(REVIEW ARTICLE)

The relationship of alcohol consumption to the incidence of Hypoglycemia

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Abstract

Introduction: Alcohol can be interpreted as an organic compound that contains a hydroxyl functional group and is often consumed by some people in the form of a drink. In several studies it was noted that someone who consumes alcohol continuously for one month or more can cause a decrease in appetite. Decreased appetite can later cause hypoglycemia which occurs because glycogen reserves in the liver are depleted due to alcohol inhibiting gluconeogenesis. This study aims to determine the relationship between alcohol consumption and the chance of hypoglycemia in a person.

Method: Article searches were conducted on Google Scholar, PubMed, Researchgate, and Sciencedirect databases, with the keywords Alcohol, Hypoglycemia, and Glucose. Keywords are used together with Boolean operators (OR and AND) to combine searches. The search was carried out on full text of national and international journals using index limits for the last 10 years (2012-2022). The article is included if it is related to the correlation of alcohol consumption with the incidence of hypoglycemia.

Results: From the results of previous studies, it is known that hypoglycemia can occur more frequently after being given the simultaneous consumption of alcohol and glucose than after consuming alcohol alone. Simultaneous alcohol together with glucose induces reactive hypoglycemia.

Conclusion: This review shows that there is a relationship between alcohol consumption and the incidence of hypoglycemia.

Keywords: Alcohol; Hypoglycemia; Glucose; Diabetes; Gluconeogenesis

1. Introduction

According to data presented in the Global Status Report on Alcohol and Health 2014, of the total populace of 241,000,000 Indonesians who suffer from a disorder attributable to alcohol consumption, 0.8% and alcohol dependence constitutes 0.7% of the 241,000,000 populace. In the United States of America, 75% of adults regularly indulge in the consumption of alcoholic beverages. The majority of these individuals partake in alcohol consumption for a variety of reasons; some utilize it for physical warmth, soothing the mind, improving focus, fostering creativity, and so forth. However, in the context of the previously mentioned advantages, some individuals choose to consume it solely to experience gratification from the alcoholic content, which introduces significant risks, as exemplified by conditions such as hallucinations, seizures, nausea, coma, and the possibility of death. 10% of the total U.S. population is unable to regulate their intake of ethanol, a condition also referred to as alcohol abuse. Alcoholism is a term used to describe individuals who demonstrate a lack of concern for the harmful medical and societal consequences.

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Alcohol is a psychoactive compound that possesses addictive characteristics (dependency). This psychoactive agent functions primarily due to its selectivity for the cerebral structures, thereby capable of inducing alterations in the behavior, emotion, cognition, perception, and consciousness of the individual. The psychoactive component in alcohol is ethanol, which can be derived from the fermentation process of honey, saccharides from fruit juice, or tuberous plants. Alcoholic beverages exhibit varying concentrations, with beer and fermented beverages containing alcohol (1%-10% alcohol), martini and wine (10%-20% alcohol), and whiskey and brandy (20%-50% alcohol).

The perils associated with alcohol consumption elevate the likelihood of disability, hepatic cirrhosis, neoplasia, hypoglycemia resulting in convulsions, lactic acidosis, hypothermia, and injuries stemming from direct or indirect consequences. Hypoglycemia is characterized by a reduction in serum glucose concentration levels with or without the manifestation of autonomic nervous system symptoms and neuroglycopenia. This type of hypoglycemia linked to alcohol may emerge because of sustained fasting and high alcohol consumption, particularly when liver glycogen levels are exhausted, and alcohol disrupts the gluconeogenesis pathway [8]. The metabolic processing of alcohol results in elevated NADH concentrations, which can disrupt the gluconeogenesis pathway. Elevated NADH levels inhibit the conversion of lactate to pyruvate. This pyruvate is essential for the gluconeogenesis pathway [8].

Blood glucose is a saccharide that is present in the circulatory system, produced from dietary carbohydrates and stored as glycogen within the liver and skeletal muscle. Endocrine substances that influence blood glucose concentrations include the hormone insulin and the hormone glucagon, both of which are secreted by the pancreas. Serum glucose concentrations typically range between 80-110 mg/dl, with glucose levels measured two hours subsequent to glucose administration remaining ≤140 mg/dl, and blood glucose levels not exceeding ≤110 mg/2. Endogenous factors may influence blood glucose concentrations in individuals, including insulin, glucagon, and cortisol, which play a beneficial role in hepatic and muscular receptor activity. Moreover, exogenous determinants are affected by individual characteristics (age, familial diabetes mellitus history, sex), dietary factors, sedentary lifestyle, hypertension, and nutritional imbalances. Hyperglycemia is defined as a blood glucose concentration surpassing >125 mg/dL during fasting and exceeding >180 mg/dL two hours post glucose administration, whereas hypoglycemia is characterized by levels at or below ≤70 mg/dL, with clinical manifestations typically not presenting until levels drop to ≤55 mg/dL.

Hypoglycemia may manifest in individuals with diabetes mellitus who are undergoing pharmacological treatments involving sulfonylureas, insulin, or meglitinides. Pharmacological agents can be implicated as the etiology of this hypoglycemia. Additional prevalent causes of hypoglycemia today include cortisol insufficiency, critical illness, malnutrition, or excessive alcohol intake.

2. Methods

The method applied in the creation of this investigation is a literature review that is systematically curated to deliver substantiation, appraisal, and synthesis of the research outcomes. The chosen review model is a narrative review. The narrative review intends to discern and encapsulate several articles or journals that have conducted prior investigations on the topic presented.

The literature review conducted incorporates theoretical perspectives and empirical findings related to the relationship between alcohol consumption and hypoglycemia prevalence, utilizing the databases of Google Scholar, PubMed, Researchgate, and Sciencedirect, with the keywords Alcohol, Hypoglycemia, and Glucose. Keywords are employed in conjunction with Boolean operators (or and and) to amalgamate searches. Searches were executed on full-text national and international journals utilizing index constraints of the preceding decade (2013-2023). Inclusion criteria: (1) English-language publications; (2) Subjects diagnosed with Hypoglycemia; (3) Interventions that encompass subjects with alcohol consumption; (4) Randomized clinical trials, cohort studies, case reports, systematic reviews, meta-analyses, or high-validity studies. Exclusion criteria: (1) Trials not involving patients with hypoglycemia; (2) Studies that did not include patients with alcohol consumption.

3. Results

An inquiry into citations through Google Scholar, PubMed, ResearchGate, and ScienceDirect repositories uncovered as many as 21 scholarly journals. The outcomes of the evaluative discourse by journal, abstract, and full text were executed to yield the 15 principal journals to be addressed in the discourse.

Table 1 Study Literature Result

No	Writer	Study design	Parameter	Result
1.	R Tetzschner, K Nørgaard, dan A Ranjan (2017)	Randomized controlled trials and observational investigations.	Impacts of ethanol on plasma glucose in conjunction with placebo in individuals diagnosed with Type 1 Diabetes.	The principal outcome is a modification in plasma glucose levels. Subsequent outcomes encompass a variety of hypoglycaemic incidents, alterations in counter-regulatory hormones, variations in metabolites, modifications in hypoglycaemic awareness, and alterations in cognitive functioning.
2.	Agustina Welhelmina Djuma dan Yofita Weo Kapa (2017)	Analytical Examination with Case-Control Investigation	Analysis of Direct Bilirubin Concentrations in Alcoholic and Non-Alcoholic Individuals	These findings indicated that there existed a significant rate in direct bilirubin concentrations between the experimental cohort (alcohol consumers) and the reference cohort (non-alcohol users). That is, elevated in the experimental cohort.
3.	Vivi Eprillia Rosares dan Elman Boy (2022)	Techniques of pedagogy and assessment of glycaemic levels and clinical evaluation.	Techniques of pedagogy and assessment of glycaemic levels and clinical evaluation.	As a consequence of the increase of glucose concentrations, it is imperative to furnish instruction on reducing saccharide intake in regular existence and it is prudent to observe the nutritional regimen.
4.	Martinus Telaumbanua (2022)	Field Research	The density of ethanol in nira that can reduce glucose levels in individuals with diabetes.	The ethanol concentration of nira aligns with the experience and perspective of the populace that the ethanol concentration of nira may reduce glucose levels in individuals afflicted with diabetes mellitus.
5.	Jae-Seung Yun, Kyungdo Han, Yong-Moon Park, Eugene Han, Yong-ho Lee, Seung-Hyun Ko (2022)	Study population	Individuals diagnosed with adult-onset type 2 diabetes mellitus who participated in a sequential 2-year interval health assessment initiative from 2009 to 2012. Data regarding the history of tobacco use, ethanol intake, and physical exertion, alongside modifications in these variables, is acquired.	Tobacco users and substantial consumers of alcoholic beverages exhibit an elevated susceptibility to profound hypoglycaemia, in contrast to individuals who abstain from smoking and non-alcohol consumption.
6.	Chiho Oba Yamamoto, Jun Takeuchi, Akinobu Nakamura, Ryoko Takikawa, Ayano Ozaki, Hiroshi Nomoto, Hiraku Kameda, Kyu Yong Cho, Tatsuya Atsumi (2020)	Study population	Individuals with undiagnosed diabetes mellitus. Employed an alcoholic perspiration-patch assessment to ascertain alcohol resistance.	Hypoglycaemia occurs more frequently following the simultaneous consumption of ethanol and glucose rather than after glucose consumption alone, suggesting that ethanol combined with glucose triggers reactive hypoglycaemia.
7.	Alia García, Vanessa Moscardó,	The investigation	Outcomes of postprandial haematological data with	Alcohol ingestion alongside combined edibles has significant metabolic

	Agustín Ramos-Prol, Julián Díaz, Miguel Boronat, Jorge Bondia, Paolo Rossetti (2021)	employed a randomized, crossover, and open-ended methodology.	the incorporation of protein and lipid in ethanol ingestion	implications absent heightened susceptibility to hypoglycaemia
8.	Louis E. Ugahari, Yanti M. Mewo, Stefana H. M. Kaligis (2016)	Surveys expository with the approach of comprehensive sampling.	Evaluation of glucose concentrations hematic fasting (GDP) in office employees executed subsequent to participants having abstained from caloric intake for 10-12 hours.	The majority of office employees exhibit standard fasting blood glucose concentrations. Furthermore, diminished glucose-6-phosphate (hypoglycaemia) may be attributable to the ingestion of alcoholic beverages.
9.	Suryanti, S., Sudarman, S., Aswadi (2021)	Expository examination with transverse sectional research design.	Observations that were discerned in this investigation included tobacco use behaviours, levels of physical exertion, consumption patterns of alcohol, dietary practices, and prevalence of diabetes.	Ethanol can induce hypoglycaemia (as it suppresses the mechanism of gluconeogenesis).
10.	Intan Ambarwati (2017)	Descriptive correlation, employing a cross-sectional methodology.	Univariate and bivariate examination, on pupils of PKBM Negeri 33 Malaka East Jakarta utilizing ethanol and existing in adolescence.	There was a considerable correlation between excessive alcohol intake and hypoglycaemia with P value = 0.000 ($\alpha < 0.05$).
11.	Tali Cukierman-Yaffe, Jackie Bosch, Hyejung Jung, Zubin Punthakee, Hertzel C. Gerstein. (2018).	Retrospective cohort investigation	The specimen parameters encompass fasting glycaemic anomalies, compromised glucose tolerance, or preclinical type 2 diabetes, which also possesses supplementary cardiovascular ailments.	Cognitive Impairment can be induced by acute hypoglycaemia and excessive alcohol consumption.
12.	Surbhi Sharma, Manjusha Choudhary, Sapna Bhardwaj, Nitesh Choudhary, Avatar Chand Rana (2014).	Study reviewed by Institutional Animal Ethics Committee (IAEC)	The assessment outcomes exhibited enhancements in diverse metrics of the organism and plasma, as well as restoration of pancreatic beta-cells.	Substantial hypoglycaemic efficacy in diabetic rodents prompted by alcoholic rhizome extract of Cassia occidentalis Linn in streptozotocin.
13.	Masanori Iwase, Yuji Komorita, Hiroki Fujii, Toshiaki Ohkuma, Hitoshi Ide, Masahito Yoshinari, Yutaro Oku, Taiki Higashi, Udai Nakamura, Takanari Kitazono (2020)	Study participants, Clinical evaluation, Assessment of severe hypoglycaemia and Statistical analysis.	Parameters pertaining to type 1 diabetes (mean age 55 years) and type 2 diabetes managed with insulin	A chronicle of acute hypoglycaemic pathology, one of which is associated with ethanol intake ≥ 60 g/day.

14.	Tristan Richardson, Melanie Weiss, Peter Thomas, David Kerr. (2015)	Analytical scrutiny involving cohorts of 16 individuals diagnosed with type 1 diabetes.	Subjects with type 1 diabetes ranging from 39 ± 7 years of age, with a duration of diabetes extending over 15 ± 11 years, who partake in alcohol consumption consistently (28 units/week).	The results of the study demonstrated that following the ingestion of alcoholic beverages, participants reported an increase of over twofold in the occurrence of hypoglycaemic events within a 24-hour timeframe.
15.	Topaz Kautsar Tritama (2015)	Literature review	Critical examination	The ensuing oxidation of alcohols surpasses reducing equivalents in heparin. The overproduction of NADH contributes to metabolic disturbances in chronic alcohol dependence and acts as a precursor for lactic acidosis, as well as hypoglycaemia during acute alcohol poisoning.

4. Discussion

Hypoglycemia is defined as a state of abnormal blood glucose levels, occurring when glucose concentrations fall below 50 to 60 mg/dl (2.7 to 3.3mmol/L). In non-diabetic individuals, hypoglycemia may be attributable to iatrogenic factors such as the administration of insulin. Additional etiological factors of hypoglycemia include the existence of severe illness, ethanol ingestion, cortisol insufficiency, and malnutrition.

Individuals who excessively partake in alcohol consumption often exhibit a lack of self-regulation. In such situations, it has the potential to elevate the risk of the individual ignoring their basic necessities. Alcohol induces excessive production of NADH, thereby contributing to metabolic disturbances in individuals with addiction or those who are heavy consumers of alcohol, resulting in hypoglycemic episodes. Adequately elevated levels of NADH can obstruct the process of gluconeogenesis. The reduction of glycogen levels, combined with the suppression of gluconeogenesis due to the metabolism of alcohol, ultimately results in alcoholic hypoglycemia.

The metabolic processing of ethanol leads to an increase in NADH concentrations within the organism. Increased levels of NADH may induce a disruption of the gluconeogenesis pathway. Elevated NADH levels inhibit the transformation of lactate into pyruvate. Pyruvate is essential for the gluconeogenesis pathway [8]. An excessive synthesis of NADH contributes to metabolic disturbances in severe alcoholism, which is characterized by the manifestation of hypoglycemia. Elevated NADH obstructs the gluconeogenesis process. The reduction of glycogen stores, in combination with the suppression of gluconeogenesis because of alcohol metabolism, culminates in hypoglycemia [6]. Alcoholic hypoglycemia results from the inhibition of gluconeogenesis by ethanol, whilst alcoholic ketosis arises from the accumulation of beta-hydroxybutyrate due to increased NADH concentrations. Hence, alcoholic hypoglycemia and alcoholic ketosis are sequential phenomena that manifest consecutively in the context of alcoholism, and the liver can recuperate its functions related to glucose provision; however, the most salient characteristic of the liver is that hepatic alterations are only observable following chronic alcoholism, which is also associated with malnutrition. Further research is required to illuminate the pathways within the liver that contribute to the maintenance of a diminished hepatic redox state throughout protracted episodes of alcoholism

5. Conclusion

Based on this discussion it is demonstrated that the ingestion of ethanol amplifies the frequency of hypoglycemia. Within the limitations of this research, we infer that there exists a correlation between ethanol consumption and the prevalence of hypoglycemia. Ethanol triggers the responses in the organism that can adversely affect physiological functions. In addition, hypoglycemia manifests more frequently after the combined management of ethanol intake and glucose levels than after the consumption of glucose in isolation.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1]   Ambarwati, I. 2017. The Relationship between Alcohol Consumption and Hypoglycemia Incidents in Adolescent Students at PKBM 33 Malacca, East Jakarta. pp. 1-8.

[2]   Djuma, A. W., Kapa, Y., W. 2017. Comparison of Direct Bilirubin Levels in Alcohol Consumers and Those Who Do Not Consume Alcohol. Health Info Journal, 15(2), pp. 428-434.

[3]   García, A., Moscardó, V., Ramos-Prol, A., Díaz, J., Boronat, M., Bondia, J., Rossetti, P. 2021. Effect of meal composition and alcohol consumption on postprandial glucose concentration in subjects with type 1 diabetes: a randomized crossover trial. BMJ Open Diab Res Care, pp. 1-8.

[4]   Iwase, M., Komorita, Y., Fujii, H., Ohkuma, T., Ide, H., Yoshinari, M., Oku, Y., Higashi, T., Nakamura, U., Kitazono T. 2020. Incidence of severe hypoglycemia and its association with serum adiponectin in Japanese patients with type 1 and insulin-treated type 2 diabetes: The Fukuoka Diabetes Registry. J Diabetes Investig, 11(5), pp. 1258-1264.

[5]   Kandi, Sabitha, dkk. (2014). Alcoholism and its relation to hypoglycemia – an overview. American Journal of Medicine Studies, 2(3), 46-49.

[6]   Marks, Dawn B., dkk. (2009). Basic medical biochemistry and a clinical approach. Translator editor. Jakarta: EGC.

[7]   Seung Yun, J., Han, K., Moon Park, Y., Han, E., Yong-ho, L., Hyun Ko, S. 2022. Adherence to healthy lifestyle behaviors as a preventable risk factor for severe hypoglycemia in people with type 2 diabetes: A longitudinal nationwide cohort study. J Diabetes Investig, 13(9), pp. 1533-1542.

[8]   Kandi, Sabitha, dkk. (2014). Alcoholism and its relation to hypoglycemia – an overview. American Journal of Medicine Studies, 2(3), 46-49.

[9]   Richardson, T., Weiss, M., Thomas, P., Kerr, D. 2015. Day After the Night Before: Influence of evening alcohol on risk of hypoglycemia in patients with type 1 diabetes. Diabetes Care, 28(7), pp. 1800-1802.

[10] Rosares, V.E., Boy, E. 2022. Checking Blood Sugar Levels to Screen for Hyperglycemia and Hypoglycemia. HUSADA IMPLEMENTA JOURNAL, 3(2), pp. 65-71.

[11] Sharma, S., Choudhary, M., Bhardwaj, S., Choudhary, N., Rana, A.C. 2014. Bulletin of Faculty of Pharmacy, Cairo University, 52, pp. 211–217.

[12] Suryanti, S., Sudarman, S., Aswadi. 2021. Relationship between lifestyle and eating patterns with the incidence of diabetes mellitus at Bhayangkara Hospital, Makassar City. Journal of Preventive Promotion, 4(1), pp 1-9.

[13] Telaumbanua, M. 2022. Benefits of the alcohol content of sugar palm juice against diabetes mellitus. 2022. Journal of Community Service, 2(2), pp. 119-126.

[14] Tetzschner, R., Nørgaard, K., Ranjan, A. 2017. Effects of Alcohol on Plasma Glucose and Prevention of Alcohol-induced Hypoglycemia in Type 1 Diabetes.

[15] Tritama, T.K. 2015. Alcohol Consumption and Its Effects on Health. Majority, 4(8), pp. 7-10.

[16] Ugahari, L.E., Mewo, Y. M. Kaligis, S, HM. 2016. Overview of fasting blood glucose levels in office workers. e-Biomedic Journal (eBm), 4(2).

[17] Yaffe, T.C., Bosch, J., Jung, H., Punthakee, Z., Gerstein, H. C. 2018. Hypoglycemia and Incident Cognitive Dysfunction: A Post Hoc Analysis From the ORIGIN Trial. Diabetes Care, pp. 1-6.

[18] Yamamoto, C., Takeuchi, J., Nakamura, A., Takikawa, R., Ozaki, A., Nomoto, H., Kameda, H., Yong Cho, K., Atsumi, T. 2020. Combination of alcohol and glucose consumption as a risk to induce reactive hypoglycemia. J Diabetes Investig. pp. 1-7.