Journal of Obesity and Chronic Diseases

https://doi.org/10.17756/jocd.2025-052

Review Article

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Obesity Management: Interventions, Anti-obesity Drugs, Efficacy, Long-term use, Association with Eating Disorders, and Role of Gender-socio-economic Barriers

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Received: November 07, 2024
Accepted: January 30, 2025
Published: February 03, 2025

Citation: Gaddalay SL, Seshu Priya RK, Mittapally SR, Thota S, Subhana A. 2025. Obesity Management: Interventions, Anti-obesity Drugs, Efficacy, Long-term use, Association with Eating Disorders, and Role of Gender-socio-economic Barriers. *J Obes Chronic Dis* 9(1): 1-12.

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Abstract

Obesity management involves a comprehensive approach that combines lifestyle interventions, pharmacotherapy, and, in some cases, surgical procedures to address the complex and multifactorial nature of the condition. Lifestyle interventions, including dietary modifications, increased physical activity, and behavioral therapy, remain the cornerstone of treatment, but for individuals who are unable to achieve significant weight loss through these methods alone, anti-obesity drugs offer a valuable alternative. These medications, such as glucagon-like peptide-1 (GLP-1) agonists, orlistat, and phentermine-topiramate, target various pathways related to appetite regulation and energy metabolism. While these drugs can be effective in promoting weight loss, their long-term use remains a topic of ongoing research due to concerns about efficacy over time and potential side effects. Additionally, the relationship between obesity treatments and eating disorders (EDs), particularly binge eating disorder (BED), is an important consideration, as some pharmacological treatments may affect eating behaviors, and individuals with obesity may be at heightened risk for developing or exacerbating EDs. Balancing weight loss goals with the potential for adverse impacts on eating behaviors is crucial for ensuring successful, sustainable obesity management.

Keywords

Obesity management, Drugs, Side effects, Long-term use, Gender, Ethnicity, Economic status, Geography

Introduction

Obesity, characterized as a chronic and relapsing disease, poses significant challenges to global health [1]. It disrupts normal metabolic processes and serves as a primary risk factor for developing a spectrum of cardiovascular diseases, which remain leading causes of morbidity and mortality worldwide [2]. The complexity of obesity extends beyond excessive weight gain, as it involves a multifactorial interplay of genetic, environmental, behavioral, and metabolic factors [3]. This intricate nature not only complicates the prevention and management of obesity but also underlines the necessity for multifaceted treatment strategies [4].

Behavioral modification, often recognized as a cornerstone in obesity management, emphasizes the importance of dietary changes, increased physical activity, and psychological support [5]. However, achieving substantial and sustained

weight loss through behavioral approaches alone often proves to be a daunting challenge for many individuals. Long-term weight management requires an ongoing commitment to lifestyle changes, which can be difficult to maintain due to various physiological and psychological barriers [6]. These include the body's adaptive metabolic responses, such as reduced resting energy expenditure during weight loss, and behavioral challenges, like dietary temptations and stress-induced overeating [7].

Given these hurdles, contemporary guidelines for obesity management strongly advocate for a combination of lifestyle interventions and medical treatments. Pharmacotherapy, an integral component of medical treatment, has emerged as an effective adjunct to behavior-based strategies [8]. Clinical evidence underscores the efficacy of certain medications in promoting weight loss and enhancing metabolic health when combined with lifestyle interventions [9]. These medications work through various mechanisms, such as appetite suppression, modulation of nutrient absorption, or alterations in fat metabolism, thereby complementing behavioral changes.

Furthermore, this integrated approach has demonstrated significant benefits not only in achieving weight loss but also in improving cardiometabolic profiles. Improved blood pressure, lipid levels, and glycemic control are among the observed outcomes, highlighting the potential of pharmacotherapy in addressing the metabolic and cardiovascular complications of obesity [10, 11]. Such findings affirm the importance of a comprehensive treatment model that recognizes the limitations of singular approaches and leverages the synergistic effects of combined therapies.

In summary, while behavioral modification remains essential in the fight against obesity, its limitations necessitate the inclusion of medical treatments, including pharmacotherapy, to optimize outcomes. This multidimensional approach aligns with current evidence-based guidelines and holds promise for addressing the complexities of obesity management, offering hope for better health outcomes for individuals grappling with this pervasive disease.

Obesity Management

The management of obesity in adolescents presents a unique and multifaceted challenge, necessitating treatment strategies that are not only evidence-based but also specifically tailored to the developmental, psychological, and physiological needs of this population [12]. Adolescence represents a critical period of physical and emotional growth, marked by significant hormonal, metabolic, and behavioral changes [13]. These changes interact with the multifactorial etiology of obesity, complicating both its prevention and treatment. Consequently, obesity management in adolescents requires a nuanced understanding of these interrelated factors to ensure effective and sustainable outcomes [4].

Adolescent obesity stems from a complex interplay of genetic predispositions, environmental influences, and behavioral patterns [12]. During this phase of life, metabolic rates shift, pubertal hormones affect energy balance and fat distribution, and adolescents gain greater autonomy over their lifestyle choices. These physiological and behavioral transitions often contribute to weight gain and resistance to standard weight management strategies. Moreover, psychosocial factors, such as body image concerns, peer pressure, and mental health challenges like depression or anxiety, further complicate obesity treatment in this age group [14].

In light of these complexities, current treatment approaches for adolescent obesity are comprehensive, encompassing behavioral, pharmacologic, surgical, and device-based interventions (Table 1) [15]. Behavioral strategies, which focus on modifying diet, increasing physical activity, and provid-

Table 1: Overview of obesity management approaches.

Management approach	Description	Advantages	Challenges/limitations
Behavioral interventions	Includes dietary changes, increased physical activity, and psychological support	Non-invasive, improves overall health, customizable to lifestyle	Requires long-term adherence, high relapse rates, less effective for severe obesity
Pharmacotherapy	Use of medications like Orlistat, Semaglutide, or Naltrexone/Bupropion	Adjunctive to lifestyle changes, significant weight loss for many	Potential side effects, cost, weight regain upon discontinuation, not suitable for all patients
Surgical interventions	Procedures like gastric bypass, sleeve gastrectomy, and adjustable gastric banding	Effective for severe obesity, rapid weight loss, improves comorbidities	Invasive, risk of complications, requires lifelong dietary changes, limited to select patients
Device-based therapies	Includes gastric balloons, vagal nerve blocking, or endoscopic sleeves	Less invasive than surgery, reversible, promising for moderate obesity	Limited availability, less data on long-term efficacy, potential device-related complications
Lifestyle interventions	Holistic approach combining diet, exercise, sleep hygiene, and stress management	Improves overall health, prevents weight gain, supports sustainable habits	Difficult to achieve sufficient weight loss in isolation, requires intensive support for effectiveness
Psychological therapies	Includes CBT, motivational interviewing, and mindfulness-based interventions	Addresses emotional eating, improves adherence to other treatments	Requires trained professionals, time-intensive, may not directly reduce weight without additional measures
Public health interventions	Community-based programs, taxation on sugary drinks, or educational campaigns	Targets population-level obesity, promotes awareness, and prevention	Slow to show impact, requires policy support and substantial funding, limited for individual treatment
Emerging treatments	Includes gene therapy, microbiome manipulation, and new pharmacological agents	Innovative, potential for personalized treatments, may target underlying causes	Largely experimental, high cost, limited data on safety and efficacy for general use

ing psychological support, remain the first-line treatment [16]. However, their effectiveness is often limited by low adherence rates and the unique challenges of adolescent lifestyle patterns, such as irregular meal timings and sedentary behaviors associated with technology use.

Pharmacologic interventions offer additional options for adolescents who do not achieve sufficient weight loss through lifestyle changes alone [17]. Medications approved for adolescent obesity target specific mechanisms, such as appetite regulation or nutrient absorption. While these pharmacologic therapies have shown promise in clinical settings, their long-term safety and efficacy in this population require further investigation due to the potential for side effects and varying responses based on individual physiology [18].

For severe cases of obesity or when other treatments fail, surgical interventions, such as bariatric surgery, may be considered. Although highly effective in achieving significant weight loss and improving comorbidities, these procedures are invasive and carry risks, necessitating careful patient selection and lifelong follow-up [19]. Additionally, device-based therapies, including gastric balloons or endoscopic sleeves, are emerging as less invasive alternatives but remain less studied in adolescents compared to adults [20].

Despite advancements in these treatment modalities, a critical gap persists in addressing adolescent obesity at the population level. Evidence indicates that while individual interventions can yield positive results, they often fail to produce significant, sustained impacts on a broader scale [21]. This underscores the need for public health strategies, including prevention programs, policy changes, and community-based initiatives, to complement clinical efforts.

In summary, the treatment of adolescent obesity demands a multifaceted, individualized approach that integrates behavioral, pharmacologic, surgical, and emerging device-based interventions (Figure 1). However, the lack of widespread effectiveness highlights the importance of addressing systemic factors contributing to obesity while continuing to refine and adapt evidence-based practices to better meet the needs of the adolescent population.

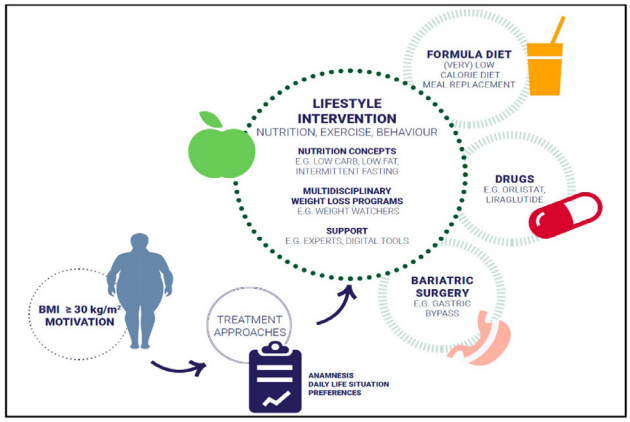


Figure 1: Obesity management approaches [22].

Anti-Obesity Drugs

The treatment of obesity through pharmacologic interventions has evolved with the development of anti-obesity drugs approved for long-term use. These medications are designed to assist individuals in achieving and maintaining significant weight loss, especially when lifestyle interventions alone prove insufficient. By targeting various physiological pathways involved in appetite regulation, energy balance, and fat metabolism, these drugs provide an adjunctive approach to obesity treatment [23, 24]. Table 2 presents an overview of the currently approved anti-obesity medications for long-term use.

Orlistat

Orlistat is a gastrointestinal lipase inhibitor that reduces the absorption of dietary fats by approximately 30%. By inhibiting the enzyme responsible for breaking down triglycerides in the intestine, Orlistat leads to a calorie deficit and subsequent weight loss. It is available in prescription (120 mg) and over-the-counter (60 mg) forms. Common side effects include gastrointestinal disturbances such as steatorrhea (fatty stools) and flatulence, which often decrease with adherence to a low-fat diet. Orlistat is also associated with modest improvements in blood pressure and lipid profiles, making it suitable for patients with obesity-related comorbidities [25, 26].

Lorcaserin (withdrawn in some regions)

Lorcaserin is a selective serotonin 2C receptor agonist that enhances satiety by acting on appetite-regulating pathways in the brain. While it showed effectiveness in promoting weight loss and improving glycemic control in patients with obesity and type 2 diabetes, concerns about potential cancer risks have led to its withdrawal in some markets. Patients who were previously prescribed Lorcaserin may need alternative therapies [27, 28].

Phentermine/topiramate extended-release

This combination medication pairs the appetite-suppressing effects of phentermine, a sympathomimetic amine, with topiramate, an anticonvulsant known to induce weight loss through multiple mechanisms, including appetite suppression and increased energy expenditure. Phentermine/topiramate extended-release is one of the most effective pharmacotherapies for weight loss, achieving significant reductions in body weight and improvement in cardiometabolic parameters. However, it carries potential risks, such as teratogenicity and psychiatric side effects, necessitating careful monitoring and contraindications in certain populations [29-31].

Naltrexone/bupropion extended-release

Naltrexone/bupropion combines an opioid receptor antagonist with a dopamine and norepinephrine reuptake inhibitor, targeting the reward centers of the brain involved in food cravings and appetite control. This combination has shown efficacy in achieving moderate weight loss and improving obesity-related conditions like diabetes and dyslipidemia. However, it may increase the risk of seizures and hypertension, requiring thorough patient evaluation and monitoring [32, 33].

Liraglutide

Originally developed as an antidiabetic medication, Liraglutide is a GLP-1 receptor agonist that promotes weight loss

Table 2: Overview of anti-obesity drugs.

Drug name	Dosage	Dose escalation	Efficacy	Common side effects	Serious side effects
Orlistat	120 mg three times daily with meals (prescription) or 60 mg OTC	Start with 60 mg (OTC) or 120 mg (Rx) with meals, no further escalation	5 to 10% weight loss over 6 to 12 months	Gastrointestinal symptoms (e.g., oily stools, flatulence, fecal urgency).	Rare cases of severe liver injury.
Lorcaserin (Withdrawn)	10 mg twice daily or 20 mg extended-release	-	3 to 5% weight loss over 1 year	Headache, dizziness, fatigue	Potential cancer risks (reason for withdrawal in some regions).
Phentermin/ Topiramate	3.75/23 mg to 15/92 mg daily (extended-release)	Start at 3.75/23 mg daily, escalate to 7.5/46 mg after 14 days, maximum 15/92 mg daily	Up to 10 to 15% weight loss over 1 to 2 years	Insomnia, dry mouth, constipation, increased heart rate	Teratogenicity, mood changes, increased heart rate.
Naltrexone/ Bupropion	8/90 mg daily, titrated to 16/180 mg twice daily	Start at 8/90 mg once daily, increase weekly to 16/180 mg twice daily over 4 weeks	4 to 5% weight loss over 1 year	Nausea, headache, constipation, insomnia	Risk of seizures, elevated blood pressure
Liraglutide	3.0 mg subcutaneous injection daily	Start at 0.6 mg subcutaneous daily, escalate weekly by 0.6 mg to target dose of 3.0 mg	8 to 10% weight loss over 1 year	Nausea, vomiting, diarrhoea	Rare pancreatitis, potential risk of thyroid tumors
Semaglutide	2.4 mg subcutaneous injection weekly	Start at 0.25 mg subcutaneous weekly, escalate every 4 weeks to target dose of 2.4 mg	10 to 15% weight loss over 1 year	Nausea, vomiting, diarrhoea	Rare pancreatitis, potential risk of thyroid tumors
Setmelanotide	Dosage individualized, daily subcutaneous injection	Individualized based on response, titration as per clinical protocols for genetic obesity	Significant weight loss in patients with specific genetic conditions	Injection site reactions, nausea, diarrhoea	Hyperpigmentation, psychological effects in rare cases

Note: Efficacy is based on average weight loss compared to baseline body weight in clinical trials. Side effects listed are common and serious adverse events; individual tolerance may vary. Lorcaserin has been withdrawn in some regions due to safety concerns but is included for historical context.

by enhancing satiety and delaying gastric emptying. Administered via daily subcutaneous injection, Liraglutide has demonstrated significant benefits in weight loss and improvement in glycemic control. Common side effects include nausea and vomiting, which often subside with continued use. Liraglutide's cardiovascular safety profile has made it a preferred option for obese patients with type 2 diabetes or cardiovascular risk factors [34-36].

Semaglutide

Semaglutide, another GLP-1 receptor agonist, is administered weekly via subcutaneous injection. It has shown superior efficacy in weight reduction compared to other anti-obesity medications. In clinical trials, Semaglutide has led to substantial weight loss and improved metabolic parameters, including blood glucose control and lipid profiles. It is generally well-tolerated, with gastrointestinal symptoms as the most common side effects. The long duration of action and high efficacy make Semaglutide a promising option for long-term obesity management [37, 38].

Setmelanotide

Setmelanotide is a melanocortin-4 receptor agonist approved for specific rare genetic disorders of obesity, such as pro-opiomelanocortin (POMC) deficiency and leptin receptor deficiency. By addressing the genetic drivers of obesity in these conditions, Setmelanotide offers a targeted treatment approach. It is not intended for generalized obesity and requires genetic confirmation of the relevant conditions [39-41].

In summary, the landscape of anti-obesity pharmacotherapy continues to expand with a focus on developing medications that are both effective and safe for long-term use [42]. Each of these drugs provides a unique mechanism of action, allowing clinicians to tailor treatments to individual patient needs based on their medical history, obesity-related comorbidities, and treatment goals. Despite their benefits, these medications must be used as part of a comprehensive weight management program that includes lifestyle modification for optimal and sustainable outcomes.

Efficacy and safety of anti-obesity drugs

The long-term efficacy and safety of anti-obesity drugs are crucial considerations in determining their role in the management of obesity [43]. While these medications have demonstrated significant potential in achieving and maintaining weight loss, their long-term use requires a careful balance between therapeutic benefits and the risk of adverse effects. Below, we delve into the evidence surrounding the long-term outcomes of these drugs.

Efficacy in long-term weight management

Clinical trials consistently demonstrate that anti-obesity drugs can facilitate meaningful and sustained weight loss when used alongside lifestyle interventions [44]. Medications such as Orlistat, Phentermine/Topiramate, and GLP-1 receptor agonists like Liraglutide and Semaglutide have shown the ability to produce and maintain weight loss over extended periods, typically ranging from 5% to 15% of baseline body weight [45, 46]. This level of weight loss is clinically significant, as it is associated with reductions in obesity-related comorbidities, including type 2 diabetes, hypertension, and dyslipidemia.

For instance, long-term studies of Semaglutide report sustained weight loss of up to 15% over 68 weeks, with concurrent improvements in glycemic control and cardiovascular risk factors [47]. Similarly, Phentermine/Topiramate has shown durable efficacy in maintaining weight loss over two years [48]. Such results highlight the potential of pharmacotherapy as a cornerstone of long-term obesity management.

Impact on cardiometabolic health

Beyond weight loss, anti-obesity drugs confer additional benefits in improving metabolic and cardiovascular health. GLP-1 receptor agonists, such as Liraglutide and Semaglutide, have demonstrated substantial reductions in haemoglobin A1c levels, blood pressure, and lipid profiles, contributing to a decreased risk of cardiovascular events [49, 50]. Medications like Orlistat also provide modest improvements in cholesterol levels and blood pressure, supporting their role in managing cardiometabolic risks [51]. These effects underline the broader health benefits of these drugs, extending beyond weight reduction alone.

Safety profile and adverse effects

While the efficacy of anti-obesity drugs is well-established, their long-term safety profiles vary, requiring individualized treatment planning (Table 2). Orlistat, for example, is generally safe but associated with gastrointestinal side effects like oily stools and flatulence, which can limit adherence [52]. Phentermine/Topiramate carries risks of teratogenicity, psychiatric disturbances, and cardiovascular concerns, necessitating close monitoring and contraindications in pregnant individuals or those with unstable mental health [53].

GLP-1 receptor agonists, including Liraglutide and Semaglutide, are well-tolerated but commonly cause transient gastrointestinal symptoms such as nausea and vomiting [54, 55]. Rare but serious side effects, including pancreatitis and thyroid tumors, have been reported, prompting precautionary measures in patients with relevant medical histories. Naltrexone/Bupropion carries the risk of seizures and elevated blood pressure [56], while Setmelanotide is reserved for rare genetic conditions, with side effects like injection site reactions and gastrointestinal disturbances [57].

Sustainability and limitations

One of the primary challenges with anti-obesity drugs is sustaining weight loss after discontinuation [58]. Studies show that patients often regain lost weight upon stopping the medication, underscoring the chronic nature of obesity and the need for long-term pharmacologic support. Moreover, adherence can be hindered by side effects or the financial burden of some medications, which are not always covered by insurance.

In summary, the long-term efficacy and safety of anti-obesity drugs highlight their value as an integral component of obesity management. While these medications offer sustained weight loss and improved metabolic outcomes, their use requires a thorough understanding of potential risks and patient-specific factors. Comprehensive management should involve continuous monitoring and integration with lifestyle interventions to maximize benefits and ensure safety over time. Future advancements in pharmacotherapy may further refine the balance between efficacy and safety, offering hope for improved treatment options in the fight against obesity.

EDs and Obesity Management

The intersection of obesity treatment and the risk of developing EDs presents a complex clinical challenge [59]. Effective obesity management requires interventions targeting weight reduction and improving metabolic health, but these efforts can inadvertently contribute to behaviors or psychological patterns associated with EDs (Table 3) [60]. This underscores the urgent need for comprehensive research to better assess and monitor ED risk within the context of obesity treatment.

A 2022 review examined 27 studies (22 focused on adults, 5 on adolescents) that validated 15 ED self-report questionnaires against diagnostic interviews in individuals with overweight or obesity [61]. Most of these studies focused on screening for binge eating or BED, with only a few questionnaires validated for identifying the full range of ED diagnoses. The eating disorder examination-questionnaire (EDE-Q) and the questionnaire on eating and weight patterns (QEWP-R) were the most commonly validated, with six studies each, showing sensitivity between 0.16 to 0.88 and specificity between 0.62 to 0.89 for the EDE-Q, and sensitivity from 0.07 to 0.88 and specificity from 0.63 to 0.93 for the QEWP-R. The binge eating scale (BES) and the QEWP-R demonstrated better diagnostic accuracy for detecting BED compared to other self-report tools [61]. It is important to note that ED assessments may perform differently in individuals with higher body weight. For example, the original subscale structure of the EDE-Q, which includes dietary restraint, shape concern, weight concern, and eating concern, has been shown to have a poor fit for individuals with class 2 or 3 obesity (BMI ≥ 35 kg/m^2). Instead, a 7-item, 3-factor structure (dietary restraint, shape/weight overvaluation, and body dissatisfaction) has been found to have a better fit [62], though this scoring system is not widely used.

Understanding the intersection of obesity and EDs

Both obesity and EDs, such as BED, anorexia nervosa, and bulimia nervosa, share overlapping etiological factors, including genetic predispositions, environmental influences, and psychological stressors [63]. Obesity treatments often emphasize weight monitoring, calorie restriction, and behavioral changes, which, while essential for weight loss, can unintentionally reinforce disordered eating behaviors (Figure 2) [64].

Table 3: Overview of EDs and obesity management approaches.

Aspect	EDs	Obesity mtanagement
Focus	Treatment of disordered eating behaviors and psychological factors	Reduction of body weight and improvement of metabolic health
Common conditions	Anorexia nervosa, bulimia nervosa, BED	Obesity, severe obesity, metabolic syndrome
Primary goals	Normalize eating patterns, address body image issues, improve mental health	Achieve and sustain weight loss, reduce obesity-related comorbidities
Behavioral interventions	CBT, family-based therapy, mindfulness training	Lifestyle changes: diet modifications, increased physical activity, behavioral counselling
Pharmacotherapy	Limited use, may include SSRIs for bulimia or BED	Anti-obesity medications like Orlistat, Semaglutide, Phentermine/Topiramate
Surgical interventions	Rarely used, limited to severe medical complications (e.g., gastrostomy in anorexia)	Bariatric surgeries such as gastric bypass or sleeve gastrectomy for severe obesity
Monitoring	Focuses on mental health, eating behaviors, weight stability	Focuses on weight reduction, comorbidity improvement, adherence to treatments
Risks of mismanagement	Potential weight loss leading to malnutrition, organ damage, chronic psychological distress	Risk of disordered eating behaviors, psychological stress, weight regain
Psychological support	Essential, focuses on body image, emotional regulation, and eating attitudes	Secondary; often focuses on adherence to dietary and physical activity changes
Target population	Individuals with normal weight or underweight, some overlap with obesity in BED	Individuals with overweight or obesity, often with metabolic complications
Outcomes	Restoration of healthy eating habits, improvement in psychological health	Weight loss, improved cardiometabolic outcomes, better quality of life
Key challenges	High relapse rates, social stigma, co-occurring mental health issues	Sustaining long-term weight loss, addressing psychological aspects of eating

For instance, the pursuit of rigid dieting or an excessive focus on body weight may trigger or exacerbate pre-existing tendencies toward disordered eating.

Gaps in current practices

Current obesity treatment guidelines inadequately address the dual challenge of promoting healthy weight loss while minimizing the risk of EDs [66, 67]. Screening tools for identifying vulnerable individuals before initiating obesity treatments remain underdeveloped, and ongoing monitoring for disordered eating behaviors is rarely integrated into standard care protocols [68]. Moreover, the complex psychological dynamics of patients undergoing obesity treatments are not consistently recognized or managed.

Research priorities

Development of screening tools

Future research must prioritize the development of validated tools to assess ED risk in individuals seeking obesity treatment. These tools should incorporate psychological, behavioral, and biological markers to identify those at higher risk [69].

Integration of monitoring protocols

Studies should explore the effectiveness of routine monitoring protocols during obesity treatments to detect early signs of disordered eating [70]. Monitoring should include periodic assessments of psychological health, eating behaviors, and attitudes toward food and body image.

Evaluation of treatment modalities

Different obesity treatment modalities, including behavioral interventions, pharmacotherapy, and bariatric surgery, may carry varying risks for disordered eating [71]. Comparative research is needed to quantify these risks and develop tailored interventions that mitigate potential harms.

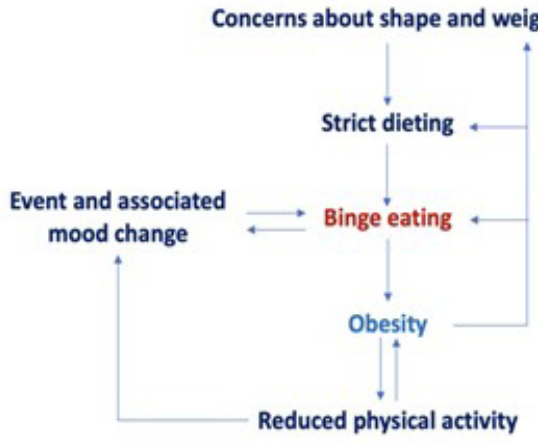


Figure 2: Association between obesity and ED [65].

Behavioral and psychological interventions

Research should investigate strategies for integrating psychological support, such as cognitive-behavioral therapy (CBT) or mindfulness-based interventions, into obesity treatments [72]. These approaches can address underlying psychological factors while promoting sustainable weight management.

Longitudinal studies

Long-term studies are essential to understand the trajectory of ED development in patients undergoing obesity treatment. These studies should track the interplay between weight changes, psychological health, and eating behaviors over extended periods [73, 74].

Addressing youth and adolescents

Adolescents are particularly vulnerable to developing EDs due to the psychological and hormonal changes associated with this life stage [75]. Research should focus on creating age-appropriate tools and interventions for this population.

Clinical implications

Incorporating research findings into clinical practice can significantly improve patient outcomes. Early identification of at-risk individuals will allow for personalized treatment plans that prioritize both physical and psychological health. Monitoring and addressing EDs risk can prevent the onset or exacerbation of these conditions, ensuring that obesity treatments achieve their intended benefits without unintended harm [76].

In summary, the interplay between obesity treatments and ED risk is an underexplored but critical area of research. Addressing this gap requires a multidisciplinary approach involving psychologists, dietitians, physicians, and researchers. By advancing our understanding and developing robust assessment and monitoring frameworks, we can optimize obesity treatment outcomes while safeguarding mental health, creating a more holistic and compassionate healthcare paradigm [77, 78].

Role of Gender/Race/Economic/Geography

Obesity is a complex, multifactorial condition that varies significantly across different populations due to a combination of biological, social, cultural, economic, and environmental factors (Figure 3) [79]. Understanding how gender, race, economic status, and geography influence obesity prevalence, comorbidities, and treatment is essential for developing tailored approaches to its prevention and management (Table 4).

Gender differences

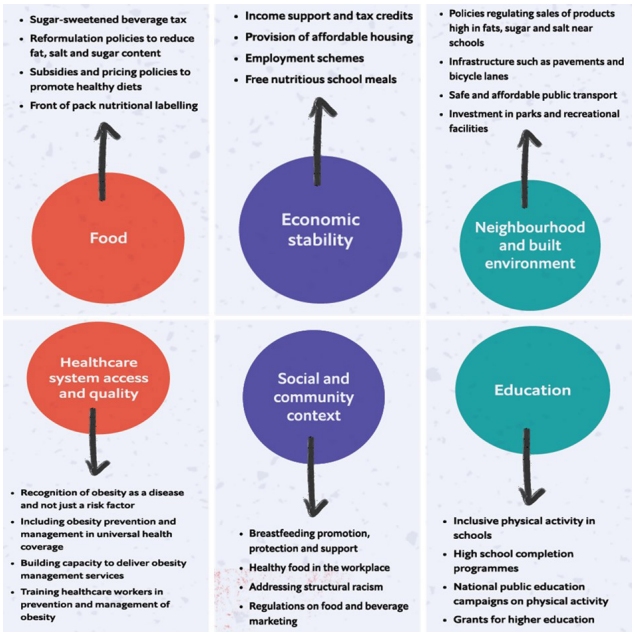


Figure 3: Social determinants of health and obesity [80].

Obesity prevalence and its associated comorbidities often differ between men and women due to a variety of factors, including hormonal influences, body composition, and societal roles [81]. Women generally have a higher prevalence of obesity than men, particularly in Western countries [82]. This difference is often linked to hormonal changes, especially during menopause, when there is an increase in fat accumulation, particularly abdominal fat [83]. Additionally, women are more likely to experience emotional and psychological factors such as stress and depression, which are closely tied to eating behaviors and obesity [84]. On the other hand, men tend to accumulate fat around the abdomen (visceral fat), which is more strongly associated with metabolic diseases like type 2 diabetes and cardiovascular disease [85]. This abdominal fat

Table 4: Differences in obesity prevalence, comorbidities, and treatment across gender, race, economic status, and geography.

Factor	Prevalence	Comorbidities	Treatment
Sex/Gender	Women generally have higher obesity rates than men	Women have higher rates of depression and EDs	Women face unique barriers such as body image pressures. Men may be less likely to seek treatment due to societal norms
Race/Ethnicity	Higher obesity rates in African Americans, Hispanic Americans, and Native Americans compared to white populations	African Americans and Hispanics have higher rates of diabetes, hypertension, and certain cancers. Minority populations have increased risk of metabolic syndrome	Limited access to healthcare and obesity treatments in minority communities. Cultural preferences for certain foods can hinder treatment adherence
Economic status	Higher obesity rates among low-income populations due to limited access to healthy foods and safe spaces for physical activity	Increased prevalence of obesity-related diseases such as type 2 diabetes, hypertension, and sleep apnea in lower-income groups	Limited access to obesity treatments (e.g., medications, bariatric surgery) due to cost. Economic barriers prevent adherence to lifestyle interventions
Geography	Obesity rates are higher in Southern and Midwestern US states, and in rural areas globally. Urbanization in developing countries leads to rising obesity rates	Higher rates of obesity-related chronic diseases in urban centers of high-income countries. Low- and middle-income countries may experience a "double burden" of obesity and malnutrition	Rural areas often lack access to obesity treatments and healthcare facilities. In low-income countries, obesity treatments may be underutilized due to resource constraints

pattern increases the risk of comorbidities such as hypertension, dyslipidemia, and insulin resistance. While both genders are affected by obesity-related health issues, women may face unique challenges due to pregnancy, reproductive health, and societal pressures related to body image, which can affect their approach to treatment and adherence [86].

Racial and ethnic differences

Race and ethnicity are significant determinants of obesity prevalence and its comorbidities [87]. In the United States (US), for example, African Americans, Hispanic Americans, and Native Americans have higher obesity rates compared to their White counterparts [88]. This is influenced by a range of factors, including genetics, dietary patterns, physical activity levels, and socioeconomic status. African American women, in particular, have some of the highest obesity rates among US populations, and obesity-related comorbidities like hypertension, diabetes, and certain cancers are more prevalent in this group [89, 90]. These disparities are also compounded by cultural factors, such as preferences for calorie-dense traditional foods and reduced access to healthy, affordable food options in low-income neighborhoods. Similarly, Hispanic populations often have higher rates of obesity and are at increased risk for type 2 diabetes, partly due to genetic predispositions and dietary habits rich in fats and sugars [91]. Additionally, Latino and African American communities may have less access to healthcare, leading to delayed diagnosis and treatment of obesity and its comorbidities [92].

Economic factors

Economic status is one of the most influential determinants of obesity [93]. People with lower incomes often face significant barriers to healthy eating and regular physical activity. Limited access to nutritious foods, particularly fresh fruits and vegetables, and the widespread availability of cheap, processed, calorie-dense foods contribute to higher obesity rates in economically disadvantaged populations [94]. Furthermore, individuals in lower socioeconomic groups may have less time and resources to engage in physical activity due to longer work hours or the lack of safe outdoor spaces. These factors contribute to higher obesity rates and an increased burden of obesity-related comorbidities, such as diabetes, cardiovascular diseases, and mental health disorders. Economic disparities also influence access to healthcare and weight loss interventions, with individuals from lower-income backgrounds often facing challenges in obtaining medical treatment or undergoing bariatric surgery [95, 96]. The cost of medications, treatment, and access to obesity management programs are often prohibitive, exacerbating health disparities.

Geographical differences

Geography plays a significant role in obesity prevalence and its related health outcomes [97]. The prevalence of obesity varies widely across countries and regions, reflecting differences in diet, lifestyle, socioeconomic conditions, and healthcare systems [98]. In developed countries, obesity rates have surged in recent decades due to changes in dietary patterns, increased consumption of fast food, and a more sedentary lifestyle [99]. In the US, for example, obesity is more prevalent in the southern and midwestern states, which are associated with higher levels of poverty, limited access to healthcare, and cultural dietary preferences that may include fried foods and sugary beverages [100]. Conversely, in many lower- and middle-income countries, rapid urbanization, the spread of Western-style diets, and reduced physical activity are contributing to a rise in obesity rates [101]. However, the patterns of obesity may differ in rural areas compared to urban centers. In rural areas, access to healthcare, healthy food, and weight management programs may be limited, resulting in higher rates of obesity and obesity-related diseases [102].

Globally, there are notable geographic disparities in obesity-related comorbidities. For example, in some low- and middle-income countries, the rising rates of obesity are accompanied by a double burden of disease, where obesity coexists with malnutrition and infectious diseases [103]. In contrast, countries like the US and other high-income nations tend to experience higher rates of obesity-related chronic diseases such as type 2 diabetes, cardiovascular diseases, and certain cancers [104].

Treatment disparities

Disparities in obesity treatment are influenced by a combination of cultural, economic, and healthcare access factors [105]. While pharmacological treatments and bariatric surgery have proven to be effective, their availability and use vary widely across different population groups. Obesity treatments are often more accessible in high-income countries, where advanced medical interventions and bariatric surgery are available, although cost and insurance limitations can still prevent some individuals from accessing these services [106]. In low-income populations, particularly among racial and ethnic minorities, there is often underutilization of these treatments due to financial constraints, lack of knowledge, or cultural beliefs [107]. Furthermore, culturally sensitive interventions that consider dietary habits, physical activity levels, and cultural attitudes toward body weight are essential for improving treatment outcomes [108]. In some communities, traditional medicine or alternative therapies may be preferred over conventional treatments, which can affect engagement with formal healthcare services.

In summary, the complex interaction between gender, race, economic status, and geography significantly influences obesity prevalence, comorbidities, and treatment. Addressing these disparities requires a multifaceted approach that includes improving access to healthcare, promoting culturally sensitive interventions, and addressing the social determinants of health that contribute to obesity. Only through targeted strategies that consider these differences can we achieve more effective and equitable obesity management.

Conclusions

In conclusion, effective obesity management requires a multifaceted approach that includes lifestyle interventions, pharmacotherapy, and, for some individuals, surgical options (Table 5). Lifestyle changes such as improved diet, increased physical activity, and behavioral therapy are foundational, but for many individuals, especially those with severe obesity, pharmacological treatments can provide critical support in

Table 5: Overview of conclusive remarks, limitations, and future prospects of obesity management.

Aspect	Details
Conclusive remarks	• Obesity is a complex, multifactorial chronic disease requiring multidisciplinary management • Effective management integrates lifestyle changes, pharmacotherapy, and surgical options tailored to individual needs • Clinically significant weight loss (5 - 15% of baseline weight) improves obesity-related comorbidities • Sustained long-term management is necessary due to the chronic and relapsing nature of obesity
Limitations	• Limited long-term adherence to lifestyle modifications and treatments • Side effects and accessibility issues with pharmacotherapy, including cost and insurance coverage • Surgical interventions are effective but invasive and not universally accessible • Insufficient focus on psychological health, including disordered eating risks • Obesity management at the population level remains inadequate, with persistent high prevalence rates • Lack of personalization in treatment plans, despite variability in genetic, environmental, and behavioral factors
Future prospects	• Development of safer, more effective anti-obesity drugs with better long-term outcomes and tolerability • Integration of digital health tools (e.g., mobile apps, wearable devices) to support lifestyle changes • Advancements in personalized medicine, leveraging genetic and microbiome insights for tailored therapies • Expansion of non-invasive interventions, such as new device-based treatments and improved bariatric techniques • Greater focus on prevention through community-based initiatives, policy changes, and education programs • Comprehensive frameworks to address psychological health and ED risks in obesity treatment • Research into the role of gut-brain signalling, hormones, and epigenetics in obesity pathogenesis

achieving weight loss goals. Anti-obesity medications, such as GLP-1 agonists and orlistat, offer promising efficacy in the short term, though their long-term use raises concerns about sustainability and side effects. Furthermore, the role of EDs in individuals with obesity, particularly BED, must be carefully considered in treatment planning, as certain medications may affect eating behavior, complicating treatment efforts. A personalized approach, considering individual health status, comorbidities, and psychological well-being, is essential for achieving optimal outcomes.

Additionally, obesity management is deeply influenced by social determinants of health, including gender, race, economic status, and geography. Gender differences in obesity prevalence, comorbidities, and treatment response highlight the need for gender-sensitive interventions that address unique biological, psychological, and social factors. Racial and ethnic disparities in obesity rates, especially among African American, Hispanic, and Native American populations, necessitate culturally tailored approaches to treatment that consider dietary habits, lifestyle, and healthcare access. Economic disparities further exacerbate the obesity crisis, with lower-income populations facing barriers to effective treatment and long-term care. Geographically, rural areas and regions with limited access to healthcare resources often experience higher obesity rates and poorer treatment outcomes. To effectively combat obesity, public health strategies must address these inequities, ensuring that interventions are accessible, culturally relevant, and financially feasible for all populations.

Acknowledgments

None.

Conflict of Interest

None.

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