Insulin Resistance and Inulin-Type Carbohydrates in Type 2 Diabetes and Obesity Patients: A Systematic Review and Meta-Analysis

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Received: 28-Nov-2022, Manuscript No. jdm-22-20990; **Editor assigned:** 01-Dec-2022, PreQC No: jdm-22-20990(PQ); **Reviewed:** 15-Dec-2022, QC No: jdm-22-20990; **Revised:** 22-Dec-2022, Manuscript No: jdm-22-20990(R); **Published:** 29-Dec-2022, DOI: 10.35248/2155-6156.1000971

Abstract

Type 2 diabetes mellitus (T2DM) and obesity are both physiological conditions known as insulin resistance (IR), which is characterised by elevated blood insulin and glucose levels. In an animal model, inulin-type carbohydrate (ITC), a form of fermentable fructan, can lower blood sugar and improve insulin resistance, however there is debate over its potential benefits in human clinical studies. In order to assess the effectiveness of ITC supplementation in reducing IR in T2DM and obese patients, the authors carried out a comprehensive literature analysis. This involved supplementation with ITC in reducing IR in T2DM and obese patients. Studies using the meta-analysis of the following variables for T2DM patients were included: body mass index (BMI), fasting plasma glucose (FPG), fasting insulin (FI), HbA1c, homeostatic model assessment IR (HOMA-IR), and quantitative insulin sensitivity check index (QUICKI). The main outcomes were determined to be HOMA-IR and QUICKI. A thorough analysis was done to determine how ITC affected IR in obese persons.

25 researches were found in the database that satisfied the criteria for inclusion; 11 of these studies underwent meta-analysis, and an additional 5 articles on type 2 diabetes and 9 articles on simple obesity underwent a thorough evaluation. According to our findings, ITC supplementation did not result in a post-intervention BMI reduction. However, the postintervention and reduction statistics of FPG, FI, HbA1c, and HOMA-IR can be greatly reduced. By performing a subgroup analysis based on baseline BMI, heterogeneity was removed. In terms of QUICKI improvement, there was no discernible difference between the ITC and control groups. After subgroup analysis based on ITC intakes, the difference was statistically significant and the heterogeneity was removed, the findings of blood glucose, insulin, and HbA1c were found to be debatable in 14 studies for a systematic review. Seven studies on simple obesity were examined, and only one found that ITC intervention significantly improved HOMA-IR; the other six did not.

Keywords: Type 2 Diabetes; Obesity; Carbohydrates; Insulin Resistance; Plasma glucose; Diabetes mellitus.

Introduction

The multifactorial condition known as type 2 diabetes mellitus (T2DM), which is characterised by chronic hyperglycemia and insulin resistance, is encouraged by both hereditary and environmental factors (IR). According to the International Diabetes Federation's estimate of the global prevalence of diabetes, there were 451 million diabetic individuals worldwide in 2017- of these, T2DM accounted for nearly 90% of cases. Obesity, which is a very important risk factor for T2DM, has been associated with diets high in fat, sugar, and fat content. IR occurs before the development of overt diabetes in persons with T2DM and may serve as a diagnostic indicator for the condition. Patients with T2DM who are obese will experience worse IR. Consequently, body control based on dietary intervention will aid in reducing IR and enhancing the effectiveness of hypoglycemic drugs for T2DM patients [1].

Obesity, which is one of the elements strongly contributing to chronic diseases, has continually posed a danger to world health. It is widely known that chronic diseases are the leading cause of death. Weight loss is linked to lower metabolic and cardiovascular risks while losing weight causes less comorbidity such hypertension, hyperlipidemia, and hyperglycemia. Weight control, in particular for obese adults with prediabetes, may reduce the incidence of or delay the emergence of type 2 diabetes mellitus (T2DM), with stringent calorie restriction even slowing the evolution of T2DM in patients with established disease [2].

In the past few decades, bariatric surgery has been widely regarded as a weight-control option for people for whom conventional treatment has failed. For patients who are moderately to extremely obese, bariatric surgery is more effective than nonsurgical weight loss methods. Additionally, bariatric surgery has been shown to significantly and permanently improve metabolic and cardiovascular risk factors in patients who are extremely obese. The long-term and short-term effects of bariatric surgery-reduced caloric intake and lower fat mass and body weight-combine to improve glucose metabolism, insulin resistance, adipocytokines release, and quality of life. Currently, it is widely acknowledged that bariatric surgery is a viable therapeutic option for T2DM management in patients whose conditions are not sufficiently controlled by good lifestyle choices and medical care [3].

There are numerous bariatric procedures available nowadays. The three most popular bariatric procedures are laparoscopic adjustable gastric banding (LAGB), laparoscopic sleeve gastrostomy (LSG), and laparoscopic Roux-en-Y gastric bypass (LRYGB). LRYGB is generally regarded as the "gold standard" procedure because it results in more rapid and significant weight loss than the "restrictive" procedure (LAGB) and less risk of failure or complication than the "malabsorptive" procedure (LS Laparoscopic mini gastric bypass (LMGB) is the LRYGB surgery that has been simplified. When LMGB first appeared, it spread slowly and was the subject of numerous debates. However, LMGB also has some benefits, such as one less anastomosis, shorter operative time (OT), lower risk of anastomotic leakage and internal herniation, shorter learning curve, and ease of reversibility, which made it less popular due to complications like marginal ulcers, chronic alkaline reflux, Barrett oesophagus, anastomosis leakage, and stenosis and necessitating revision surgery. The clinical usefulness of LMGB in comparison to other procedures is regrettably not evaluated in large scale multicenter randomised controlled trials, and the indications and results of LMGB in obese patients are still controversial. In order to uncover some evidences to support the use of LMGB in treating obesity and T2DM, we did this systematic review and meta-analysis to evaluate and compare the efficacy, benefits, and complications of LMGB with those of LAGB, LSG, and LRYGB [4].

Materials and Method

From inception to December 2014, we conducted the literature search by retrieving the electronic databases of PubMed, EMBASE, and the Cochrane Library. "Mini gastric bypass," "single anastomosis gastric bypass," "omega loop gastric bypass," "loop gastric bypass," "MGB," or "LMGB" were the terminologies used. Additionally, manual retrieval of included literature references was done for additional analysis. The literature search was carried

out independently by two authors (Quan and Huang), and the findings were cross-checked to come to a consensus [5].

Studies were included if they detailed the results of LMGB, contrasted LMGB with one or more bariatric surgeries, and described the surgical effects of BMI, WC, remission rates for T2DM, %EWL, and other characteristics linked to obesity or diabetes. Since it was unable to obtain specific information regarding the patient characteristics, interventions, or outcomes, conference abstracts were excluded. The most recent study or the one with the biggest sample size was chosen when two or more studies from the same centre or author were obtained. Studies were considered for a meta-analysis if they compared LMGB to LAGB, LSG, or LRYGB and for a systematic review if they solely reported LMGB results. The procedures for preferred reporting items for systematic reviews and meta-analyses were followed when conducting this meta-analysis [6].

Discussion

The goal of the current investigation was to conduct the first systematic review and meta-analysis to examine the relationship between Hg levels in various body samples and the risk of T2DM. Overall, we uncovered epidemiological evidence that showed Hg levels in diabetic patients' blood and hair samples were significantly greater than in the non-diabetic control group. Nevertheless, altogether, this study's findings showed no conclusive link between exposure to mercury and the incidence of type 2 diabetes. Hg exposure, however, may lessen the incidence of T2DM in the male subgroup [7].

The results of the current meta-analysis showed no evidence of a connection between mercury exposure and the incidence of type 2 diabetes. Even in the subgroups according to the type of study and sample source (blood, urine, and toenail), this lack of relationship was seen (case-control vs. prospective cohort). Blood Pb, Hg, and Cd concentrations in diabetic patients were marginally higher than those of non-diabetics, according to a cross-sectional study on 1588 men and 1596 women in the general population of South Korea with ages 30 years; however, this difference was not statistically significant. The prevalence of diabetes remained unaffected by the blood heavy metals concentrations, even after adjusting for factors such as age, gender, geography, smoking, alcohol consumption, and frequent exercise. However, the Hg levels in red blood cells (RBC-Hg) of T2DM patients were significantly greater than the nondiabetic subjects in the 2019 study by Tsai et al. on 646 Taiwanese people [8].

A substantial direct correlation between the RBC-Hg and the prevalence of T2DM was observed after adjusting for the relevant confounders. The Hg concentration of toenails did not correlate with a greater prevalence of diabetes in either men or women, according to a cohort study on samples of toenails from 9262 American participants. Even after separate studies based on categories of Hg with greater amounts, fish or Omega 3 consumption, BMI, and age, this trend persisted. There is likely a link between the total Hg content and the risk of developing diabetes, according to a review research that included 34 in vivo and in vitro investigations. However, there was insufficient proof of a consistent and causal association. A case-control research revealed that people with high blood Hg levels (>16 mg/L) had significantly higher fasting blood glucose levels. Furthermore, a comprehensive evaluation of 29 publications did not identify sufficient evidence of any relationships between Hg levels and diabetes, validating our findings when taking Hill's causative criteria into account. The disparity between studies could be due to study design, the source of Hg exposure, or demographic traits like age and sex. Furthermore, as blood levels of Hg vary among ethnic groups, ethnic differences may be the cause of the data' variability. The geographic region has an impact on the amounts of Hg exposure, and this regional variation may be one reason why the existing information is inconsistent [9].

Conclusions

According to this meta-analysis, ITC supplementation is effective in improving IR and glycemic control in T2DM patients, particularly those who are obese. In patients who are fat, it is debatable. To validate or update the findings of this work, additional randomised, double-blind, and large-sample ITC trials for T2DM and simple obesity are required in the future. In terms of weight loss and T2DM remission when compared to LAGB, LSG, and LRYGB, LMGB was at least comparable and had few problems. The long-term (>5 years) impact on weight loss and T2DM remission, late consequences, and their treatment are still some matters that need to be better defined. Future clinical trials with prospective designs are still required to set the standards for LMGB and show that it is useful.

Conflict of Interest

None

Acknowledgement

None

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Cite this article: Maryam Miraghajani. Insulin Resistance and Inulin-Type Carbohydrates in Type 2 Diabetes and Obesity Patients: A Systematic Review and Meta-Analysis. J Diabetes Metab, 2022, 13(12): 971.