Review Article

Alcohol consumption and its relationship to diabetes mellitus: friend or foe?

Abstract

The diabetes mellitus rates are increasing worldwide reaching epidemic levels. Alcohol consumption is also increasing globally. It is known that excessive alcohol consumption is an important lifestyle risk factor for several chronic conditions, including diabetes mellitus and its complications. The relationship between diabetes mellitus and alcohol is not completely elucidated. Most studies suggest a "U" shape relation of alcohol drinking and diabetes mellitus risk and its complications. The ingestion of moderate amounts of alcohol might not just decrease diabetes mellitus development risk, but also be associated to better metabolic control, decrease in some microvascular complications (retinopathy and nephropathy), decrease in macrovascular events and mortality. The benefits may be restricted not just to the moderate amount of alcohol intake, but also vary according to age, gender, body mass index, ethnics and type of alcohol drinks.

Keywords: diabetes mellitus, alcohol consumption, diabetes onset, microvascular complications, macrovascular complications

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Received: December 17, 2018 | **Published:** January 24, 2018

Abbreviations: DM, diabetes mellitus; T2DM, type 2 diabetes mellitus; IDF, international diabetes federation; WHO, world health organization; HbA1c, glycated hemoglobin; NIAAA, national institute on alcohol abuse and alcoholism

Introduction

The world population with diabetes mellitus (DM) is estimated at 425million, which represents 8.8% of adults aged 20 to 79years, and could reach 629million by 2045.[1] Of these, 438.2million will be of productive age. There is a slight predominance among men. In older population (65-79years), the predominance between the sexes is similar. About 90% of the cases are type 2 diabetes mellitus (T2DM). According to the International Diabetes Federation (IDF) 727 billion dollars per year are spent on diabetes care.[1] The countries with the greatest amounts of individuals with DM, as expected, are the most populous, such as China, India, the United States, Brazil, and Mexico. The population with the highest prevalence (13.7%) of DM is the Eastern Mediterranean region. In the last decades, developing countries have increased prevalence of DM.[1,2]

It was estimated in 2010 that 40.6% of the world's adult population consumed alcohol.[3] Worldwide consumption of pure alcohol per capita in individuals older than 15years, according to World Health Organization (WHO), is on average 6.2liters per year or 13.5grams per day.[4] In 2015, in the United States, 86.4% of the population over 18years old reported they have already consumed alcohol.[5] The highest consumption rates occur in developed countries, although there is great variation in consumption among the regions due to social and cultural factors. Therefore, the Central and Eastern regions of Europe concentrate the highest alcohol intake.[3,4]

In the world, in 2010, the prevalence of alcohol abuse was estimated at 11.7% in the population aged 15 to 19years, compared to 7.5% in the total population aged 15 years or older. On the other hand, 48% of the world population has never consumed alcohol.[4] The abstinent population was more prevalent in North Africa, the Middle East and South Asia and reaches 90% in Southeast Asia.[3]

There are more consumers of alcoholic drinks, with a low-risk consumption pattern, among the population with a higher socioeconomic level, whereas abstinent ones are more common in the poorer social groups. However, people from lower socioeconomic status appear to be more vulnerable to the deleterious effects of alcohol consumption. Many factors may explain this situation, including the lack of resources in the treatment of comorbidities, and less access to quality health services.[4] The most widely consumed type of alcoholic beverage in the world is distilled, representing 50% of consumption and is more common in the Southeast Asia and Western Pacific regions. Secondly, beer accounts for 34.8% of that consumption and predominates in the Americas region, while wine accounts for 8% of global consumption and is more consumed in Europe.[4]

One serving of alcoholic beverage equals 300ml of beer, 100ml of wine or 30ml of distilled drinks corresponding to 10 to 12g of pure alcohol.[4] According to the Centers for Disease Control and Prevention, alcohol consumption is defined as binge drinking in four or more doses for women, and five or more doses for men, at the same time within the last 30 days. Heavy drinking is defined by consuming 8 or more alcoholic beverages for women, and 15 or more for men per week.[6] Low-risk (moderate) consumption can be estimated for 4 doses, or less, on a single day and no more than 14 doses per week for men. For women, this consumption cannot exceed 3 doses in a single day, and no more than 7 doses per week.[4,7] The pattern and amount of female consumption differs from males, and this is due to both physiological and cultural differences. The woman's body is more vulnerable to the effects of alcohol due to less metabolizing capacity, lower proportion of water in the body and generally, lower weight compared to men.[4,8] Children, adolescents and the elderly are typically more vulnerable to alcohol-related harms. The most common pattern of consumption among young people is binge drinking. The increase in age is associated with decreased binge drinking and increased heavy drinking. While young people tend to behave recklessly, engaging in risky accidents, elderly who drink alcohol tend to suffer unintentional accidents, as falls.[4,9]

Relationship between alcohol consumption and the onset of diabetes mellitus

Different studies have shown a generally beneficial relationship between alcohol consumption and the onset of T2DM. Variations may

occur depending on the amount and pattern of consumption, type of drink, race, body mass index, age, and gender. Recent studies present results with reduced risk in the development of DM in moderate alcohol users compared with nondrinkers.[10–13] Risk reduction of up to 30% has already been found in adults.[11]

Researchers have described a "U-shaped" relation between alcohol consumption and DM risk. Compared to the minimal or non-consumption, the risk of T2DM is lower for moderate alcohol consumption, while high alcohol consumption leads to an increased risk similar to that of nondrinkers. A meta-analysis found significant evidence, among cohort studies from different countries, that the consumption of less than 30grams of alcohol per day is associated with the lower risk of T2DM in the general population.[14] Knott et al.,[13] showed maximal risk reduction of 18% with consumption between 10 and 14g per day.[13] The protective effect of alcohol consumption on the onset of diabetes occurred in both men and women.[11,12,15–17] The highest protective effect was associated with an approximate consumption of 22g per day for men and 24g per day for women. Above 50g for women and 60g per day for men, it has been described as harmful.[11]

The consumption pattern can also define the risk. It is suggested that episodic binge drinking is associated with increased risk of cardiovascular disease and complications when compared to individuals with frequent consumption patterns of the same amount spread over 3 to 4days per week.[11,13] It has been suggested in New Zealand adult workers, an inverse relationship between alcohol consumption and the incidence of T2DM in individuals with normal weight and overweight. The study found no protection with obesity.[17] A Japanese systematic review concluded that in Japanese men with low body mass index (defined as ≤22.0 kg/m²) alcohol intake increase risk of developing DM.[18]

In elderly (65years of age or more) moderate alcohol users has led to 40% decrease in the risk of T2DM. The Cardiovascular Health Study indicated that mild to moderate alcohol consumption was associated with a lower incidence of T2DM among the elderly.[19] Knott et al.,[13] suggested that the lower risk of developing T2DM may be restricted to women and non-Asian populations.

Regarding the type of alcoholic beverage wine, beer and distilled drinks showed the same "U" pattern in relation to T2DM risk, although they presented different risk proportions. A recent systematic review published in 2017 concluded that the consumption of up to 80g per day of wine reduces the risk of T2DM, with best rates (up to 20% reduction in the risk) if between 20 and 30g per day. As for beer consumption, the same daily amount showed a 9% risk reduction and for distillates, a 5% decrease in the risk with consumption between 7 and 15grams per day. However, the risk of T2DM increased when daily beer consumption was greater than 80g.[16] Other studies have also shown beneficial effects of moderate wine consumption, especially in women.[10,12] Moderate alcohol consumption may increase insulin sensitivity in women and reduce glycemia and glycated hemoglobin (HbA1c) levels in non-diabetics.[17] This risk reduction is present regardless of association with healthy lifestyle habits.[18]

Alcohol consumption in individuals with diabetes mellitus

In a multicenter study, with 11.140 diabetic patients evaluated, 30% reported detailed alcohol consumption as 5 servings of wine and 7 servings of beer or distillate on average per week. Of these, 4% reported extremely high intakes of more than 21 doses for men and 14 doses for women per week.[20] Similar prevalence of alcohol consumption was estimated at 30.9% among elderly with at least one chronic illness such as diabetes in the United States.[21]

The American Diabetes Association recommends that diabetic patients limit alcohol intake to one daily dose for women and two for men. One serving corresponds to 340g of beer, 140g of wine or 42g of distillate. The risk of hypoglycemia increases in diabetic patients who are insulin dependent or on secretagogues when they consume alcohol.[22] The IDF recommends for a healthy lifestyle that the general population limit alcohol consumption for up to 2 daily doses; for diabetics, excessive alcohol consumption should be avoided for better glycemic control.[1]

The alcohol consumption by diabetic patients makes it difficult to adhere to the treatment, mainly to lifestyle changes. Besides preventing behavioral measures, excessive alcohol consumption impairs glycemic control. The study suggested a measure known as "brief intervention", which consists of counseling sessions by health professionals directed at diabetic outpatients who reported risk pattern on alcohol consumption, as defined by NIAAA (National Institute on Alcohol Abuse and Alcoholism). This intervention resulted in a decrease in the percentage of patients with high alcohol consumption and the study suggests that this change improved the adherence to DM treatment.[23]

Effects of alcohol consumption on glycemic control and chronic complications of DM

Moderate alcohol consumption may increase insulin sensitivity in women and reduce glycemia and HbA1c levels even in non-diabetics.[24] This risk reduction is present regardless of healthy lifestyle habits.[25] There is evidence that alcohol in moderate doses improves glycemic control and progression of complications.[26]

It has been shown an inverse relationship between alcohol consumption and HbA1c values in an analysis of 38.564 diabetic adults. Compared to abstinent, consumption of 2 to 2.9 doses of alcohol per day represented a significant reduction of 0.5% in HbA1c values. Worse glycemic control was identified with consumption of 3 or more doses per day and in non-alcohol drinkers.[26]

Regarding the development of microvascular complications, the consumption of alcohol by individuals with DM does not increase the risk of developing diabetic retinopathy, actually a meta-analysis with 15 studies identified that wine consumption may reduce the risk of this complication.[27] Moderate alcohol consumption, but not heavy, had a significant reduction in the development of chronic kidney disease in individuals with DM.[28] It is speculated that moderated alcohol consumption might be protective for renal vasculature and excessive alcohol consumption increases blood pressure and consequently damages the kidney.[29]

In individuals with DM alcohol consumption was negatively associated with peripheral neuropathy. The prevalence and rate of development of symptomatic peripheral neuropathy was higher in diabetic men who consumed alcohol daily compared to nondrinkers, possibly due to their own and additives effects of alcohol in the development of neuropathies.[30,31] About macrovascular diseases, individuals with DM that consume moderate alcohol amounts are less likely to have cardiovascular events than nondrinkers.[32] We also found a significant reduction in mortality rates due to coronary heart disease in diabetics with daily alcohol consumption of 14g or more compared

to nondrinkers.[33] In another diabetic population, with a prevalence of 30% of alcohol consumption, a reduction in cardiovascular events has also been demonstrated.[20]

In individuals with T2DM, consuming mainly wine reduces the risk of cardiovascular events and is related to lower mortality rates compared to non-alcohol drinkers. A reduction in the mortality of these diabetic patients who consumed mainly beer or distillates was also observed, although, no reduction in cardiovascular events has been shown.[20]

A 17% reduction in cardiovascular events and 13% of the causes of mortality was reported in a study that evaluated the protective effect of moderate alcohol consumption in diabetic patients.[20] In agreement with these findings, a Swiss study concluded that alcohol consumption between 16 and 30g per day is associated with mortality reduction by cardiovascular disease, but consumption above 30g per day increased mortality.[34]

Abusive consumption of alcohol, otherwise, is related to an increased risk of cirrhosis which results in the development of DM (35). Alcohol abuse causes a pro-inflammatory stimulus in the liver and metabolic system that causes a systemic subclinical inflammatory state and contributes to atherosclerosis.[36] Abusive alcohol consumption is associated with increased risk of DM and higher rates of diabetic complications, so this pattern of consumption should be strongly discouraged.[11] According to the WHO, abusive consumption of alcoholic beverages is considered a risk factor not just for DM, but for several chronic diseases.[4]

Pathophysiological beneficial mechanisms of alcohol consumption (vascular effects)

Some hypotheses suggest the influence of moderate alcohol consumption on the reduction of oxidative damage, both in circulating lipoproteins and in the coronary endothelial layer, reducing the severity of coronary artery disease.[36] The polyphenols present in the wine were associated with reduced DM risk.[16] Ingestion of 25 to 30g per day of alcohol is related to increase in adiponectin gene expression and its serum concentration. This protein is inversely associated with inflammatory activity, incidence of T2DM and positively related to increased insulin sensitivity in women.[25] Significant reduction in the levels of inflammatory markers, such as tumor necrosis factor and fibrinogen, as well as improved endothelial function were positively related to moderate alcohol intake (<25g per day) in diabetic men. It has also been shown the "U" pattern of alcohol consumption and concentration of inflammatory markers, especially C-reactive protein.[15] These correlations might explain the protective characteristic of alcohol to cardiovascular events in this population.[15,37]

Conclusion

In conclusion, DM is a prevalent chronic disease responsible for impaired quality of life and associated with early mortality. Moderate alcohol consumption reduces the risk of developing T2DM, it is potentially beneficial in metabolic control, in preventing the progression of some complications and cardiovascular events and mortality. A possible and important confounding factor is related to the consumption of alcohol and higher socioeconomic levels, which is an important protective factor for any chronic non-communicable diseases, such as DM. On the other hand, excessive consumption may increase the risk of DM, other chronic diseases and diabetic neuropathy. Excessive alcohol consumption also increases mortality from external causes such as accidents, leading to loss of life-years,

especially in young men. More prospective studies are needed to access the protective and harm effects of alcohol consumption in diabetes risk, its influence on diabetic complications and the mechanisms for that. The possible protective effect of alcohol consumption also needs to be balanced with the potential risks.

Acknowledgment

Conflicts of interest

None.

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