be attempted. The intake of visible fat should be minimized.<sup>[34]</sup> Diabesity adversely affects the quality of life of the patients, and the psychological aspects of diabesity may require treatment.<sup>[122]</sup> The patients should be educated about diabesity and should be involved in their own care by respecting their decisions and values. Drugs like metformin, sodium-glucose cotransporter-2 (SGLT2) inhibitors, glucagon-like peptide-1 (GLP-1) receptor agonists, which induce weight loss, and DPP-4 inhibitors (weight neutral) should be preferred in the management of hyperglycemia in diabesity.<sup>[123]</sup> An observational study from India suggests that including two or more drugs from the classes of biguanides, SGLT2 inhibitors, GLP-1 receptor agonists and orlistat may be beneficial in diabesity. Those on two or three drugs had greater weight loss and greater reduction in HbA1c as compared to monotherapy.<sup>[124]</sup> Bariatric surgery should be considered in patients with diabesity who do not appear to benefit from MNT and appropriate pharmacotherapy. Bariatric surgery has shown good results in both weight reduction as well as glycemic control even in patients without morbid obesity.<sup>[125]</sup> In fact, remission of diabetes has been observed in a large percentage of patients in several studies.<sup>[126,127]</sup>

#### Recommendations:

- 10.24 Medical nutrition therapy (MNT) and advice on physical activity should be provided to all patients with diabesity.
- 10.25 The MNT for diabesity should include a reduction of carbohydrate intake while maintaining adequate protein intake and a minimization of intake of visible fat.
- 10.26 The impact of diabesity on quality of life should be taken into account and psychological aspects of the disease should be addressed.
- 10.27 Patient education about diabetes and obesity should be provided, and shared decision-making should be encouraged to improve motivation
- 10.28 The drugs which induce weight loss or are weight-neutral should be preferred for glycemic control in diabesity.
- 10.29 Multidrug therapy with two or more drugs capable of inducing weight loss is advisable, if adequate weight loss has not been achieved with lifestyle intervention and/or monotherapy.

- 10.30 Bariatric surgery can be considered in patients who are not able to meet glycemic or weight-loss targets despite optimal MNT and pharmacotherapy.<sup>[128]</sup>

#### Limited care recommendations:

- 10.22 (L) MNT and advice on physical activity should be provided to all patients with diabesity.
- 10.23 (L) The MNT for diabesity should include a reduction of carbohydrate intake while maintaining adequate protein intake and a minimization of intake of visible fat.
- 10.24 (L) The impact of diabesity on quality of life should be taken into account and psychological aspects of the disease should be addressed.
- 10.25 (L) Patient education about diabetes and obesity should be provided, and shared decision-making should be encouraged to improve motivation.
- 10.26 (L) The drugs which induce weight loss or are weight-neutral should be preferred for glycemic control in diabesity.
- 10.27 (L) Multidrug therapy with two or more drugs capable of inducing weight loss is advisable if adequate weight loss has not been achieved with lifestyle intervention and/or monotherapy.
- 10.28 (L) Bariatric surgery can be considered in patients who are not able to meet glycemic or weight-loss targets despite optimal MNT and pharmacotherapy.<sup>[128]</sup>

## **11. ROLE OF GENETIC TESTING**

Obesity is a heterogenous disorder which also has a heritable component. Genetic and syndromic obesity disorders constitute a small portion of pediatric obesity. Most of adult obesity has a polygenic inheritance, with a small percentage of patients suffering from monogenic causes of obesity.<sup>[129]</sup> Genome-wide association studies have shown that over 900 independent single nucleotide variants (SNVs) are associated with obesity.<sup>[130]</sup> The fat mass and obesity (*FTO*) gene is probably the dominant contributor to polygenic obesity. Common variants, especially rs8050136, of the *FTO* gene have been associated with obesity in the Indian population as well.<sup>[131,132]</sup> Tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) 308G > A polymorphisms and LMNA 1908C > T variant have also been associated with obesity in India.<sup>[133,134]</sup> Polymorphisms of *INSIG2* gene have been associated with obesity in North Indian subjects.<sup>[135]</sup> Polymorphisms of *FTO* and vitamin D receptor genes may influence the response to weight-loss intervention in Indian patients.<sup>[136]</sup> However, since many genes and their variants contribute synergistically to the development of obesity, polygenic risk scores are probably superior in predicting obesity risk than individual variants.<sup>[137]</sup> The clinical utility of these risk scores is still being explored. The behavioral outcomes of genetic testing for obesity are also unclear.<sup>[138]</sup> At present, the management recommendations of obesity remain uniform for adults with polygenic obesity, and routine testing is not recommended.

Childhood extreme obesity with early onset may be due to genetic conditions associated with developmental delay including Prader–Willi syndrome, Albright hereditary osteodystrophy, Bardet–Biedl syndrome.<sup>[139]</sup> Other causes which may not cause developmental delay include melanocortin 4 receptor (MC4R) deficiency, Alström syndrome, leptin or leptin receptor deficiency, proopiomelanocortin (POMC) deficiency and proprotein convertase subtilisin/kexin (PCSK-1) deficiency.<sup>[140]</sup> Genetic testing is advisable in these conditions. Whole exome sequencing has been used to identify novel mutations in Indian patients.<sup>[141]</sup> Specific treatments for obesity may be available in some of these conditions such as leptin deficiency and Prader–Willi syndrome.<sup>[142,143]</sup>

#### Recommendations:

- 11.1 Genetic testing for obesity in adults is not recommended outside of research settings unless other clinical features of genetic obesity syndromes are present.
- 11.2 Genetic testing is recommended for children who have extreme obesity with an onset before 5 years of age along with clinical features of genetic obesity syndromes and/or family history of extreme obesity.

#### Limited care recommendations:

- 11.1 (L) Genetic testing for obesity in adults is not recommended outside of research settings unless other clinical features of genetic obesity syndromes are present.
- 11.2 (L) Genetic testing is recommended for children who have extreme obesity with an onset before 5 years of age along with clinical features of genetic obesity syndromes and/or family history of extreme obesity.

## 12. BARRIERS TO OBESITY MANAGEMENT IN THE INDIAN SETTING

Physician education on obesity and its management during their training has been noted to be poor.<sup>[144]</sup> Personal biases, both explicit and implicit, have been noted in physicians which can affect the delivery of care.<sup>[145,146]</sup> Physicians have reported that their busy schedules may not allow enough time to spend on the care of obesity.<sup>[147]</sup> Primary and secondary care facilities may not have dieticians, educators and psychologists with expertise regarding management of obesity.

Most patients do not realize that obesity is a chronic relapsing condition which requires lifelong intervention.<sup>[65]</sup> Patients, and many physicians, feel that the treatment of obesity is limited to losing weight. However, since weight regain is common, strategies to prevent weight regain are essential. Obese individuals may not realize or accept that lifelong changes in diet and physical activity are needed to maintain weight loss.<sup>[148]</sup> There may be a reluctance to implement long-standing lifestyle alterations. Poor compliance to pharmacological interventions may also be a factor.

The patients belonging to low socioeconomic status may encounter barriers such as higher cost of healthy foods

including fruits and vegetable, cheaper and easily available foods that are high in refined carbohydrates, and lack of space for engaging in physical activity.<sup>[149]</sup> The ability to access health care advice and cost of pharmacotherapy may also be limiting factors. There may be a greater acceptability of obesity in lower socioeconomic strata.<sup>[150]</sup> As diseases such as tuberculosis, which often manifest with weight loss, are common, at least milder forms of obesity may be inferred as good health.<sup>[151]</sup> Patients with busy schedules may not find enough time to engage in physical activity. Similarly, lack of time is a deterrent in planning and cooking healthy meals instead of consuming readily available calorie-dense food.<sup>[152]</sup> Consumption of large amounts of food during social gatherings and festivals is common, and refusal to participate may not be considered positively by family and friends.<sup>[153]</sup> Similarly social and professional obligations also may mandate consumption of alcohol along with unhealthy foods.<sup>[154]</sup> Adequate support from family and friends is needed to sustain weight loss and weight maintenance intervention. Obese patients, especially those seeking treatment, are more likely to be having mental health issues including depression, anxiety disorders, eating disorders (binge eating disorders and night eating syndromes) and substance abuse.<sup>[155,156]</sup>

Disrupted or inadequate sleep has been associated with obesity. Obstructive sleep apnea with daytime somnolence may lead to poor physical activity and reduced compliance with other weight loss efforts.<sup>[157,158]</sup> Osteoarthritis of the knee, back pain and chronic generalized pains are associated with obesity. These may reduce the ability as well as the motivation to engage in physical activity as well as other lifestyle modifications.<sup>[159]</sup> Obesity is associated with cardiovascular

**Table 20: Barriers of obesity management in the Indian setting**

Physician	Lack of knowledge and confidence with regards to managing obesity Personal biases which can influence delivery of care Scarcity of time in view of high workload Lack of trained personnel including dieticians, educators and psychologists
Patient	Lack of recognition of obesity as a chronic relapsing disorder Misbeliefs about obesity management Low socioeconomic status Lack of time Social and cultural factors Comorbidities and medications Mental health Obstructive sleep apnea and sleep disorders Musculoskeletal disorders Cardiac and respiratory disorders Insulin resistance states Substance abuse Drugs Reduced access to surgical and pharmacological treatments

diseases as well as dyspnoea.<sup>[160]</sup> Symptoms like angina, claudication, dyspnea or paralysis due to stroke can impair physical activity.<sup>[161]</sup> Insulin resistance states like T2DM and polycystic ovary disease are associated with high insulin levels and increased liver and visceral fat. These factors have been associated with a poor response to lifestyle interventions as well as pharmacotherapy.<sup>[162]</sup> Alcohol consumption may be associated with higher BMI.<sup>[163]</sup>

Awareness and access to surgical treatments is low.<sup>[55,164]</sup> Fear of complications is also a deterrent. The high cost of pharmacological therapy and the injectable nature of some medications are also barriers to drug treatment.<sup>[165]</sup>

**Table 21: Prevention of obesity**

Population-based	
Policy direction	
Proactive leadership	
Health oriented mindset	
Non-communicable disease (NAD) orientation	
Inter-sectoral collaboration and concordance	
Long-term commitment	
Policy-making decisions	
Nutrition labeling	
Promotion of health nutrition labeling	
De-incentivization of unhealthy eating/substance abuse	
Promotion of physical activity/exercise	
De-incentivization of sedentary lifestyle	
Policy through partnership	
Social marketing	
Public awareness	
Involvement of community leaders	
Policy implementation	
Increase fruit/vegetable intake, e.g., kitchen gardening	
Reduce sugar/fat intake, e.g., cola tax, sugar tax	
Increased physical activity, e.g., open air gyms	
Increase exercise/sports facilities	
Policy for targeted population	
Healthy menu in schools	
Physical training in schools	
Individual based	
Pragmatic therapy	
Sensible sustenance (nutrition)	
Structured physical activity/sports/exercise	
Stress management	
Sleep hygiene	
Substance abuse prevention	
Pragmatic targets:	
Optimal weight gain during pregnancy	
Optimal birth weight	
Optimal weight gain	
Growth during childhood	
Adolescence	
Pragmatic tool	
Motivation interviewing	
Text messaging	
Social media messaging	
Digital therapeutics	

#### Recommendations:

12.1 The barriers to obesity management in the Indian setting are listed in Table 20.

#### Limited care recommendations:

12.1 (L) The barriers to obesity management in the Indian setting are listed in Table 20.

## 13. PREVENTION OF OBESITY

Obesity is easier to prevent than to manage. It makes sense, therefore, to focus on obesity prevention. The multifactorial nature of obesity, its causes, clinical features, comorbidities, and complications, however, require a multidimensional approach to its prevention.<sup>[34,122]</sup> Various arms of the government, including political, bureaucratic and technocratic, need to work in cohesion. Ministries should ensure their policies regarding nutrition, health, agriculture, trade and finance are concordant with each other.

Obesity can be tackled at a population level (community level) as well as individual level. While multiple strategies will need to run concurrently, it must be noted that obesity is a community or family disorder, rather than a disease of individuals. This means that individual-based strategies will have limited chance of success, unless they are coupled with sensitization and behavior modification of the family, in particular, and society, in general.<sup>[166]</sup>

**Table 22: Focus areas for future research in obesity**

Epidemiology	Regional variation in obesity and its determinants
	Gender and age determinants of obesity
	Secular trends in obesity prevalence
Etiology	
	Prevalence of non-exogenous obesity
	Obesity in endocrine disorders
	Sarcopenic obesity
Diagnosis	
	Re-look at BMI cutoffs for overweight/obesity diagnosis
Clinical features	
	The Indian baro-phenotype (adipose tissue topography)
	Normative data for whole body DEXA in various age groups
	Complications and comorbidities in obesity
Prevention	
	Role of various public health/community-oriented strategies
	Role of various individual/family-target strategies
	Utilization of traditional/religious/community-leaders in effective public health messaging
	Social marketing for weight optimization
Non-pharmacological management	
	Role of various dietary patterns and compositions
	Role of various physical activity/exercise regimens
	Characterization of behavioral or motivational therapeutic interventions
Pharmacological management	
	Effectiveness and tolerability of various drugs for obesity management
	Repurposing psychotropic and metabolic drugs, as well as complementary medication, for use in obesity

Table 21 lists the various levels of obesity prevention. Population-based strategies are structured as policy direction, policy-making, partnership and policy implementation. A separate heading, "Policy for targeted population," has been included to highlight the need to focus on childhood obesity. Individual-based intervention is listed under three headings: pragmatic therapy, target and tools. This helps readers conceptualize these approaches and activities.

#### Recommendations:

- 13.1 The population-based and individual-based strategies for prevention of obesity are shown in Table 21.

#### Limited care recommendations:

- 13.1 (L) The population-based and individual-based strategies for prevention of obesity are shown in Table 21.

## 14. FUTURE DIRECTION AND NEED FOR RESEARCH

As the obesity epidemic grows, so will the need for more information and insight regarding the syndrome. This is especially true for India, which needs local data upon which to base its clinical and public health strategies. While we do have good quality work published by Indian authors, there is a need to promote original research in the country. While original research is the gold standard, one can also perform secondary data analysis of pre-existing published data sets to attain meaningful insights into obesity and its management. Some focus areas for future research are listed in Table 22.

Indian endocrine and metabolic journals should take the lead in promoting obesity as an integral part of endocrinology, by publishing manuscripts related to the field.

#### Recommendations:

- 14.1 The focus areas for future research in obesity are listed in Table 22.

#### Limited care recommendations:

- 14.1 The focus areas for future research in obesity are listed in Table 22.

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