OBESITY RELATIONSHIP, METABOLIC SYNDROME AND INSULIN RESISTANCE: A SYSTEMATIC REVIEW

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Abstract: Objective: The present study aims to describe the relationship of obesity with metabolic syndrome and insulin resistance in obese patients. Methodology: The present study is a bibliographic review that seeks to study articles on the biochemistry of obesity and insulin resistance. 18,955 PUBMED databases and Virtual Health Library of the Ministry of Health were consulted with the following filters: randomized study articles and epidemiological review articles. Articles written in English published between 2006 and 2023 were used in the research. The research was conducted in 2 phases: articles and summaries screening phase that were used in the bibliographic review where 7 articles were selected, then the work were read and built the Scientific article. RESULTS: Longitudinal research of literature review points out that obesity develops an inflammatory process of dysfunctional adipocytes where cytokines ampha and macrophages are triggered causing an accumulation of systemic fatty acids in the body's tissues such as: liver and muscle pancreas generating lipotoxicity and one one Systemic inflammation that prevents adequate insulin signaling. Metabolic syndrome was diagnosed in 45.5% of obese patients and insulin resistance at 29.1%. Insulin resistance had an association with HDL-cholesterol ($p = 0.032$) and with metabolic syndrome ($p = 0.006$). The body composition indicators were correlated with insulin resistance ($p < 0.01$). The values of 23.5 and 36.3% above the IMC reference point allowed to identify insulin resistance and metabolic syndrome in patients. Conclusion: The present study sought to review the literature on the relationship of obesity, biochemistry and insulin resistance. Studies indicate that 45.5% of obsessed patients have metabolic diseases arising from obesity such as insulin resistance, tissue lipotoxicity and diabetes, which occur due to the inflammatory process of anf-alpha cytokines in

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adipose tissue dysfunctional obese patients leading to a significant loss of the patient's quality of life.

Keywords: insulin resistance; interference between organs; muscular atrophy; obesity.

Introduction

Obesity is a clinical condition whose prevalence has grown alarmingly in recent decades. From 1975 to 2014, the number of obesity cases tripled, and by 2022, it is estimated that about 1 billion individuals around the world were obese. Obesity is now widely recognized as a global pandemic, affecting adults, children and adolescents in various sociocultural and economic contexts. Its classification as a pandemic stems not only from its universal reach, but also from the serious consequences that entails for public health. Obesity is strongly associated with a number of adverse conditions, including cardiovascular disease, metabolic diseases and a significant increase in the risk of various cancers. Additionally, this condition is linked to a considerable reduction in life expectancy, underlining the urgent need for effective interventions. Among the metabolic conditions most commonly associated with obesity are insulin resistance and type 2 diabetes indicate that approximately 29.1% of obese patients develop these metabolic changes, which highlights the complexity and severity of the impact of obesity on health metabolic. Insulin resistance, a pathological state where body cells do not respond adequately to the hormone insulin, is a direct consequence of obesity and is often present in individuals with metabolic syndrome. This syndrome is characterized by a set of conditions, including arterial hypertension, dyslipidemia and hyperglycemia, which together increase the risk of development of cardiovascular disease and type 2 diabetes. The relationship between obesity, insulin resistance and metabolic syndrome is intrinsically linked, creating one Metabolic deterioration cycle that compromises the health of the individual. This study reviews the existing literature to analyze the interrelationship between obesity, insulin resistance and metabolic syndrome, highlighting underlying pathophysiology and the mechanisms involved. Understanding these mechanisms is crucial to identifying effective interventions and preventive

strategies that can improve patients' quality of life and reduce associated mortality. The importance of this study lies in the need to face the global crisis of obesity and its metabolic complications, providing insights for the implementation of public health policies and more effective clinical treatments.

Objective

The present study aims to describe the relationship of obesity with metabolic syndrome and insulin resistance in obese patients.

Methodology

The present study consists of a comprehensive bibliographic review, with the objective of investigating and analyzing the relationship between obesity, metabolic syndrome and insulin resistance through biochemistry underlying these conditions. To ensure a strict and comprehensive approach, a detailed search was conducted in the available scientific literature. Initially, two main databases were consulted: PubMed and the Ministry of Health's Virtual Health Library (BVS). These databases were selected due to their wide coverage and relevance in health. The search was performed using specific filters to refine the results and focus on studies with greater methodological robustness. The filters applied included the selection of articles from randomized studies and epidemiological reviews, ensuring that only the most relevant and reliable literature was considered. The survey covered articles published between 2006 and 2023, ensuring the inclusion of recent and relevant data for the current context. The descriptors used in the search were "insulin", "resistance", "obesity" and "diabetes". These terms were chosen to reflect the main aspects of the theme under study and facilitate the identification of articles that directly address biochemistry and interactions between obesity, insulin resistance and diabetes. The review process was divided into two main phases. In the first phase, the initial screening of the articles and summaries was performed. At this stage, a total of

18,955 articles were evaluated to select those who aligned with the established inclusion criteria. The screening was made based on the relevance of the title, summary and, when necessary, of the full text of the articles. After screening, 7 articles were selected that met the inclusion criteria and which had an in -depth analysis of the topics of interest. In the second phase, the selected articles were read in full and critically analyzed to extract relevant and relevant information about the biochemistry of obesity and insulin resistance.

Results

P Russell (2004) suggests that accumulation of intramiellular triglycerides (IMTG) may play a significant role in the development of insulin resistance, particularly in obese and diabetic patients. It has been observed that high levels of IMTGs are correlated with insulin resistance in these individuals, which is not the case in resistance trained individuals (ETR). This difference can be attributed, in part, to variations in gene expression and key enzyme activities involved in the transport and oxidation of fatty acids, as well as the state of peroxidation of IMTGs between obese/ diabetic patients and individuals ETR. The research points out that the homeostasis of fats and lipids in the skeletal muscles can be interrupted by activation of kinase c (PKC) protein, which positively interferes with various signaling pathways, including those mediated by insulin and IKK/NFKB. In addition, increased peroxidation of IMTGs can reduce insulin sensitivity, raising tnf-alpha levels, a proinflammatory cytokine that increases the expression of cytokine signaling suppressor proteins (PCS). Both PKC activation and increase in TNF-alpha and SOCS3 levels result in the inhibition of IRS-1 tyrosine phosphorylation, a crucial step in insulin signaling road, which compromises its activation and, consequently, downstream signaling.

C Lelliott (2004) addresses obesity and type 2 diabetes mellitus as the main public health problems of the 21st century, highlighting the importance of developing effective strategies to prevent and treat obesity. However, despite scientific advances in identifying weight regulatory pathways, the

obesity epidemic continues to expand faster than scientific progress, especially in a aging population. This can lead to an subsequent uncontrolled epidemic of complications associated with obesity. The main focus of the research lies in the mechanisms that cause lipotoxicity, in order to identify appropriate strategies to prevent or slow the development of metabolic syndrome. Previous studies using transgenic mice and knockout models have revealed a significant interaction between white adipose tissue and skeletal muscle, where fatty acid synthesis (FA) on adipose tissue has reciprocal effects on FA oxidation on skeletal muscle. Research suggests that adipose tissue dysfunction is a crucial link between obesity, insulin resistance and type 2 diabetes, as it promotes the development of lipotoxicity in peripheral tissues. In an energy -rich environment, adipose tissue reacts in ways that depend on genetic and physiological factors, impacting the functions of other peripheral tissues. The models proposed in research describe how adipose tissue can respond to an excessive energy environment, influencing the energy balance between different organs.

Thomas Plötz (2024) explores the harmful effects of free fatty acids (FFAS) on various cell functions on pancreatic beta cells, which are essential for insulin production and regulation. Traditionally, studies in this area have focused on the effects of more common physiological fatty acids such as palmitic acid and oleic acid. However, this limited approach does not consider variations in FFAS structure, such as chain length and saturation degree, which can significantly influence lipotoxicity mechanisms. For a broader understanding of lipotoxicity mechanisms, research suggests that it is necessary to investigate a wide range of structurally related FFAS. Studies using Endoc-βH1 Human Beta Beta Line have allowed detailed analysis of FFAS structural-activity relationships, providing deep insights on how different FFAs contribute to beta cell lipotoxicity. Research points out that certain structural characteristics of FFAS play a crucial role in Development of lipotoxicity in human beta cells. These findings are particularly relevant in the context of obesity and type 2 diabetes, where there is an increase in triglyceride reserves. This accumulation of triglycerides is associated with greater lipotoxicity, which can compromise the function of beta cells and contribute to the progression of diabetes.

Ruth C R Meex (2019) explores the relationship between insulin resistance, muscle loss and type 2 diabetes, highlighting how these factors often coincide, especially in overweight patients. Obesity and disorders in lipid metabolism play crucial roles in the development of insulin resistance, particularly due to the increase in the mass of adipose tissue and the dysfunction of this tissue, which result in a systemic overflow of lipids and low -grade inflammation, mediated by secretion altered adipocins and cytokines. The study points out that the increased flow of fatty acids from adipose tissue contributes to increased fat storage in the liver and skeletal muscle. This can lead to altered secretion of hepatocinas, mitochondrial dysfunction and insulin signaling compromised in skeletal muscle. These processes not only exacerbate insulin resistance, but are also associated with the development of muscle atrophy, suggesting that insulin resistance and muscle loss can be two sides of the same coin. Although the exact connection between lipid accumulation, type 2 diabetes and muscle atrophy is still largely unexplored, research suggests that lipid disorders in peripheral tissues such as liver and skeletal muscle play an important role. These disorders may affect peripheral sensitivity to insulin and muscle mass through common pathways such as mitochondrial dysfunction and cytokine -mediated inflammation.

G Las (2010) investigates the role of autophagy, a cellular catabolic process, in the health of pancreatic beta cells and their implication in diabetes. Autophagia, involved in both cellular survival and cell death, is crucial for adequate insulin secretion and the viability of beta cells. In experimental models, such as transgenic mice that do not have beta cell autophagia, a decrease in these cells and a reduction in insulin secretion in response to glucose was observed. Several studies indicate that stress can stimulate autophagia in beta cells. The increase in the number of autofagosomes was observed in several in vivo models of diabetes, such as mice DB/DB, mice fed with rich fat diet, PDX-1 Knockout mice, as well as in vitro models of glucotoxicity and lipotoxicity. The pharmacological and molecular inhibition of autophagia has shown to increase susceptibility to cell stress, suggesting that autophagia can play a protective role against diabetes relevant stresses. However, recent discoveries release doubts about these conclusions. In diabetic pancreas and beta cells exposed to fatty acids,

it was observed the accumulation of abnormal morphology autofagosomes and the suppression of expression of lysomal genes, suggesting a compromise in the self -filled turnover. This indicates that under certain conditions, autophagia may be impaired, contributing to cell dysfunction rather than protecting against stress.

Takashi Kadowaki (2022) Research on cardio-renal metabolic disease (CRM) explores the complex interaction between metabolic disorders, cardiovascular disease (CVD) and renal dysfunction, highlighting the interconnection between these conditions and their implications for global health. CRM is defined as multidirectional interaction between metabolic diseases such as type 2 diabetes (T2D), various types of cardiovascular diseases, and chronic kidney disease (CKD). Type 2 diabetes increases the risk of heart failure, a well -known aspect that has only recently received more attention in treatment. In addition, there are variations in the risk of heart failure based on ethnicity, and atherosclerotic heart disease is a well -established T2D complication. Many patients with T2D also develop CKD, with a particularly high risk among Asians compared to their western counterparts. The research also points out that CVD increases the risk of CKD and vice versa, with heart failure present in approximately half of patients with CKD. Molecular mechanisms involved in CRM diseases include hyperglycemia, insulin resistance, renin-angiotensin-aldosterone hyperactivity, advanced glycation product production, oxidative stress, lipotoxicity, endoplasmic reticulum stress, calcium handling abnormalities, mitochondrial dysfunction, poor energy production and chronic inflammation. Pathophysiological manifestations of these processes include diabetic cardiomyopathy, vascular endothelial dysfunction, cardiac and renal fibrosis, glomerular hyperfilling, renal hypoperfusion, venous congestion, tolerance reduction to metabolic dysfunction, and calcification of atherosclerotic plaques.

Conclusion

The present study sought to review the literature on the relationship of obesity, biochemistry

and insulin resistance. Studies indicate that 45.5% of obese patients have had metabolic diseases arising from obesity, such as insulin resistance, tissue lipotoxicity and diabetes. These conditions are attributed to the proinflammatory process of TNF-Alpha cytokines in obese patients' dysfunctional fat, which results in a significant loss of quality of life. As with respiratory complications that can be divided into bass and light, the metabolic consequences of obesity also vary in gravity. Laryngospasm, for example, is a severe complication, while the persistent stricker and cough are considered less severe but still important. Similarly, insulin resistance and lipotoxicity can be seen as severe manifestations of obesity, while other metabolic complications may have a less immediate but equally impactful presentation. Effective prevention and management of these metabolic complications follow a similar approach to respiratory complications: require early identification and adequate intervention. In the case of obesity and insulin resistance, prophylactic strategies include the implementation of lifestyle changes such as diet and exercise, and, when necessary, directed pharmacological interventions. Just as the use of simulators and training is effective in difficulty management, education and continuous training on health practices and obesity control are crucial to improving results and reducing the impact of metabolic diseases. Therefore, recognizing and treating obesity and its complications associated holistically and early is fundamental to prevent disease progression and improve patients' quality of life. Proper management with integrated interventions can lead to significant improvement in metabolic health and reduce the adverse effects associated with obesity.

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