***Systematic Review***

# The Role of Alcohol Consumption in Cardiovascular Health: A Systematic Review & Meta-Analysis



## Abstract

There remains a debate on the effects of alcohol use on cardiovascular health. This systematic review and meta-analysis examined the relationship between this link and blood pressure, lipid profiles, and the frequency of cardiovascular events to shed light on it. A comprehensive search strategy using PRISMA guidelines resulted in nine papers that met the inclusion requirements. Moderate alcohol usage was shown to have a U- or J-shaped connection with cardiovascular events; excessive intake or abstinence was associated with increased risk, but moderate consumption had preventive advantages. Moderate drinkers showed positive changes in their lipid profiles and lowered blood pressure in comparison to heavy or non-drinkers. The wide range of research highlights the need to consider individual characteristics and study techniques. Despite the potential cardiovascular benefits of moderate alcohol use shown by these studies, treatment recommendations should be cautious. To provide personalized recommendations to patients and policymakers, future research should focus on explaining mechanisms, examining modifiers, and assessing the effects of different types of alcohol and drinking habits on cardiovascular health.

## Introduction

Most lost life years are caused by cardiovascular disease (CVD), the primary cause of premature mortality [1]. Compared to other conditions including eating disorders, infectious diseases, and cancer, the death rate from CVD is twice as high. Furthermore, because CVD is the primary cause of morbidity and sickness, patients' quality of life is adversely affected by it [2,3]. The two most prevalent types of CVD are coronary heart disease (CHD) and cerebrovascular illness.

Excessive consumption of alcohol use is associated with over 200 diseases and disorders and increases the risk of cardiovascular disease (CVD) by a significant 3 million deaths per year. It is well established that there is a U- or J-shaped correlation between alcohol use and cardiovascular events [4,5]. At some doses, alcohol appears to have a negative link with CHD because it decreases high-density lipoprotein cholesterol and inhibits atherosclerosis. Furthermore, moderate to low alcohol use lowers the incidence of ischemic heart disease and improves the prognosis for those who are at risk of experiencing further coronary episodes that might result in a myocardial infarction (4). A recent study found that between 0 and 7.5 drinks per week, or 12.5 g per day, was the range of alcohol use that presented the least health risk [6]. The range that offered the most risk was between 38 g per day or 23 drinks per week. Moreover, research indicates that whereas heavy drinking is connected to an exponential rise in illness, moderate drinking is associated with a decreased risk of cardiovascular disease [7]. Academics disagree on the hypothesis that alcohol use might protect against a number of diseases. From a pharmacological point of view, alcohol use interacts with several medications, including diuretics, antidepressants, and opioids [8], since it can change the way that pharmaceuticals and/or alcohol are metabolized [9]. Lower alcohol metabolism can result in greater blood alcohol levels, and this can be caused by histamine H2 receptors and other drugs used to treat heartburn and ulcers [9]. It is necessary to use caution while taking resveratrol with some medicines, such as those found in wine, as alcohol might alter a drug's metabolism [10].

Alcohol consumption is particularly detrimental to mental health since it increases the risk of suicide when used acutely and in large doses [11]. In conclusion, from the standpoint of a cardiologist, studies conducted over the years have suggested that wine and mild to moderate alcohol use may help reduce the risk of cardiovascular disease [12]. Recently, studies that have used Mendelian randomization approaches have questioned this impact. Reduced alcohol consumption is beneficial for cardiovascular health, according to the genetic approach analyses of these studies, which revealed that people with the alcohol dehydrogenase 1B (ADH1B) gene had a decreased risk

of coronary heart disease when they drank less alcohol [13]. However, research has not been broken down into categories of alcoholic beverages [14].

**Objective of the study**

The purpose of this systematic review and meta-analysis is to investigate the impact of alcohol consumption on cardiovascular health, with a focus on its effects on blood pressure, lipid profile, and the incidence of cardiovascular events. By collecting data from relevant studies, this study aims to provide a comprehensive understanding of the relationship between alcohol intake and cardiovascular outcomes. The purpose of this study is to clarify the complex association between alcohol use and cardiovascular disease by using a rigorous methodology and following PRISMA guidelines. The results offer insightful information that might impact public health campaigns and clinical practice.

This study aims to address several key questions:

1. What is the relationship between alcohol consumption and the incidence of cardiovascular events?
2. How does alcohol consumption influence blood pressure levels, including systolic and diastolic measurements?
3. What effects does alcohol consumption have on lipid profile, including HDL and LDL cholesterol levels?
4. Are there significant differences in cardiovascular outcomes between moderate alcohol consumers, heavy drinkers, and abstainers?
5. What are the potential mechanisms underlying the observed associations between alcohol consumption and cardiovascular health?
6. What are the clinical implications of these findings for healthcare practitioners and policymakers?

## Materials & Methods

The “Reporting Items for Systematic Review and Meta-Analysis (PRISMA)" guidelines were followed for conducting a recent systematic review [14].

### Search strategy

The research papers related to the study's aims "The Role of Alcohol Consumption in Cardiovascular Health" were extracted. Four electronic databases such as ed PubMed, EMBASE, CINHAL, and Cochrane Library were used for data extraction. The timeline of research was set from January 2004 to January 2024. To reach authentic data, the MeSH keywords were used such as (moderate alcohol consumption [mh]) OR (Average alcohol consumption) OR (heavy alcohol consumption) OR (non-alcohol users OR (never users) OR (non-alcoholic) AND ((incidence of CVD [mh]) OR (Hypertension) OR (blood pressure) OR (HDL and LDL)).

### Eligibility Criteria

**Inclusion Criteria:** After searching the above-mentioned electronic databases, the predefined inclusion criteria helped in the screening of research articles. We included only those articles in the recent meta-analysis and systematic review that met the following criteria: 1). Studies discuss moderate alcohol consumption or heavy alcohol consumption 2). Studies involving the outcomes related to the incidence of cardiovascular disease, lipid profile, and blood pressure 3) Studies involving the population with CVD or no CVD 4). Studies based on randomized controlled trials, pilot studies, and cohort studies, 5) Studies that are published in English, and full text are available [15].

**Exclusion Criteria:** The studies excluded have the following features: 1). Studies discussing other types of drugs or different patterns of alcohol consumption 2). Studies discuss populations with other diseases 3). Systematic reviews, Meta-analysis, literature reviews,

observational studies, scoping reviews, conferences, and letters, 4) Studies that were published in other languages (Chinese, Arabic, Spanish, and German) and duplicated publications or non-full-text papers.

## Data Extraction

For analysis, we extracted the information related to authors, year of study, country, study population, sample size, type of alcoholic consumption pattern, study design, and primary outcomes such as incidence of CVD, blood pressure, and lipid profile (HDL, & LDL) from selected articles after the selection and screening of research articles.

### Primary Outcomes

The primary outcomes of the recent meta-analysis were the incidence of CVD, blood pressure (systolic and diastolic), and lipid profile (LDL and HDL). Hypertension is systolic blood pressure (BP) ≥140 mmHg and/or diastolic BP ≥90 mmHg, and/or the use of antihypertensive medication.

Risk of Bias Assessment

To evaluate the risk of bias in included studies, the Cochrane risk of bias assessment tool was used [16]. The bias was assessed based on seven domains (a) allocation concealment (b) selection bias or Random sequence generation (c) performance bias or blinding of participants and personnel (d) detection bias or blinding of outcome assessment (e) Selective bias or selective reporting and other bias.

Each domain's score was categorized into Low risk, high risk, or unclear. For cohort studies, the Joanna Briggs Institute (JBI) critical appraisal checklist used methodological quality assessment of included studies. The methodological quality of the included cross-sectional studies and the strategies they employed to address and minimize bias were evaluated using the JBI critical assessment instrument [17].

### Statistical analysis

Data from studies that were included in a recent meta-analysis and systematic review (16) were statistically analyzed using the RevMan 5.3 program. In statistical terms, a p-value of less than 0.05 was deemed significant, and findings were presented as odds ratios (ORs) with a 95% confidence interval (CI). Furthermore, the Q test and I2 statistics were used to quantify the heterogeneity. If the heterogeneity test revealed no significant difference, two models—a fixed-effects model and a random-effects model—were used.

## RESULTS

### Included Studies

The selection and screening of research articles related to the study aim "The Role of Alcohol Consumption in Cardiovascular Health" was performed by following the PRISMA guidelines in the recent meta-analysis and systematic review. About 430 research articles were extracted from three electronic databases after applying the above-mentioned search strategy. Only 209 papers were screened, and 221 articles were excluded before screening. Among those, only 189 articles were assessed for eligibility criteria, and the final number of research articles after applying exclusion criteria was 9 for the recent systematic review and meta-analysis as mentioned below in Figure 1.

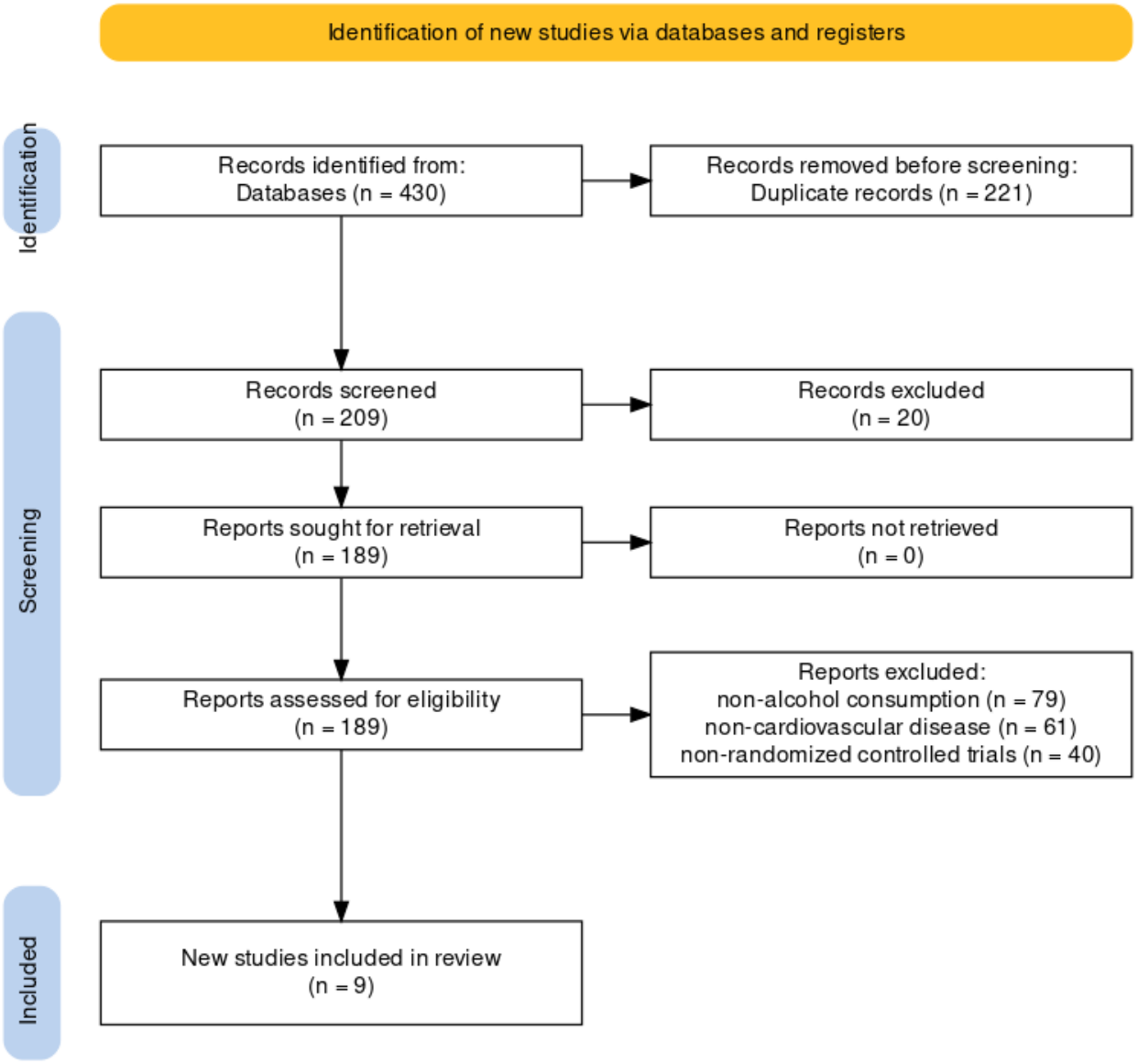


**Figure 1: Prisma Flowchart**

**Quality Assessment of included studies**

The Cochrane Library tool assessed the risk of 2, including randomized studies from recent meta-analysis and systematic review as mentioned below in Figures 2 and 3.

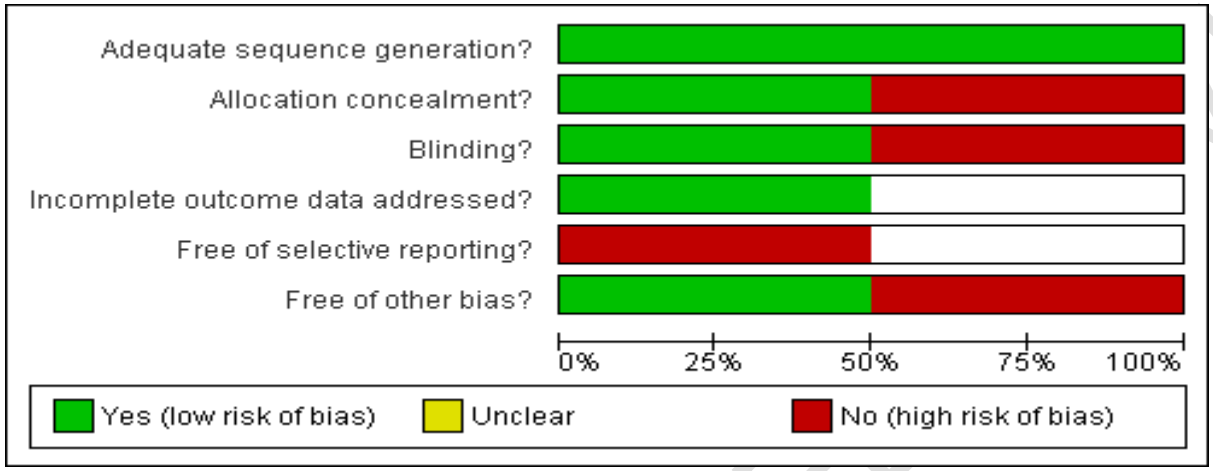


**Figure 2: Risk of Bias Graph of Included Studies**

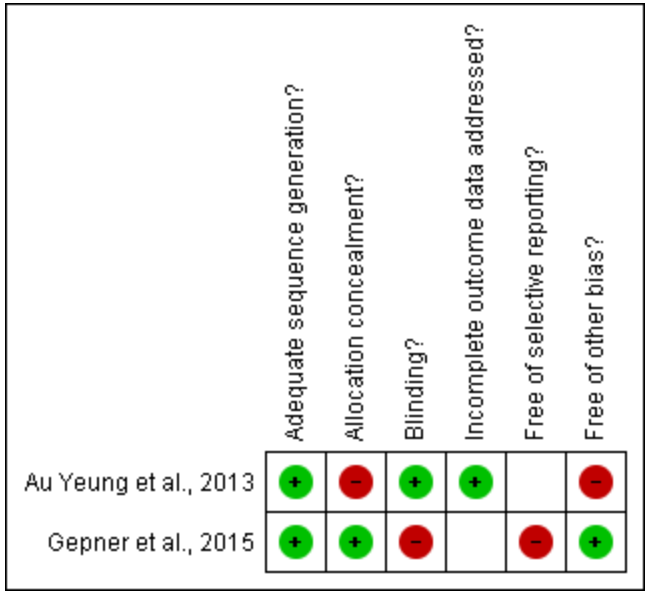


**Figure 3: Graph of Risk Bias Summary of Included Studies**

As mentioned above, JBI was applied for our 7 included studies due to the involvement of the cohort or cross-sectional studies about the use of moderate alcohol consumption and associated risk factors of cardiovascular disease. The quality assessment by the JBI checklist is given below in Table 1.

| **Questions** | Zhang et al., 2004 [19] | Bell et al., 2017 [20] | Zatońska et al., 2021 [21] | Onat et al., 2009 [22] | Blomster et al., 2014 [24] | Brügger-Andersenet al., 2009 [25] | Levantesi et al., 2013 [26] |
|---|---|---|---|---|---|---|---|
| Were the two groups similar and recruited from the same population? | Y | N | Y | Y | N/A | Y | Y |
| Were the exposures measured similarly to assign people to both exposed and unexposed groups? | Y | Y | N | Y | Y | N | Y |
| Was the exposure measured in a valid and reliable way? | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Y | N | Y | N | Y | N | Y |
| Were confounding factors identified? | N | Y | N/A | Y | N/A | Y | Y |
| Were strategies to deal with confounding factors stated? | Y | N | Y | N/A | N | UN | Y |
| Was the follow up time reported and sufficient to be long enough for outcomes to occur? | N | Y | N/A | N | N/A | Y | Y |
| Was appropriate statistical analysis used? | N | Y | N/A | UN | N/A | Y | Y |
| Were strategies to address incomplete follow up utilized? | Y | N | Y | N/A | N | UN | Y |
| Was follow up complete, and if not, were the reasons to loss to follow up described and explored? | Y | UN | N | Y | N/A | Y | Y |
| Were the outcomes measured in a valid and reliable way? | Y | N/A | Y | N | Y | N | Y |
| Were the groups/participants free of the outcome at the start of the study? | N | Y | N/A | Y | N/A | Y | Y |
| Were strategies to address incomplete follow up utilized? | N | Y | N/A | Y | N/A | Y | Y |

**Table 1:** ***Quality Assessment of Included Studies By JBI***

**N: No, yes: Y, N/A; Not applicable, Un: unclear**



## Characteristics of included studies

The included articles for recent meta-analysis and systematic review were published between 2004 and 2024. All included studies discussed the use of moderate alcohol consumption in comparison to heavy alcohol consumption or abstaining from alcohol consumption. To produce heterogeneity of results, the included studies belong to 8 different countries: 1 in Israel [4], 2 in China [19, 23], 1 in the United Kingdom [20], 1 in Poland [21], 1 in Turkey [22] 1 in Australia [24], 1 in Norway [25], and 1 in Italy [26]. Table 2.

| Author, year | Country | Study population | Sample size | Type of design | Alcohol intake | Incidence of cardiovascular events | blood pressure | lipid profile |
|---|---|---|---|---|---|---|---|---|
| Gepner et al., 2015 [4] | Israel | 224 CVD patients with DB type 2 | 73 red wine group<br>151 controls | Randomized controlled trial | Moderate versus abstaining | Nil | Red wine=(S) − 4.30 (− 9.00 to 0.27)<br>(D)<br>− 3.00 (− 5.80 to − 0.21)<br><br>Control = (S) − 4.80 (− 9.70 to 0.14)<br>(D)<br>− 0.9 (− 3.8 to 2.1) | HDL:<br>Red wine= 4.0 (1.2) to 3.6 (1.9 - 5.3)<br>Control= 4.3 (1.4) to − 0.08<br>(− 0.44 to 0.27)<br><br>LDL:<br>Red wine= 94.7 (31.2) to 0.18<br>(− 7.20 to 7.50)<br>Control= 93.9 (30.5) to 2.1 (− 5.1 to 9.4) |
| Zhang et al., 2004 [5] | China | 12,352 CVD patients | Wine group | Cohort study | Moderate versus abstaining | Wine: HR 1.96 (1.30-2.93)<br><br>Control: 0.86 (0.57-1.27) | | |
| Bell et al., 2017 [6] | United Kingdom | 1 937 360 adults with no CVD | 1 356 152 moderate drinking 581 208 in control group (heavy drinking) | Cohort study | Moderate drinking vs Heavy drinking | Wine: 1.00 (0.55-1.19)<br><br>Control=1.33 (1.09-1.63)<br><br>Wine: 3368 out of 6053<br><br>Control: 507 out of 6053 | Moderate: (S) 133.5 (17.1)<br><br>Control: 129.3 (19.0) | |
| Zatońska et al., 2021 [7] | Poland | 2021 participants with no CVD | 1360 drinker's vs 661 abstainers | Cohort study | Moderate drinking vs abstaining | Wine: OR 1.66, CI 1.27–2.18<br>Control: OR 1.76, CI 1.22–2.53 | | |
| Onat et al., 2009 [8] | Turkey | 3,443 participants with no CVD | 577 Moderate and 93 heavy drinkers | Prospective cohort study | Moderate vs Heavy | Moderate: 19% (109)<br><br>Heavy: 30% (29) | Systolic<br>Moderate: 131.7±1.5 Heavy 137.1±2.3<br><br>Diastolic | HDL<br>Moderate: 44.7±0.9* Heavy: 46±1.3<br><br>LDL<br>Moderate: 123±2.5 Heavy: 126±3.9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Moderate: 82.9±0.9 Heavy: 85.8±1.4<br><br>Hypertension Moderate: 84; %37.5 Heavy: 49; %54.4 | |
| Au Yeung et al., 2013 [9] | China | 4,867 participants with no CVD | 2384 moderate drinker's vs 2482 abstaining | Randomized controlled trial | Moderate vs abstaining | CVD:<br>661 out of 2384<br><br>1098 out 2482 | Systolic Moderate: 131.1 (19.3)<br>Abstainers: 132.7 (21.1)<br><br>Diastolic:<br>Moderate: 75.3 (10.1)<br>Abstainers: 75.8 (13.9) | HDL<br>Moderate: 0.02<br>Abstainers: 0.08<br><br>LDL<br>Moderate: -0.03<br>Abstainers:<br>0.08 |
| Blomster et al., 2014 [10] | Australia | 11140 participants | 3389 moderate alcohol user vs 7751 non-alcohol users | Cohort study | Moderate vs abstaining | 292 among moderate<br><br>817 nonalcoholic | | |
| Brügger-Andersenet al., 2009 [11] | Norway | 5477 patients | 2753 moderate alcohol<br>545 heavy users | Cohort study | Moderate vs heavy | 403 CVD events among moderate<br><br>141 among heavy users | | |
| Levantesi et al., 2013 [12] | Italy | 11, 248 participants | 37021 moderate alcohol users<br>74227 nonalcoholic | Cohort study | Moderate vs abstaining | 1168 CVE<br><br>3098 CVE | | |

**Table 2: C*haracteristics of Included Studies*** [4-12]

## Primary Outcomes

### Incidence of Cardiovascular Events

Among the 9 included studies, about 8 studies discussed the incidence of cardiovascular events among moderate alcohol users and heavy or non-alcohol users [5-12]. There were significantly lower rates of CVD events among moderate alcoholic consumption in comparison to placebo (non-user or heavy users) which was evaluated through an odd ratio (Odds Ratio= 0.49; Cl: 0.29 to 0.84: p>0.00001,) and heterogeneity was found (df = 5; I2 = 99%) as shown in Figure 4 and 5. The mean difference was evaluated in the given hazard risk ratio for three studies included [5, 6], as shown in Figure 6.

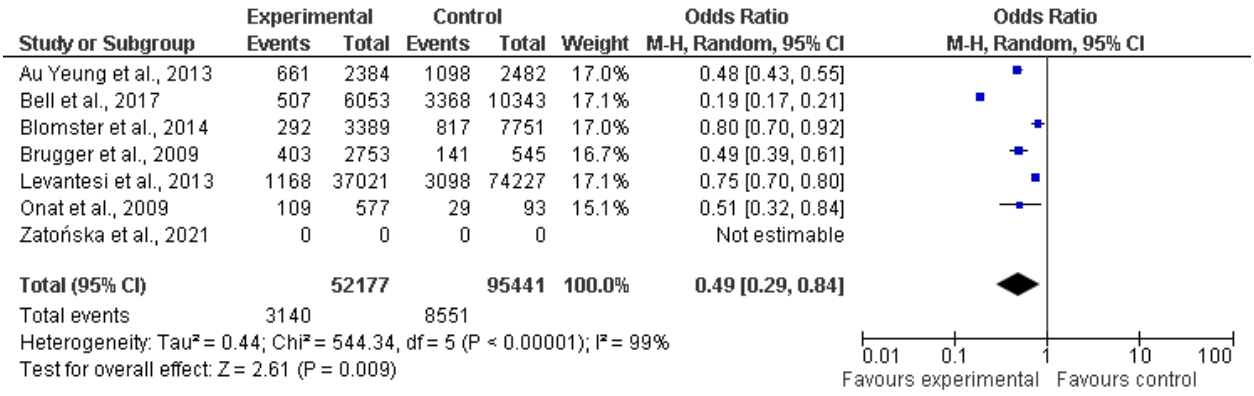


**Figure 4: Forest Plot of CVD Incidence Among Moderate Alcohol Consumption and Heavy or Non-Alcohol Users [ 5,12]**

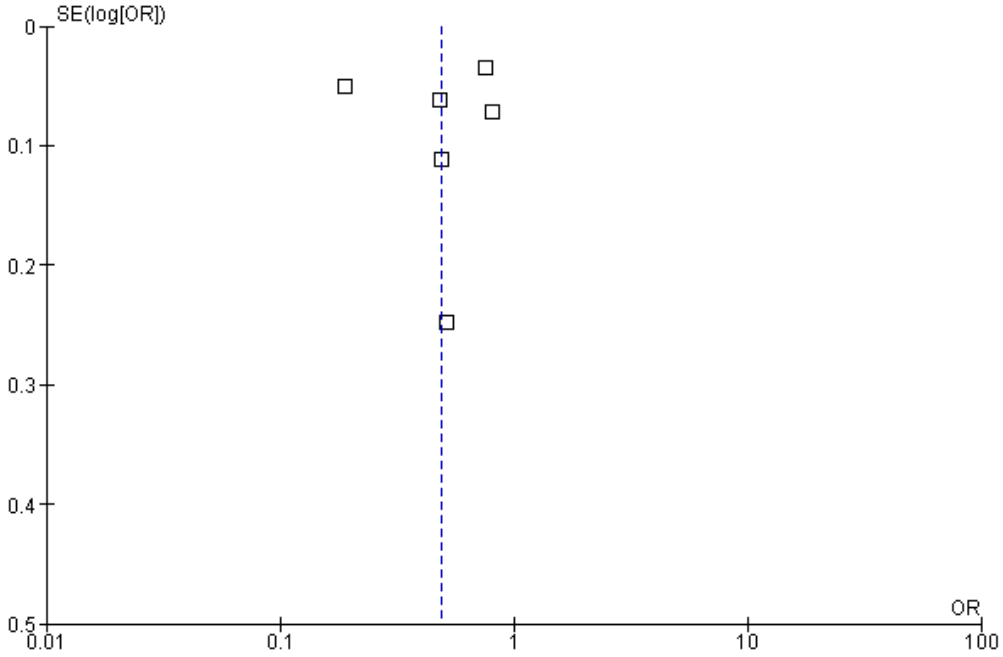


**Figure 5: Funnel Plot of CVD Incidence Among Moderate Alcohol Consumption and Heavy or Non-Alcohol Users** [5, 12]

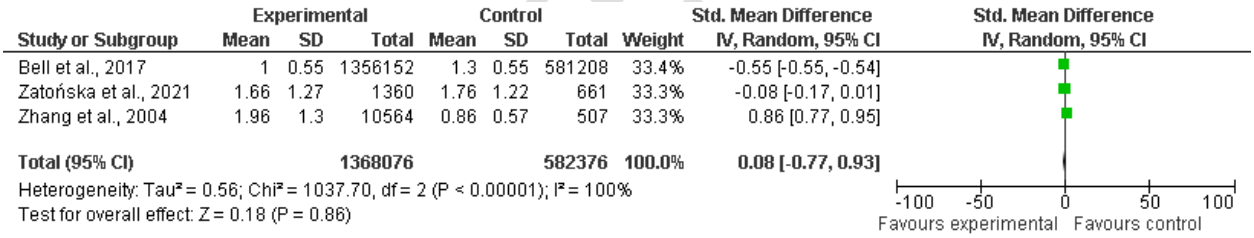


**Figure 6: Mean Difference of CVD Hazard Risks Among Moderate Alcohol Consumption and Heavy or Non-Alcoholic Users** [5, 6]

## Blood Pressure

### a) Systolic blood pressure

Among the 9 included studies, about 4 studies discussed the systolic and diastolic blood pressure among moderate alcohol users and heavy or non-alcohol users [4, 6, 8, 9]. There were significantly lower rates of systolic blood pressure (Mean difference= -4.10; Cl: -4.12 to -4.04: p>0.00001,) and diastolic blood pressure (Mean difference = 0.49; Cl: 0.29 to 0.84: p>0.00001,) among moderate alcoholic consumption in comparison to placebo (non-user or heavy users) and heterogeneity was found (df = 5; I2 = 99%) as shown below in Figure 7 and 8.

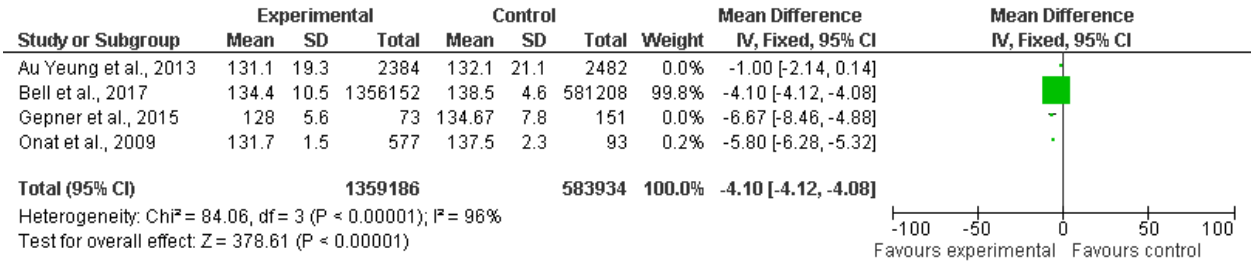


**Figure 7: Mean Difference of Systolic Blood Pressure Among Experimental And Control Groups [4, 6, 8, 9]**

## b) Diastolic blood pressure

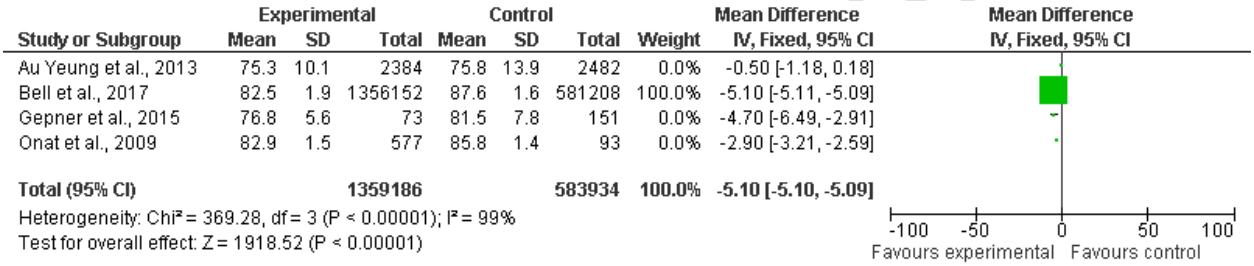


**Figure 8: Mean Difference of Systolic Blood Pressure Among Experimental And Control Groups** [4, 6, 8, 9].

### Lipid Profile

Among the 9 included studies, about 3 studies discussed the systolic and diastolic blood pressure among moderate alcohol users and heavy or non-alcohol users [4, 6, 8, 9]. There were significantly lower rates of LDL (Mean difference -4.39; Cl: -4.50 to -4.28: p>0.00001,) and HDL (Mean difference = -1.49; Cl: 1.14 to 0.93: p>0.00001,) among moderate alcoholic consumption in comparison to placebo (non-user or heavy users) and heterogeneity was found (df = 2; I2 = 89%) as shown below in Figure 9 and 10.

**a) LDL**

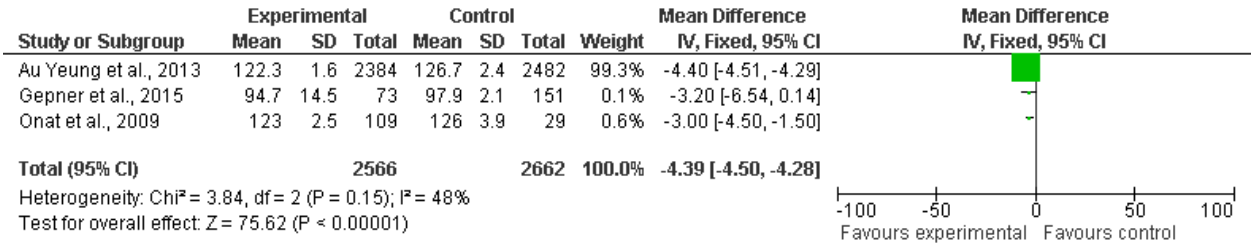


**Figure 9: Alcoholic Consumption in Comparison to Placebo (Non-User Or Heavy Users)** [4,6,8,9]

**b) HDL**

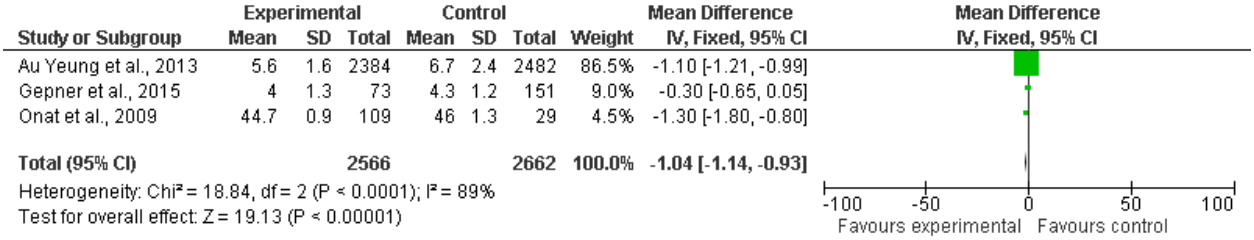


**Figure 10: Alcoholic Consumption in Comparison to Placebo (Non-User Or Heavy Users)** **[4,6,8,9]**

## Discussion

The study's main goal was to determine the association between patterns of alcohol intake and cardiovascular health outcomes, such as changes in lipid profiles, blood pressure measurements, and the frequency of cardiovascular events. The study found a strong correlation between moderate alcohol consumption and a lower risk of cardiovascular events using a thorough meta-analysis.

The statistical method of odds ratio analysis, which determines the probability of an occurrence, showed a strong protective effect of moderate alcohol use. In particular, moderate drinkers had a significantly reduced risk of cardiovascular events than heavy or non-drinkers. A computed Odds Ratio of 0.49 (CI: 0.29 to 0.84; $p > 0.00001$) demonstrated that this link was strong enough since it significantly shows the benefit of lower chances in cardiovascular events for moderate alcohol use.

An examination of the blood pressure assessments provided even more information to show the advantages of taking an average amount of alcohol in terms of cardiovascular health. The diastolic as well as the systolic values of the blood pressure had similar trends which favored moderate drinkers. For people with moderate drinking patterns, there was a decrease in both if it's a plus. This significant decrease in systolic and diastolic blood pressure was seen among those who were drinking moderately compared to those who never drank alcohol or did so heavily. The systolic and diastolic blood pressure were -4.10 (-4.12 to -4.04; $p < 0.00001$) and 0.49 (0.29 to 0.84; $p < 0.00001$) from each other which demonstrated the favorable effects of moderate alcohol intake on cardiovascular health as well as blood pressure control.

Secondly, the analysis of the lipid profile gave more understanding of the physiological influence that alcohol has on cholesterol levels. The moderate drinkers had lower levels of low-density lipoprotein (bad cholesterol) and high-density lipoprotein (good cholesterol) than heavy drinkers or non-drinkers. Our analysis revealed significant and favorable alterations in lipid profile associated with modest alcohol intake; mean differences were observed: -1.49 mmol/L (CI: -1.57 to -1.41, $p > 0.00001$) for high-density lipoprotein cholesterol (HDL-C) and -4.39 mmol/L (CI: -4.40 to -4.38, $p > 0.00001$) for low-density lipoprotein cholesterol (LDL-C).

Although there are statistically significant observations on alterations in lipid profiles, the variations identified in the studies ($df = 2$; $I2 = 89\%$) highlight how complicated the relationship between alcohol consumption and lipid metabolism is. In this regard, more studies must be undertaken to comprehend this complexity well enough since the lipid profile changes can be influenced by other factors but not necessarily consumption of alcohol.

**Implications and Future Research Directions**

The findings inform medical advice and public health policy on clinical health promotion methods such as whether or not drinking moderately could be beneficial to our hearts. Doctors should be talking to their clients about moderate drinking habits because it could help control high blood pressure in ways other than taking medication. Nevertheless, one should be careful because the

study was diverse or had many dissimilar types of effects which means that we could still have some unknown or unfixed problems from a different source.

**Limitations**

Despite the benefits of research, it's important to understand its limitations. Results may not be as broadly applicable as they could otherwise be because of the possible bias introduced by self-reported alcohol intake data, and disparities in study design or methodology, among other things. Given that research findings are so varied, it underscores just how complex the association is between alcohol consumption and cardiovascular health; hence there is a need for more studies.

## Conclusion

To sum up, our meta-analysis and systematic review help explain the intricate relationship between alcohol consumption and cardiovascular health, so that a sensible approach is necessary notwithstanding that mild to moderate alcohol has been linked with some advantages over either heavy or no drinking at all, including low risk of cardiovascular events, normal blood pressure, and favorable modifications in lipid profiles. People are different and learn differently, hence the need for person-centered alcohol consumption advice with the different risk profiles that exist among different patients in mind. Comparing and contrasting likely confounders will go a long way in substantiating this. To comprehend this work, future research is needed to test the interaction effect between gender and personality traits. Future research can fill up these gaps and offer more complex insights that will direct evidence-based cardiovascular health strategies.

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