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Advances in obesity therapy: Innovative medications in development

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Abstract

Obesity is a multifactorial condition characterized by an energy imbalance, which can be attributed to excessive consumption of high-calorie foods, reduced energy expenditure, and predisposing genetic factors. This combination of factors contributes to excessive body fat accumulation, leading to structural and functional changes in the body. Such changes are associated with significant health risks, debilitating complications, high morbidity and mortality rates, and a negative impact on individuals' quality of life. Innovative approaches to obesity treatment include a combination of pharmacological therapies, behavioral interventions, and medical devices aimed at improving weight control and patients' metabolic health. This article aims to provide an overview of innovative approaches in obesity treatment, addressing pharmacological therapies, behavioral interventions, and the use of innovative medical devices. A literature review was conducted through a comprehensive search in scientific databases, including PubMed, Scielo, LILACS, and Google Scholar, focusing on articles published in the last five years. Notably, advanced-stage therapies such as immunotherapy, which aims to modulate immune responses associated with weight gain, gene therapy, which seeks to correct genetic predispositions related to obesity, and modulation of the gut microbiota, which has shown potential in regulating metabolism and improving lipid profiles, are highlighted. The combination of these approaches, integrated in a personalized and targeted manner, represents a significant advancement in obesity treatment, providing more effective, sustainable, and tailored therapeutic solutions to meet patients' individual needs, with a positive impact on quality of life and the prevention of complications associated with this condition.

Keywords: Obesity; Pharmacological treatment; Immunotherapy; Medical devices; Innovative treatment

1. Introduction

Obesity is defined by the World Health Organization (WHO) as the abnormal or excessive accumulation of body fat that poses significant risks to human health. This condition is considered a public health issue and is classified as an underdiagnosed and undertreated epidemic. It is a chronic, progressive, and recurrent metabolic disease (WHO, 2024).

The diagnosis of obesity is established using the Body Mass Index (BMI), with individuals classified as obese when their BMI is equal to or greater than 30 kg/m^2. Values within this range are associated with reduced life expectancy, highlighting the severity of this condition (WHO, 2024).

According to the *World Obesity Atlas 2023*, it is estimated that more than 4 billion people will be overweight or obese by 2035, representing over half of the global population (51%). Specifically, obesity prevalence is projected to reach 24% globally, indicating that 1 in 4 individuals will be obese by this time (WORLD OBESITY FEDERATION, 2023).

In Brazil, the prevalence of obesity has risen alarmingly. Currently, 24.3% of Brazilian adults are obese, with the age group of 45 to 54 years showing the highest prevalence, reaching 32.6% among men. Among young adults aged 18 to

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24 years, obesity increased from 9% in 2022 to 17.1% in 2023, representing a 90% increase in just one year (WORLD OBESITY FEDERATION, 2023).

Projections suggest that by 2035, 41% of the Brazilian population could be classified as obese, emphasizing the urgent need for effective interventions to curb this trend (WORLD OBESITY FEDERATION, 2023).

The increase in obesity is associated with numerous health complications, including type 2 diabetes, hypertension, cardiovascular diseases, and certain cancers. Additionally, the economic impact of treating conditions associated with overweight and obesity in Brazil is expected to reach R$100 million by 2035 (WORLD OBESITY FEDERATION, 2023).

Obesity is a multifactorial condition characterized by an energy imbalance attributed to excessive consumption of high-calorie foods, reduced energy expenditure, and predisposing genetic factors. This combination of factors contributes to excessive fat accumulation, leading to structural and functional changes in the body. These changes are associated with significant health risks, debilitating complications, high morbidity and mortality rates, and a negative impact on individuals' quality of life (RIBEIRO, 2023).

Given the implications of obesity, preventive and therapeutic approaches have become a public health priority. Scientific studies show that a weight reduction of 5% to 10% is associated with clinically significant benefits, including substantial improvements in metabolic parameters, overall functionality, and quality of life (RIBEIRO, 2023).

The management of obesity involves three main therapeutic approaches: non-pharmacological medical interventions, which include lifestyle modifications; pharmacological treatments, involving medications to aid in weight loss; and surgical interventions in severe or refractory cases to reduce food intake capacity or induce physiological changes for weight control. Each strategy is applied according to the severity of obesity, associated comorbidities, and individual treatment responses (RIBEIRO, 2023).

Innovative approaches to obesity treatment include a combination of pharmacological therapies, behavioral interventions, and medical devices aimed at improving weight control and patients' metabolic health. Furthermore, advanced-stage therapies, such as immunotherapy, which seeks to modulate immune responses associated with weight gain, gene therapy, which aims to correct genetic predispositions related to obesity, and gut microbiota modulation, which has shown potential in regulating metabolism and improving lipid profiles, are fundamental. These strategies represent a significant advance in the search for more effective and personalized treatments for obesity (HANNA et al., 2023).

In recent years, considerable advances have been made in developing medications for treating obesity. GLP-1 receptor agonists, such as liraglutide and semaglutide, are notable examples. These medications act on the central nervous system to enhance satiety and reduce food intake, while also improving glycemic control and reducing cardiovascular risks associated with obesity. Such pharmacological therapies have demonstrated promising results in terms of weight loss and metabolic health improvement (ABESO, 2024; HANNA et al., 2023).

While lifestyle modifications remain a cornerstone in treating obesity, innovative behavioral interventions utilize advanced technologies, such as monitoring apps and digital cognitive-behavioral therapy, to support changes in eating behavior and physical activity. The personalization of these programs through artificial intelligence and data analysis enables a more effective and tailored approach to meet individual patients' needs (HANNA et al., 2023).

In addition to medications and behavioral interventions, innovative medical devices are being developed to assist in treating obesity. Examples include gastric balloons and electrical stimulation devices, which can help reduce food intake or improve satiety control. These devices are generally used as complementary to other treatments, such as diets and exercise, and are an option for patients who do not respond well to pharmacological therapies (RUBAN et al., 2019).

Immunotherapy is an emerging approach to treating obesity, involving the modulation of the immune system to alter the inflammatory response associated with weight gain. Studies have shown that low-grade chronic inflammation, frequently observed in obese patients, can affect metabolism and contribute to insulin resistance. Immunotherapy aims to reduce this inflammation, promoting a healthier metabolic environment and facilitating weight loss (BORBA, RAMOS & MAYNARD, 2023).

Gene therapy for obesity is in its early stages of development but holds enormous potential. This approach involves genetic modification to correct genetic variants associated with increased appetite or slower metabolism, factors that

may predispose individuals to obesity. By manipulating these genes, a more durable and specific solution is anticipated for cases of genetically driven obesity (HANNA et al., 2023).

Recent research has suggested that the gut microbiota plays a crucial role in the development and maintenance of obesity. Modulation of the gut microbiota, whether through probiotics, prebiotics, or fecal transplantation, is being studied as an innovative strategy for treating obesity. By balancing the intestinal bacterial composition, it is possible to improve digestion, metabolism, and inflammatory responses—essential factors in controlling body weight (FLORIO & SILVA, 2024).

Innovative approaches represent significant advancements in medicine, offering new possibilities for treating obesity, a disease that affects millions worldwide. Combining these therapies with traditional treatments can enable more effective weight control and management of associated comorbidities, such as type 2 diabetes, hypertension, and cardiovascular diseases, significantly improving patients' quality of life (HANNA et al., 2023).

Thus, this article aims to provide an overview of innovative approaches to obesity treatment, addressing pharmacological therapies, behavioral interventions, and the use of innovative medical devices. The article also explores new therapeutic strategies under development, such as immunotherapy, gene therapy, and gut microbiota modulation, presenting effective and promising alternatives for managing this complex condition

2. Methodology

This review article aims to analyze innovative approaches to the treatment of obesity, focusing on pharmacological therapies, behavioral interventions, and innovative medical devices, as well as exploring new therapeutic strategies under development.

The literature review was conducted through a comprehensive search in scientific databases, including PubMed, Scielo, LILACS, and Google Scholar, focusing on articles published in the last five years (2018–2023). The search was carried out using the following terms in English and Portuguese: "obesity treatment innovations," "novos tratamentos para obesidade," "pharmacological therapies for obesity," "interventions for obesity," "GLP-1 agonists," "microbiota and obesity," "gene therapy obesity," and "obesity management." Additionally, relevant articles on advances in behavioral, pharmacological, and medical device therapies applied to obesity treatment were included.

Peer-reviewed articles and clinical studies presenting data on new therapeutic approaches to obesity treatment were selected. Only relevant studies with updated information addressing innovations in obesity treatment were included in the review. Articles in both English and Portuguese were considered, given the relevance and accessibility of the data.

In addition to academic articles, data and reports from relevant health organizations and entities, such as the Brazilian Association for the Study of Obesity and Metabolic Syndrome (ABESO), the World Health Organization (WHO), and the World Atlas of Obesity, were also included. These documents provided updated epidemiological information and data on the prevalence and global trends of obesity, enabling a broader analysis of the context in which therapeutic innovations are being applied.

Data from international organizations were used to contextualize the prevalence of obesity and treatment trends worldwide, offering a comprehensive view of the innovations being implemented globally.

The results obtained were synthesized to provide a broad overview of innovative approaches to obesity treatment, highlighting the key innovations and the most promising therapeutic advancements.

It is important to note that, due to the nature of this review, the study did not involve direct experimentation or primary data collection. The analysis was limited to already published data available in the selected sources, which may restrict the inclusion of new approaches or therapies still in early stages of development.

This methodology aims to provide a critical and detailed overview of innovative approaches to obesity treatment, focusing on the most recent advancements and the therapies shaping the future of managing this condition.

3. Literature Review

Obesity is a widely prevalent chronic disease characterized by the excessive or abnormal accumulation of body fat, leading to health impairments. It is a complex, progressive, recurrent, and multifactorial condition influenced by genetic, environmental, behavioral, and emotional factors. The Foresight Obesity Systems Map highlights this complexity by presenting 108 interconnected variables linked by approximately 300 causal relationships (WHO, 2024; UNITED KINGDOM, 2007).

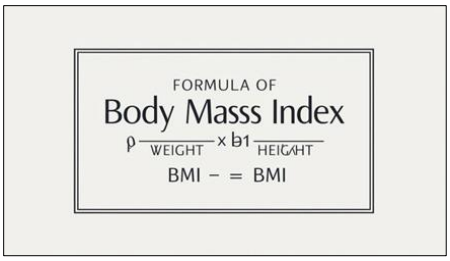
The alarming rise in obesity worldwide reflects a significant contribution of the environment to its origins. There is a strong association with inadequate dietary patterns, physical inactivity, and psychosocial factors, which account for approximately 95% of cases. The contemporary lifestyle, marked by high consumption of ultra-processed foods, reduced physical activity, circadian rhythm disruption, and increased stress levels, serves as a significant driver of obesity development (ABESO, 2016).

Additionally, about 5% of obesity cases have specific causes, with 2% linked to rare genetic syndromes and the remainder to endocrine dysfunctions or adverse effects of medications (ABESO, 2016).

The primary tool for diagnosing obesity is the calculation of the Body Mass Index (BMI), a simple indicator that relates body weight (in kilograms) to height squared (in meters). According to the World Health Organization (WHO) criteria, obesity is diagnosed when the BMI is equal to or greater than 30 kg/m^2. Furthermore, the normal weight range, or eutrophic range, is defined for BMI values between 18.5 and 24.9 kg/m^2 (WHO, 2024).

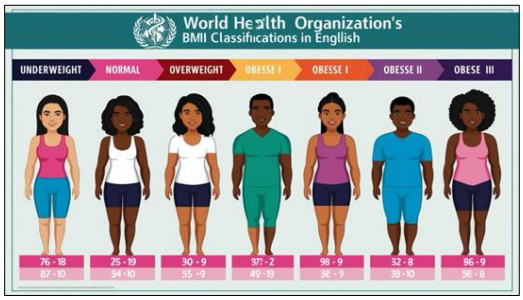
Scientifically, BMI is widely used due to its practicality and ability to provide an approximate estimate of body adiposity in populations. However, it has limitations, as it does not distinguish body composition, such as the proportion of lean mass and fat mass, nor does it account for fat distribution, which is a critical factor in assessing metabolic risk. For example, individuals with a higher accumulation of visceral fat have a greater risk of developing cardiovascular and metabolic diseases, even if their BMI falls within the normal weight range (WHO, 2024).

Therefore, the diagnosis and evaluation of obesity should be complemented by other methods, such as waist circumference measurement, bioelectrical impedance analysis, or imaging exams, especially in cases where BMI does not accurately reflect an individual's health status (ABESO, 2016).



Source: WHO, 2024.

Figure 1 Body Mass Index Formula



Source: WHO, 2024.

Figure 2 Body Mass Index Classification

The management of obesity involves three main therapeutic approaches: non-pharmacological medical intervention, which includes lifestyle modifications; pharmacological treatment, which involves the use of medications to aid weight loss; and, in more severe or refractory cases, surgical intervention, which aims to reduce food intake capacity or promote physiological changes for weight control. Each of these strategies is applied according to the severity of obesity, associated comorbidities, and individual treatment response (RIBEIRO, 2023).

Innovative approaches to obesity treatment include a combination of pharmacological therapies, behavioral interventions, and medical devices aimed at improving weight control and patients' metabolic health. Furthermore, it is crucial to highlight the development of advanced-stage therapies, such as immunotherapy, which seeks to modulate immune responses associated with weight gain; gene therapy, which aims to correct genetic predispositions related to obesity; and gut microbiota modulation, which has shown potential in regulating metabolism and improving lipid profiles. These strategies represent significant progress in the quest for more effective and personalized treatments for obesity (HANNA et al., 2023).

3.1.1. Main Classes of Current Medications for Obesity Treatment

One of the primary classes of medications used in obesity treatment is glucagon-like peptide-1 receptor (GLP-1) agonists, with Liraglutide and Semaglutide being prominent examples. Recently, Tirzepatide was also introduced as an innovative therapeutic option, acting as a dual agonist of GLP-1 and glucose-dependent insulinotropic polypeptide (GIP) receptors (STAICO et al., 2023).

Scientifically, GLP-1 agonists are analogs of an endogenous incretin hormone that regulates glucose and appetite. These medications mimic the action of GLP-1 by stimulating insulin secretion from the pancreas in response to elevated blood glucose, slowing gastric emptying, and promoting a feeling of satiety. These combined effects help reduce caloric intake and facilitate weight loss (STAICO et al., 2023).

Tirzepatide goes further by combining GLP-1 receptor action with that of the GIP receptor, another incretin that amplifies insulin release and may improve insulin sensitivity. Studies indicate that this dual action provides more significant weight reduction compared to isolated GLP-1 agonists, making it one of the most promising options for treating obesity and associated metabolic diseases (STAICO et al., 2023).

Despite their benefits, these therapies must be individualized, considering contraindications, tolerability, and cost, and should always be combined with lifestyle changes, such as diet and physical activity, to maximize results (STAICO et al., 2023).

Source: ANVISA, 2024.

Figure 3 Innovative pens and medications for obesity

3.2. Behavioral Therapies

Behavioral therapies play a crucial role in the treatment of obesity, as they aim to modify behavior patterns that contribute to poor eating habits, lack of physical activity, and inadequate stress management. These therapeutic approaches are grounded in psychological models that promote sustainable lifestyle changes in patients, with the goal of reducing body weight and improving overall health (HANNA et al., 2023).

One of the main modalities of behavioral therapy is Cognitive Behavioral Therapy (CBT), which focuses on identifying and modifying dysfunctional thoughts related to eating and physical behavior. CBT uses cognitive restructuring techniques to help patients replace distorted beliefs and harmful eating habits with healthier patterns. Studies show

that CBT can lead to significant weight loss when combined with other interventions such as nutritional counseling and physical activity (TOMAZ, BATISTA & MATOS, 2020).

Mindfulness-based interventions have also proven effective in the treatment of obesity. These approaches help individuals develop greater awareness of their eating patterns, emotions, and triggers for overeating. Regular mindfulness practice can improve emotional regulation and reduce episodes of compulsive eating, promoting healthier food choices (BARBOSA, PENAFORTE & SILVA, 2020).

Additionally, the use of smartphone apps has become an increasingly common tool in the behavioral management of obesity. These apps allow individuals to track their food intake, physical activity levels, and other lifestyle factors, providing real-time feedback and encouraging behavior changes. The use of technology has been shown to be helpful, as it facilitates treatment adherence, providing continuous and personalized monitoring (OLIVEIRA et al., 2024).

These behavioral approaches, when combined, can offer an effective and lasting solution for managing obesity by promoting habit change and the adoption of a healthier lifestyle (HANNA et al., 2023).

3.3. Medical Devices

Medical devices have become an increasingly popular option in the treatment of obesity, representing non-pharmacological alternatives for patients whose results with other therapeutic interventions, such as diets or medications, have been unsatisfactory. Notable among these devices are intragastric balloons, vagus nerve electrical stimulation, and wearable monitoring devices, such as fitness trackers and vital sign monitors (HANNA et al., 2023).

3.4. Intragastric Balloons

These devices are filled with a saline solution and placed in the stomach through an endoscopic procedure. They occupy space in the stomach, promoting a sense of early satiety, which can help reduce food intake. Studies show that the use of intragastric balloons leads to significant weight loss in the short and medium term, typically recommended for patients with moderate to severe obesity, especially those who have not responded well to conventional treatments (HANNA et al., 2023; RUBAN et al., 2019).

3.5. Vagus Nerve Electrical Stimulation

This device involves electrical stimulation of the vagus nerve, which connects the brain to the stomach. By applying electrical impulses, the stimulation can influence hunger and appetite control. The technique has shown promising results in reducing food intake, aiding weight loss in obese patients (HANNA et al., 2023; RUBAN et al., 2019).

3.6. Wearable Activity and Vital Sign Monitoring Devices

These devices, such as smartwatches or fitness monitors, can track physical activity, vital signs (heart rate, blood pressure, etc.), and sleep patterns in real-time. These devices encourage exercise adherence, promote real-time health monitoring, and help manage obesity-related conditions, such as hypertension and type 2 diabetes (HANNA et al., 2023; RUBAN et al., 2019).

These devices, with different mechanisms of action, offer a complementary approach to traditional treatments, allowing for more effective obesity management with fewer adverse effects compared to pharmacological treatments. However, their use should be carefully monitored, preferably in combination with lifestyle changes such as a healthy diet and regular physical activity (HANNA et al., 2023; RUBAN et al., 2019).

3.7. Immunotherapy

Immunotherapy has emerged as a promising approach for the treatment of obesity, focusing on modulating the immune system to control underlying inflammation, which plays a critical role in the development of obesity and its metabolic complications. Chronic low-grade inflammation, especially in adipose tissue, is a central factor in the worsening of obesity and the onset of metabolic disorders, such as insulin resistance and dyslipidemia. In this context, immunological therapies, such as monoclonal antibodies and cytokine inhibitors, are being developed with the aim of reducing inflammation and improving the body's response to insulin, which could result in weight loss and normalization of metabolic parameters (HANNA et al., 2023).

3.8. Inflammation and Obesity

In the context of obesity, especially visceral obesity, excess body fat leads to the activation of immune cells in adipose tissue. This results in the release of inflammatory mediators, such as TNF-α, interleukins, and other cytokines, which not only promote local inflammation but also contribute to insulin resistance. This inflammatory state directly impacts metabolic functions, exacerbating the risk of type 2 diabetes, cardiovascular diseases, and other obesity-related conditions (BORBA, RAMOS & MAYNARD, 2023).

3.9. Immunotherapy Action

Immunotherapy aims to neutralize these inflammatory mediators through agents such as monoclonal antibodies and cytokine inhibitors, which block or attenuate the action of inflammatory substances in the body. By reducing systemic inflammation, these therapies can restore insulin sensitivity and improve glucose uptake by tissues, as well as promote weight loss and overall improvement in metabolic parameters (BORBA, RAMOS & MAYNARD, 2023).

3.10. Monoclonal Antibodies and Cytokine Inhibitors

These therapies have shown effectiveness in clinical and experimental studies by interrupting the inflammatory mechanisms that impair glucose metabolism and weight control. The use of these antibodies can reduce the production of inflammatory cytokines, promoting reduced insulin resistance and improving the lipid profile of obese patients (BORBA, RAMOS & MAYNARD, 2023).

Immunotherapy offers a new frontier in the treatment of obesity, effectively addressing chronic inflammation that contributes to insulin resistance and other metabolic disorders. This approach has the potential to complement or even replace traditional therapies, providing more targeted and effective alternatives for managing obesity and its comorbidities (HANNA et al., 2023).

3.11. Gene Therapy

Gene therapy emerges as a promising strategy in the fight against obesity, seeking to alter or correct the expression of genes directly involved in regulating body weight and energy metabolism (Müller & König, 2018). Several genes, such as FTO, and biological pathways, such as leptin and melanocortin signaling, have been identified as potential targets for genetic interventions due to their key role in controlling appetite and energy expenditure (HANNA et al., 2023).

3.12. Gene Therapy in Obesity

Obesity is a complex condition resulting from the interaction of genetic and environmental factors. Gene therapy aims to address the genetic basis of this condition, offering an innovative approach that goes beyond conventional treatments by focusing on modifying genes that regulate key metabolic processes. The goal is to correct or regulate the expression of these genes to improve body weight control and energy balance (HANNA et al., 2023).

3.13. FTO Gene

The FTO (fat mass and obesity-associated) gene is one of the key genes identified as influencing obesity risk. Variations in this gene affect appetite control and energy expenditure mechanisms. Modulating or correcting the expression of this gene through gene therapy could help reduce the risk of obesity in genetically predisposed individuals, promoting better weight control (HANNA et al., 2023).

3.14. Leptin-Melanocortin Pathway

Leptin is a crucial hormone in regulating appetite and energy balance, and its signaling through the melanocortin pathway helps regulate energy expenditure and food intake. In many cases of obesity, there is leptin resistance, which impairs appetite regulation. Gene therapy could restore the effectiveness of this pathway, allowing for a more efficient response to leptin and helping maintain a healthy body weight (HANNA et al., 2023).

Thus, gene therapy offers an innovative approach to the treatment of obesity, allowing for more precise modulation of the genetic processes involved in weight control and metabolism, with the potential to provide more effective and lasting solutions for managing obesity (HANNA et al., 2023).

3.15. Gut Microbiota Modulation

Gut microbiota modulation is an emerging approach in the treatment of obesity, aiming to alter the composition and function of gut bacteria to improve metabolism and body weight control. Recent research has shown that the gut

microbiota plays a crucial role in regulating energy metabolism, inflammation, and insulin sensitivity. Changes in gut microbiota composition are associated with the development of obesity, influencing processes such as fat accumulation and insulin resistance. Strategies for microbiota modulation include the use of probiotics, prebiotics, and fecal microbiota transplantation (FMT) (HANNA et al., 2023).

3.16. Gut Microbiota and Obesity

The gut microbiota consists of trillions of microorganisms that inhabit the gastrointestinal tract and have a significant impact on digestion, metabolism, and immune response. Studies indicate that the composition of the gut microbiota can directly influence the development of obesity. An imbalanced microbiota, with a predominance of bacteria that favor excessive nutrient absorption and increased fat storage, can contribute to weight gain (BORBA, RAMOS & MAYNARD, 2023).

3.17. Relation to Energy Metabolism

The gut microbiota influences energy metabolism by affecting food digestion and calorie absorption. Additionally, it can modulate the production of short-chain fatty acids, which have beneficial effects on metabolic health, such as improving insulin sensitivity and reducing inflammation. Changes in the microbiota can therefore alter how the body processes food, directly impacting body weight (BORBA, RAMOS & MAYNARD, 2023).

3.18. Microbiota Modulation Approaches

Probiotics: These are live microorganisms that, when administered in adequate amounts, can improve gut health and balance the microbiota. Probiotics can help reduce inflammation and improve gut function, contributing to weight control (FLORIO & SILVA, 2024; UEBEL et al., 2023).

Prebiotics: These are indigestible substances that promote the growth and activity of beneficial bacteria in the gut. By promoting a healthy environment for gut bacteria, prebiotics can improve digestion and metabolism, helping prevent or treat obesity (FLORIO & SILVA, 2024; UEBEL et al., 2023).

3.19. Fecal Microbiota Transplantation (FMT)

This technique involves transferring gut microbiota from a healthy donor to a patient's gut. The aim is to restore a balanced microbiota, which may have positive effects on metabolism and weight control, particularly in obesity cases (GALIARDO, 2022).

Gut microbiota modulation emerges as an innovative and promising strategy for the treatment of obesity, with the potential to correct microbial imbalances and improve metabolic health, positively influencing body weight and insulin sensitivity (GALIARDO, 2022).

The selection of the most suitable treatment for individuals with obesity should involve a detailed analysis of the benefits and risks, considering factors such as efficacy, safety, cost, and personal preferences. Additionally, adopting personalized treatment strategies that integrate genetic, metabolic, and behavioral aspects can enhance therapeutic outcomes and minimize inequalities in access and treatment effects (HANNA et al., 2023).

4. Conclusion

In summary, the treatment of obesity should be approached in a multifaceted manner, combining recent innovations with established therapeutic practices to optimize clinical outcomes and promote personalized management strategies. The modulation of the gut microbiota, through the use of probiotics, prebiotics, and fecal microbiota transplantation, has shown promise as an intervention in the regulation of energy metabolism and improvement in weight control due to its ability to alter the intestinal bacterial composition and positively influence insulin sensitivity. Gene therapy, focused on modifying the expression of genes involved in obesity, emerges as an innovative strategy with the potential to benefit genetically predisposed patients, offering a therapeutic alternative for managing this complex condition.

In the pharmacological context, currently available treatments such as lipase inhibitors, serotonin modulators, and agents that promote satiety have demonstrated effectiveness in weight control, especially in scenarios where behavioral and dietary changes alone do not result in significant weight loss. Meanwhile, medical devices like intragastric balloons and vagus nerve stimulation present themselves as effective non-invasive interventions, offering additional alternatives in managing obesity and controlling metabolic parameters.

Behavioral therapies, including cognitive-behavioral therapy, mindfulness, and dietary reeducation programs, are crucial components in the treatment of obesity as they aim to address the psychosocial and behavioral determinants of this condition. These approaches have proven effective in modifying eating habits and strengthening self-control strategies, supporting long-term weight loss maintenance.

Finally, the implementation of personalized treatments that consider the genetic, metabolic, and behavioral characteristics of each patient is essential to optimize therapeutic results and reduce disparities in access to and effectiveness of treatments. The combination of these approaches, integrated in a personalized and targeted manner, represents a significant advance in obesity treatment, providing more effective, sustainable, and individualized therapeutic solutions, with a positive impact on quality of life and the prevention of complications associated with this condition.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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