

ALCOHOL CONSUMPTION AND CARDIOVASCULAR SYSTEM HEALTH: HARMFUL EFFECTS ON THE HEART - A SYSTEMATIC REVIEW



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ABSTRACT

Objective: To evaluate the relationship between alcohol consumption and the cardiovascular system, observing the different types of alcohol consumption. Methods: A systematic review was carried out using the PubMed, Jama Network and Elsevier databases. Data collection took place from September to October 2024. Results: Among the studies, 6 articles conclude that no amount of alcohol is protective against cardiovascular disease, 3 studies show beneficial effects on light/moderate consumption and 1 article highlights the benefit of wine consumption. Conclusion: alcohol consumption, regardless of type and quantity, is widely associated with increased cardiovascular risks.

Keywords: Alcohol. Cardiovascular. Hypertension.

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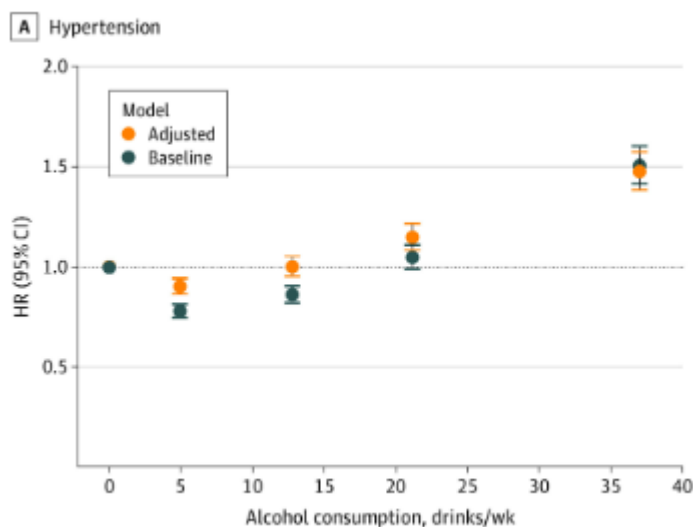
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INTRODUCTION

The relationship between alcohol consumption and cardiovascular health is a topic of considerable relevance in modern medicine and public health. Several studies over the last few decades have investigated how alcohol, when consumed in different amounts and frequencies, can impact the cardiovascular system, through various mechanisms that are harmful to the individual's health, such as endothelial dysfunction, increased LDL cholesterol (Toma, A. et al, 2017), among other aspects that affect the health of the heart and blood vessels. The complex nature of these effects has raised controversy among researchers and health professionals, since some studies suggest possible benefits of moderate alcohol consumption (Costanzo, S. et al, 2010) while other authors discuss potential risks associated with any type of alcohol consumption (Biddinger, Kiran J. et al, 2022).

At first, it should be noted that some studies suggest that moderate alcohol consumption can bring benefits to the cardiovascular system, and these results are evidenced in the J or U-shaped curve related to alcohol consumption (Costanzo, S. et al, 2010), which - according to some researchers - represents the relationship between different types of alcohol consumption and the various effects - beneficial or harmful - caused to the cardiovascular system. This curve is based on findings that abstainers have a higher risk of cardiovascular diseases than individuals who drink alcohol moderately - a relationship evidenced in the first decline of the curve - and that individuals who drink alcohol heavily have a very high risk of developing cardiovascular disorders, such as decreased left ventricular ejection fraction - LVEF - (Seppä, K. et al, 1999), a fact evidenced by the sharp growth in the right part of the J-shaped curve. This curve can be observed by the dark blue highlight in figure 1 - which shows a graph that correlates the risk of an individual developing hypertension as a function of the amount of alcohol ingested by him. Furthermore, it should be noted that the interpretation of these results should be cautious, as the definition of moderate consumption varies widely between countries (Kalinowski, A. et al, 2016).

Figure 1: Graph showing the J or U curve.



Source: Biddinger, 2022.

In a second observation about this panorama of alcohol consumption, it is essential to emphasize that some researchers claim that all types of alcohol consumption are harmful to health. According to Biddinger (2022), in a study entitled "Association of Habitual Alcohol Intake With Risk of Cardiovascular Disease", the J- or U-shaped relationship addressed by some authors on alcohol consumption does not show reality, since the confounding factors of the studies -such as people's life factors- are not properly addressed in the relationship between alcohol consumption and the cardiovascular system, which provides a false belief that moderate alcohol consumption is beneficial for the body.

Although there are disagreements among the authors about light and moderate alcohol consumption, all researchers agree that excessive alcohol consumption is extremely harmful to the individual's health. Certainly, among the harms caused by excessive alcohol consumption, the following are evident: heart failure (Laonigro, I. et al, 2009), decrease in LVEF, acute inhibition of fibrinolysis -which may be relevant for the pathogenesis of coronary heart disease (CHD)- (van de Wiel, A. et al, 2001), increased oxidative stress, stress on the myocardial wall, occurrence of atrial fibrillation, hypertension, cardiomyopathy and stroke -occlusive and hemorrhagic- (O'Keefe, Evan L. et al, 2018).

Thus, in view of the different results observed later, the present study aims to analyze the relationship between alcohol consumption and the health of the cardiovascular system, through a systematic review, evaluating the relationship between different consumption patterns and cardiovascular effects.

METHODOLOGY

A systematic review of scientific articles, published between 2012 and 2024, on the relationship between alcohol consumption and the cardiovascular system, was carried out, observing the harmful effects of this consumption.

RESEARCH QUESTION

The PICOT methodology was used to define the research question: P (participant or patient) = Individuals who abstain or consume alcohol; I (intervention) = People who consume alcohol or who abstain from the use of this substance; C (comparator) = Individuals who consume or do not consume alcohol; O (outcomes/outcomes) = The effects caused by alcohol on different types of users and the result of not using this substance; T (type of study) = Original studies.

SEARCH STRATEGIES IN THE LITERATURE

Three databases widely used in the health area were selected: Elsevier, Jama Network and PubMed. Electronic data collection took place during the period from September to October 2024. To find the analyzed articles in the databases, the following keywords were used: alcohol, cardiovascular and hypertension.

ELIGIBILITY CRITERIA AND SELECTION OF STUDIES

The inclusion criteria were as follows: original articles -such as cohort studies and cross-sectional studies- in Portuguese, English and Spanish, published between 2012 and 2024, free of charge, which discuss the topic, whose population is made up of people who consume alcohol or not. The identified studies were submitted to a screening process and, upon reading the titles and abstracts, the following were excluded: (i) studies prior to 2012; (ii) secondary studies, such as narrative or integrative reviews; (iii) articles not related to the topic. Gray literatures (non-scientific literatures) were not taken into account.

DATA EXTRACTION

Two reviewers, working independently, selected the studies based on the title and abstract and exported the articles to the Rayyan® software. Subsequently, the initial screening was carried out, in which the selected articles were evaluated in relation to the inclusion and exclusion criteria. After the initial screening, a full-text analysis of the articles

that fit the established criteria was performed. Finally, after the complete reading of the articles, the studies that corresponded to the objective proposed by the research were selected. In addition, it should be noted that this data extraction process was exposed in the PRISMA diagram, through the information obtained in the Rayyan® software. In addition, it should be noted that the present study follows the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), a guideline used for reporting systematic reviews and meta-analyses.

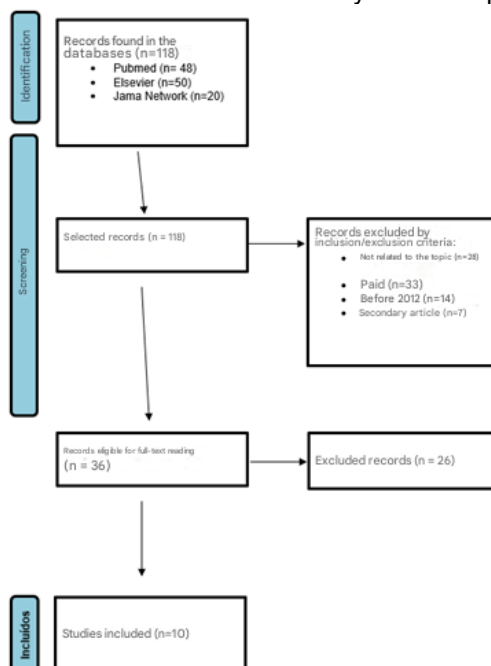
RISK OF BIAS ASSESSMENT

The quality of the included studies was assessed using the Newcastle-Ottawa scale (NOS), which consisted of eight questions. This instrument aims to assess the methodological quality of cohort studies and case-control studies and to determine the possibility of biases, through the analysis of criteria established in the scale - selection of participants, comparability of the study and outcome - (Bitencourt, Fernando Valentim et al, 2021). In addition to this scale, the Joanna Briggs Institute (JBI) scale was also used to assess the methodological quality of cross-sectional studies, through eight questions established on the scale (Defendants, Jéssica Conti et al, 2021).

RESULTS

After searching the databases, 118 scientific articles were initially found. After applying the inclusion/exclusion criteria, 36 articles were found and, when submitted to full-text analysis, 10 full-text scientific productions were selected. The process of selecting studies is described in Figure 2.

Figure 2: Prisma 2020 with the study selection process.



The selected research was developed in 7 locations, and the most approached place among the research was the United States. The other places covered in the surveys were: Denmark, Europe, England, South Korea and Switzerland. As for the year of publication, the oldest study was published in 2012. In addition, regarding the most recent studies, 4 studies published in 2024 were found, and this was the year with the most studies found and approved in the article selection process. The studies are included in Table 1.

Table 1: studies selected for the systematic review.

Year	Author	Local	Goals	Sample	Findings
2012	Pai et al	United States	To examine the association between long-term alcohol consumption, alcohol consumption before and after myocardial infarction, and all-cause and cardiovascular mortality among myocardial infarction survivors.	1818	There is an inverse association between moderate alcohol consumption (10-29.9 g/day) and cardiovascular mortality and a suggestion of excessive mortality among male heavy alcohol users (>30 g/day).

2016	Grabas et al	Denmark	To examine the association between alcohol consumption and mortality among patients undergoing coronary artery bypass grafting (CABG), considering a wide range of serious comorbidities and other potential confounders.	1919	In a study model adjusted for several factors, there was no increased risk of cardiovascular mortality for abstainers (0 units), moderate heavy drinkers (15-21 units/week), and heavy drinkers (>21 units/week). While in another model of the study, adjusted only for age and sex, there is a divergence in relation to heavy drinkers, because in this model the risk of mortality for this category is very high.
2020	Ricci, et al	United States	To assess the relationship between alcohol consumption trends over a 15-year period and all-cause and cause-specific mortality. In addition, the adequacy of the current recommended limits for alcohol according to the 2015-2020 U.S. Dietary Guidelines for Americans (USDGA) was evaluated.	34.672	A J-shaped relationship was observed between the risk of mortality and alcohol use, as it was observed that abstainers had a higher risk of mortality in relation to the moderate alcohol consumption category or reference category (intake of 0.1 to <14 g/day of alcohol) and that the categories that consume alcohol above the value of the reference category (intake of 28-42 g/day and greater than or equal to 42 g/day) have a higher mortality risk.
2022	Biddinger, et al	Europe	To assess the association of habitual alcohol consumption with cardiovascular disease risk and to assess the direction and magnitude of cardiovascular risk associated with different amounts of alcohol consumption.	371.463	The study refuted the J- or U-shaped curve highlighted by other authors, by adjusting for life factors, verifying that individuals with light and moderate consumption had healthier lifestyles than abstainers, a factor that -according to the authors- justifies the apparent benefit of alcohol consumption. Thus, it was observed, through nonlinear Mendelian randomization, that all amounts of alcohol consumed were associated with an increased risk of cardiovascular disease.

2022	Schutte, et al	England	To investigate possible biases that exist in the available epidemiological evidence, resulting in negative associations or underestimation of cardiovascular (CV) risk associated with alcohol consumption.	354.969	The article highlights the following aspects: there is no general cardiovascular protection from alcohol consumption; consumption of beer/cider and spirits is associated with an increased cardiovascular risk, even at low levels of consumption (up to 14 units per week); Wine is associated with a reduced risk of ischemic heart disease, but not other cardiovascular events; The combination of all types of beverages in the analyses leads to an underestimation of cardiovascular risk.
2023	Mezue, et al.	United States	The aim of this study was to evaluate whether the association between mild/moderate alcohol consumption (LCA_m) and major cardiovascular events (MACE) is mediated by a decrease in ANS.	53.064	A U-shaped relationship was observed between alcohol consumption and MACE. In addition, light/moderate alcohol consumption (1-14 drinks/week) was associated with a 21.4% lower risk of MACE compared to minimal/no consumption. Furthermore, light/moderate alcohol consumption was associated with a decrease in ANS, mainly by reducing amygdala activity. Finally, the mediation analysis showed that the effect of alcohol on MACE risk was partially mediated by the reduction in ANS.
2024	Masum, et al.	United States.	To investigate the association between alcohol consumption patterns and the prevalence of diagnosed and undiagnosed hypertension	12.950	According to the study, drinking more than 3 times a week increased the odds of measured hypertension by 64%, undiagnosed by 70%, and compounded by 54%. In addition, frequent episodes of binge drinking (consumption greater than or equal to 6 units of alcohol on one occasion - 60 g of ethanol) increased the chances of hypertension measured by 82%, undiagnosed by 65% and compounded by 47%. In addition, individuals with

					more than 12 binge drinking episodes per year had, on average, systolic blood pressure 4.71 mmHg higher than the reference group. In addition, no evidence was found of the "J" curve that suggests protective effects of moderate alcohol consumption.
2024	Jensen, et al.	Denmark	To assess the relationship between alcohol types and blood pressure.	104.467	The study concludes that alcohol consumption is associated with highly significant increases in SBP and DBP. Furthermore, the authors suggest that reducing alcohol consumption in the population may be an important public health measure to reduce blood pressure-related morbidity and mortality.
2024	Kang, et al.	South Korea.	To investigate the association between reduced alcohol consumption and the risk of major adverse cardiovascular events (MACEs) in heavy drinkers in different subtypes of cardiovascular disease.	21.011	The article highlights that the group that kept consumption high had a significantly higher incidence of MACEs. In addition, reduced alcohol consumption was associated with a 23% lower risk of MACEs. In addition, significant benefits were observed for: coronary artery disease, angina, any type of stroke, all-cause mortality.
2024	Tessitore, et al.	Switzerland.	To assess the risk of alcohol consumption after acute coronary syndromes (ACS).	6.557	The article highlights that heavy weekly alcohol consumption (>14 units/week) was not significantly associated with a higher risk of MACE compared to abstinence. In addition, episodes of excessive alcohol consumption, even less than once a month, are associated with worse clinical outcomes after CHA. In addition, the amount of alcohol consumed in an episode of binge drinking, rather than

					weekly frequency, is associated with a worse prognosis.
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Source: The Authors, 2024.

The main characteristics of alcohol consumption analysed were their relationship with the increase or reduction in the risk of major adverse cardiovascular events (MACE) as a function of the types of beverages - wine, beer/cider, spirits and all beverages combined - and/or the consumption averages defined as abstinence, light/moderate (1-14 units/week for men and 1-7 units/week for women, being 1 unit = 12g of alcohol), and excessive (men > 4 drinks (56g) per day or > 14 drinks (196g) per week and women > 3 drinks (42g) per day or > 7 drinks (98g) per week). Binge Drinking defined as consumption of ≥6 units of alcohol on one occasion (60g of ethanol). A standard drink is equivalent to: beer = 355ml (14g alcohol), glass of wine = 150ml (14g alcohol) and spirits = 44ml (14g alcohol). It should be noted that each of the articles presented stratifications about these intakes and addressed different, but similar, values about each of them, making it possible to establish a parameter between the lowest and the highest value presented in the studies in relation to all the established values.

Of the ten articles reviewed, six studies - MASUM, Muntasir et al, 2024; JENSEN, G. B. et al, 2024; KANG, D.O, 2024; TESSITORES, E. et al, 2024; RICCI, Cristian et al, 2020 and BIDDINGER, Kiran J. et al, 2022 – conclude that no amount of alcohol is protective against cardiovascular disease and that reducing alcohol consumption for heavy drinkers can be extremely beneficial. These studies also determined that there are no significant differences in effects between different types of alcoholic beverages. On the other hand, three of the ten articles - GRABAS, Mads P. K. et al, 2016; MEZUE, Kenekchukwu et al, 2023 and PAI, Jennifer K et al, 2012 – presented beneficial effects of light/moderate consumption in reducing cardiovascular risks and one of the articles – SCHUTTE, Rudolph et al, 2022 – specifically highlighted wine as associated with reduced risk of heart disease but not other cardiovascular events.

It is important to note that two of the three articles advocating moderate alcohol consumption date from 2012 and 2016 - PAI, Jennifer K et al, 2012 and GRABAS, Mads P. K. et al, 2016 -, which suggests that they may be outdated in relation to the most recent findings on the subject. New evidence and more recent studies point to a review of these

findings, emphasizing the need for a cautious approach when considering the potential benefits of alcohol consumption.

To assess the methodological quality of the included studies, the Newcastle Ottawa (NOS) and Joanna Briggs Institute (JBI) scales were used. After analysis, it was noticed that 3 studies met all the criteria of the NOS scale and no study met all the criteria of the JBI scale, but all studies presented a good methodological quality. Therefore, it is important to highlight that the studies that met all 9 criteria of the NOS scale were KANG, D.O, 2024; TESSITORES, E. et al, 2024; and SCHUTTE, Rudolph et al, 2022, as illustrated in Table 2. The criteria for the critical analysis were based on two practical guides for the assessment of risks of bias in cohort studies and cross-sectional studies (Bitencourt, Fernando Valentim et al, 2021) (Defendants, Jéssica Conti et al, 2021). At this stage, two reviewers worked independently. All studies of low or moderate quality were excluded.

Table 2: Results of the evaluation of the methodological quality of the included articles using the Newcastle Ottawa scale (NOS).

Studies	Items								Score
	Selection				Comparability	Exposure			
	1	2	3	4		1	2	3	
Pai et al.	—	*	*	*	**	*	*	*	8/9
Grabas et al.	*	*	*	*	**	*	*	—	8/9
Ricci et al.	*	*	*	*	**	*	*	—	8/9
Biddinger et al.	*	*	*	—	**	*	*	—	7/9
Kang et al.	*	*	*	*	**	*	*	*	9/9
Tessitore et al.	*	*	*	*	**	*	*	*	9/9
Schutte et al.	*	*	*	*	**	*	*	*	9/9
Mezue et al.	*	*	*	—	**	*	*	—	7/9

Source: The Authors, 2024.

Table 3: Results of the evaluation of the methodological quality of the included articles using the Joanna Briggs Institute (JBI) tool.

Studies	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total	Quality
Jensen et al.	S	S	S	S	N	N	S	S	6	Good
Masum et al.	S	S	S	S	N	N	S	S	6	Good

Source: The Authors, 2024.

DISCUSSION

The present study evaluated the relationship between alcohol consumption, based on the amount and type of beverage ingested, and its implications for the risks of major adverse cardiovascular events (MACE), which include: heart disease/coronary artery disease, angina, stroke (both ischemic and hemorrhagic), and death from cardiovascular causes.

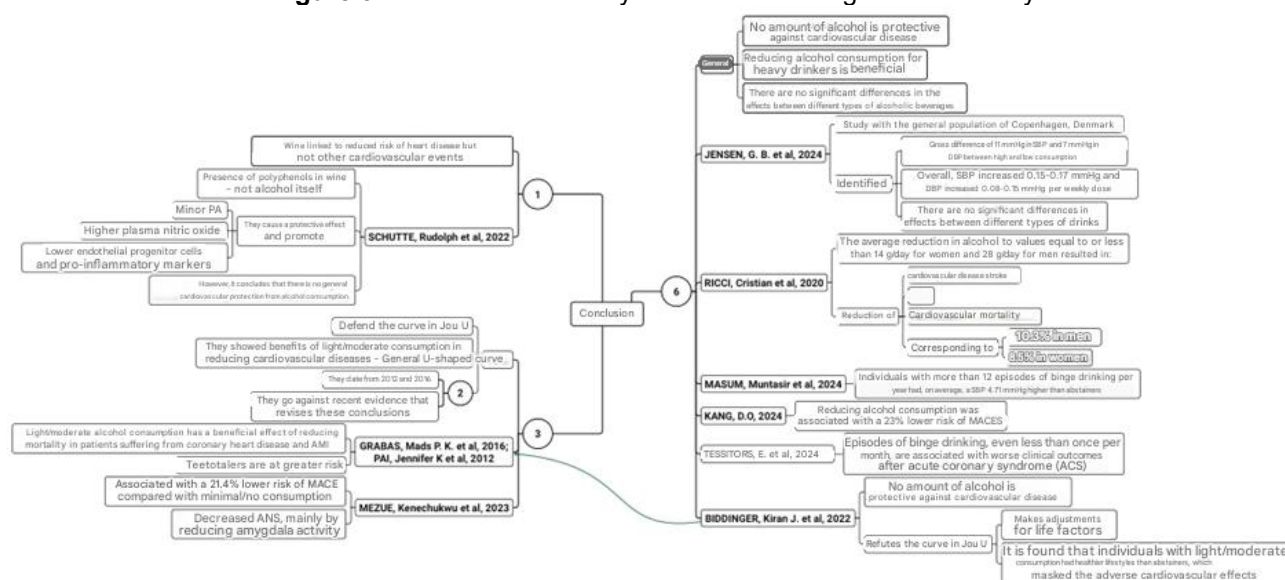
From the analysis of the studies, it was observed that the articles by MASUM, Muntasir et al, 2024; JENSEN, G. B. et al, 2024; KANG, D.O, 2024; TESSITORES, E. et al, 2024; RICCI, Cristian et al, 2020 and de BIDDINGER, Kiran J. et al, 2022 concluded that consumption of any type of beverage under any measure of alcohol is associated with an increased risk of cardiovascular. A study with the general population of Copenhagen, Denmark identified the crude difference of 11 mmHg in SBP and 7 mmHg in DBP between high (>35 drinks/week) and low (1-2 drinks/week) consumption and that, in general, SBP increased by 0.15-0.17 mmHg and DBP increased by 0.08-0.15 mmHg per weekly dose, in addition to highlighting that there were no significant differences in the effects between wine, beer and spirits on blood pressure. In addition, according to the article by RICCI, Cristian et al, 2020, the average reduction of alcohol to values equal to or less than 14 g/day for women and 28 g/day for men would reduce cardiovascular disease, stroke, and cardiovascular mortality in men and women by 10.3% and 8.5%, respectively. In addition to these results, the studies also highlight that non-drinkers may have an increased risk of mortality due to proven external factors, such as poor health, which is independent of alcohol intake.

Furthermore, the article by BIDDINGER, Kiran J. et al, 2022 concluded that no amount of alcohol is protective against cardiovascular diseases and is in line with the articles by GRABAS, Mads P. K. et al, 2016; MEZUE, Kenechukwu et al, 2023 and PAI, Jennifer K et al, 2012 –who argue that moderate alcohol consumption has the beneficial effect of reducing mortality in patients suffering from coronary heart disease and being associated with a 21.4% lower risk of MACE compared to minimal/no consumption, refuting the J or U curve after adjusting for life factors and verifying that individuals of mild/moderate people had healthier lifestyles than teetotalers, which masked the beneficial effects of light/moderate alcohol consumption. In the wake of this process, the study by SCHUTTE, Rudolph et al, 2022 highlights potential benefits in wine consumption, highlighting a reduction in the risk of ischemic heart disease, but not of other

cardiovascular events, due to the presence of polyphenols in wine - not alcohol itself - since they provide a protective effect for the cardiovascular system and promote a decrease in blood pressure, increased amounts of plasma nitric oxide and endothelial progenitor cells and attenuation of pro-inflammatory markers. However, it concludes that there is no overall cardiovascular protection from alcohol consumption. In addition, the information highlighted above can be better visualized through figure 3, which presents a summary of the main conclusions of each study.

Therefore, based on the analysis of the articles, it is observed that alcohol consumption, regardless of type and quantity, is widely associated with an increase in cardiovascular risks. There are challenges in the final conclusion of these studies, given that their variability may have been influenced by methodological differences, populations studied, and adjustments for confounding factors. Therefore, it is necessary that the reduction or mitigation of alcohol consumption, especially among those who consume in excess, be encouraged as a public health measure to reduce the risk of MACE, as well as research should continue to investigate the mechanisms by which alcohol affects cardiovascular health and to identify populations that may be at greater risk, in order to reduce these risks and promote cardiovascular health.

Figure 3: Schematic summary of the main findings of each study



Source: Autoral, 2024.

CONCLUSION

Based on the analysis of the aforementioned studies, it is concluded that alcohol consumption, regardless of type and quality, is widely associated with an increase in cardiovascular risks.

The data indicate that both moderate and excessive alcohol consumption contribute to increased blood pressure and the risks of major adverse cardiovascular events (MACE), such as heart disease, stroke, and mortality from cardiovascular causes. While some studies suggest that moderate alcohol consumption may have beneficial effects on individuals with coronary heart disease, these benefits are potentially masked by healthier lifestyles that these individuals generally adopt. Thus, the idea of a "J or U curve," which shows benefits of moderate consumption, can be misleading after adjusting for life factors.

Therefore, based on the available evidence, it is recommended to promote the reduction or mitigation of alcohol consumption as a public health measure to reduce the risks of MACE. It is equally important that research continues to investigate the mechanisms by which alcohol affects cardiovascular health and identify populations that may be at higher risk, with the goal of reducing these risks and promoting cardiovascular health.

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