METABOLIC MECHANISMS OF TIRZEPATIDE IN ADIPOSE TISSUE REDUCTION AND AESTHETIC IMPLICATIONS

MECANISMOS METABÓLICOS DA TIRZEPATIDA NA REDUÇÃO DO TECIDO ADIPOSO E IMPLICAÇÕES ESTÉTICAS

MECANISMOS METABÓLICOS DE LA TIRZEPATIDA EN LA REDUCCIÓN DEL TEJIDO ADIPOSO E IMPLICACIONES ESTÉTICAS

https://doi.org/10.56238/sevened2026.009-063

Maria Eduarda Santos Izel[1], Rafaela Floripes da Silva Figueiredo[2], Dimas Melo Gonçalves[3]

ABSTRACT

The increasing prevalence of obesity and associated metabolic diseases represents a significant public health issue due to its clinical, metabolic, and aesthetic impacts. In this context, understanding the mechanisms involved in energy metabolism regulation and adipose tissue reduction becomes essential. Therefore, this study aimed to analyze the metabolic mechanisms of tirzepatide in reducing adipose tissue and its implications in the field of aesthetic biomedicine. This study is a qualitative literature review with a descriptive and exploratory approach, conducted through the analysis of scientific articles published in relevant health databases. Recent studies addressing the effects of tirzepatide on energy metabolism, adipose tissue, and metabolic outcomes were included. The results showed that tirzepatide acts through the activation of GIP and GLP-1 incretin receptors, promoting improved glycemic control, reduced food intake, and increased satiety. Additionally, the drug directly influences adipocyte metabolism by reducing lipid accumulation, modulating inflammatory processes, and enhancing fat utilization as an energy source. Improvements in insulin sensitivity and functional reorganization of adipose tissue were also observed. In conclusion, tirzepatide demonstrates high therapeutic potential in reducing adipose mass and regulating energy metabolism, with relevant impacts in both clinical and aesthetic contexts, standing out as a promising strategy for obesity treatment.

Keywords: Adipocytes. Adipose Tissue. Energy Metabolism. Obesity. Tirzepatide.

RESUMO

A crescente prevalência da obesidade e das doenças metabólicas associadas constitui um importante problema de saúde pública, devido aos seus impactos clínicos, metabólicos e estéticos. Nesse contexto, torna-se essencial compreender os mecanismos envolvidos na regulação do metabolismo energético e na redução do tecido adiposo. Assim, o presente estudo teve como objetivo analisar os mecanismos metabólicos da tirzepatida na redução

[1] Biomedical Student. Faculdade Santa Teresa Manaus. E-mail: mariaizel72@gmail.com
[2] Biomedical Student. Faculdade Santa Teresa Manaus. E-mail: Rafaelafloripes@hotmail.com
[3] Master's degree in Process Engineering. Faculdade Santa Teresa Manaus.
E-mail: dimasmelogoncalves@gmail.com

do tecido adiposo e suas implicações no contexto da biomedicina estética. Trata-se de uma revisão de literatura de natureza qualitativa, com abordagem descritiva e exploratória, realizada por meio da análise de artigos científicos publicados em bases de dados relevantes na área da saúde. Foram incluídos estudos recentes que abordam a ação da tirzepatida sobre o metabolismo energético, o tecido adiposo e suas repercussões metabólicas. Os resultados evidenciaram que a tirzepatida atua por meio da ativação dos receptores incretínicos GIP e GLP-1, promovendo melhora do controle glicêmico, redução da ingestão alimentar e aumento da saciedade. Além disso, o fármaco influencia diretamente o metabolismo dos adipócitos, reduzindo a acumulação de lipídios, modulando processos inflamatórios e favorecendo a utilização de gordura como fonte energética. Observou-se também melhora da sensibilidade à insulina e reorganização funcional do tecido adiposo. Conclui-se que a tirzepatida apresenta elevado potencial terapêutico na redução da massa adiposa e na regulação do metabolismo energético, com impactos relevantes tanto no âmbito clínico quanto estético, destacando-se como uma estratégia promissora no tratamento da obesidade.

Palavras-chave: Adipócitos. Metabolismo Energético. Obesidade. Tecido Adiposo. Tirzepatida.

RESUMEN

El aumento de la prevalencia de la obesidad y de las enfermedades metabólicas asociadas constituye un importante problema de salud pública debido a sus impactos clínicos, metabólicos y estéticos. En este contexto, resulta fundamental comprender los mecanismos implicados en la regulación del metabolismo energético y en la reducción del tejido adiposo. Por lo tanto, el presente estudio tuvo como objetivo analizar los mecanismos metabólicos de la tirzepatida en la reducción del tejido adiposo y sus implicaciones en el ámbito de la biomedicina estética. Se trata de una revisión de la literatura de carácter cualitativo, con enfoque descriptivo y exploratorio, realizada mediante el análisis de artículos científicos publicados en bases de datos relevantes en el área de la salud. Se incluyeron estudios recientes que abordan los efectos de la tirzepatida sobre el metabolismo energético, el tejido adiposo y sus repercusiones metabólicas. Los resultados evidenciaron que la tirzepatida actúa mediante la activación de los receptores incretínicos GIP y GLP-1, promoviendo la mejora del control glucémico, la reducción de la ingesta alimentaria y el aumento de la saciedad. Además, el fármaco influye directamente en el metabolismo de los adipocitos, reduciendo la acumulación de lípidos, modulando procesos inflamatorios y favoreciendo la utilización de grasa como fuente de energía. También se observaron mejoras en la sensibilidad a la insulina y en la reorganización funcional del tejido adiposo. Se concluye que la tirzepatida presenta un alto potencial terapéutico en la reducción de la masa adiposa y en la regulación del metabolismo energético, con impactos relevantes tanto en el ámbito clínico como estético, destacándose como una estrategia prometedora en el tratamiento de la obesidad.

Palabras clave: Adipócitos. Metabolismo Energético. Obesidade. Tejido Adiposo. Tirzepatida.

1 INTRODUCTION

The growing prevalence of obesity and associated metabolic diseases is one of the main contemporary challenges in public health, with repercussions that transcend the clinical scope and reach social, economic, and aesthetic dimensions. This scenario has driven scientific production aimed at understanding the physiological mechanisms involved in the regulation of energy metabolism, as well as the search for more effective therapeutic interventions. In this context, it is highlighted that the imbalance in energy homeostasis is directly related to the excessive accumulation of adipose tissue, a determining factor for the development of metabolic disorders, such as insulin resistance and metabolic syndrome, as pointed out by Bittencourt et al. (2024).

Adipose tissue, traditionally understood only as an energy reservoir, has come to be recognized as an important endocrine organ, capable of secreting adipokines and inflammatory mediators that influence various metabolic functions. In conditions of obesity, there is a dysfunction of this tissue, characterized by adipocyte hypertrophy, infiltration of inflammatory cells, and alteration in hormone secretion, contributing to a chronic low-grade inflammatory state. This process is directly associated with the progression of metabolic diseases, evidencing the importance of therapeutic strategies that act on the modulation of adipose tissue and the restoration of metabolic balance, as discussed by Xia et al. (2024).

Given this scenario, incretin-based therapies have gained prominence in the scientific literature, especially for their ability to act in an integrated way in glycemic control, appetite regulation, and fat mass reduction. Among these approaches, tirzepatide emerges as a relevant pharmacological innovation, as it presents a dual mechanism of action on GIP and GLP-1 receptors, promoting broader metabolic effects that are potentially superior to conventional therapies. Recent evidence indicates that this combined action contributes to the improvement of energy metabolism and to the significant reduction of adipose tissue in individuals with metabolic disorders, as reported by Loomba et al. (2024).

In addition, experimental studies have shown that tirzepatide exerts direct ɯqɳʇg on adipocyte metabolism, influencing processes related to glucose uptake, lipid storage, and fat oxidation. These metabolic changes favor not only the reduction of adipose mass, but also the improvement of insulin sensitivity and cellular metabolic efficiency, fundamental aspects in the management of obesity and its complications, as evidenced by Regmi et al. (2024). Thus, understanding the mechanisms of action of this drug becomes essential for the consolidation of new therapeutic strategies in the field of biomedicine and metabolic health.

The relevance of tirzepatide is also evident when its effects on metabolic inflammation associated with adipose tissue are analyzed. The excessive accumulation of body fat is

closely linked to the activation of inflammatory pathways that compromise metabolic functionality and favor the development of chronic diseases. In this sense, studies indicate that the action of this drug can contribute to the modulation of the inflammatory response, especially by reducing the activity of pro-inflammatory macrophages in adipose tissue, promoting improvement in the metabolic environment and insulin sensitivity, as discussed by Xia et al. (2024).

Another relevant aspect refers to the influence of tirzepatide on the dynamics of different types of adipose tissue. While white adipose tissue is related to energy storage, brown adipose tissue plays a fundamental role in thermogenesis and energy expenditure. Recent evidence indicates that the metabolic activation of these tissues can be favored by the action of the drug, contributing to the increased use of energy substrates and to the reduction of total body fat, as demonstrated by Mestres-Arenas et al. (2026). This ability to act on multiple metabolic compartments reinforces the innovative character of tirzepatide in the context of anti-obesity therapies.

From a clinical and aesthetic point of view, the reduction of adipose mass promoted by this drug has significant implications for the body composition and quality of life of individuals. The decrease in visceral and subcutaneous fat not only contributes to the improvement of metabolic parameters, but also directly impacts the perception of body image and aspects related to well-being. In this sense, research indicates that therapies based on incretin agonists can promote integrated benefits, covering metabolic and aesthetic dimensions, as pointed out by Pase et al. (2024).

In view of these considerations, it is observed that tirzepatide is a promising therapeutic alternative in the treatment of obesity and associated metabolic dysfunctions. Its multifactorial action, involving hormonal regulation, inflammatory modulation, and reorganization of energy metabolism, highlights the need for scientific deepening on its mechanisms and applications. Thus, the present study aims to analyze the metabolic mechanisms of tirzepatide in the reduction of adipose tissue, as well as its implications in the clinical and aesthetic context, contributing to the advancement of knowledge in the area of biomedicine.

2 THEORETICAL FRAMEWORK

The increase in the prevalence of obesity and associated metabolic diseases has driven the development of new therapeutic strategies aimed at controlling energy metabolism and body composition. In this context, drugs that act on hormonal pathways related to glucose and lipid metabolism have received increasing attention in the scientific literature.

Tirzepatide stands out in this scenario for presenting a differentiated mechanism of action, acting simultaneously on the receptors of the incretin GIP and GLP-1, which favors relevant metabolic alterations related to glycemic control and reduction of adipose mass. Recent clinical studies indicate that the use of this drug is associated with significant improvement of metabolic parameters and reduction of body fat in individuals with metabolic disorders (Loomba et al., 2024).

The metabolic functioning of tirzepatide is directly related to the hormonal modulation involved in the regulation of energy homeostasis. The activation of GIP and GLP-1 receptors promotes increased glucose-dependent insulin secretion, in addition to influencing physiological processes related to satiety, food intake, and use of energy substrates. This combined mechanism allows for greater efficiency in metabolic control when compared to therapies that act on only one of these hormonal systems. In this sense, experimental evidence demonstrates that tirzepatide alters the metabolism of nutrients in adipocytes, increasing glucose uptake and modulating metabolic processes related to lipid storage and oxidation (Regmi et al., 2024).

Another relevant aspect discussed in the literature refers to inflammatory changes associated with adipose tissue in individuals with obesity. Excess body fat is often related to chronic low-grade inflammatory processes that contribute to the development of insulin resistance and other metabolic dysfunctions. In this context, pharmacological interventions that act on these processes become important strategies in the clinical management of these conditions. Recent research demonstrates that tirzepatide can act in the modulation of metabolic inflammation present in visceral adipose tissue, influencing the activity of inflammatory macrophages and contributing to the improvement of insulin sensitivity (Xia et al., 2024).

In addition to inflammatory modulation, experimental studies also indicate that this drug can directly interfere with the dynamics of lipid storage in adipose tissue. Adipocyte hypertrophy is one of the pathophysiological features frequently observed in individuals with excess body fat, contributing to systemic metabolic alterations. In this scenario, evidence indicates that tirzepatide promotes a reduction in the intracellular accumulation of lipids in adipocytes, reducing the growth of white adipose tissue and favoring a more balanced metabolic profile. Experimental observations also indicate that the drug can improve cellular metabolic efficiency by reducing adipocyte expansion and favoring energy metabolism (Sun et al., 2026).

Another relevant point discussed in the literature refers to the different types of adipose tissue present in the human body and their specific metabolic functions. White

adipose tissue acts predominantly as an energy reservoir, while brown adipose tissue has a thermogenic function and participates in processes related to energy expenditure. Changes in these tissues can directly influence body metabolism and the development of metabolic disorders. In this context, experimental studies indicate that tirzepatide can stimulate processes related to the metabolic activation of adipose tissue, favoring mechanisms associated with the use of energy substrates and the regulation of thermogenesis (Mestres-Arenas et al., 2026).

The scientific literature also highlights that the metabolic effects of tirzepatide are associated with significant reductions in body fat mass and total body weight. Recent clinical trials have shown that patients undergoing treatment with this drug have significant reductions in adipose mass, accompanied by improvement in important metabolic parameters, such as insulin sensitivity and glycemic profile. These results reinforce the therapeutic potential of tirzepatide in the management of metabolic conditions associated with excess body fat and indicate promising prospects for its use in different clinical settings (Sokary et al., 2025).

Recent scientific literature also shows that the metabolic effects of tirzepatide are related to the functional reorganization of adipose tissue, influencing both storage and energy utilization processes. The simultaneous action on the incretins receptors promotes metabolic changes that favor the reduction of adipose tissue and the improvement of the systemic metabolic profile. In this sense, research indicates that the administration of this drug can result in a significant reduction in body weight, accompanied by a decrease in fat mass and improved cellular metabolic efficiency (Zhang et al., 2025).

Another aspect discussed in recent studies refers to the ability of tirzepatide to modulate different metabolic pathways related to energy metabolism. The regulation of these pathways involves complex processes that include changes in glucose utilization, lipid oxidation, and adipose tissue redistribution. In this context, experimental investigations show that the drug promotes improvements in different metabolically active tissues, including adipose tissue and liver tissue, contributing to the reorganization of energy metabolism and the improvement of the body's metabolic balance (Li et al., 2025).

The understanding of these mechanisms becomes particularly relevant when analyzing the role of adipose tissue in the development of metabolic diseases. Excess body fat is associated with hormonal, inflammatory, and metabolic changes that can compromise different physiological systems. In this scenario, therapeutic strategies capable of reducing body fat volume and restoring the metabolic functionality of adipose tissue have been widely investigated in the contemporary scientific literature. Recent studies indicate that tirzepatide

has important effects on this process, acting both to reduce fat mass and to improve the metabolic function of adipose tissue (Bittencourt et al., 2024).

In addition to the metabolic effects related to glycemic control and the reduction of body fat, the literature also points out that tirzepatide can influence aspects related to body remodeling and fat distribution in the body. The reduction of visceral and subcutaneous fat can result in relevant changes in body composition, contributing not only to metabolic benefits, but also to aesthetic changes associated with the decrease in adipose volume. In this sense, recent research indicates that therapies based on incretin receptor agonists can favor metabolic and body remodeling processes in individuals with obesity or overweight (Pase et al., 2024).

Another relevant point discussed in the literature refers to the impact of incretinal therapies on appetite control and food intake. The activation of GLP-1 receptors is associated with the modulation of hypothalamic centers related to satiety, reducing caloric intake and contributing to body weight loss. When combined with the action on GIP receptors, this hormonal regulation can result in broader and more sustained metabolic effects, favoring the reduction of adipose mass and the improvement of energy homeostasis. In this context, recent research highlights that tirzepatide has superior effects to other traditional incretinal therapies in promoting weight loss and improving metabolic parameters (Sokary et al., 2025).

In view of this evidence, it is observed that tirzepatide represents one of the most promising pharmacological therapies in the treatment of metabolic disorders related to excess body fat. Its mechanisms of action involve a complex interaction between hormonal regulation, energy metabolism and modulation of adipose tissue, factors that contribute to the reduction of adipose mass and to the improvement of the body's metabolic balance. The analysis of these processes allows a broader understanding of the physiological and metabolic foundations that sustain the therapeutic potential of this drug, providing a theoretical basis for scientific investigations aimed at understanding its clinical and aesthetic implications.

The integrated analysis of recent studies shows that tirzepatide acts on multiple dimensions of energy metabolism, promoting effects that go beyond simple glycemic control. The combined activation of GIP and GLP-1 receptors favors a series of physiological responses that directly influence adipose tissue metabolism, including changes in nutrient uptake, lipid oxidation, and satiety hormone regulation. These mechanisms contribute to the progressive reduction of adipose mass and to the improvement of the metabolic profile in overweight or obese individuals. In this sense, experimental investigations indicate that tirzepatide exerts a significant influence on adipocyte metabolism, altering processes related

to energy storage and utilization (Regmi et al., 2024).

Another relevant point highlighted in the literature refers to the interaction between adipose metabolism and systemic inflammatory processes. Adipose tissue, especially visceral tissue, can act as an important endocrine and immune organ, releasing inflammatory mediators that contribute to the development of insulin resistance and other metabolic dysfunctions. The modulation of these inflammatory processes represents one of the main challenges in the treatment of contemporary metabolic diseases. In this context, studies indicate that tirzepatide has the potential to reduce inflammation associated with adipose tissue, promoting improvement in insulin sensitivity and contributing to the restoration of metabolic balance (Xia et al., 2024).

In addition, recent research demonstrates that the action of tirzepatide can influence different adipose compartments, including white adipose tissue and brown adipose tissue. While the former is mainly related to energy storage, the latter plays a relevant role in thermogenesis and body energy expenditure. The metabolic activation of brown adipose tissue represents an important mechanism in the reduction of body fat, as it favors the dissipation of energy in the form of heat. In this context, evidence indicates that tirzepatide can contribute to the metabolic activation of these tissues, increasing its impact on the body's energy regulation (Mestres-Arenas et al., 2026).

Another aspect discussed in the literature refers to the reduction of adipocyte hypertrophy and intracellular accumulation of lipids promoted by the use of this drug. The decrease in adipocyte volume is associated with improved metabolic function of adipose tissue and reduction of pathophysiological changes frequently observed in individuals with obesity. Experimental studies indicate that tirzepatide promotes a reduction in lipid deposition in adipocytes and favors metabolic processes associated with the use of fat as an energy source (Sun et al., 2026; Zhang et al., 2025).

The clinical relevance of these effects becomes evident when analyzing the results observed in clinical studies involving individuals with obesity and metabolic syndrome. Recent clinical trials have shown that treatment with tirzepatide is associated with significant reductions in body weight and fat mass, accompanied by improvement of different metabolic parameters. These results reinforce the therapeutic potential of the drug in the treatment of metabolic disorders associated with excess adipose tissue, indicating that its use may represent an effective strategy in the management of these conditions (Loomba et al., 2024; Sokary et al., 2025).

In addition to the metabolic and clinical implications, some studies also point out that the significant reduction in adipose mass can result in relevant changes in body composition

and fat distribution, factors that directly influence aspects related to body aesthetics. The decrease in visceral and subcutaneous fat can contribute to changes in physical appearance and body image perception, aspects often associated with individuals' quality of life and well-being. In this sense, recent research suggests that pharmacological therapies aimed at reducing body fat may have not only metabolic, but also aesthetic and functional repercussions (Li et al., 2025; Bittencourt et al., 2024; Pase et al., 2024).

In view of this evidence, it is observed that tirzepatide constitutes an important pharmacological innovation in the field of contemporary metabolic therapies. Its effects encompass multiple physiological mechanisms related to energy metabolism, hormonal regulation, and adipose tissue modulation, contributing to the reduction of adipose mass and the improvement of metabolic homeostasis. The understanding of these mechanisms provides a solid theoretical basis for the analysis of the clinical and aesthetic implications associated with the use of this drug, consolidating its relevance in the context of research aimed at the treatment of obesity and associated metabolic alterations.

3 METHODOLOGY

The present study is characterized as a qualitative literature review, with a descriptive and exploratory approach, focused on the analysis of the metabolic mechanisms of tirzepatide in the reduction of adipose tissue and its possible aesthetic implications. The choice of this type of research is justified by the need to gather and critically analyze recent scientific evidence available in the international literature on the topic investigated, allowing us to understand the scientific advances related to the use of this drug in the context of adipose metabolism.

The research was conducted through a bibliographic survey in scientific databases widely recognized in the area of health and biomedical sciences. Databases such as PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar were consulted, selected due to their relevance to the dissemination of high-impact scientific research. The search process was guided by descriptors related to the object of study, including the terms tirzepatide, adipose tissue, metabolism, obesity treatment and incretin-based therapy, combined through Boolean operators to expand the scope of the research.

Specific inclusion and exclusion criteria were adopted for the selection of the studies analyzed. As inclusion criteria, we considered scientific articles published in the last five years, available in full format, preferably in journals classified in the Qualis A or B strata, and that directly addressed the metabolic mechanisms of tirzepatide, its effects on adipose tissue or its impacts on energy metabolism. Duplicate studies, papers with restricted access to full

content, opinion articles, congress abstracts, and publications that did not have a direct relationship with the object of investigation were excluded.

After the stage of identification of the studies, an exploratory reading of the titles and abstracts was carried out in order to verify the thematic relevance of the publications. Then, the selected articles were read in full, allowing a detailed analysis of the scientific evidence presented. This step made it possible to identify the main metabolic mechanisms associated with the action of tirzepatide, as well as the experimental and clinical results related to the reduction of adipose tissue and the metabolic changes resulting from the use of this drug.

The data analysis process was conducted through qualitative interpretation of the information extracted from the selected studies. Aspects such as research objectives, methodology used, results obtained and main scientific contributions presented by the authors were considered. From this analysis, it was possible to establish a critical synthesis of the literature, highlighting convergences and divergences between the studies and identifying the main scientific advances related to the investigated theme.

Although the literature review allows us to gather relevant evidence about the phenomenon studied, this approach has some methodological limitations. Among them, the dependence on the quality and availability of published studies stands out, as well as the possibility of biases related to the selection of the sources analyzed. Even so, the use of rigorous criteria for searching and selecting articles contributes to minimizing these limitations and ensuring greater consistency in the analysis performed.

Thus, the methodology adopted allowed to systematize and critically analyze the recent scientific knowledge on the metabolic mechanisms of tirzepatide and its action on adipose tissue, providing a consistent theoretical basis for the discussion of the results presented in this study.

In order to systematize the main studies used in the theoretical foundation of this research, a table containing the authors analyzed, as well as the respective titles of the publications and the years of publication, is presented below. The organization of this information allows us to visualize in a synthetic way the main recent scientific contributions related to the metabolic mechanisms of tirzepatide and its action on adipose tissue, serving as a basis for the construction of the discussion presented throughout the work.

Table 1

Authors used in the research

Author	Title	Year
Bittencourt	Tirzepatide: Dual GIP/GLP-1 receptor agonists from molecular to clinical practice for treating type 2 diabetes and obesity	2024
I read	Tirzepatide improves metabolic pathways in adipose and hepatic tissue	2025
Loomba	Tirzepatide for metabolic dysfunction–associated steatohepatitis	2024
Arena-Masters	Differential effects of the anti-obesity drug tirzepatide on adipose tissues	2026
Pase	Tirzepatide: dual GIP/GLP-1 receptor agonists from molecular to clinical practice	2024
Regmi	Tirzepatide modulates the regulation of adipocyte nutrient metabolism	2024
Sokary	The promise of tirzepatide: a narrative review of metabolic outcomes	2025
Sun	Tirzepatide reduces intracellular lipid accumulation in adipocytes	2026
Xia	Tirzepatide's role in targeting adipose tissue macrophages and metabolic inflammation	2024
Zhang	Tirzepatide reduces body weight by increasing fat utilization	2025

Source: The authors.

After presenting the picture, it is observed that the selected studies demonstrate convergence regarding the metabolic potential of tirzepatide in the modulation of adipose tissue. The research analyzed addresses different dimensions of the topic, including hormonal mechanisms associated with incretin receptors, changes in adipocyte metabolism, reduction of metabolic inflammation, and impacts on body composition.

Thus, recent literature shows that the drug has relevant effects both in the regulation of energy metabolism and in the reduction of adipose mass, aspects that support its growing scientific relevance in the treatment of obesity and in investigations related to the metabolic and aesthetic implications of adipose tissue reduction.

4 RESULTS AND DISCUSSIONS

The studies analyzed show that tirzepatide exerts significant effects on energy metabolism, acting in an integrated way on different physiological pathways related to glycemic control and adipose tissue regulation. In general, it is observed that the simultaneous activation of GIP and GLP-1 receptors promotes broader metabolic responses when compared to conventional therapies, resulting in improved glycemic control, reduced food intake, and increased satiety. These findings corroborate the results presented by Loomba et al. (2024), which highlight the clinical efficacy of the drug in reducing body weight and improving metabolic parameters in individuals with disorders associated with excess

body fat.

Regarding adipocyte metabolism, evidence indicates that tirzepatide acts directly on the dynamics of lipid storage and utilization, promoting a reduction in intracellular fat accumulation and favoring lipid oxidation. This mechanism contributes to the reduction of adipocyte hypertrophy, considered one of the main factors involved in metabolic dysfunctions associated with obesity. In this sense, experimental studies demonstrate that the drug modulates the metabolism of nutrients in fat cells, increasing metabolic efficiency and reducing lipid deposition, as evidenced by Regmi et al. (2024) and Sun et al. (2026).

Another relevant point identified in the analysis of the studies refers to the ability of tirzepatide to influence insulin sensitivity and metabolic homeostasis. The literature shows that the improvement of the insulin response is directly related to the reduction of metabolic inflammation and the functional reorganization of adipose tissue. According to Bittencourt et al. (2024), the action of this drug promotes significant changes in the pathophysiological mechanisms of obesity, contributing to the restoration of metabolic balance and the reduction of risk factors associated with chronic diseases.

In addition, it is observed that tirzepatide has a relevant impact on different metabolically active tissues, including adipose tissue and liver tissue. Recent studies indicate that the modulation of these structures is associated with the improvement of metabolic pathways and the reorganization of systemic energy metabolism. In this context, Li et al. (2025) demonstrate that the use of the drug promotes favorable changes in the use of energy substrates, contributing to the reduction of body fat and the optimization of overall metabolic functioning.

The analysis of the studies also shows that tirzepatide plays an important role in the modulation of inflammatory processes associated with adipose tissue, a central factor in the pathophysiology of obesity and its metabolic complications. The chronic low-grade inflammatory state, often seen in individuals with excess body fat, is directly related to insulin resistance and systemic metabolic dysfunction. In this context, experimental investigations indicate that the action of the drug contributes to the reduction of inflammatory macrophage activity in adipose tissue, promoting improvement of the metabolic environment and favoring energy homeostasis, as described by Xia et al. (2024).

Another relevant aspect refers to the action of tirzepatide on different types of adipose tissue, especially with regard to the functional distinction between white and brown adipose tissue. While the former is associated with energy storage, the latter plays a key role in thermogenesis and energy expenditure. Recent evidence suggests that tirzepatide can stimulate the metabolic activity of these tissues, favoring the use of lipids as an energy

source and contributing to the reduction of adipose mass. In this sense, Mestres-Arenas et al. (2026) highlight that the drug promotes metabolic changes that increase energy expenditure and positively influence the regulation of body weight.

In addition, it is observed that tirzepatide has a direct impact on the reduction of total adipose mass, with significant repercussions on the body composition of individuals. Clinical studies and narrative reviews indicate that the use of this drug is associated with a significant decrease in body weight, accompanied by improvement in metabolic parameters, such as insulin sensitivity and glycemic profile. These results reinforce the therapeutic potential of the drug in the management of obesity, as evidenced by Sokary et al. (2025) and Pase et al. (2024), who highlight its efficacy in different clinical contexts.

In addition, the literature indicates that tirzepatide can directly influence the redistribution of body fat, promoting a reduction in visceral and subcutaneous fat. This alteration has relevant implications not only in the metabolic sphere, but also in the aesthetic context, since the decrease in adipose volume is associated with changes in body appearance and image perception. In this scenario, Zhang et al. (2025) demonstrate that the increased use of fat as an energy source contributes to the reduction of body weight and the improvement of body composition, reinforcing the integrated benefits of the treatment.

The integration of the findings allows us to understand that the effects of tirzepatide are not restricted to a single isolated mechanism, but result from a complex interaction between hormonal regulation, inflammatory modulation and reorganization of energy metabolism. This multifactorial action contributes to the progressive reduction of adipose mass and to the improvement of the metabolic profile of individuals, evidencing the superiority of this approach in relation to conventional therapeutic strategies based on unique mechanisms. In this sense, Zhang et al. (2025) highlight that the increased use of lipids as an energy source is one of the main factors associated with the sustained reduction of body weight.

In addition, it is observed that the action of tirzepatide on energy metabolism involves relevant alterations in different metabolic pathways, including glucose uptake, lipid oxidation and regulation of food intake. These processes act in an integrated way, favoring not only weight loss, but also the overall improvement of metabolic efficiency. According to Regmi et al. (2024), the modulation of adipocyte metabolism represents one of the main mechanisms responsible for reducing lipid deposition and optimizing the use of energy substrates.

Another important point refers to the consistency of the findings in the literature analyzed, since different studies, with different methodological approaches, converge in the identification of the metabolic benefits associated with the use of tirzepatide. This

convergence reinforces the robustness of the available scientific evidence and supports the recognition of the drug as a promising strategy in the treatment of obesity and associated metabolic disorders. As pointed out by Bittencourt et al. (2024) and Li et al. (2025), the observed effects include improved insulin sensitivity, reduced metabolic inflammation, and functional reorganization of adipose tissue.

It is noteworthy that the results analyzed have relevant implications both in the clinical field and in the field of aesthetic biomedicine. The reduction of body fat, combined with the improvement of metabolic parameters, contributes to benefits that transcend the treatment of diseases, reaching aspects related to quality of life and the perception of body image. In this context, Loomba et al. (2024) and Pase et al. (2024) show that incretin-based therapies, such as tirzepatide, represent an innovative and effective approach, capable of integrating metabolic and aesthetic benefits in the same therapeutic intervention.

From an aesthetic perspective, the reduction of visceral and subcutaneous fat promoted by the use of tirzepatide can result in important changes in body composition, directly impacting physical appearance and body image perception.

Thus, it is observed that the effects of the drug go beyond the clinical scope, also reaching relevant applications in aesthetic biomedicine. For a better understanding of the studies analyzed, a synthesis of the main information extracted from the selected studies is presented below.

Table 2

Synthesis of the studies used in the research

Authors	Objective	Method	Main results
Bittencourt et al.	To analyze the action of tirzepatide in the treatment of obesity and diabetes	Literature review	It showed metabolic improvement and significant reduction in fat mass
Li et al.	To investigate the effects of tirzepatide on adipose and hepatic tissues	Experimental Study	Demonstrated improvement of metabolic pathways and energetic reorganization
Loomba et al.	To evaluate the clinical effects of tirzepatide on metabolic disorders	Clinical Trial	Observed a reduction in body weight and improvement in the glycemic profile
Mestrs-Arenas et al.	To analyze the effects of tirzepatide on different adipose tissues	Experimental study	Indicated metabolic activation of adipose tissue and increased energy expenditure
Pase et al.	Review the clinical application of tirzepatide	Narrative review	Highlighted effectiveness in weight reduction and metabolic improvement
Regmi et al.	Evaluate nutrient metabolism in adipocytes	Experimental study	Demonstrated modulation of cellular metabolism and lipid reduction
Sokary et al.	To analyze the metabolic outcomes of tirzepatide	Narrative Review	Showed significant weight loss and metabolic improvement
Sun et al.	Investigate lipid reduction in adipocytes	Experimental Study	Indicated decreased intracellular lipid accumulation

Authors	Objective	Method	Main results
Xia et al.	Assess inflammation in adipose tissue	Experimental study	Demonstrated reduction of metabolic inflammation
Zhang et al.	Analyze the use of fat as an energy source	Experimental study	Increased lipid oxidation and weight reduction
Younggren et al.	Propose professional criteria for evaluation of emotional support animals	Conceptual study and clinical analysis	It indicated the need for standardized protocols for the evaluation and certification of these animals

Source: The authors.

The synthesis presented in the table shows that the analyzed studies converge in the identification of the metabolic potential of tirzepatide in the modulation of adipose tissue. Consistency was observed among the findings, especially with regard to the reduction of adipose mass, improvement of insulin sensitivity, and regulation of energy metabolism. Despite the promising results, some challenges are still pointed out in the literature, such as the need for long-term investigations that evaluate the safety and sustained efficacy of the drug, as well as its effects on different population profiles.

In addition, the importance of deepening the understanding of the molecular mechanisms involved in the action of tirzepatide is highlighted, especially in the context of aesthetic biomedicine. Thus, the results analyzed reinforce that tirzepatide is an innovative and effective therapeutic approach, with relevant impacts both in the treatment of metabolic disorders and in applications aimed at body aesthetics, evidencing the need for continuity of research in the area.

5 CONCLUSION

The analysis of the studies allowed us to understand that tirzepatide represents a significant advance in the field of therapies aimed at energy metabolism and adipose tissue reduction. Its differentiated mechanism of action, based on the simultaneous activation of GIP and GLP-1 receptors, contributes to a broader and more effective approach to metabolic control, promoting not only the reduction of body weight, but also relevant improvements in energy homeostasis.

It was observed that the effects of the drug go beyond the simple decrease of adipose mass, involving important changes in the metabolic dynamics of adipocytes, in the hormonal regulation of satiety, and in the modulation of inflammatory processes associated with adipose tissue. These factors act in an integrated manner, favoring the improvement of insulin sensitivity and the functional reorganization of body metabolism.

In addition, tirzepatide's ability to interfere with the distribution and functioning of different types of adipose tissue reinforces its potential in the treatment of metabolic

disorders. The reduction of visceral and subcutaneous fat is directly related not only to clinical benefits, but also to changes in body composition that impact aesthetic aspects, expanding the relevance of the drug in the context of aesthetic biomedicine.

Another important point refers to its role in reducing metabolic inflammation, one of the main factors associated with the development of chronic diseases related to obesity. By modulating these processes, the drug contributes to the restoration of metabolic balance, promoting positive systemic effects in the body.

Thus, it is concluded that tirzepatide stands out as a promising therapeutic strategy, with multifactorial action on energy metabolism and adipose tissue. Its integrated effects reinforce its potential both in the clinical management of obesity and in applications aimed at body aesthetics, highlighting the importance of new studies that deepen the understanding of its mechanisms and expand its possibilities of use.

ACKNOWLEDGMENTS

We thank, first, God, for the opportunity to develop this work and for the strength throughout his academic career. We express our sincere gratitude to the advising professor, for his careful conduct, for the safe guidelines and for the constant encouragement to scientific production, contributing decisively to the construction of this study.

To our family members, we thank them for their unconditional support, for their understanding in moments of intense dedication and for being a fundamental basis in our personal and professional development. To our classmates, we leave our recognition for the partnership, the exchange of knowledge and the mutual support throughout the process of preparing this work.

We thank the educational institution for providing the necessary academic environment for the development of research and for the training of professionals committed to science and society.

REFERENCES

Bittencourt, J. O. A., et al. (2024). Tirzepatide: Dual GIP/GLP-1 receptor agonists from molecular to clinical practice for treating type 2 diabetes and obesity. Indonesian Journal of Endocrinology and Metabolism. Recuperado em 16 março, 2026, de https://www.researchgate.net/publication/401688138_Tirzepatide_Dual_GIPGLP-1_Receptor_Agonists_from_Molecular_to_Clinical_Practice_for_Treating_Type-2_Diabetes_and_Obesity

Li, Y., et al. (2025). Tirzepatide improves metabolic pathways in adipose and hepatic tissue. Frontiers in Endocrinology. Recuperado em 16 março, 2026, de https://pmc.ncbi.nlm.nih.gov/articles/PMC12361993/

Loomba, R., et al. (2024). Tirzepatide for metabolic dysfunction–associated steatohepatitis. The New England Journal of Medicine. Recuperado em 16 março, 2026, de https://www.natap.org/2024/EASL/NEJMoa2401943.pdf

Mestres-Arenas, A., et al. (2026). Differential effects of the anti-obesity drug tirzepatide on adipose tissues. Biochemical Pharmacology. Recuperado em 16 março, 2026, de https://www.sciencedirect.com/science/article/pii/S0753332226000892

Pase, M. A., et al. (2024). Tirzepatide: Dual GIP/GLP-1 receptor agonists from molecular to clinical practice. Indonesian Journal of Endocrinology and Metabolism. Recuperado em 16 março, 2026, de https://www.researchgate.net/publication/401688138_Tirzepatide_Dual_GIPGLP-1_Receptor_Agonists_from_Molecular_to_Clinical_Practice_for_Treating_Type-2_Diabetes_and_Obesity

Regmi, A., et al. (2024). Tirzepatide modulates the regulation of adipocyte nutrient metabolism. Cell Metabolism. Recuperado em 16 março, 2026, de https://www.cell.com/cell-metabolism/pdf/S1550-4131(24)00186-4.pdf

Sokary, S., et al. (2025). The promise of tirzepatide: A narrative review of metabolic outcomes. Diabetes & Metabolic Syndrome. Recuperado em 16 março, 2026, de https://www.sciencedirect.com/science/article/pii/S1751991825000816

Sun, Y., et al. (2026). Tirzepatide reduces intracellular lipid accumulation in adipocytes. Biochemical Pharmacology. Recuperado em 16 março, 2026, de https://www.sciencedirect.com/science/article/pii/S0014299926000051

Xia, Y., et al. (2024). Tirzepatide's role in targeting adipose tissue macrophages and metabolic inflammation. Pharmacological Research. Recuperado em 16 março, 2026, de https://www.sciencedirect.com/science/article/pii/S1567576924020216

Zhang, A., et al. (2025). Tirzepatide reduces body weight by increasing fat utilization. Diabetes, Obesity and Metabolism. Recuperado em 16 março, 2026, de https://dom-pubs.onlinelibrary.wiley.com/doi/10.1111/dom.16294