

Review of moderate alcohol consumption and reduced risk of coronary heart disease: is the effect due to beer, wine, or spirits?

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See editorial and p 736

Abstract

Objectives—To review the effect of specific types of alcoholic drink on coronary risk.

Design—Systematic review of ecological, case-control, and cohort studies in which specific associations were available for consumption of beer, wine, and spirits and risk of coronary heart disease.

Subjects—12 ecological, three case-control, and 10 separate prospective cohort studies.

Main outcome measures—Alcohol consumption and relative risk of morbidity and mortality from coronary heart disease.

Results—Most ecological studies suggested that wine was more effective in reducing risk of mortality from heart disease than beer or spirits. Taken together, the three case-control studies did not suggest that one type of drink was more cardioprotective than the others. Of the 10 prospective cohort studies, four found a significant inverse association between risk of heart disease and moderate wine drinking, four found such an association for beer, and four for spirits.

Conclusions—Results from observational studies, where alcohol consumption can be linked directly to an individual's risk of coronary heart disease, provide strong evidence that all alcoholic drinks are linked with lower risk. Thus, a substantial portion of the benefit is from alcohol rather than other components of each type of drink.

Introduction

The inverse association between moderate alcohol consumption and coronary heart disease is well established. Evidence for a causal interpretation comes from over 60 ecological, case-control, and cohort studies. Previous reviews have concluded that men and women who drink one to two drinks a day have the lowest risk of coronary heart disease.^{1,4} In a recent meta-analysis of cohort studies Maclure found a summary relative risk of coronary heart disease of 0.83 (95% confidence interval 0.77 to 0.89) for moderate drinkers (2-3 drinks a day) compared with teetotallers.²

Several reports give individual relative risks attributable to consumption of beer, wine, and spirits. Although the possible additional benefits of wine—especially red wine—have received considerable attention in the media (*Sixty Minutes*, CBS Television, 17 November 1991, 5 November 1995), whether any specific type of alcoholic drink has particular benefit has not been systematically addressed. In this review we examine the relation between specific alcoholic drinks and reduction of risk of coronary heart disease by summarising published reports from ecological, case-control, and cohort studies.

Methods

We searched the Medline database for epidemiological investigations of alcohol and coronary heart

disease published after 1965. We supplemented our search through citations in review articles,^{1,4} proceedings of meetings and symposia, and journals dedicated to tracking alcohol related research. We selected studies that provided specific information on consumption of beer, wine, or spirits in relation to risk of coronary heart disease. We also included results from the few investigations in which the alcohol consumption in the study population was generally limited to only one or two of the three main types of drink.

Several observational studies gave relative risks of coronary heart disease for specific types of alcoholic drink. However, differences in categorisation of the amounts consumed and the extent of control for confounding factors precluded a useful meta-analysis or summary statistic. We discuss the strengths and weaknesses of each study design and provide an overall qualitative conclusion from the evidence.

Results

ECOLOGICAL STUDIES

Since 1979, 12 studies have examined the association between per capita consumption (or, more accurately, disappearance data) of specific alcoholic drinks and mortality from heart disease across countries or over time (table 1). Only mortality is used in the analyses summarised since there are no standardised rates for morbidity from coronary heart disease. St Leger *et al* published the first ecological analysis showing a strong inverse association between average per capita consumption of wine and mortality from ischaemic heart disease.⁵ The inverse association was pronounced for wine in both men and women, less strong for spirits, and non-existent for beer. The other studies generally reported similar results (table 1).

CASE-CONTROL AND COHORT STUDIES

Three case-control studies provided estimates of the relative risk of coronary heart disease in relation to intake of specific types of alcoholic drink (table 2). Hennekens *et al*⁶ and Rosenberg *et al*⁷ reported that each type of drink was associated with a reduction in risk of coronary heart disease. Among men spirits were most strongly associated with a reduced risk of death from coronary heart disease,¹⁶ while among women only wine was significantly associated with a reduction in risk of non-fatal myocardial infarction.¹⁷ Kaufman *et al* did not find an inverse association between total alcohol consumption and coronary heart disease¹⁸: each drink type was marginally positively associated with risk of myocardial infarction, with wine showing the strongest association. Taken together, these case-control studies do not suggest that one specific type of drink may be more cardioprotective.

Ten separate prospective cohort studies have provided results on risk of coronary heart disease in association with specific types of alcoholic drink

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Table 1—Ecological studies of consumption of specific types of alcoholic drink and correlation with mortality from heart disease

Study	Correlation			Comment
	Wine	Beer	Spirits	
St Leger <i>et al</i> 1979^a Per capita consumption (by county) v ischaemic heart disease mortality, 1970. Men and women aged 55-64 in 18 developed countries	Men -0.70 Women -0.61	Men 0.23 Women 0.31	Men -0.26 Women -0.32	Not adjusted
LaPorte <i>et al</i> 1980^a Per capita consumption (by county) v coronary heart disease mortality, 1972. Men aged 55-64 in 20 countries	-0.62	0.15	-0.29	Adjusted for meat consumption
Werth 1980^a Per capita consumption (by state) v coronary heart disease mortality, 1969-78. Men and women in USA	-0.49 to -0.58 ($P < 0.001$) for each year between 1969 and 1978	Not given	Not given	Not adjusted
LaPorte <i>et al</i> 1981^a Per capita consumption (by state) v coronary heart disease mortality, 1970. Men and women in USA	White men 0.05 White women 0.17	White men 0.11 White women 0.09	White men 0.19 White women 0.24	Adjusted for age
Schmidt <i>et al</i> 1981^a Per capita consumption (by state) v coronary heart disease mortality, 1970. Men and women in USA	-0.28 ($P < 0.05$)*	-0.06 (NS)*	-0.26 ($P < 0.05$)*	Adjusted for cigarette smoking
Nanji 1985^a Per capita consumption (by country) v ischaemic heart disease mortality, 1970. Men in 27 developed countries	-0.75 ($P < 0.001$)	0.60 ($P < 0.001$)	No association	Drink type presented as % of total alcohol
Nanji <i>et al</i> 1986^a Change in per capita alcohol intake (by country) v change in ischaemic heart disease mortality, 1970-80. Men in 22 countries	-0.50 ($P < 0.01$)	0.32 ($P < 0.05$)	Not given	Not adjusted
Hegsted 1988^a Per capita consumption (by country) v coronary heart disease mortality, 1971, 1973. Men in 18 countries	$P < 0.01$ (inverse)	NS	NS	Adjusted for saturated and polyunsaturated fat. Predictive equation almost identical when total alcohol used instead of each drink type
Renaud <i>et al</i> 1992^a Per capita consumption (by country) v coronary heart disease mortality, 1987. Men and women aged 35-64 in 17 countries	-0.87 ($P < 0.0001$)	NS	NS	Adjusted for dairy fat intake
Artaud-Wild <i>et al</i> 1993^a Per capita consumption (by country) v coronary heart disease mortality, 1977. Men aged 55-64 in 40 countries	-0.16 (NS)	Not given	Not given	Total alcohol significantly correlated with mortality for all countries ($r=0.35$) but significantly inversely correlated with mortality in countries with high cholesterol and saturated fat intake
Criqui <i>et al</i> 1994^a Per capita consumption (by country) v coronary heart disease mortality, 1965, 1970, 1980, 1988. Men and women aged 35-74 in 21 countries	1965 $P=0.07$ (inverse) 1970 $P < 0.01$ (inverse) 1980 $P < 0.01$ (inverse) 1988 $P=0.12$ (inverse)	1965 NS 1970 $P=0.09$ (inverse) 1980 NS 1988 NS	1965 $P=0.12$ (inverse) 1970 NS 1980 NS 1988 NS	Each year had a separate model which controlled for % calories for animal fat, vegetables, and fruit
La Porte <i>et al</i> 1980^a (time trend analysis) Per capita consumption (by state across years) v coronary heart disease mortality, 1950-75. Men and women in USA	-0.41	-0.61	-0.07	After incorporating 5 year lag, change in consumption of beer and cigarettes were strongest predictors of changes in mortality

*Interstate correlations.

(table 3). Only two of the studies did not simultaneously account for the effects of each alcoholic drink.^{19,21} Four of the studies reported a significant inverse association between wine consumption and coronary heart disease,^{24,25,29,31} four reported such an association for beer,^{19,23,29,31} and four reported an association for spirits.^{22,23,26,29} To determine whether one type of drink was most advantageous, we identified studies in which only one of the three drink types was strongly associated with reduced coronary heart disease. Two studies found wine to have the strongest inverse association with coronary heart disease,^{25,31} none found this for beer, and two found it for spirits.^{22,26} In many of these studies the other types of drink also showed trends towards protection; the significance for any single type of drink was partly a function of the distribution of intake of different drinks in the population studied.

Discussion

ECOLOGICAL STUDIES

Ecological studies of alcohol consumption and coronary heart disease are based on existing data typically collected by government agencies or international surveillance programmes. In addition to easy

accessibility of data, ecological analyses provide a unique opportunity to study associations across a wide variation of alcohol intake. These studies generally showed a strong inverse association between consumption of wine and mortality from heart disease, while the association was weaker or non-existent for spirits and beer.

The thoughtful analysis by Renaud *et al* illustrates the strengths and weaknesses of drawing definitive conclusions from ecological data.¹³ Whereas controlling for dairy fat strengthened the association between wine and coronary heart disease, other characteristics not accounted for might have been related to wine consumption and could have explained the reported correlations.^{32,33}

Ecological studies (cross cultural and time trend) have other important limitations. In some countries a small proportion of the population may consume a large proportion of a specific type of alcoholic drink so that average per capita consumption may be an inaccurate representation. In other countries, like France, average per capita consumption of wine may be more representative as this is drunk by much of the population. Furthermore, what may seem to be a moderate or low level of consumption of spirits on the basis of per capita per day may mask excessive

Table 2—Case-control studies of consumption of specific types of alcoholic drink and relative risk of coronary heart disease

Study	Wine		Beer		Spirits		Comment
	Consumption	Relative risk	Consumption	Relative risk	Consumption	Relative risk	
Hennekens <i>et al</i> 1979¹⁶ 1136 Men aged 30-70 (568 died from coronary heart disease, 568 controls) in Boston, USA	Total alcohol (oz/day): 0 ≤2 >2	1.0 0.3 (P<0.001) 1.0	Total alcohol (oz/day): 0 ≤2 >2	1.0 0.3 (P<0.001) 1.0	Total alcohol (oz/day): 0 ≤2 >2	1.0 0.2 (P<0.001) 1.1	Adjusted for cigarette smoking, previous hospitalisation for congestive heart failure, religion, and relative weight
Rosenberg <i>et al</i> 1981¹⁷ 1431 Women aged <50 (513 with myocardial infarction, 918 hospital controls) in Boston, New York, and Philadelphia, USA	None Only drink wine	1.0 0.4 (P<0.001)	None Only drink beer	1.0 0.8	None Only drink spirits	1.0 0.9	Results not materially altered when crude odds ratio adjusted for confounders. Women who drank more than one drink type had relative risk of 0.6
Kaufman <i>et al</i> 1985¹⁸ 3151 Men aged <55 (2170 with non-fatal myocardial infarction, 981 hospital controls) in northeastern USA	Total alcohol (oz/week): 0 <5 5-9 10-19 ≥20	1.0 1.2 1.8 2.4	Total alcohol (oz/week): 0 <5 5-9 10-19 ≥20	1.0 1.3 1.1 1.2 1.1	Total alcohol (oz/week): 0 <5 5-9 10-19 ≥20	1.0 1.1 1.3 1.7 1.0	Adjusted for age and smoking

1 oz alcohol=28.3g.

consumption by a small proportion of the population. In countries like the United States²⁸ wine drinkers tend to be of higher socioeconomic status, have a healthier lifestyle, and have better access to health care; thus, the stronger inverse association between wine consumption and mortality from coronary heart disease could be explained in part by a lower case fatality rate.

St Leger *et al* reported a strong correlation between per capita wine consumption and mortality from coronary heart disease (-0.70 for men) but weaker correlations for cigarette smoking and mortality from coronary heart disease (0.28) and cerebrovascular mortality (0.08).⁵ However, later studies have shown strong associations between smoking and death from heart and cerebrovascular disease.³⁴⁻³⁶ This illustrates the importance of confirming results from ecological data with results from studies with more rigorous methods.

CASE-CONTROL AND COHORT STUDIES

The best evidence to judge whether an association exists between a type of alcoholic drink and coronary heart disease comes from observational data, in which individual intake can be linked directly to coronary heart disease. In addition, depending on the study design, both morbidity and mortality can be examined.

Although case-control studies of diet and chronic disease may produce biased results due to incomparability of controls³⁷ or differential recall of past intake,³⁸ recall of past alcohol consumption is not as problematic as is recall of many other exposures.³⁹ Furthermore, most case-control studies of total alcohol consumption and coronary disease have found inverse associations similar to those from prospective studies.¹

Almost all cohort studies find a strong inverse association between total alcohol intake and coronary heart disease,² but no consistent pattern has emerged for specific types of drink. Even in the three largest studies, where the absolute consumption of all drink types would be greatest and the data would provide the most stable relative risks, all three types of drink conferred a reduction in coronary heart disease.^{25 26 28} From all the cohort studies—with data collected from more than 305 000 men and women followed up for over 1.8 million person years—we conclude that if any type of drink does provide extra cardiovascular benefit apart from its alcohol content, the benefit is likely to be modest at best or possibly restricted to certain sub-populations.

REASONS FOR DIFFERENCES BETWEEN STUDIES

If no single type of drink provides all or most of the cardiovascular benefit, then why do results from several individual cohort studies suggest a stronger association for one particular type of drink? The differences between studies may be due to different drinking patterns or aspects of lifestyle correlated with choice of drink in particular populations. In the studies where only one type of drink was significantly associated with reduced risk of coronary heart disease, that drink was usually consumed by much of the population, typically at levels of one or two glasses a day. This pattern of widespread "healthy" drinking is more likely to take place with meals than is heavy or episodic drinking by a small percentage of the population.

In the health professionals follow up study, in which spirits were the most commonly consumed type of drink and were the most strongly protective, total alcohol consumption was strongly correlated with total number of days alcohol was consumed (r=0.89).²⁶ This suggests that spirits were consumed most days of the week and were not restricted to heavy weekend consumption. Conversely, in the Copenhagen city heart study, in which consumption of spirits did not reduce coronary heart disease, only 8.5% of the men and 4% of the women reported drinking spirits on average once a day or more.³¹ Because this small sample of consumers of spirits may have had different drinking patterns (and other lifestyle characteristics) from the rest of the population in Copenhagen, it may explain the absence of a cardioprotective effect for spirits in this population.

Klatsky *et al* studied drinking patterns and characteristics correlated with choice of drink among 85 000 men and women who specified a preference for one of the three main drink types.⁴⁰ Compared with people who preferred spirits (after adjustment for age), wine consumers were less likely (relative risk=0.7) and beer drinkers were more likely (relative risk=1.2) to develop coronary heart disease. These differences were almost completely eliminated after further adjustment for sex, race, daily intake of alcohol, cigarette smoking, coffee drinking, and education. This is strong evidence that characteristics correlated with choice of drink may explain the different relative risks associated with types of drink in different populations. The behavioural characteristics that are correlated with choice of drink will vary widely among different populations and socioeconomic groups and will change over time.

An ideal study of the effects of types of alcoholic

Table 3—Cohort studies of consumption of specific types of alcoholic drink and relative risk of coronary heart disease

Study	Wine		Beer		Spirits		Comment
	Consumption	Relative risk (95% confidence interval)	Consumption	Relative risk (95% confidence interval)	Consumption	Relative risk (95% confidence interval)	
Yano et al 1977,^a Kagan et al 1981^a							
7591 Men aged 46-68 (190 deaths from myocardial infarction or coronary heart disease in 6 years follow up) in Honolulu heart study	ml/day*:		ml/day*:		ml/day*:		Adjusted for age, drink types not simultaneously adjusted for
	0	1.0†	0	1.0†	0	1.0†	
	1	0.67†	1-299	0.74†	1-2	0.93†	
	≥2	0.71 (NS)†	≥300	0.57 (P<0.001)†	≥3	0.71 (NS)†	
Kozarevic et al 1980^a							
11 121 Men aged 35-62 (estimated 166 with non-fatal myocardial infarction or fatal coronary heart disease in 7 years follow up) in Yugoslavia	No of drinks/day:		No of drinks/day:		No of drinks/day (weak rakija, 30% alcohol):		Adjusted for age, drink types not simultaneously adjusted for
	<1	1.0†	<1	1.0†	<1	1.0†	
	≥1	0.7 (NS)†	≥1	0.6 (NS)†	≥1	0.8 (NS)†	
					No of drinks/day (strong rakija, 40% alcohol):		
					<1	1.0†	
					≥1	0.6 (NS)†	
Salonen et al 1983^a							
4063 Men aged 30-59 (209 with acute myocardial infarction in 7 years follow up) in eastern Finland	Negligible consumption		No of bottles/week:		No of drinks/week:		Adjusted for age, smoking, serum cholesterol and triglyceride concentrations, blood pressure
			<5	1.0	<1	1.0	
			≥5	0.8 (0.5 to 1.4)	≥1	0.3 (0.1 to 0.7)	
Kittner et al 1983^a							
9150 Men aged 35-79 (164 died from coronary heart disease in 8 years follow up, 306 died in 12 years follow up) in Puerto Rico heart health program	Negligible consumption		Beer and spirits combined (drinkers v non-drinkers):				Alcohol intake assessed by single 24 hour recall; adjusted for age, smoking, exercise, location of residence
			Sudden coronary heart disease:		1.3 (0.8 to 2.0)		
			Non-sudden coronary heart disease:		0.7 (0.4 to 1.0)		
			Non-fatal myocardial infarction:		0.7 (0.5 to 1.0)		
Friedman et al 1986^a							
2106 Men aged 30-59 (24 year follow up) in Framingham heart study	No of drinks/day in non-smokers‡:		No of drinks/day in non-smokers‡:		No of drinks/day in non-smokers‡:		Adjusted for systolic blood pressure, serum cholesterol concentration, haemoglobin concentration, left ventricular hypertrophy, relative weight
	0	1.0	0	1.0	0	1.0	
	2	0.25 (P=0.07)	2	0.49 (P=0.15)	2	0.66 (P=0.21)	
Stampfer et al 1988^a							
87 526 Women aged 34-59 (200 with fatal or non-fatal myocardial infarction in 4 years follow up) in nurses' health study	Total alcohol (g/day):		Total alcohol (g/day):		Total alcohol (g/day):		Adjusted for family history of coronary heart disease, menopause, hormone replacement therapy, age, smoking, body mass index, hypertension, high cholesterol concentration, exercise, intake of dietary fat and cholesterol
	0	1.0	0	1.0	0	1.0	
	<5	0.9 (0.7 to 1.2)	<5	0.3 (0.2 to 0.8)	<5	1.1 (0.7 to 1.8)	
	≥5	0.4 (0.2 to 0.8)	≥5	1.0 (0.6 to 1.6)	≥5	0.7 (0.4 to 1.3)	
Rimm et al 1991^a							
44 059 Men aged 40-75 (350 with fatal or non-fatal heart disease or revascularisation in 2 years follow up) in health professionals follow up study	No of drinks/day§:		No of drinks/day§:		No of drinks/day§:		Adjusted for family history of coronary heart disease; smoking; age; body mass index; profession; diabetes; hypertension; high cholesterol concentration; intake of dietary fat, fibre, and cholesterol
	0	1.0	0	1.0	0	1.0	
	2	0.98 (0.64 to 1.50)	2	0.80 (0.54 to 1.18)	2	0.55 (0.39 to 0.77)	
Farchi et al 1992^a							
1563 Men aged 45-64 (166 died from cardiovascular disease in 15 years follow up) in Italian rural cohorts study	Quintiles of mean alcohol intake (g/day):		Alcohol consumption mainly or exclusively wine				Adjusted for age, smoking, and occupation. Men with prevalent cardiovascular disease at baseline were excluded
	22.7	1.0					
	56.4	0.77 (0.34 to 1.76)					
	77.8	0.67 (0.29 to 1.58)					
	108.2	1.31 (0.64 to 2.66)					
	164.7	1.61 (0.79 to 3.31)					
Klatsky et al 1992,^b 1993,^a 1990,^a 1986^a							
129 170 Men and women (600 died from coronary heart disease in 7 years follow up) in Kaiser Permanente study	No of drinks/week :		No of drinks/week :		No of drinks/week :		Adjusted for age, race, sex, smoking, body mass index, marital status, education
	<2	1.0	<2	1.0	<2	1.0	
	≥2	0.5 (0.4 to 0.7)	≥2	0.7 (0.5 to 0.9)	≥2	0.6 (0.5 to 0.8)	
Gronbaek et al 1995^a							
7217 Women and 5633 men aged 30-70 (1119 died from coronary heart disease in 12 year follow up) in Copenhagen city heart study	Drinks¶:		Drinks¶:		Drinks¶:		Age, smoking, sex
	Never	1.0	Never	1.0	Never	1.0	
	Monthly	0.69 (0.62 to 0.77)	Monthly	0.79 (0.69 to 0.91)	Monthly	0.95 (0.85 to 1.06)	
	Weekly	0.53 (0.45 to 0.63)	Weekly	0.87 (0.75 to 0.99)	Weekly	1.08 (0.93 to 1.26)	
	1-2 Daily	0.47 (0.35 to 0.62)	1-2 Daily	0.79 (0.68 to 0.91)	1-2 Daily	1.16 (0.98 to 1.39)	
	3-5 Daily	0.44 (0.24 to 0.80)	3-5 Daily	0.72 (0.61 to 0.88)	3-5 Daily	1.35 (1.00 to 1.83)	

*Consumption of alcohol calculated as consumption of each drink type without conversion to alcohol. In this population consumption of wine and spirits was small compared with beer: average monthly consumption was 1-2 glasses of wine, 1-2 glasses of spirits, and 22 12 oz glasses of beer.²⁰

†Relative risks (age adjusted) derived from rates of coronary heart disease for each category of alcohol consumption divided by rate for abstainers.

‡Alcohol content per drink was defined as 4 oz for wine (16.75% alcohol), 8 oz for beer (5% alcohol), and 2 oz for spirits (50% alcohol). We calculated relative risks from published β coefficients from a Cox proportional hazards model which accounted for all three drink types simultaneously.²⁴

§Drinks of each type defined as a 4 oz glass of wine (10.8 g alcohol), a 12 oz glass of beer (13.2 g alcohol), and a shot of spirits (15.2 g alcohol).

||The amount of alcohol per drink was not defined.

¶Drinks defined to contain 12 g alcohol on average.

1 oz alcohol=28.3 g.

NS=Non-significant.

Key messages

- Moderate alcohol consumption is associated with a reduced risk of coronary heart disease, but whether any specific type of alcoholic drink has particular benefit has not been systematically addressed
- We examined the relation between specific alcoholic drinks and reduction of risk of coronary heart disease by summarising published reports from ecological, case-control, and cohort studies
- Most ecological studies suggested that wine was more effective in reducing risk of mortality than beer or spirits, whereas the three case-control studies together did not suggest that one type of drink was more cardioprotective than others
- Of the 10 prospective cohort studies, four found a significant inverse association between risk of heart disease and moderate wine drinking, four found the association for beer, and four found it for spirits.
- The evidence suggests that all alcoholic drinks are linked with lower risk, so that much of the benefit is from alcohol rather than other components of each type of drink

drink would have maximum variation in alcohol consumption from specific types of drink, with additional information on drinking patterns associated with specific drink types, but minimal variation in other risk factors for coronary heart disease such as socioeconomic group, smoking, diet, and obesity. A complete analysis could then include the simultaneous assessment of both drinking patterns and total alcohol intake. The Copenhagen city heart study had adequate variation in alcohol intake and drink type,³¹ but the participants were drawn from all inhabitants of a defined area of Copenhagen and their large variation in other factors like diet, occupation, and drinking patterns might explain why wine seemed to be most strongly associated with reduced risk of coronary heart disease.

Observational studies of alcohol consumption in populations where alcoholic drinks are limited to one or two types provide a unique opportunity to test the possibility that only one type of drink is largely responsible for the reduction in coronary heart disease. For example, in an angiographic study linking alcohol intake to reduced risk of coronary stenosis, Baboriak *et al* reported that few patients drank wine, suggesting that the association was due mainly to beer and spirits.⁴¹ Ducimetiere *et al* reported a similar association for alcohol in an angiographic study of a population where most of the alcohol consumed was from wine.⁴² In the Italian rural cohorts of the seven countries study the lowest mortality from cardiovascular disease occurred in the group of men who consumed an average 77.8 g of alcohol a day, almost exclusively wine.²⁷ Conversely, the Honolulu heart study found a significant inverse association between coronary heart disease and beer consumption but no such association for wine.¹⁹ However, in this study only 15% of the population drank wine, with a median intake of half a glass a month. These studies suggest that alcohol itself rather than a particular type of drink is responsible for the reduction in coronary heart disease.

MECHANISM OF ALCOHOL'S PROTECTIVE EFFECT

Several short term experimental studies have shown that alcohol (not specific to drink type) increases the serum concentration of high density lipoprotein cholesterol.⁴³⁻⁴⁴ This mechanism provides a biological basis for a causal relation between alcohol consumption and lower rates of coronary heart disease.⁴⁵ In epidemiological studies of total alcohol consumption and coronary heart disease in which measurements of high density lipoprotein cholesterol concentration are also available⁴⁶⁻⁴⁹ it was estimated that about half of the

beneficial effect of alcohol was due to its effect on high density lipoprotein cholesterol. However, this calculation does not take into account laboratory and biological variability in high density lipoprotein concentrations or potential confounding by other lifestyle factors (such as diet, obesity, or physical activity). Thus, the true proportion of the effect attributable to high density lipoprotein is likely to be greater. Other potential mechanisms include an effect of alcohol on platelet function⁵⁰ and on tissue plasminogen activator and other components of clotting and fibrinolysis.^{51,52} These mechanisms might partly explain an apparent acute protective effect of recent alcohol consumption (for example, previous evening).⁵³

Each type of alcoholic drink has many non-alcohol components. Wine is the best studied⁵⁴ and has been found to contain antioxidants,^{55,56} vasorelaxants,⁵⁷ and stimulants to antiaggregatory mechanisms.⁵² For example, Maxwell *et al* found that 10 subjects who drank wine with meals had higher serum antioxidant activity than others who abstained from wine.⁵⁶ However, little is known about any association between circulating serum antioxidant activity and risk of coronary heart disease, and comparisons were not made with other alcohol drinks.

CONCLUSION

Although most ecological studies support the hypothesis that wine consumption is most beneficial, the methodological problems of these studies limit their usefulness in drawing conclusions. Most of the differences in findings regarding specific drink types are probably due to differences in patterns of drinking specific types of alcoholic drink and to differing associations with other risk factors. Results from observational studies, where individual consumption can be assessed in detail and linked directly to coronary heart disease, provide strong evidence that a substantial proportion of the benefits of wine, beer, or spirits are attributable primarily to the alcohol content rather than to other components of each drink.

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Alcohol consumption, serum low density lipoprotein cholesterol concentration, and risk of ischaemic heart disease: six year follow up in the Copenhagen male study

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See editorial and p 31

Abstract

Objectives—To investigate the interplay between use of alcohol, concentration of low density lipoprotein cholesterol, and risk of ischaemic heart disease.

Design—Prospective study with controlling for several relevant confounders, including concentrations of other lipid fractions.

Setting—Copenhagen male study, Denmark.

Subjects—2826 men aged 53-74 years without overt ischaemic heart disease.

Main outcome measure—Incidence of ischaemic heart disease during a six year follow up period.

Results—172 men (6.1%) had a first ischaemic heart disease event. There was an overall inverse association between alcohol intake and risk of ischaemic heart disease. The association was highly dependent on concentration of low density lipoprotein cholesterol. In men with a high concentration (≥ 5.25 mmol/l) cumulative incidence rates of ischaemic heart disease were 16.4% for abstainers, 8.7% for those who drank 1-21 beverages a week, and 4.4% for those who drank 22 or more beverages a week. With abstainers as reference and after adjust-

ment for confounders, corresponding relative risks (95% confidence interval) were 0.4 (0.2 to 1.0; $P < 0.05$) and 0.2 (0.1 to 0.8; $P < 0.01$). In men with a concentration < 3.63 mmol/l use of alcohol was not associated with risk. The attributable risk (95% confidence interval) of ischaemic heart disease among men with concentrations ≥ 3.63 mmol/l who abstained from drinking alcohol was 43% (10% to 64%).

Conclusions—In middle aged and elderly men the inverse association between alcohol consumption and risk of ischaemic heart disease is highly dependent on the concentration of low density lipoprotein cholesterol. These results support the suggestion that use of alcohol may in part explain the French paradox.

Introduction

Several epidemiological studies have shown an inverse association between alcohol consumption and risk of ischaemic heart disease, the association often being described as J or U shaped.¹

Epidemiological studies have shown a positive cor-

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