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## Cardiovascular effects of alcohol consumption



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### ABSTRACT

Alcohol consumption has a major but complex impact on cardiovascular diseases. Both irregular and chronic heavy drinking occasions detrimentally impact on most major cardiovascular disease categories, whereas light to moderate drinking has been associated with beneficial effects on ischemic heart disease and ischemic stroke. Both detrimental and beneficial effects of alcohol consumption have been corroborated by biochemical pathways. The impact of alcohol consumption on cardiovascular disease should be evaluated within the context of other effects of alcohol on health.

**Key words:** Alcohol consumption, Drinking pattern, Hypertensive heart disease, Ischemic heart disease, Cardiomyopathy, Atrial fibrillation and flutter, Stroke.

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In 1989, Davidson [1] wrote an overview article with the same heading, and pointed out effects of alcohol consumption on almost all categories of cardiovascular disease. More than 25 years later, alcohol consumption is still seen as causally impacting most categories of cardiovascular disease [2], but there is a more differentiated view on the various beneficial and detrimental effects, and our knowledge about the mechanisms underlying these effects has increased substantially. Accordingly, we will try to highlight these developments, while pointing out controversies and open questions.

We will start this narrative review with outlining the different dimensions of exposure linked to the different cardiovascular disease categories. The broad cardiovascular categories used are based on groupings used in the Global Burden of Disease study (for corresponding ICD codes see the Table; and Ref. [3]), which include groups of single

diagnoses and syndromes, and overlap. The narrative review will be based on the most important reviews and selected large landmark studies (for a listing of all meta-analyses and systematic reviews between alcohol consumption and the cardiovascular disease categories since 2010 see Ref. [2]; Supplementary Material). We will then examine the three most important drinking patterns separately in more detail, and finally explore controversies in current interpretation.

### Overview of drinking patterns and cardiovascular disease categories

The Table gives an overview of the key literature on the impact of drinking patterns and cardiovascular disease categories.

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**Table – Reviews and meta-analyses on drinking patterns and their impact on cardiovascular disease categories.**

Cardiovascular categories	ICD based on GBD wide categories	On average light to moderate drinking without heavy drinking occasions	On average light to moderate drinking with heavy drinking occasions	Chronic heavy drinking
Hypertensive heart disease	I11–I11.9	Briasoulis et al. [11]; Taylor et al. [12]	No systematic review or meta-analysis	Briasoulis et al. [11]; Taylor et al. [12]
Ischemic heart disease	I20–I25.9	Roerecke and Rehm [31]; Ronksley et al. [30]	Roerecke and Rehm [6,19]	Roerecke and Rehm [7]
Cardiomyopathy	A39.52, B33.2–B33.24, D86.85, I40–I43.9, I51.4–I51.5	No relationship	Rehm et al. [50]	Rehm et al. [50]; Piano [51]
Atrial fibrillation and flutter	I48–I48.92	Larsson et al. [40]; Samokhvalov et al. [52]	No systematic review or meta-analysis	Larsson et al. [40]; Samokhvalov et al. [52]
Heart failure	I50, I11.0, I13.0, I13.2	Larsson et al. [53]; Padilla et al. [54]	No systematic review or meta-analysis	Larsson et al. [53]
Ischemic stroke	G45–G46.8, I63–I63.9, I65–I66.9, I67.2–I67.3, I67.5–I67.6, I69.3–I69.398	Larsson et al. [55]; Patra et al. [56]	Mostofsky et al. [21]; Guiraud et al. [22]	Larsson et al. [55]; Patra et al. [56]
Hemorrhagic and other non-ischemic stroke	I60–I61.9, I62.0–I62.03, I67.0–I67.1, I68.1–I68.2, I69.0–I69.298	Larsson et al. [55]; Patra et al. [56]	Mostofsky et al. [21]	Larsson et al. [55]; Patra et al. [56]

### The effects of chronic heavy drinking

Chronic heavy drinking, often defined as drinking 60 g and more pure alcohol for men, and 40 g and more for women [4], clearly has a detrimental effect on most cardiovascular outcomes. This is corroborated by the results of elevated relative risks of people with alcohol use disorders for these diseases [5–7].

There are different reasons for this effect. First, chronic heavy alcohol is acting as a toxin to weaken the heart muscle directly [8,9] (for experimental demonstrations of the toxic effect of alcohol on muscles see Ref. [10]). Second, alcohol consumption causes increase in blood pressure in a dose-response fashion [11,12], and as this relationship is stable, reversible, and clinically meaningful [13,14], alcohol interventions have been recommended as first-line treatment for incident hypertension in heavy drinkers [15]. Third, alcohol has negative impact on the vascular functions, associated with oxidative stress [16]. Finally, chronic heavy drinking is often associated with other risk factors such as smoking or malnutrition, creating a negative synergistic effect on cardiovascular disease, especially in underprivileged individuals [17].

There is little controversy that chronic heavy alcohol use has detrimental effects on the cardiovascular system. However, only a minority of drinkers are chronic heavy drinkers even in countries and regions with the highest over *per capita* consumption such as Europe (for a modeling of the distribution of alcohol consumption based on surveys in more than 50 countries see Ref. [18]).

### The effects of irregular heavy use of alcohol

There is evidence for an increased risk associated with irregular heavy drinking, even in people who are on average light to moderate drinkers when compared to non-heavy

drinkers (ischemic heart disease [6,19–21]; stroke [21–23]). The literature on irregular heavy drinking occasions is based on different kinds of evidence: alcohol as a trigger for cardiovascular events, where the time period before the event in cases is compared to similar time periods in controls (case-control study) or to similar time periods of the same person in the past (case-crossover design), or longitudinal designs, where the authors assessed usual drinking patterns separately for volume and patterns of drinking, and could show that irregular heavy drinking patterns were associated with higher risk for ischemic events even when controlled for average level of consumption (cohort studies).

For the effects of irregular heavy drinking occasions on cardiovascular disease, there are potentially four main biopathological mechanisms [24,25]. First, irregular heavy drinking increases the risk of coronary artery disease via unfavorable impacts on blood lipids. Second, there are effects on clotting, increasing the risk of thrombosis. Third, irregular heavy drinking affects the conducting system, leading to a greater risk of arrhythmias [26]. Finally, any heavy drinking increases blood pressure, leading to acute or sustained hypertension [14].

The effects of irregular heavy drinking cannot only be observed on the individual level. Countries that have an overall pattern of irregular heavy drinking, such as some countries in the Eastern part of Europe, show a unique profile of alcohol-attributable mortality, where cardiovascular death is a major factor [27,28]. Natural experiments, where alcohol consumption had been decreased, such as the so-called Gorbachev reforms in the 1980s in the Soviet Union or the Russian alcohol policies implemented in the last decade, could demonstrate marked decreases in cardiovascular diseases associated with a decrease in heavy drinking occasions [27,29]. While natural experiments are by definition ecological in nature, and lack randomized control, there had not been many alternative explanations brought forward to explain the above described effects for the Soviet Union or Russia.

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