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Alcohol intake reduction for controlling hypertension (Review)

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[Intervention Review]

Alcohol intake reduction for controlling hypertension

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ABSTRACT

Background

High blood pressure constitutes one of the leading causes of mortality and morbidity all over the world. At the same time, heavy drinking increases the risk for developing cardiovascular diseases, including cardiomyopathy, hypertension, atrial arrhythmias, or stroke. Several studies have already assessed specifically the relationship between alcohol intake and hypertension. However, the potential effect on blood pressure of alcohol intake reduction interventions is largely unknown.

Objectives

To assess the effect of any intervention to reduce alcohol intake in terms of blood pressure decrease in hypertensive people with alcohol consumption compared to a control intervention or no intervention at all. To determine additional effects related to mortality, major cardiovascular events, serious adverse events, or quality of life.

Search methods

The Cochrane Hypertension Information Specialist searched the following databases for randomised controlled trials up to June 2020: the Cochrane Hypertension Specialised Register, the Cochrane Central Register of Controlled Trials (CENTRAL) (Issue 5, 2020), MEDLINE Ovid (from 1946), MEDLINE Ovid Epub Ahead of Print, and MEDLINE Ovid In-Process, Embase Ovid (from 1974), ClinicalTrials.gov and the World Health Organization International Clinical Trials Registry Platform. Trial authors were contacted when needed and no language restrictions were applied.

Selection criteria

We included randomised controlled trials with minimum 12 weeks duration and including 50 or more subjects per group with quantitative measurement of alcohol consumption and/or biological measurement of the outcomes of interest.

Participants were adults (16 years of age or older) with systolic blood pressure (SBP) greater than 140 mmHg and diastolic blood pressure (DBP) greater than 90 mmHg, and SBP ≥ 130 or DBP ≥ 80 mmHg in participants with diabetes. We included any intervention implemented to reduce their alcohol intake.

Data collection and analysis

Two review authors independently assessed search results and extracted data using standard methodological procedures adopted by Cochrane.

Main results

A total of 1210 studies were screened. We included one randomised controlled trial involving a total of 269 participants with a two-year follow-up. Individual patient data for all participants were provided and used in this review.

No differences were found between the cognitive-behavioural intervention group and the control group for overall mortality (RR 0.72, 95% CI 0.16 to 3.17; low-certainty evidence), cardiovascular mortality (not estimable) and cardiovascular events (RR 0.80, 95% CI 0.36 to 1.79; very low-certainty evidence). There was no statistical difference in systolic blood pressure (SBP) reduction (Mean Difference (MD) -0.92 mmHg, 95% confidence interval (CI) -5.66 to 3.82 mmHg; very low-certainty evidence) or diastolic blood pressure (DBP) decrease (MD 0.98 mmHg, 95% CI -1.69 to 3.65 mmHg; low-certainty evidence) between the cognitive-behavioural intervention group and the control group. We also did not find any differences in the proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg (Risk Ratio (RR) 1.21, 95% CI 0.88 to 1.65; very low-certainty evidence).

Concerning secondary outcomes, the alcohol intake was significantly reduced in the cognitive-behavioural intervention compared with the control group (MD 191.33 g, 95% CI 85.36 to 297.30 g). We found no differences between the active and control intervention in the proportion of subjects with lower-risk alcohol intake versus higher-risk and extreme drinkers at the end of the study (RR 1.04, 95% CI 0.68 to 1.60). There were no estimable results for the quality of life outcome.

Authors' conclusions

An intervention for decreasing alcohol intake consumption did not result in differences in systolic and diastolic blood pressure when compared with a control intervention, although there was a reduction in alcohol intake favouring the active intervention. No differences were found either for overall mortality, cardiovascular mortality or cardiovascular events. No data on serious adverse events or quality of life were available to assess. Adequate randomised controlled trials are needed to provide additional evidence on this specific question.

PLAIN LANGUAGE SUMMARY

Alcohol intake reduction for controlling hypertension

Review question

We evaluated whether an intervention to reduce alcohol intake has a greater impact than other kinds of interventions (or no intervention at all) in reducing blood pressure in people with high blood pressure and alcohol consumption.

Background

High blood pressure is associated with an increase in the risk of heart attack, stroke and mortality. Heavy drinking increases cardiovascular risk and has been associated with heart and vascular problems. Some studies have confirmed a relationship between alcohol intake and hypertension.

Some studies have already assessed how alcohol intake can affect blood pressure. However, it is still unclear whether interventions to reduce alcohol intake can also modify blood pressure.

Search date

We searched for evidence up to June 2020.

Study characteristics

We included one trial with 269 participants who were followed up for 24 months. We assessed data to identify differences in blood pressure, number of deaths and serious diseases between a group of people receiving psychological assistance to reduce alcohol intake and people not receiving this assistance.

Key results

Based on this limited information, although those participants who received psychological assistance were able to reduce their alcohol intake more than those without such assistance, we found no differences in the number of deaths, total heart problems and total vascular problems between people receiving psychological assistance to decrease alcohol intake and those not receiving such help. We also found no differences in blood pressure reduction. Data on quality of life or serious adverse effects were not available.

Certainty of evidence

We found only one relevant study to answer our question. The certainty of evidence from this single included study was evaluated as being low to very low. More long-term trials need to be conducted to assess the effect of reduction in alcohol intake on blood pressure.

SUMMARY OF FINDINGS

Summary of findings 1. Summary of findings

Cognitive-behavioural intervention compared with control intervention for mortality and morbidity

Patient or population: alcohol consumers with high blood pressure

Settings: outpatients (trial duration 2 years)

Intervention: cognitive-behavioural intervention programme aimed to reduce alcohol intake

Comparison: control observational group

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect* (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Control group	Cognitive-behavioural intervention group				
Overall mortality	Study population		RR 0.72 (0.16 to 3.17)	269 (1 RCT)	⊕⊕⊖⊖ LOW[2,3,4]	
	30 per 1000	22 per 1000				
Cardiovascular events	Study population		RR 0.80 (0.36 to 1.79)	269 (1 RCT)	⊕⊖⊖⊖ VERY LOW[1,2,3,4]	
	91 per 1000	73 per 1000				
Decrease in systolic blood pressure (mmHg)	Study population		---	269 (1 RCT)	⊕⊖⊖⊖ VERY LOW[1,2,3,4]	
	7.05 [SD 13.86]	6.13 [SD 16.14] MD -0.92 (-5.66 to 3.82)				
Decrease in diastolic blood pressure (mmHg)	Study population		---	269 (1 RCT)	⊕⊕⊖⊖ LOW[1,3,4]	
	6.07 [SD 7.99]	7.05 [SD 8.91] MD 0.98 (-1.69 to 3.65)				
Decrease in alcohol intake (g)	Study population		---	269 (1 RCT)	⊕⊕⊖⊖ LOW[1,3,4]	
	65.10 [SD 362.11]	256.43 [SD 300.28] MD 191.33 (85.36 to 297.30)				

Proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg	Study population		RR 1.21 (0.88 to 1.65)	269 (1 RCT)	⊕⊖⊖⊖ VERY LOW[1,2,3,4]
	466 per 1000	563 per 1000			

*. The **risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI). Anticipated absolute effect is described as number of patients per 1000 in the case of dichotomous outcomes and as mean (and its standard deviation) in the case of continuous outcomes. Relative effect is described as risk ratio (and its 95% CI) in the case of dichotomous outcome. Mean differences (and its 95% CI) are provided in the case of continuous outcomes.
CI: Confidence interval; **MD**: Mean Difference; **RR:** Risk Ratio; **SD**: Standard Deviation

GRADE Working Group grades of evidence
High certainty: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate certainty: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low certainty: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low certainty: We are very uncertain about the estimate.

[1]Downgraded one level due to high risk of performance bias
[2]Downgraded one level due to serious imprecision (95% CI was wider than the minimal important difference)
[3]No available data to assess inconsistency/heterogeneity
[4]Data available from a subgroup of only 1 study

BACKGROUND

Description of the condition

Hypertension or high blood pressure has been defined as having a systolic blood pressure (SBP) ≥ 140 mmHg and a diastolic blood pressure (DBP) ≥ 90 mmHg, or SBP ≥ 135 mmHg and DBP ≥ 85 mmHg when using automated office blood pressure (AOBP). Hypertension in patients with diabetes has been established as SBP ≥ 130 or DBP ≥ 80 mmHg with or without AOBP (Hypertension Canada 2018). This condition is associated with structural changes in the heart and blood vessels, which increases the risk for some cardiovascular diseases such as stroke, myocardial infarction or congestive heart failure. Nowadays, high blood pressure constitutes one of the leading causes of mortality and morbidity all over the world. Globally, about 1.4 billion people are affected by hypertension (Mills 2016), and up to 10.5 million deaths and 212.1 million disability-adjusted life-years (DALYs) are attributable to high systolic blood pressure (GBD 2016).

Heavy drinking increases the risk for developing cardiovascular diseases, including cardiomyopathy, hypertension, atrial arrhythmias, or stroke (Klatsky 2015; Larsson 2016). Several studies have already assessed specifically the relationship between alcohol intake and hypertension. A systematic review and meta-analysis obtained a linear dose–response relationship with a relative risk of 1.57 at 50 g pure alcohol per day and 2.47 at 100 g per day for men. Among women, a relative risk of 1.81 at 50 g per day and of 2.81 at an average daily consumption of 100 g pure alcohol per day was found. This dose-related increase in blood pressure, together with the relatively high prevalence of alcohol consumption, translates into a relatively high attributable risk for hypertension (Taylor 2009). Frequent binge drinking is associated with higher systolic blood pressure in young adults (Wellman 2016). Some studies confirmed that alcohol consumption exceeding two drinks per day increases the risk for developing hypertension (Sesso 2008). The lower blood pressure, observed irrespective of the type of drink, is approximately 1 mmHg for each drink less per day (1 drink ≈ 14 g alcohol consumed) (Cushman 2001). This effect is believed to occur within two to four weeks of abstinence or with a substantial reduction in alcohol intake (Puddey 2006).

Description of the intervention

We included any structured psychosocial intervention or advice, such as brief interventions done by a physician or other healthcare provider, motivational interviewing, and motivational enhancement therapy. We also included any pharmacological treatments and financial incentives used to reduce alcohol intake.

How the intervention might work

Brief interventions have been used mainly for heavy drinkers who tend not to seek support for alcohol problems. Brief interventions are grounded in social-cognitive theory and typically incorporate at least some of the following elements: feedback on the alcohol use and alcohol-related harms; criteria for defining low-risk alcohol consumption; provision of knowledge on the harms associated with alcohol misuse and on the benefits of reducing its intake; motivational enhancement; analysis of high-risk situations for drinking and coping strategies; and the development of a personal plan to reduce consumption (Kaner 2018).

Motivational interviewing is defined as a brief - in its original format, usually consisting of one session lasting for about one hour - personalised, directive method of enhancing intrinsic motivation to change by exploring and resolving ambivalence focussing on the three key components of motivation: readiness, willingness and ability to change (Moyers 2009). Motivational enhancement therapy is a four-session adaptation of motivational interviewing that was developed within the framework of a multicentre trial for the treatment of alcohol abuse and dependence, which showed to be effective in dealing with substance misuse (Ismail 2010).

Several pharmacological treatments, such as acamprosate, nalmefene, naltrexone or disulfiram, have been approved by regulatory agencies for the treatment of alcohol use disorder with persistent symptoms (Kranzler 2018).

The specific efficacy and safety of the alcohol dependence treatments is beyond the scope of this systematic review. In this review, we focussed primarily on assessing the potential collateral effects of these interventions linked to a decrease in blood pressure.

Why it is important to do this review

The impact of both pharmacological and psychosocial interventions on treating alcohol dependence and withdrawal has been addressed in previous Cochrane systematic reviews and protocols. Systematic reviews published so far have focussed on assessing the impact of interventions to reduce alcohol consumption by decreasing the intake and by treating dependence in people with alcohol abuse or dependence, without analysing other health outcomes such as hypertension (Amato 2010; Fernández-Solà 2015; Ferri 2006; Foxcroft 2015; Foxcroft 2016; Gilligan 2016; Ipser 2015; Kaner 2018; Kazeem 2015; Lui 2008; McQueen 2009; Minozzi 2010; Pani 2010a; Pani 2010b; Rösner 2010; Smith 2009; Stade 2009; Vaz de Lima 2010; Wellman 2016).

Low levels of alcohol consumption, 10-20 g alcohol in men and 10 g in women per day, have been associated with benefits for cardiovascular health (Puddey 2006). More recent studies have found opposing associations between alcohol intake and different cardiovascular disease types (Ricci 2018). Nevertheless, given that the risk for hypertension increases linearly with alcohol consumption, limiting alcohol intake is recommended for both men and women (Taylor 2009) and, in hypertensive subjects, consumption above certain levels is considered unwise (Puddey 2006). A recent Cochrane review has been carried out to quantify the acute effects of different doses of alcohol over time on blood pressure and heart rate in adults (Tasnim 2020). The main conclusion was that high-dose alcohol (> 30 g of alcohol for men and > 20 g for women) shows a biphasic effect by decreasing blood pressure up to 12 hours after consumption and increasing it beyond that time. Heart rate was increased by high-dose alcohol at all times up to 24 hours (Tasnim 2020). Finally, some recommendations on hypertension management in healthy adults propose limiting alcohol consumption to no more than 14 standard drinks per week for men or 9 standard drinks per week for women (one standard drink is considered to be equivalent to 13.6 g or 17.2 mL of ethanol) (Hypertension Canada 2018).

A systematic review and meta-analysis by Roerecke 2017 showed that a reduction in alcohol intake is associated with lower blood pressure in a dose-dependent manner. There was no blood

pressure-lowering effect with alcohol intake below two drinks per day. Several differences can be found between the study by Roerecke 2017 and this review, which are mainly based on study outcomes and selection criteria. Our study aimed at analysing data on changes in overall mortality, cardiovascular mortality, serious adverse events, cardiovascular events and quality of life. Limited data related to behaviour or changes in lifestyle are included in the study by Roerecke 2017. Mortality data were not obtained from the selected studies for the systematic review and meta-analysis. Cardiovascular mortality was estimated based on an United Kingdom population with heavy alcohol use. This may be due to the limited trial duration (from one to four weeks). The inclusion criteria prespecified in our protocol set up a minimum duration of 12 weeks. Therefore, our approach is explicit with regard to hard outcomes, by assessing changes in blood pressure with an estimation of the potential clinical consequences.

Given that hypertension and excessive alcohol consumption are both highly prevalent worldwide, it is important to assess the blood pressure lowering effect of interventions to reduce alcohol intake in people with hypertension. This systematic review aims to examine all randomised controlled trials including people with hypertension which assess specifically the impact of interventions to reduce alcohol intake, either psychological, educational, or both, or pharmacological, on hypertension control.

OBJECTIVES

To assess the effect of any intervention to reduce alcohol intake in terms of blood pressure decrease in hypertensive people with alcohol consumption compared to a control intervention or no intervention at all. To determine additional effects related to mortality, major cardiovascular events, serious adverse events, or quality of life.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials of at least 12 weeks duration and that included 50 or more subjects per group to ensure a minimum statistical power, with quantitative measurement of alcohol consumption and/or biological measurement of the outcomes of interest.

Types of participants

Adults (16 years or older) with alcohol consumption and with blood pressure greater than 140/90 mmHg based on standard readings or those who were taking an antihypertensive drug, and SBP ≥ 130 or DBP≥ 80 mmHg in patients with diabetes.

Types of interventions

Any intervention in a healthcare or social care setting addressed to modify alcohol intake in people with hypertension:

1. Structured psychosocial interventions such as brief interventions by physician or other healthcare provider, motivational interviewing or motivational enhancement therapy.
2. Pharmacological interventions, such as benzodiazepines, acamprosate, disulfiram, naltrexone, or nalmefene.
3. Any other interventions, such as financial incentives.

Trials with the following comparison groups were considered eligible: usual practice or no formal intervention, a health intervention (i.e. on weight control or exercise promotion), any other structured psychological or pharmacological intervention or any other intervention to lower blood pressure.

Types of outcome measures

Primary outcomes

1. Overall mortality.
2. Cardiovascular mortality.
3. Serious adverse events. According to the International Conference on Harmonisation Guidelines (ICH 1995) that defines serious adverse events as any event that leads to death, that was life-threatening, required inpatient hospitalisation or prolongation of existing hospitalisation, resulted in persistent or significant disability, or is a congenital anomaly/birth defect.
4. Cardiovascular events: including myocardial infarction, stroke, sudden death, hospitalisation or death from congestive heart failure and other significant vascular events such as ruptured aneurysms (does not include angina, transient Ischaemic attacks, surgical or other procedures or accelerated hypertension).
5. Decrease in blood pressure.
6. Proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg.

Secondary outcomes

1. Decrease in alcohol intake defined as the difference between baseline and current consumption.
2. Proportion of subjects with lower-risk alcohol intake versus higher-risk and extreme drinkers at the end of the study. We defined several grades of alcohol risk: non-drinkers, drinkers at lower-risk levels (≤ 14 standard units per week), drinkers at increasing-risk levels (> 14 units to < 35 units per week for women and to < 50 units per week for men), drinkers at higher-risk levels (≥ 35 units for women and ≥ 50 units to < 75 units per week for men), extreme drinkers (≥ 75 units per week) (Burton 2016). Studies with other alcohol intake scales are also included.
3. Changes in quality of life according to validated scales.

Search methods for identification of studies

Electronic searches

The Cochrane Hypertension Information Specialist searched the following databases without language, publication year, or publication status restrictions:

- the Cochrane Hypertension Specialised Register via the Cochrane Register of Studies (CRS-Web) (searched 26 June 2020);
- the Cochrane Drugs & Alcohol Specialised Register via the Cochrane Register of Studies (CRS-Web) (searched 26 June 2020);
- the Cochrane Central Register of Controlled Trials (CENTRAL) via the Cochrane Register of Studies (CRS-Web) (searched 26 June 2020);

- MEDLINE Ovid (from 1946 onwards), MEDLINE Ovid Epub Ahead of Print, and MEDLINE Ovid In-Process & Other Non-Indexed Citations (searched 26 June 2020);
- Embase Ovid (from 1974 onwards) (searched 26 June 2020);
- ClinicalTrials.gov (www.clinicaltrials.gov) (searched 29 June 2020);
- World Health Organization International Clinical Trials Registry Platform (www.who.it.trialsearch) (searched 29 June 2020).

The Information Specialist modelled subject strategies for databases on the search strategy designed for MEDLINE. Where appropriate, they were combined with subject strategy adaptations of the highly sensitive search strategy designed by Cochrane for identifying randomised controlled (as described in the *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0, Box 6.4.c.(Higgins 2011)). We present search strategies for major databases in Appendix 1.

Searching other resources

- The Information Specialist searched the Hypertension Specialised Register segment (which includes searches of MEDLINE, Embase, and Epistemonikos for systematic reviews) to retrieve existing reviews relevant to this systematic review, so that we could scan their reference lists for additional trials. The Specialised Register also includes searches for controlled trials in the Allied and Complementary Medicine Database (AMED), CAB Abstracts & Global Health, CINAHL, ProQuest Dissertations & Theses and Web of Science.
- We checked the bibliographies of included studies and any relevant systematic reviews identified for further references to relevant trials.
- Where necessary, we contacted original authors for clarification and further data if trial reports were unclear.
- Individual patient data from included trials were obtained through the Biologic Specimen and Data Repository Information Coordinating Center of the National Institute of Health (https://biolincc.nhlbi.nih.gov/home/)

Data collection and analysis

Search results were independently assessed by review authors working in pairs. One review author (LCS) reviewed all results. We used Covidence (https://www.covidence.org/) for screening and classifying references.

Selection of studies

Six authors (MTA, NA, JE, JG, JRR and LCS) independently screened titles and abstracts yielded by the search to assess whether they met the criteria for inclusion. We obtained the full text of papers or trial reports that appeared relevant or for which more information was needed to determine eligibility. We provisionally included studies that were likely to include subgroups of participants that met our criteria, and contacted study authors to request individual patient data. If necessary, additional information from the trials' authors was sought. Reviewers were not blinded to the authors, institutions, or journals linked to the involved articles. Disagreements were resolved through discussion or by other authors, or both. The study selection process is described in the PRISMA flow diagram (Figure 1). The reasons for excluding trials are reported in Characteristics of excluded studies.

Figure 1. PRISMA flow diagram

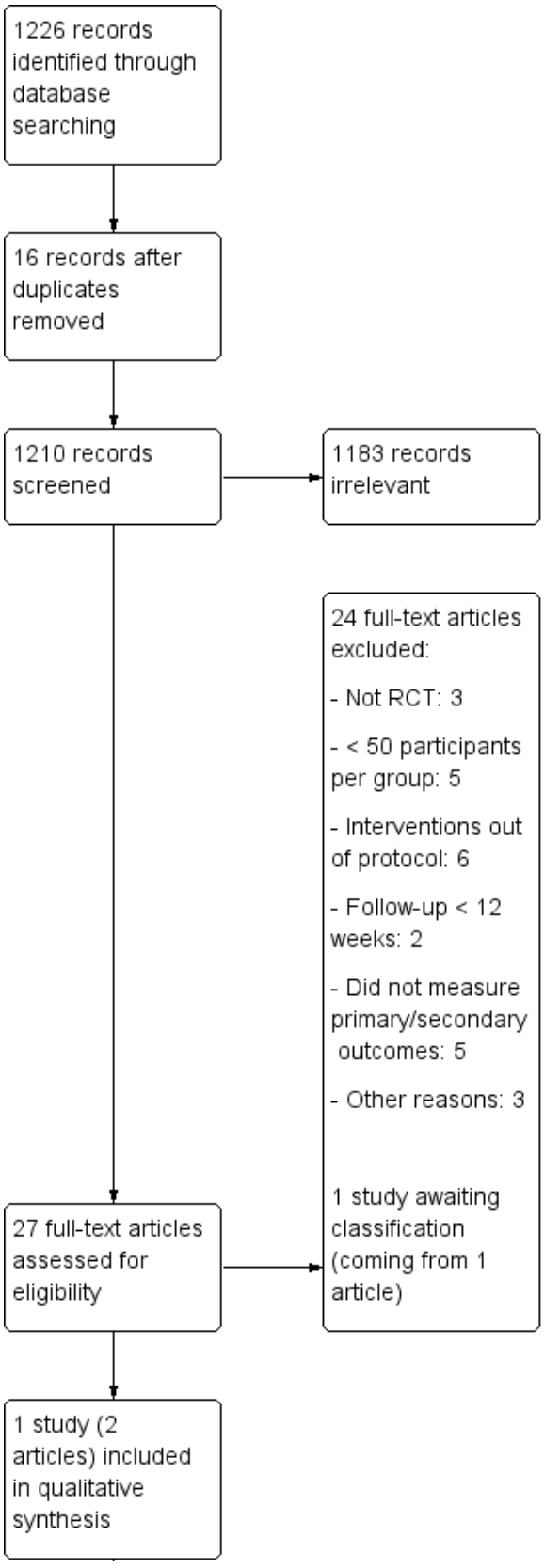
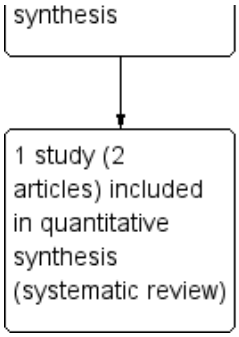


Figure 1. (Continued)



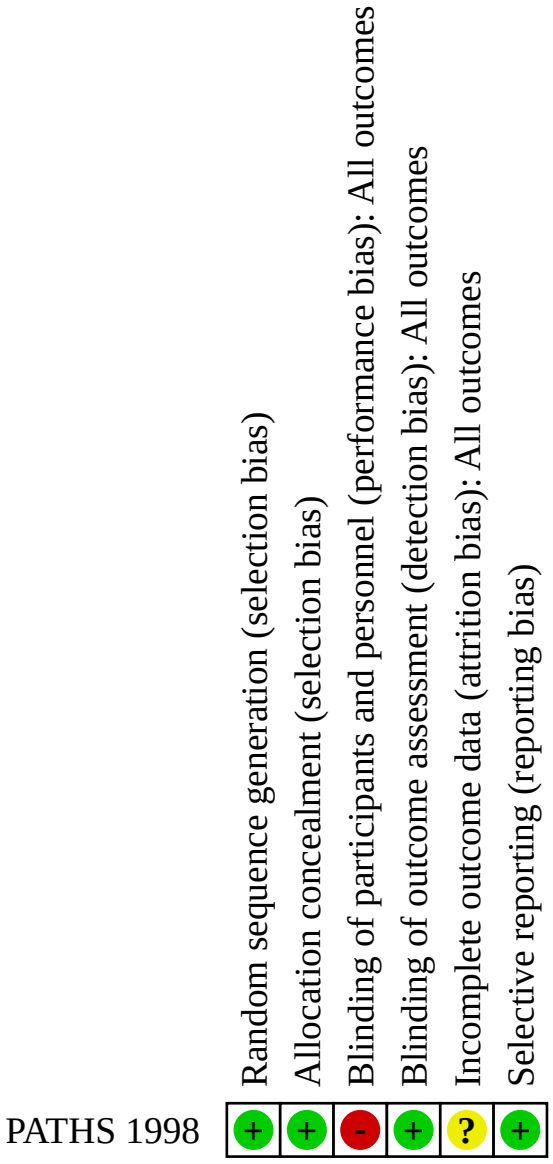
Data extraction and management

Two authors (MTA and LCS) independently extracted data for each trial. A data extraction form was used to collect information about the following topics: population, comparison of interventions, randomisation methods, blinding, outcome measures, follow-up duration, attrition and handling of missing data, and methods of analysis. This information is noted in the descriptions of included and excluded studies, where relevant, in the review. Data analysis was performed using Review Manager 5.3 software (RevMan 2014). Microsoft Access was used to manage individual patient data.

Assessment of risk of bias in included studies

The risk of bias in the included studies was assessed independently by two authors (MTA and LCS). Judgement was performed based on the domains and criteria of the Cochrane Collaboration's tool for assessing risk of bias (Higgins 2011). The following six domains were assessed: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), and selective reporting (reporting bias). For each domain, the following categories were used to assess the management of the risk of bias: 'Yes' (meaning low risk of bias), 'No' (high risk of bias) or 'Unclear'. Disagreements were resolved by discussion among the review authors and were arbitrated, if needed, by a third author. A summary of the 'Risk of bias' analysis is shown in Figure 2.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.



When information from the papers was insufficient, we contacted authors for clarification.

Measures of treatment effect

We analysed continuous data when means and standard deviations were available in the publications or, as it was the case for the only included study, were calculated from available individual patient data. We analysed the data by using mean differences (and their 95% confidence intervals [CI]) when outcomes were measured using the same scale. If different studies used different scales for the same outcome measure, we would have calculated the standardised mean difference (SMD) using Hedges (adjusted) g.

We assessed the effect measures for ordinal data as continuous data, using weighted mean difference, after ensuring that the different scales used in the trials pointed towards a single direction.

We analysed dichotomous outcomes by using the risk ratio (RR) with 95% confidence interval [CI] as effect size, which we calculated for each outcome.

Unit of analysis issues

We took into consideration whether individual participants had undergone multiple interventions at once. We performed the main analysis with studies that had a follow-up of six months or longer, until the end of each study. If the results were reported at multiple time points, we analysed each outcome, when possible, at each time point in a separate meta-analysis. Time points after the intervention were grouped as follows: three to six months, seven to 12 months, more than one year.

Dealing with missing data

We investigated and reported for each included study the reasons, numbers and characteristics of dropouts, exclusions from the analysis, or missing data.

The following strategies were used to deal with missing data:

1. contacting original investigators to request missing data;
2. assuming that these people had not experienced a change in their clinical outcomes variables; and
3. performing sensitivity analyses to assess how sensitive results were to changes in the assumptions made.

We addressed the potential impact of missing data on the findings of the review in the Discussion section.

We contacted study authors to obtain individual patient data.

Assessment of heterogeneity

We assessed the clinical heterogeneity of participants from the included studies by taking into account clinical features such as the degree of hypertension or alcohol intake levels. We examined the statistical heterogeneity in the included studies through the use of the Chi^2 test, where a low P value indicated heterogeneity of treatment effects. We also used the I^2 statistic for quantifying inconsistency and to determine the percentage of variability that was due to heterogeneity rather than sampling error or chance (Higgins 2011). We discussed the possible reasons for any heterogeneity and conducted sensitivity analyses accordingly, where data permitted.

Assessment of reporting biases

In order to investigate the likelihood of reporting biases, we planned to perform funnel plots (trial effect against standard error) if there were at least ten studies included in the meta-analysis for a particular outcome measure. That was not possible in this review.

Data synthesis

We planned to perform a meta-analysis if event rates or means and standard deviations were available or could be calculated and studies included similar interventions, methodology (measurements, time points, etc.), and outcome measurements. We planned to combine studies only if clinically similar and where the Chi^2 test or the I^2 statistic did not show large deviations (Chi^2<0.05 or I^2>60%) from homogeneity. We conducted all analyses with a random-effects model. We planned to undertake a separate meta-analysis, if data were available, for the following different groups: sex, age range (≥ 65 or < 65 years old), different levels of alcohol consumption (non-drinkers, lower-risk, increasing-risk, higher-risk and extreme drinkers) (Burton 2016), different levels of hypertension (grade 1, grade 2 and grade 3), or presence of concomitant cardiovascular disease.

In case a meta-analysis was inappropriate, we planned to provide a narrative description of the study results.

Subgroup analysis and investigation of heterogeneity

We planned to conduct further investigation of the causes of heterogeneity by using subgroup analyses of participants with moderate drinking versus heavy/harmful drinking levels of alcohol consumption, age, race and sex groups, participants with different levels of hypertension, or additional diagnoses.

Sensitivity analysis

We planned to conduct a sensitivity analysis to assess the robustness of the results, by removing studies with particular characteristics and re-analysing the remaining studies to determine whether the relevant factors affected the results. These analyses would have been aimed at examining the effects of the following:

1. Including only trials in which intention-to-treat analysis (all subjects randomised to treatment arms are included in the outcome analysis) was done (excluding per-protocol analysis trials).
2. Including only studies with low risk of bias.
3. Including only studies with low or unclear risk of bias.
4. Assuming that people with missing data did not experience changes in their clinical outcome variables.

Summary of findings and assessment of the certainty of the evidence

We summarised the review findings in the Summary of findings 1 using the GRADE approach. We presented the effect estimates and the certainty of the body of evidence associated with the primary outcomes of the Cochrane review (Schünemann 2013). We used the GRADE system to prioritise the importance of the variables included in the Summary of findings 1. The results of the prioritisation showed that all variables were considered key or important for the review process. We pre-selected the following outcomes in order of scoring according to the GRADE scale: 'overall mortality', 'cardiovascular events', 'decreased blood pressure', 'cardiovascular mortality', 'serious adverse events', 'changes in quality of life' and 'decreased alcohol intake'. We considered that the information provided by the variables 'proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg' and 'proportion of subjects with lower-risk alcohol intake vs higher-risk and extreme drinkers at the end of the study' were included to some extent in the previous seven outcomes. We entered data into ReviewManager 5 (RevMan 2014) and generated the Summary of findings 1 using GRADEpro software (GRADEpro).

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

Results of the search

The search identified 1226 records. After removal of 16 duplicates and subsequent manual screening of 1210 records by title and

abstract, 1183 records were excluded and 27 records remained. We analysed the full text of these 27 articles, excluding 19 for different reasons in a first stage. We contacted the authors responsible for the remaining seven studies (eight articles), asking them for additional information. Based on the obtained information, five of these studies were also subsequently excluded for different reasons and one study remained as awaiting classification. As a result, only one study meeting inclusion criteria was finally identified (Figure 1).

Included studies

We included one trial (PATHS 1998), where trial participants were randomised to either a cognitive-behavioural intervention to reduce alcohol intake or no intervention.

Methods

The only included trial (PATHS 1998) was a randomised controlled trial. The follow-up duration was 24 months.

Participants

A total of 641 participants were randomised in this study (PATHS 1998) to a cognitive-behavioural (n = 320) or a control intervention (n = 321) for up to 24 months. The trial was conducted in the US between 1990 and 1995. All participants were outpatient veterans with an average intake of three or more alcoholic drinks per day in the six months before entry and with diastolic blood pressure 80 to 99 mmHg. Exclusion criteria included alcohol or psychoactive substance dependence, alcohol-attributed medical complications, major psychiatric diagnoses, cardiovascular end-organ damage, severe or secondary hypertension, malignancies, seizure disorders, coagulopathies or current pregnancy. PATHS 1998 was promoted by the National Heart, Lung and Blood Institute, the National Institute on Alcohol Abuse and Alcoholism, along with the Veterans Affairs Cooperative Studies Program. Participants averaged 57 years of age, body mass index (BMI) was 28, 75% were white and only five out of 641 were women. Mean basal blood pressure averaged 140/86 mmHg for the whole recruited population and the mean alcohol intake was 6.0 drinks per day in the six months before randomisation. Average duration of drinking was 37 years. Nevertheless, according to our protocol criteria, only the subgroup of 269 hypertensive participants (cognitive-behavioural arm, 137; control, 132) was included in the review (42% of the total PATHS 1998 study participants). More precisely, the subgroup of interest was constituted by people with untreated DBP of 90 to 99 mmHg, or DBP 80 to 99 mmHg if recently receiving treatment for hypertension. Participants' baseline characteristics for this subgroup are shown in Table 1. Similarly to the data coming from the full study population, the vast majority were men, 59 years of age, 75% white, 146/89 mmHg for mean blood pressure, 5.8 drinks per day in prior six months to randomisation and 38 years as average duration of drinking.

Interventions

Participants were randomly assigned to a cognitive-behavioural alcohol reduction intervention programme or a control observation group. Participants randomised to the alcohol intervention group received intervention from interventionists (social workers or master level psychologists with some clinical experience). The intervention consisted of gradually decreasing visits that permitted participants to generate new cognitive and/or behavioural approaches to gain control over their own lives and to increase their self-confidence in mastering situation-specific behaviours. The interventionist was active in the treatment phase but served as an advisor to the participant. A self-help manual and daily drinking records were used to assist the participant throughout the intervention. The goal of the intervention was to reduce alcohol intake to no more than 14 drinks per week and at least 50% less than the participants baseline level.

Control participants received the same assessment procedures as the intervention group. They were informed that they had been assigned to the group which did not receive training to reduce alcohol intake and were not advised to change their drinking. Participants from this group did not have regular contact with the interventionist after randomisation.

Outcomes

The primary outcomes in PATHS 1998 were to ascertain changes in blood pressure and to analyse whether the reduction in alcohol intake could be achieved in six months and maintained for two years. Secondary outcomes aimed at evaluating if a dose-response relationship existed between changes in alcohol intake and changes in blood pressure, echocardiographic left ventricular mass and biochemical markers, and also determining differences between groups in the requirement of hypertension drug treatments.

Excluded studies

Following full text analysis, we excluded 24 studies for not meeting the inclusion criteria (Figure 1). The reasons for exclusion were: five did not measure primary/secondary outcomes, three were not randomised clinical trials (RCTs), five had fewer than 50 participants per group, six assessed interventions not included in our protocol, two had follow-up for less than 12 weeks and three had other reasons.

Studies awaiting classification

One study is awaiting classification (OSAKE 2015). This study is registered at the UMIN-CTR Clinical Trial Register as "Main results already published". We have requested additional data from the study authors but had not received any information before publication of this review.

Risk of bias in included studies

The summary of the 'Risk of bias' assessment of the one included study is shown in Figure 2. The assessment of risk of bias was based on both published and unpublished data.

Allocation

In PATHS 1998, treatment assignments were randomly determined at the start of the study using a fixed randomisation scheme with uniform allocation, variable block size and stratification by clinic. Accordingly, we judged PATHS 1998 as having low risk of bias for the 'random sequence generation' and 'allocation concealment' domains.

Blinding

The behavioural nature of the alcohol intervention necessitated an unmasked study design for the participant and the interventionist in the PATHS 1998 study. Furthermore, participants randomised to the control group were scheduled for data collection visits

only. Therefore, despite the efforts to maintain blindness to blood pressure and laboratory data among participants and interventionists, this trial was assessed as having high risk of performance bias.

At the same time, the authors declared that particular care was taken to maintain blindness to intervention assignments among data collectors, which led us to judge the trial as having low risk of detection bias for outcome assessment.

Incomplete outcome data

Treatment blood pressure, as defined in PATHS 1998, was available for 622 participants (97% of those randomised in the full study). It could not be determined for 19 participants who either failed to return for any follow-up visits or were started on a regimen of antihypertensive medication before their first follow-up visit. Therefore, there is no information about the intervention arm in which these 19 participants were placed, or any clear dropouts algorithm published. All these aspects were considered in the determination of the study as having uncertain risk of attrition bias.

Selective reporting

The PATHS protocol was carefully checked and all expected outcomes were accessible according to the individual patient data in PATHS 1998.

Other potential sources of bias

No other sources of bias were identified.

Effects of interventions

See: **Summary of findings 1** Summary of findings

See: Summary of findings 1 Cognitive-behavioural intervention compared to control intervention for mortality and morbidity.

Cognitive-behavioural alcohol reduction versus control observation intervention

Outcomes were based on individual patient data from the only randomised controlled trial (PATHS 1998) that met inclusion criteria. Data were obtained from published and unpublished sources.

Primary outcomes

Overall mortality

There was no difference in overall mortality between the cognitive-behavioural intervention and the control group (3 versus 4 participants, RR 0.72, 95% CI 0.16 to 3.17, P = 0.67; 1 study). There were a total of three deaths (of 137 participants) in the cognitive-behavioural intervention group and four (of 132 participants) in the control intervention group (Analysis 1.5). Certainty of the evidence was low.

Cardiovascular mortality

The PATHS 1998 did not provide information regarding cardiovascular mortality.

Serious adverse events

The included study PATHS 1998 did not provide data for analysis of serious adverse events.

Cardiovascular events

There was no difference in cardiovascular events between the cognitive-behavioural intervention and the control group (10 versus 12 participants, RR 0.80, 95% CI 0.36 to 1.79, P = 0.59; 1 study; Analysis 1.4). There were 10 cardiovascular events (among 137 participants) in the cognitive-behavioural intervention group and 12 (among 132 participants) in the control group. Analysis 1.4. Certainty of the evidence was very low.

Decrease in blood pressure

Decrease in systolic blood pressure

There was no difference in systolic blood pressure reduction between the cognitive-behavioural intervention group and the control group (6.13 ± 16.14 versus 7.05 ± 13.86 mmHg, mean difference (MD) -0.92 mmHg, 95% confidence interval (CI) -5.66 to 3.82 mmHg, P =0.70; 1 study; Analysis 1.1). Certainty of the evidence was very low.

Decrease in diastolic blood pressure

There was no difference in diastolic blood pressure reduction between the cognitive-behavioural intervention group and the control group (7.05 ± 8.91 versus 6.07 ± 7.99 mmHg, MD 0.98 mmHg, 95% CI -1.69 to 3.65 mmHg, P = 0.47; 1 study; Analysis 1.2). Certainty of the evidence was low.

Proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg

There was no difference in the proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg between the cognitive-behavioural intervention group and the control group (45 out of 80 participants versus 34 out of 73 participants, risk ratio (RR) 1.21 mmHg, 95% CI 0.88 to 1.65, P = 0.24; 1 study, Analysis 1.3). Certainty of the evidence was very low.

Secondary outcomes

Decrease in alcohol intake

The alcohol intake at 24 months was significantly reduced in the cognitive-behavioural intervention compared with the control group (256.43 ± 300.28 versus 65.10 ± 362.11 g, MD 191.33 g, 95% CI 85.36 to 297.30 g, P = 0.0004; 1 study; Analysis 1.6).

Proportion of subjects with lower-risk alcohol intake vs higher-risk and extreme drinkers at the end of the study

There was no difference between the cognitive-behavioural intervention group and the control group either in the proportion of lower-risk drinkers at 24 months (30 out of 80 participants versus 21 out of 73 participants, RR 1.30, 95% CI 0.82 to 2.06, P = 0.26; Analysis 1.7) or in the proportion of higher-risk and extreme drinkers (2 out of 80 participants versus 7 out of 73 participants, RR 0.26, 95% CI 0.06 to 1.22, P = 0.09; Analysis 1.8). Certainty of the evidence was very low.

Changes in quality of life according to validated scales

The study PATHS 1998 did not provide information regarding quality of life of participants.

DISCUSSION

Excessive drinking has been reported as a significant cause of mortality, morbidity, and social problems (Kaner 2018, Rehm 2017). Specifically, several studies have assessed the

relationship between alcohol intake and high blood pressure (Cushman 2001, Puddey 2006, Sesso 2008, Wellman 2016), which may have important clinical consequences. For example, the adverse impact of alcohol consumption on blood pressure might increase the risk of haemorrhagic stroke and outweigh potential beneficial associations of light to moderate drinking with a reduction in ischaemic stroke (Larsson 2016). On the other hand, some guidelines on hypertension management make specific recommendations on limits to alcohol consumption (Hypertension Canada 2018). Therefore, it is considered of great interest to assess the effects of interventions to reduce alcohol intake in terms of blood pressure changes in hypertensive people.

This Cochrane systematic review explored all current evidence from RCTs and evaluated important variables coming from either an active intervention to modify participants' alcohol intake or a control intervention.

We were able to include only one RCT (PATHS 1998) with a total of 269 hypertensive participants (42% of total participants in the trial), with a maximum follow-up of two years. Individual patient data were available for the included study.

Summary of main results

PATHS 1998 was the only study that met the predefined inclusion criteria. Evidence from this trial did not find benefits for overall mortality (RR 0.72, 95% CI 0.16 to 3.17) or total cardiovascular events (RR 0.80, 95% CI 0.36 to 1.79) between the cognitive-behavioural and the control interventions. With respect to cardiovascular mortality, no events were registered for this outcome. We detected no differences in systolic (MD -0.92, 95% CI -5.66 to 3.82) and diastolic (MD 0.98, 95% CI -1.69 to 3.65) blood pressure decreases. No differences were also found in the proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg (RR 1.21, 95% CI 0.88 to 1.65).

Among the secondary outcomes, a significant effect was identified in favour of the cognitive-behavioural intervention on the decrease alcohol intake (MD 191.33, 95% CI 85.36 to 297.30). However, there was no difference between the cognitive-behavioural and the control groups either in the proportion of lower-risk drinkers at 24 months (RR 1.30, 95% CI 0.82 to 2.06), in the proportion of higher-risk and extreme drinkers (RR 0.26, 95% CI 0.06 to 1.22) or both ((RR 1.04, 95% CI 0.68 to 1.60). The included study did not provide data for analysis of serious adverse events and quality of life of participants.

Taking into account that available information was very limited coming from only one study, no meta-analysis was carried out. While the protocol considered several sensitivity analyses to be explored (intention-to-treat analysis, risk of bias, missing data), final data were insufficient to achieve meaningful conclusions.

Overall completeness and applicability of evidence

Several studies have assessed specifically the relationship between alcohol intake and hypertension, but data from randomised controlled trials are clearly insufficient. This review included only one study (PATHS 1998) meeting inclusion criteria according to the protocol. As a result, these results cannot be considered as conclusive. One trial designed to examine explicitly the effects of an alcohol reduction programme on blood pressure (OSAKE 2015), which is currently awaiting classification in this review, is expected to add some interesting input to this review in the near future.

As for the applicability of the available evidence, the full body of data comes from a single study. This fact implies that a higher and direct degree of applicability for a particular setting will be achieved when considering the specific intervention (cognitive-behavioural programme) and the population chosen (ambulatory adults with mild high blood pressure, nondependent but moderate to heavy drinkers) assessed in PATHS 1998.

Quality of the evidence

We downgraded the certainty of the evidence for overall mortality to low due to serious imprecision (95% CI was wider than the 10% minimal important difference) (NICE 2016) and data available from a subgroup of only one study. The certainty of the evidence was considered very low for cardiovascular events, decrease of SBP and the proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg. In these cases, downgrading was decided for serious imprecision (too wide confidence intervals), data available from a subgroup of only one study and for high risk of performance bias. Concerning this latter point, the behavioural nature of the alcohol intervention required an unmasked study design for the participants and the interventionist which, in our opinion, might have affected the outcome results. Finally, the certainty of the evidence for decrease of DBP was deemed low. In this particular case, performance bias and limited data from only a subgroup of participants were present but observed imprecision was not influential according to the 5 mmHg minimal important difference reported by published guidelines (NICE 2016). Importantly, no evidence on serious adverse events or quality of life was detected.

Potential biases in the review process

Because of study requirements, PATHS 1998 was not blinded to participants or interventionists. However, specific care was taken to maintain blinding to intervention assignments among data collectors. Consequently, we considered the study had a high risk of performance bias for the majority of primary outcomes (excluding overall mortality), but low risk of detection bias for all of them. Treatment was available for 622 participants (97% of those randomised) but it could not be determined for 19 participants who either failed to return for any follow-up visits or were started on a regimen of antihypertensive medication before their first follow-up visit. Also, no clear dropout algorithm was published for this trial, leading to concerns related to attrition bias.

Another source of potential bias is related to the fact that all included subjects came from a subgroup study, which was a preplanned hypertensive stratum within the original study. However, it must be stressed, in this regard, that individual patient data were provided for the whole subgroup.

We had access only to a small sample size of participants meeting the criteria (N = 291). That is why our findings are not very robust and should not be considered as conclusive.

Agreements and disagreements with other studies or reviews

This systematic review shows that a decrease in alcohol intake was achieved in one study comparing a healthcare or social care intervention to modify alcohol intake versus a control intervention,

but no differences in systolic or diastolic blood pressure could be detected. Similarly, no differences were found between both arms in terms of overall mortality, cardiovascular mortality, or cardiovascular events.

Alcohol intake management in a hypertensive context is a matter of high concern, which has been explicitly tackled by some observational studies (Larsson 2016) and also mentioned in hypertension guidelines (Hypertension Canada 2018). In this latter case, alcohol consumption has been recommended not to exceed 14 or nine standard drinks per week for men or women, respectively, in order to avoid its harmful effects.

Nevertheless, after a thorough bibliographic search, comparable evidence to our specific question has proved to be very scarce. Recently, a systematic review has been published assessing the effect of a reduction in alcohol consumption on blood pressure (Roerecke 2017). The study was funded by the US National Institute on Alcohol Abuse and Alcoholism (NIAAA) and included 36 trials (N = 2865), most of them (86%) men. According to its findings, a dose-response association was identified as much in the overall population as in people with hypertension, the higher the alcohol consumption at baseline, the greater the reduction in alcohol consumption and in the blood pressure levels (Rehm 2017). A significant decrease in blood pressure was not found among those participants with two or fewer drinks per day. Conversely, people who drank more than two drinks a day experienced a statistically significant reduction in blood pressure as a result of the decrease in alcohol intake. However, many important differences linked to design decisions are present between Roerecke 2017 and our protocol, which accounts for the huge difference in the number of included studies. As mentioned in the 'Why it is important to do this review' section, our selection criteria and outcomes approach goes beyond surrogate variables (e.g. blood pressure differences) and focusses on clinically meaningful outcomes.

For example, in Roerecke 2017, 28 out of 36 included studies were shorter than our 12-week threshold, which makes it hard to explore potential major consequences caused by blood pressure changes. Another two out of 36 studies included very small sample sizes, with fewer than 50 participants per arm, and four out of 36 included studies were accepted despite differences in their basal design (1 non-RCT (Baros 2008), 1 study randomising physician work sites instead of participants (Lang 1995), and two RCTs comparing different drinks instead of strategies for alcohol intake reduction (Gepner 2015; Gepner 2016). PATHS 1998 and Wallace 1988 were also included by Roerecke 2017. We excluded Wallace 1988 because no data on the number of hypertensive participants was published and, according to the author, the dataset for the trial is no longer available. Only PATHS 1998 met our inclusion criteria.

As for other relevant methodological aspects, our systematic review differs from Roerecke 2017 in making efforts to contact trial authors when necessary, using longer estimate measurements (24 months versus three months) and using individual patient data for the whole study. Furthermore, our project was only focussed on hypertensive subjects, whereas normotensives were also admitted in Roerecke 2017. Perhaps the most important difference between these reviews concerns the interventions assessed. While our study compared alcohol intake reduction strategies in terms of their effect on blood pressure, Roerecke 2017 did not compare alcohol reduction strategies among themselves, with each study arm considered independently to calculate blood pressure changes before and after the intervention.

Taking all the previous aspects into account, the main results found in both reviews might in the end not be that contradictory. Roerecke 2017 concluded that, in general, a reduction of alcohol intake was likely to reduce blood pressure in a general population in a dose-dependent manner with a possible threshold effect. On the other hand, our study has not found differences in blood pressure decreases when active and control strategies for reducing alcohol intake were compared in a hypertensive population.

AUTHORS' CONCLUSIONS

Implications for practice

According to a very limited body of evidence of low to very low-certainty, although a greater reduction on alcohol intake was seen with the active intervention, we found no difference in systolic or diastolic blood pressures between active and control interventions aimed at reducing alcohol intake in hypertensive adults. Similarly, we found no difference in overall mortality, cardiovascular mortality and cardiovascular events. No data on serious adverse events or quality of life were available for assessment.

Implications for research

There is an urgent need for adequate long-term randomised controlled trials comparing the impact of alcohol intake reduction strategies on blood pressure and clinically relevant outcomes.

It is important for future studies to report on clinically relevant outcomes, including serious adverse events and quality of life. Wide access to clinical study reports, protocols and individual patient data will improve the quality of systematic reviews. Authors and public or private institutions are kindly called to collaborate sharing the results of their studies for the benefit of patients.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

PATHS 1998

Study characteristics	
Methods	Parallel group randomised trial Blinding: single-blind (outcome assessor blinded) Ambulatory settings in the USA Study dates: 1990 to 1995. Participants recruited from April 1990 to June 1993 Participants were followed for up to 2 years.
Participants	Inclusion criteria: army veterans; aged 21 to 79 years; with an average intake of 3 or more alcoholic drinks per day but not alcohol dependent in the 6 months before entry; and with diastolic blood pressure 80 to 99 mmHg Exclusion criteria: alcohol or psychoactive substance dependence, direct alcohol-attributed medical complications, major psychiatric diagnoses, cardiovascular diseases, malignancies, seizure disorders, coagulopathies, blood pressure out of range or current pregnancy 636 men and 5 women; 75% white; mean age 57 years; average body mass index 28; mean basal blood pressure: 140/86 mmHg For more detailed data on baseline characteristics of people with hypertension, see Table 1.
Interventions	- Cognitive-behavioural intervention (320 participants, 137 hypertensive). 6 individual sessions during 3 months and a minimum of 3 sessions at monthly intervals for the remainder of the 6-month treatment phase. Sessions included psychodynamic and interpersonal components and encouraged variation in the application of the model to meet an individual participant's needs. The maintenance phase lasted up to 18 months and consisted of a minimum of 6 visits at 1- to 3-month intervals. See Note 1 below. - Control intervention (321 participants, 132 hypertensive). Participants were scheduled for data collection visits only.
Outcomes	Primary Outcome: 1. Changes in systolic and diastolic blood pressure from baseline to the 6-month visit Secondary outcomes:

PATHS 1998 *(Continued)*

	1. Self-reported alcohol intake 2. Biochemical markers of alcohol intake 3. Echocardiographic left ventricular mass changes 4. Weight 5. Urinary electrolytes 6. Diet 7. Physical activity
Funding	The National Heart, Lung and Blood Institute, the National Institute on Alcohol Abuse and Alcoholism, along with the Veterans Affairs Cooperative Studies Program
Declarations of interest	There was no information on potential conflict of interest of authors.
Notes	1. The intervention was administered by women from diverse disciplines (nursing, psychology, and social work) and with diverse educational and career histories, who were centrally trained in special intervention techniques. 2. All statistical analysis presented in this review was based on individual patient data that met the inclusion criteria. Data were obtained from published and unpublished sources.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"A participant who met the inclusion criteria was randomised to an intervention to reduce alcohol intake or to a control condition. An eligible participant was enrolled in the study by a telephone call to the coordinating center. Treatment assignments had been randomly determined at the start of the study using a fixed randomisation scheme with uniform allocation, variable block size, and stratification by clinic. The study interventionist was notified by mail of the participant's treatment group assignment" (PATHS 1998, page 1198).
Allocation concealment (selection bias)	Low risk	"A participant who met the inclusion criteria was randomised to an intervention to reduce alcohol intake or to a control condition. An eligible participant was enrolled in the study by a telephone call to the coordinating center. Treatment assignments had been randomly determined at the start of the study using a fixed randomisation scheme with uniform allocation, variable block size, and stratification by clinic. The study interventionist was notified by mail of the participant's treatment group assignment" (PATHS 1998, page 1198).
Blinding of participants and personnel (performance bias) All outcomes	High risk	"The behavioral nature of the alcohol intervention necessitated an unmasked study design for the participant and the interventionist. Participants randomised to the control group were scheduled for data collection visits only" (PATHS 1998, page 1198).
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"Particular care was taken to maintain blindness to intervention assignments among clinic personnel involved in collecting the primary study data common to both groups (data collectors). Data collection took place in the same location for both randomisation groups" (PATHS 1998, page 1198).
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	"Treatment BP, as defined previously, was available for 622 participants (97% of those randomised); it could not be determined for 19 participants who either failed to return for any follow-up visits or were started on a regimen of antihypertensive medication before their first follow-up visit" (PATHS 1998, page

PATHS 1998 *(Continued)*

		1202). There was no information about in which intervention arm these 19 participants were placed, nor any clear dropout algorithm published.
Selective reporting (reporting bias)	Low risk	Cushman 1994 (PATHS protocol) has been checked and all expected outcomes were accessible through the study's individual patient data. Serious adverse events were defined in 1995 at the International Conference on Harmonisation (ICH) Guidelines. As the present study protocol was approved in 1994, reporting on this outcome has been considered as not mandatory.

BP: Blood pressure
USA: United States of America

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Avram 2009	Study duration < 12 weeks
Baros 2008	No available information on primary outcomes
BHAIT 2015	Surgeries (not individuals) were randomised and the trial was stopped early and closed down due to lack of funding.
Bjorkqvist 1975	Intervention assessed as not meeting protocol criteria
Bulpitt 1999	Not a randomised trial
Burke 2006	Intervention assessed as not meeting protocol criteria
Chang 2011	The study did not estimate any primary outcome stated in the protocol.
Cicolini 2014	Intervention assessed as not meeting protocol criteria
COMBINE 2006	The study did not report data on number of hypertensive participants.
Coulton 2008	The study did not estimate any primary outcome stated in the protocol.
De Bejczy 2014	The study did not estimate any primary outcome stated in the protocol.
Dennison 2007	Intervention assessed as not meeting protocol criteria.
ETOH-AF 2016	The study included fewer than 50 hypertensive participants per group.
Fleming 1999	The study did not estimate any primary outcome stated in the protocol.
Fleming 2004	The study included fewer than 50 hypertensive participants per group.
Heirich 2000	Intervention assessed as not meeting protocol criteria. Protocol violations suspected with no clarification from the study authors
Lang 1995	Worksites as the unit of randomisation. Initial GGT values were obtained for only 43 subjects in the control group

Study	Reason for exclusion
Rose 2008	Worksites as the unit of randomisation. The control group also received the intervention to some extent and outcomes of interest (blood pressure) were measured post hoc.
Soyka 2008	According to information provided by the authors, the study included fewer than 50 hypertensive participants per group.
Ueshima 1989	Not a randomised trial
Ueshima 1993	The study included fewer than 50 subjects per group and the crossover design led to a study duration < 12 weeks.
Volicer 1982	Not a randomised trial
Wallace 1988	According to the author, the dataset for the trial is no longer available.
Wilson 2014	Worksites as the unit of randomisation. The Hypertension trial included fewer than 50 subjects per group (n = 48 received leaflet; n = 35 received leaflet + brief intervention).

GGT: Gamma-glutamyl transferase

Characteristics of studies awaiting classification *[ordered by study ID]*

OSAKE 2015

Methods	Randomised controlled trial. Not blinded
Participants	Male participants between 20 and 75 years of age Key inclusion criteria: 1) Essential hypertensive patients 2) The mean home morning blood pressure for five consecutive days is more than 135/85 mmHg (includes the patients taking medication for hypertension) 3) Patients with alcohol drinking habits of more than adequate amounts Key exclusion criteria: 1) Patients with severe hypertension (home morning blood pressure more than 175/105 mmHg) 2) Alcoholic patients to be treated at the special hospital
Interventions	• Education programme for alcohol reduction by nurses • No education programme for alcohol reduction by nurses
Outcomes	Primary outcome: Morning blood pressure (measured at home) Secondary outcomes: 1) Evening blood pressure (measured at home) 2) Blood pressure (measured in the office) 3) Amount of alcohol consumption 4) Liver function (GOT, GPT, GGT), lipid profiles (TC, TG, HDL, LDL), FBS, HbA1c, UA 5) BMI, abdominal circumference 6) Amount of salt intake
Notes	Sponsor: Department of Health Promotion Science, Division of Health Sciences, Osaka University Graduate School of Medicine

OSAKE 2015 *(Continued)*

Funding source: Japanese Heart Foundation

FBS: Fasting blood sugar
GGT: Gamma-glutamyl transferase
GOT: Glutamic oxaloacetic transaminase
GPT: Glutamic pyruvate transaminase
HbA1c: Glycated haemoglobin
HDL: High-density lipoprotein
LDL: Low-density lipoprotein
TC: Total cholesterol
TG: Triglycerides
UA: Uric acid

DATA AND ANALYSES

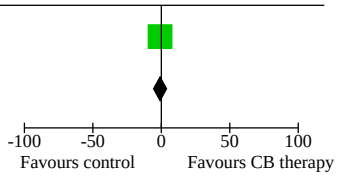
Comparison 1. Intervention on reducing alcohol intake versus control for controlling hypertension

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Decrease in systolic blood pressure	1	154	Mean Difference (IV, Fixed, 95% CI)	-0.92 [-5.66, 3.82]
1.2 Decrease of diastolic blood pressure	1	154	Mean Difference (IV, Fixed, 95% CI)	0.98 [-1.69, 3.65]
1.3 Proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg	1	153	Risk Ratio (M-H, Fixed, 95% CI)	1.21 [0.88, 1.65]
1.4 Cardiovascular events	1	269	Risk Ratio (M-H, Fixed, 95% CI)	0.80 [0.36, 1.79]
1.5 Overall mortality	1	269	Risk Ratio (M-H, Fixed, 95% CI)	0.72 [0.16, 3.17]
1.6 Decreased alcohol intake	1	153	Mean Difference (IV, Fixed, 95% CI)	191.33 [85.36, 297.30]
1.7 Proportion of subjects with lower-risk alcohol intake	1	153	Risk Ratio (M-H, Fixed, 95% CI)	1.30 [0.82, 2.06]
1.8 Proportion of subjects with higher-risk and extreme drinkers	1	153	Risk Ratio (M-H, Fixed, 95% CI)	0.26 [0.06, 1.22]

Analysis 1.1. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 1: Decrease in systolic blood pressure

Study or Subgroup	Intervention Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
PATHS 1998	6.13	16.14	81	7.05	13.86	73	100.0%	-0.92 [-5.66 , 3.82]
Total (95% CI)			**81**			**73**	**100.0%**	**-0.92 [-5.66 , 3.82]**

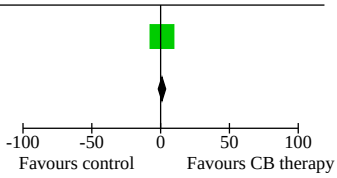
Heterogeneity: Not applicable
Test for overall effect: Z = 0.38 (P = 0.70)
Test for subgroup differences: Not applicable



Analysis 1.2. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 2: Decrease of diastolic blood pressure

Study or Subgroup	Intervention Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
PATHS 1998	7.05	8.91	81	6.07	7.99	73	100.0%	0.98 [-1.69 , 3.65]
Total (95% CI)			**81**			**73**	**100.0%**	**0.98 [-1.69 , 3.65]**

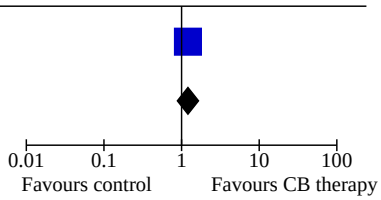
Heterogeneity: Not applicable
Test for overall effect: Z = 0.72 (P = 0.47)
Test for subgroup differences: Not applicable



Analysis 1.3. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 3: Proportion of subjects with SBP < 140 mmHg and DBP < 90 mmHg

Study or Subgroup	Intervention Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
PATHS 1998	45	80	34	73	100.0%	1.21 [0.88 , 1.65]
Total (95% CI)		**80**		**73**	**100.0%**	**1.21 [0.88 , 1.65]**
Total events:	45		34			

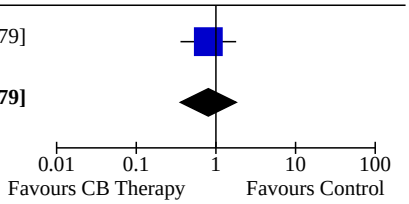
Heterogeneity: Not applicable
Test for overall effect: Z = 1.18 (P = 0.24)
Test for subgroup differences: Not applicable



Analysis 1.4. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 4: Cardiovascular events

Study or Subgroup	Experimental Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
PATHS 1998	10	137	12	132	100.0%	0.80 [0.36 , 1.79]
Total (95% CI)		**137**		**132**	**100.0%**	**0.80 [0.36 , 1.79]**
Total events:	10		12			

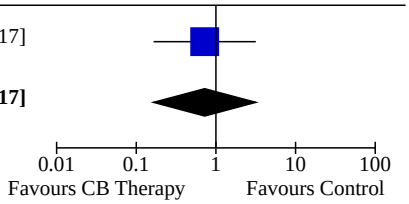
Heterogeneity: Not applicable
Test for overall effect: Z = 0.53 (P = 0.59)
Test for subgroup differences: Not applicable



Analysis 1.5. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 5: Overall mortality

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
PATHS 1998	3	137	4	132	100.0%	0.72 [0.16 , 3.17]
Total (95% CI)		**137**		**132**	**100.0%**	**0.72 [0.16 , 3.17]**
Total events:	3		4			

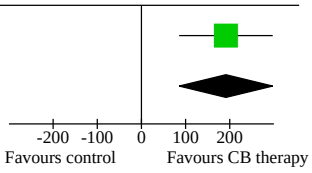
Heterogeneity: Not applicable
Test for overall effect: Z = 0.43 (P = 0.67)
Test for subgroup differences: Not applicable



Analysis 1.6. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 6: Decreased alcohol intake

Study or Subgroup	Intervention Mean	Intervention SD	Intervention Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
PATHS 1998	256.43	300.28	80	65.1	362.11	73	100.0%	191.33 [85.36 , 297.30]
Total (95% CI)			**80**			**73**	**100.0%**	**191.33 [85.36 , 297.30]**

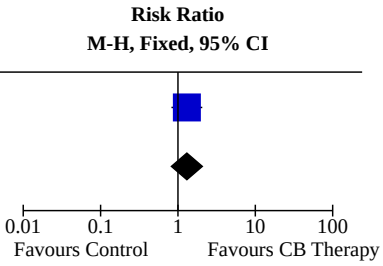
Heterogeneity: Not applicable
Test for overall effect: Z = 3.54 (P = 0.0004)
Test for subgroup differences: Not applicable



Analysis 1.7. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 7: Proportion of subjects with lower-risk alcohol intake

Study or Subgroup	Intervention Events	Intervention Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
PATHS 1998	30	80	21	73	100.0%	1.30 [0.82 , 2.06]
Total (95% CI)		**80**		**73**	**100.0%**	**1.30 [0.82 , 2.06]**
Total events:	30		21			

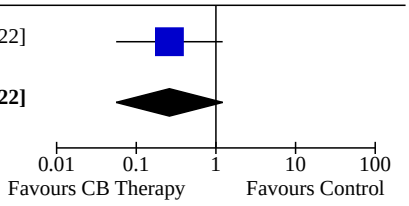
Heterogeneity: Not applicable
Test for overall effect: Z = 1.13 (P = 0.26)
Test for subgroup differences: Not applicable



Analysis 1.8. Comparison 1: Intervention on reducing alcohol intake versus control for controlling hypertension, Outcome 8: Proportion of subjects with higher-risk and extreme drinkers

Study or Subgroup	Intervention Events	Intervention Total	Control Events	Control Total	Weight	Risk Ratio M-H, Fixed, 95% CI
PATHS 1998	2	80	7	73	100.0%	0.26 [0.06 , 1.22]
Total (95% CI)		**80**		**73**	**100.0%**	**0.26 [0.06 , 1.22]**
Total events:	2		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.71 (P = 0.09)
Test for subgroup differences: Not applicable



ADDITIONAL TABLES

Table 1. Baseline characteristics of included study participants

Mean (± SD) unless otherwise stated	Intervention group	Control group
Number of participants (no)	137	132
Sex (% male)	100	98
Age (years)	58.0 ± 10.7	59.5 ± 10.9
Ethnic group (% white)	75.9	75.0
Hypertension treatment withdrawn (%)	51	53
Systolic blood pressure (mmHg)	145.3 ± 13.2	147.6 ± 12.8
Diastolic blood pressure (mmHg)	89.2 ± 5.3	89.7 ± 5.3
Heart rate (beats/min)	75.3 ± 11.5	76.0 ± 12.3
Weight (kg)	85.5 ± 14.7	85.6 ± 14.5
Alcohol intake (years)	37.3 ± 12.6	38.8 ± 12.6
Alcohol intake in prior 6 months (no. drinks per day)	6.0 ± 3.4	5.7 ± 2.8

APPENDICES

Appendix 1. Search strategies

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions(R) <1946 to June 25, 2020>
Search Date: 26 June 2020
---
1 alcohol drinking/ (66740)
2 (alcohol$ adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small$ or usage)).tw,kf. (94512)
3 (beer? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw,kf. (2269)
4 (liquor? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw,kf. (753)
5 (spirit? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw,kf. (820)
6 (wine? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw,kf. (3873)
7 or/1-6 (129530)
8 hypertension/ (233584)
9 essential hypertension/ (2258)
10 hypertens$.tw,kf. (437903)
11 ((control$ or elevat$ or high$ or lower$ or rais$) adj3 (blood pressure or bp)).tw,kf. (87299)
12 or/8-11 (521857)
13 randomized controlled trial.pt. (508294)

14 controlled clinical trial.pt. (93727)
15 randomized.ab. (483756)
16 placebo.ab. (208803)
17 clinical trials as topic/ (191748)
18 randomly.ab. (335777)
19 trial.ti. (220520)
20 or/13-19 (1296401)
21 animals/ not (humans/ and animals/) (4677648)
22 20 not 21 (1193198)
23 7 and 12 and 22 (694)

Database: Cochrane Hypertension Specialised Register via Cochrane Register of Studies (CRS-Web)
Search Date: 26 June 2020

#1 (alcohol* OR beer* OR liquor* OR spirits OR wine*) AND INSEGMENT
#2 RCT:DE AND INSEGMENT
#3 Review:ODE AND INSEGMENT
#4 #1 AND (#2 OR #3) AND INSEGMENT

Database: Cochrane Drugs & Alcohol Specialised Register via Cochrane Register of Studies (CRS-Web)
Search Date: 26 June 2020

#1 (alcohol* OR beer* OR liquor* OR spirits OR wine*) AND INREGISTER
#2 (elevat* blood pressur* OR high blood pressur* OR rais* blood pressur*) AND INREGISTER
#3 hypertens* AND INREGISTER
#4 #1 AND (#2 OR #3)

Database: Cochrane Central Register of Controlled Trials (Issue 5, 2020) via Cochrane Register of Studies (CRS-Web)
Search Date: 26 June 2020

#1 MESH DESCRIPTOR alcohol drinking EXPLODE ALL AND CENTRAL:TARGET
#2 (alcohol* OR beer* OR liquor* OR spirit* OR wine*) NEAR4 (consum* OR control* OR decreas* OR drink* OR intake OR less* OR limit* OR lower* OR moderat* OR reduc* OR restrict* OR small* OR usage) AND CENTRAL:TARGET
#3 (#1 OR #2) AND CENTRAL:TARGET
#4 hypertens* AND CENTRAL:TARGET
#5 (control OR elevat* OR high* OR lower* OR rais*) NEAR3 (blood pressur* OR bp) AND CENTRAL:TARGET
#6 (#4 OR #5) AND CENTRAL:TARGET
#7 #3 AND #6 AND CENTRAL:TARGET

Database: Embase <1974 to 2020 June 25>
Search Date: 26 June 2020
---
1 drinking behavior/ (48226)
2 (alcohol$ adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small$ or usage)).tw. (129129)
3 (beer? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw. (2845)
4 (liquor? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw. (1066)
5 (spirit? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw. (991)
6 (wine? adj4 (consum$ or control$ or decreas$ or drink$ or intake or less$ or limit$ or lower$ or moderat$ or reduc$ or restrict$ or small $ or usage)).tw. (4721)
7 or/1-6 (158219)
8 exp hypertension/ (721578)
9 (antihypertens$ or hypertens$).tw. (660358)
10 ((control$ or elevat$ or high$ or lower$ or rais$) adj3 (blood pressure or bp)).tw. (122555)
11 or/8-10 (978938)
12 randomized controlled trial/ (608155)
13 crossover procedure/ (63471)
14 double-blind procedure/ (173430)

15 (randomi?ed or randomly).tw. (1246634)
16 (crossover$ or cross-over$).tw. (106869)
17 placebo.ab. (298908)
18 (doubl$ adj blind$).tw. (210174)
19 assign$.ab. (388924)
20 allocat$.ab. (150216)
21 or/12-20 (1809119)
22 (exp animal/ or animal.hw. or nonhuman/) not (exp human/ or human cell/ or (human or humans).ti.) (6400111)
23 21 not 22 (1578673)
24 7 and 11 and 23 (1072)

Database: ClinicalTrials.gov
Search Date: 29 June 2020

Condition or disease: Hypertension
Other terms: randomized
Study type: Interventional Studies
Study Results: All Studies
Intervention/treatment: (alcohol OR alcoholic OR beer OR liquor OR spirits OR wine)

Database: WHO International Clinical Trials Registry Platform (ICTRP)
Search Date: 29 June 2020
---
alcohol AND hypertens* AND random*
beer AND hypertens* AND random*
liquor AND hypertens* AND random*
spirits AND hypertens* AND random*
wine AND hypertens* AND random*

Appendix 2. Reviews and guidelines checked

Briasoulis 2012

Kaner 2018

Larsson 2016

Rehm 2017

Roerecke 2017

Tasnim 2020

Xin 2001

HISTORY

Protocol first published: Issue 9, 2012
Review first published: Issue 9, 2020

Date	Event	Description
30 January 2017	Amended	Background, MEDLINE search strategy and references updated. Changes in criteria for considering studies (types of studies, types of outcome measures), data synthesis, unit of analysis issues and sensitivity analysis.

CONTRIBUTIONS OF AUTHORS

MT Acín is the lead author. She entered text of the review into RevMan, conducted external correspondence, appraised inclusion criteria and quality, and extracted and analysed study data.

N Alzueta appraised inclusion criteria and drafted the final review.

V Parent Mathias authored the protocol and drafted the final review.

JR Rueda authored the protocol, appraised inclusion criteria and drafted the final review.

I Solá authored the protocol and drafted the final review.

J Garjón authored the protocol, appraised inclusion criteria and drafted the final review.

LC Saiz authored the protocol, entered text of the review into RevMan, appraised inclusion criteria and quality, and extracted and analysed study data.

J Erviti authored the protocol, appraised inclusion criteria and drafted the final review.

All review authors participated in writing of the Discussion and Conclusions section.

DECLARATIONS OF INTEREST

MT Acín: none known.

N Alzueta: none known.

V Parent Mathias:none known.

JR Rueda: none known.

I Solá: none known.

J Garjón: none known.

LC Saiz: none known.

J Erviti: none known.

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Internal sources

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  Infrastructure in-kind support
- Navarre Health Service, Spain

  Infrastructure in-kind support

External sources

- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Although the original protocol did not state the following rule explicitly, in order to be eligible for inclusion, all studies needed to report data on at least one primary outcome measure.

INDEX TERMS

Medical Subject Headings (MeSH)

Alcohol Drinking [adverse effects] [mortality] [*prevention & control]; Bias; Blood Pressure; Cardiovascular Diseases [epidemiology]; *Cognitive Behavioral Therapy; Hypertension [etiology] [mortality] [*prevention & control]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Male; Middle Aged