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Systematic Review

The relationship between Insulin Secretion and Insulin Resistance and Alcohol Consumption in Diabetics

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Abstract

Introduction: The relationship between alcohol consumption and diabetes is still not well defined. In some studies, alcohol consumption is introduced as a factor that improves insulin sensitivity, and in others as a factor that increases insulin resistance. But long-term alcohol consumption increases the risk of type 2 diabetes. Since alcohol produces a lot of calories in the body, drinking alcohol in diabetics can increase blood sugar and also cause obesity.

Methods: In this systematic review, all qualitative articles related to the study objectives, published from 2008 to January 2024, were reviewed. Search in Magiran, Irandoc, IranMedex, SID, Cochrane Library, Google Scholar, ProQuest, Scopus, Web of Science, and PubMed/Medline Embase with keywords: alcohol, insulin, insulin resistance, and diabetes. The entry criteria were articles in English or Farsi, qualitative articles related to the objectives of the study. Exclusion criteria were articles that were in the form of posters, speeches, letters to the editor, and quantitative studies.

Results: The findings from the review of 20 qualitative studies showed that Alcohol can disrupt the body's blood sugar control mechanism and lead to a severe drop in sugar in diabetics.

Conclusion: There is an inverse and non-significant relationship between the amount of alcohol consumption and the beneficial effects on people with type 2.

Keywords: Diabetes, Alcohol, Insulin Resistance, Obesity

Introduction

Diabetes is a set of autoimmune, metabolic, and genetic disorders, which has one main feature, namely hyperglycemia. Its main symptoms are frequent urination, thirst, and overeating. This disease is caused by a lack of cellular absorption of blood sugar, resulting from a decrease in insulin secretion or resistance of body cells to insulin.[1]

Diabetes is divided into two types. Type 1 diabetes, or insulin-dependent diabetes, is caused by insulin deficiency caused by autoimmune damage to the β cells of the pancreas. They are lost or inactive, and in order to control the blood sugar level of these patients, who are mostly children and young people, insulin must be prescribed throughout their lives, and they must measure their blood sugar regularly and adjust its amount daily, and if necessary, the type and amount of insulin to change. While type 2 diabetes, or non-insulin -dependent diabetes, is defined by insulin resistance (IR), with or without aberrant insulin secretion. It often occurs in old age and after 40 years old. In view of the fact that the majority of type 2 diabetes sufferers are obese, it has been claimed that obesity is the cause of reducing the sensitivity of body cells to insulin.[2]

The worldwide prevalence of obesity and diabetes has reached epidemic proportions and contributes to premature mortality. Obesity is strongly associated with diabetes. There are concerns that the obesity epidemic will reduce progress in cardiovascular disease prevention and life expectancy. In addition to mortality and chronic diseases, obesity is related to disability and poor physical and cognitive performance. Obesity increases the risk of metabolic and cardiovascular diseases, musculoskeletal disorders, some types of cancer, lung diseases, and mental diseases.[3]

Alcohol is one of the factors that affects diabetes, successful aging, and quality of life. Alcohol consumption

at a level that causes or has the potential for adverse physical, psychological, or social consequences is common.[4] Alcohol consumption is associated with a combined effect on biological aging and distinct nonlinear effects. At low and heavy levels of alcohol consumption, biological aging is accelerated, while at moderate levels of consumption, there is a relative reduction effect.[5] Alcohol has profound effects on tissue fuel metabolism and the whole body, which helps to increase complications and mortality in people with alcohol use disorder. Nutritional status is also an important component of the sometimes-conflicting findings regarding the effects of alcohol on the regulation of insulin and glucose metabolism. Because the contribution of alcohol consumption to the development or exacerbation of type 2 diabetes is not well defined, and a multisystem approach is probably needed because both alcohol and diabetes affect multiple targets in the body.[6]

Therefore, what makes the current research remarkable is addressing the components that play an important role in everyone's life, considering the wide role of life satisfaction, physical health, social health, and quality of life as a factor that causes adaptation. among a group of society that has special characteristics, especially diabetic people, it seems necessary. Analyzing the relationship between these components can lead to appropriate interventions, and the research results can provide a basis for educational and counseling measures related to alcoholics so that they can improve the quality of life of people with diabetes with the highest efficiency.

Materials and Methods

The current study is a qualitative systematic review based on the PRISMA pattern, which reviews the relationship between insulin secretion and resistance and alcohol consumption in diabetic people based on articles published in domestic and foreign journals. This study was conducted in six stages.

The first stage of the research questions is what kind of relationship can there be and what other factors can have an effect on this relationship. In order to ask this question, the PICO strategy was used. P (population) are diabetic patients. I (intervention), which is related to the discovery of the relationship between alcohol and diabetes. C (comparison) was not used due to the type of review study. O (outcome) is the discovery of the relationship between alcohol and insulin resistance.

The second stage was the selection of keywords related to the research topic and search terms and planning to determine search strategies. It should be noted that descriptive terms and keywords were defined based on MESH based on the opinion of experts. The keywords are: alcohol, diabetes, insulin, insulin resistance.

The search strategies in PubMed are listed in the table below.

Search round	Syntax
1	" diabetes " (Mesh) AND "alcohol"(Mesh)
2	Alcohol AND insulin resistance AND Relationship
3	1+2
4	(diabetes [Title/Abstract]) AND alcohol [Title/Abstract)[

The third step, the entry and exit criteria were determined by the members of the research team. The criteria for entering the study are: 1. Related articles on the relationship between alcohol and diabetes 2. Studies that were conducted from January 1, 2008, to January 2024. It is that most of the studies done in this period are 3. Written in English or Persian. Exit criteria: 1. Articles that were in the form of posters, speeches, or letters to the editor and were not related to the research objectives were excluded from the study. 2. Non-qualitative articles were removed.

The fourth stage was a systematic search of electronic databases. Scientific database of academic Jihad, SID, the Bank of medical science articles of Iran, Irandoc, international databases, PubMed, the Web of Science, and Google Scholar, from January 1st to January 2024, based on predetermined keywords and strategies, was searched.

The fifth step was the selection of qualified research articles. The summaries of the articles were examined, and the screening of the studies and the extraction of the results, as well as the evaluation of the quality control of the articles, were evaluated. The related articles were separated, and their full text was extracted. A total of 10,726 articles were found, and after removing duplicate articles, 1,811 articles entered

the review stage in terms of titles and abstracts. After reviewing the titles and abstracts of the articles, 98 articles entered the next stage, in which the full text of the articles was reviewed and the articles were based on criteria Exit and entry were checked. Finally, 20 articles were included in the final analysis.

PubMed	SID	Google Scholar	Cochrace library	Total
532	497	347	435	1811

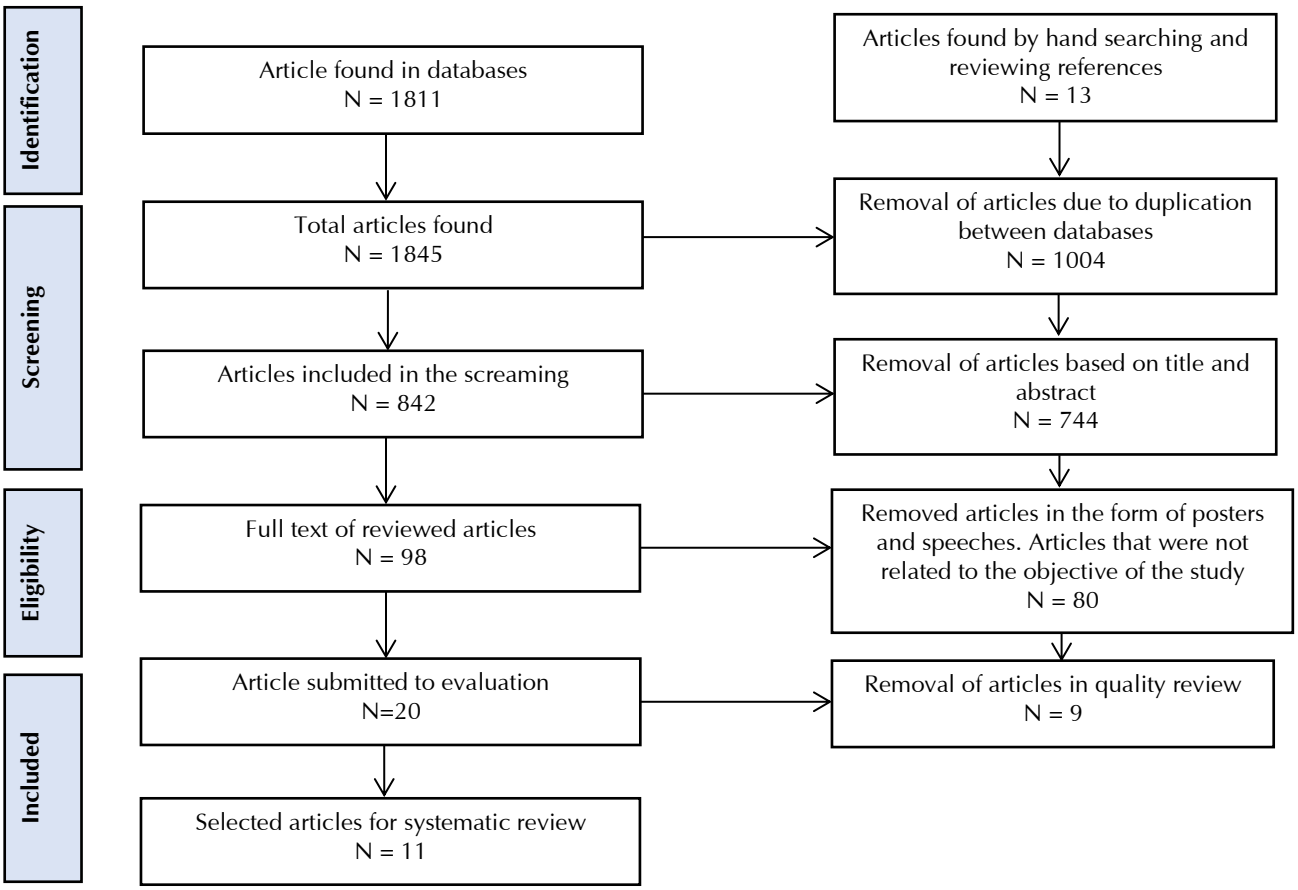

Figure 1. Prisma Flow Diagram

The sixth step was to check the quality of the articles. In order to check the quality of the articles, a checklist was prepared by Joanna Briggs to evaluate the quality of qualitative articles.[7] This tool has ten questions that are divided into yes and no, unclear, and not used. The purpose of this evaluation is to evaluate the methodological quality of the studies and the ways to achieve and find out the errors in the studies and the design and construction and analysis of the data. Thus, 9 articles were excluded from the study due to poor quality. In order to control the risk of distortion, a search strategy with controlled keywords was used for each database, and studies were selected according to the inclusion and exclusion criteria. To answer the questions of a systematic review, the data extracted from the literature review were combined, and the data extraction form was used to collect the data needed to answer the systematic review questions. The combination of data and their analysis was done descriptively.

After extraction, all the information collected from the qualitative studies was transcribed in a Word file, and the main and secondary fields were identified and coded, and the codes were compared and discussed and interpreted. A summary of the reviewed articles in the following table includes the names of the authors, year of publication, location of the study, number of samples, title of the study and findings, and key results of the study.

Author Name	Year	Place	Samples	Tools and type of study	Title	Results
Lando L J Koppes	2005	Netherlands	11959 cases of type 2 diabetes	15 prospective cohort studies	Moderate alcohol consumption reduces the risk of type 2 diabetes[8]	Current evidence from observational studies suggests an approximately 30% reduction in the risk of type 2 diabetes in moderate alcohol drinkers, while no risk reduction is seen in drinkers of >/=48 g/day.
Jemma Chiva-Blanche	2013	Spain	67 men at high cardiovascular risk	After a run-in period, all received red wine (30 g alcohol per day), an equivalent amount of non-alcoholic red wine, and gin (30 g alcohol per day) for 4 weeks, in random order. Fasting plasma glucose and insulin, homeostasis model assessment of insulin resistance (HOMA-IR), plasma lipoproteins, apolipoproteins and adipokines were determined at the beginning and after each intervention-Randomized crossover trial	Effects of red wine polyphenols and alcohol on glucose metabolism and lipid profile[9]	It supports the beneficial effect of the non-alcoholic fraction of red wine (mainly polyphenols) on insulin resistance, giving red wine greater protective effects on cardiovascular disease than other alcoholic beverages.
Yftach Gepner	2015	Israel	224 patients	Randomized, controlled trial	Effect of initiation of moderate alcohol consumption on cardiometabolic risk in adults with type 2 diabetes[10]	Sleep quality improved in both wine groups compared to the water group (P = 0.040). Overall, compared to changes in the water group, red wine reduced the number of metabolic syndrome components by 0.34.
Cullmann	2012	Sweden	Normal glucose tolerance (2070 men and 3058 women) or prediabetes (70 men and 41 women) aged 35-56 years	Cohort	Alcohol consumption and risk of prediabetes and type 2 diabetes in a Swedish population[11]	Heavy alcohol consumption increases the risk of abnormal glucose regulation in men. In women, the relationship is more complex: a reduced risk with low or moderate alcohol consumption and an increased risk with heavy alcohol consumption.
Takashi Funayama	2017	Japan	8 non-obese Japanese men with mildly elevated FPG and drinking habits	Pilot study	Effects of alcohol abstinence on glucose metabolism in Japanese men with elevated fasting glucose[12]	A two-stage clamp study showed that alcohol abstinence significantly improved hepatic IS, but not muscle IS. In conclusion, one week of abstinence from alcohol improved hepatic IS and FPG in non-obese Japanese men with a slight increase in FPG and drinking habits.
Hairong Yu	2019	China	A total of 2546 participants with 611 cases of combined type 2 diabetes and impaired glucose regulation (IGR)	Prospective cohort study	Alcohol consumption and its interaction with genetic variants are strongly associated with the risk of developing type 2 diabetes[13]	Alcohol consumption strongly increases the risk of type 2 diabetes with increased IR, especially in men with low T2D-GRS, which highlights the importance of avoiding alcohol when making recommendations for healthy lifestyle habits to prevent diabetes.

Mei Jiao Li	2022	China	15716 participants without diabetes and 11,232 participants without diabetes	Cohort study	The relationship between alcohol consumption and incident type 2 diabetes and prediabetes[14]	It supports the deleterious effect of heavy alcohol consumption on IFG and T2D. No protective effect was found for those with low-risk alleles for the ADH1B/ALDH2 genes.
Amalie R Lanng	2019	England	12 healthy men	Double-blind randomized crossover design	Glucose metabolic effects of oral and intravenous alcohol administration in men[6]	Alcohol does not appear to affect the secretion of incretin hormones, but it decreases insulin and glucagon secretion independently of gut-derived factors.
Meng Zhao Cui	2023	China	4855 patients with T2DM and prediabetes (35.2% male and 64.8% female)	Longitudinal observational study	Association of alcohol consumption with all-cause mortality, new stroke and coronary heart disease in patients with abnormal glucose metabolism[15]	For patients with abnormal glucose metabolism, occasional drinking (less than once a week) reduced the risk of all-cause mortality, whereas heavy alcohol consumption (≥30 g/day for men and ≥15 grams per day for women) significantly increases this risk. Those with a new stroke should avoid heavy alcohol consumption, but light or occasional drinking is acceptable. In addition, it is very important to control blood sugar and blood pressure and continue physical activities.
Nawé Justine Astrid Ngandeu	2018	Cameron	10 adult volunteers under the age of 40 who were occasional heavy drinkers.	Experimental study	Effects of binge drinking on glucose metabolism in occasional drinkers[16]	Heavy alcohol consumption may increase insulin sensitivity but severely decrease insulin secretion.
Charlotte Holst	2017	Denmark	70551men and women from the general Danish population	Cohort study	Alcohol drinking patterns and diabetes risk[17]	Frequency of drinking alcohol is associated with diabetes risk, and drinking more than 3 to 4 days per week is associated with the lowest risk of diabetes, even after taking into account average weekly alcohol consumption .

Results

People with diabetes should be very careful when consuming alcohol. Because alcohol can disrupt the body's blood sugar control mechanism by affecting the liver.[14] Alcohol consumption can lead to a severe drop in sugar in diabetic people; it also occurs in non-diabetic people who suffer from alcohol poisoning. This drop in sugar does not occur if a lot of carbohydrates are consumed with alcohol so that the sugar is absorbed through the digestive system.[12] There is an inverse and non-significant relationship between the amount of alcohol consumption and beneficial effects on people with type 2 diabetes.[18] The general recommendation is not to consume alcoholic beverages for both diabetic and non-diabetic people. On the other hand, alcohol reduces a person's ability to control diabetes and detect hypoglycemia due to lowering the level of alertness.[6] The results of the literature review show that alcohol consumption alone may not cause diabetes, but it can play an important role in this field. Diabetes is one of the side effects of pancreatitis, which is primarily caused by excessive alcohol consumption. Consuming a large amount of alcohol will sensitize the body to insulin, which is a

stimulus for type 2 diabetes.[14] Chronic use of alcohol is a potential risk factor for type 2 diabetes, which causes insulin resistance and disorder. Pancreatic β-cell function is a prerequisite for the development of diabetes. However, alcohol consumption in diabetes is controversial, and more detailed information on the diabetogenic effect of alcohol seems to be necessary. Diabetes, especially T2 diabetes, causes disturbances in various metabolic processes, including defects in insulin-mediated adipocyte glucose uptake and impaired insulin action in the liver. Furthermore, the neurobiological profiles of alcoholism are associated with the effects of impaired glucose homeostasis and insulin resistance, which are influenced by altered appetite that regulates peptides and neurotrophic factors. Alcohol is an effective factor in weight gain. The more alcohol is consumed, the more likely it is to be overweight, which is one of the most important and dangerous factors in type 2 diabetes.[3] Moderate alcohol consumption does not affect estimates of insulin sensitivity or fasting glucose levels but decreases fasting insulin concentrations, and gender-stratified analyses suggest that moderate alcohol consumption may improve insulin sensitivity and decrease fasting insulin concentrations in women.[19]

Alcohol can affect blood sugar in different ways and may cause blood sugar to rise or fall. In most cases, the effect of alcohol on blood sugar depends on whether it is consumed on a full or empty stomach. Consuming alcohol on an empty stomach or a few hours after a meal may cause a drop in blood sugar. Consuming three to four cups of alcohol a day may cause blood sugar to rise, especially if meals are consumed in full. Consuming alcohol in small amounts with meals may not have much effect on blood sugar.[20] Also, alcohol may impair liver function. When you consume alcohol, most of it is metabolized in the liver. This prevents the effective regulation of blood sugar in the liver, which is why it is very important to check blood sugar levels before consuming alcohol. Consuming alcohol while lowering blood glucose may have very dangerous consequences. Moderate alcohol consumption is associated with a decrease in plasma insulin concentration, and studies show that 8 weeks of moderate alcohol consumption had less effect on increasing insulin sensitivity in non-diabetic and insulin-resistant people than high consumption.[21]

Alcohol may dehydrate the body. In the case of diabetes, the lack of water in the body is not easily compensated because high blood sugar causes an increase in urine. Because alcohol causes the body to lose water, drinking alcohol while suffering from diabetes will increase the possibility of dehydration.[20]

Alcohol may cause type 2 diabetes in several different ways, including:

1. It makes changes in the way the body reacts to carbohydrates and glucose metabolism to reduce its sensitivity to insulin.
2. It provides the basis for getting extra calories.
3. causing problems in the pancreas, such as pancreatitis.
4. It provides the basis for obesity.
5. Disrupting the liver.[15]

Discussion

The current research was conducted with the aim of studing the effect of alcohol consumption on diabetic people. The results of the research and the review of previous research showed that there is an inverse and non-significant relationship between the amount of alcohol consumption and the beneficial effects on people with type 2 diabetes. Also, alcohol consumption has a positive relationship with insulin secretion disorders and insulin resistance. Of course, it should be noted that moderate and low alcohol consumption may reduce fasting insulin concentration and HbA1c.

Insulin resistance is a condition in which the cells of the body do not respond properly to insulin, and as a result, glucose absorption is disturbed, and secondarily, it causes an increase in blood sugar.[6] Insulin resistance is one of the main characteristics of patients with metabolic syndrome and diabetes. It is type 2. Obesity induces insulin resistance, and calorie restriction and alcohol consumption increase insulin sensitivity. Since adipose tissue is associated with insulin resistance and type 2 diabetes, alcohol consumption causes metabolic disorders and is a known risk factor for cardiovascular diseases.[13] Alcohol is one of the most common risk factors associated with lifestyle behavior for disease burden worldwide.[16] A recent study showed that alcohol was the seventh leading factor for disability-adjusted life years. Studies show that low alcohol consumption improves insulin resistance.[12] The main reason for fluctuations in blood sugar due to alcohol consumption is that the liver As the main center of blood sugar regulation after consuming large amounts

of alcohol, it is involved in cleansing the body of toxic substances.[10] As a result, less energy is spent on blood sugar management. Therefore, if the body does not receive additional carbohydrates, a person will experience an unusual drop in blood sugar. The indirect or long-term effect of alcohol on a person's health is that alcohol has a double negative effect on the body's blood sugar regulation mechanism through its effect on the secretion of some hormones that play a role in regulating blood sugar.

Conclusion

The results of the research show that there is an inverse and non-significant relationship between the amount of alcohol consumption and the beneficial effects on people with type 2 diabetes. Although alcohol consumption alone may not cause diabetes, it can affect blood sugar in different ways and cause insulin secretion disorders and insulin resistance. Of course, it should be noted that moderate and low alcohol consumption may reduce fasting insulin concentration and HbA1c.

Conflict of Interest

The authors declare no conflicts of interest.

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