RESEARCH REPORT

Types of alcoholic beverages and blood lipids in a French population

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Study objective: Prospective studies have shown a consistent relation between alcohol consumption and decreasing incidence of coronary artery disease. The protective effect of alcohol could be mediated through increased levels of HDL cholesterol (HDL-c). The aim of this study was to examine the relation between blood lipid levels and the consumption of different types of alcoholic beverages among 1581 men and 1535 women.

Design: Data from representative cross sectional surveys (1994–1997) in three different regions of France were used. The consumption of the different types of alcohol was quantified using a recall method according to a typical weekly consumption.

Main results: The median daily alcohol intake was 24 g for men and 4 g for women. After adjustment for confounders, total alcohol showed a positive and significant association with HDL-c and triglycerides (TG) in both sexes. In multivariate analysis, wine was positively associated with HDL-c. Beer was positively associated with HDL-c in men and with triglycerides in men and women. When taking drinking patterns into account, wine drinkers had higher HDL-c levels than non-wine drinkers. Differences became non-significant after adjustment for confounders and particularly for socioeconomic parameters.

Conclusions: In a French population sample, total alcohol was positively associated with HDL-c and triglycerides. The specific influence of any particular alcoholic beverage on blood lipids was not clearly demonstrated but wine preference found in a group with higher lifestyle standards was associated with a more favourable blood lipid profile.

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The inverse relation between alcohol intake and ischaemic heart disease is mediated by numerous potential biological mechanisms. A large part of the beneficial effects of alcohol and of the various types of beverages on ischaemic heart disease has been ascribed to the increase in HDL cholesterol.[1–4] Some authors have reported that the beneficial effects of wine were greater than those of any other beverage,[5 6] but others have suggested that the beneficial effects of beer [7–9] or both beer and wine were more effective.[10] However, the specific influence of each type of alcoholic beverage on HDL-c has been less investigated. The results of these studies do not show significant differences between the various types of beverages on HDL-c.[4 11–14] Nevertheless, no study has ever been carried out among populations in which alcohol consumption pattern is a regular one with all types of alcoholic beverages being affordable and available and with wine being the common alcoholic drink. The relation between the various types of alcoholic beverages and ischaemic heart disease is confounded by social and cultural factors, lifestyle and diet.[15] The influence of these environmental factors in the relation between alcoholic beverages and blood lipids was not investigated. The aim of this study is to assess the potential relation between the amount of alcohol intake, the type of beverage and blood lipids in a French population sample characterised by a regular alcohol drinking pattern and where alcohol consumption is supplied mainly by wine.

METHODS

Population sampling

A cross sectional study was carried out from December 1994 to April 1997 in three regions of France. A population sample of 1581 men and 1535 women aged from 35 to 64 years was selected at random, in the north (Lille 555 men/558 women), in the east (Strasbourg 472 men/473 women) and in the south west (Toulouse 554 men/504 women). The population samples were drawn from the polling lists available in each town hall. Participants were volunteers. Subjects were informed of the aim of the study and a formal consent was completed and signed by each subject. Authorisation from the appropriate ethics committee was obtained. Subjects were screened for cardiovascular risk factors in a health screening centre or at home.

Alcohol consumption

Total alcohol consumption and alcohol intake from each beverage type were assessed by quantitative questionnaires administered by a specially trained nurse. Moreover, drinking patterns specifying time and place of consumption, types of beverage and alcohol addiction (CAGE questionnaire) were established. Drinking habits were evaluated for each day according to a typical weekly alcohol consumption. Each type of alcoholic beverage (wine, beer, cider aperitifs and spirits) was recorded. Total alcohol was calculated as the sum of all the types of alcohol consumed and expressed in grams of alcohol per day.

Clinical measurement

Research nurses, specially trained in agreement with the MONICA protocol,[16] performed clinical measurements. Anthropometric measurements including height, body weight, waist and hip circumferences were taken in agreement with standardised procedures. Body mass index (BMI) and waist to hip ratio (WHR) were computed as follows: weight (kg)/height (m^2) and waist/hip respectively. Blood pressure was measured twice in a sitting position, on the right arm with a standard mercury sphygmomanometer after a five minute rest.

Abbreviations: HDL-c, HDL cholesterol

Table 1 Alcohol consumption (g/d) and clinical and socioeconomic parameters in men

	0 n=244		1–19 n=463		20–39 n=379		40–79 n=388		⩾80 n=107		
	mean	SD*	mean	SD	mean	SD	mean	SD	mean	SD	p
Alcohol consumption (g/d)	–	–	10.3	5.3	29.2	5.8	56.5	10.9	111.3	60.8	
Beverages (% from total alcohol)											
wine	–	–	60.1	34.8	71.5	28.6	69.9	29.6	60.5	28.4	
beer	–	–	17.7	27.3	18.8	25.9	19.9	26.8	29.6	28.8	
aperitifs	–	–	20.8	28.2	8.9	12.1	9.5	14.9	9.2	14.4	
spirits	–	–	0.5	2.5	0.7	3.6	0.6	1.8	0.7	2.7	
Age (y)	47.4	8.4	49.6	8.5	50.8	8.6	51.9	8.7	51.6	7.9	<0.001
Years of schooling (y)	12.6	4.3	12.8	4.0	12.0	3.7	11.8	3.5	11.3	3.7	<0.001
Systolic pressure (mm Hg)	133.0	15.6	133.2	16.9	134.1	17.2	139.9	20.4	141.3	21.3	<0.001
Diastolic pressure (mm Hg)	83.1	10.9	84.1	11.2	84.3	10.1	86.2	12.7	97.8	12.4	<0.001
Waist to hip ratio	0.93	0.07	0.94	0.07	0.94	0.06	0.96	0.06	0.96	0.07	<0.001
Body mass index (kg/m^2)	26.2	4.2	26.9	3.9	26.4	3.5	27.1	4.0	26.7	4.7	NS
Fasting glucose (mmol/l)	5.55	0.95	5.65	1.33	5.57	1.18	5.83	1.30	5.90	1.59	<0.01
Centre (%)											<0.001
North	25.4		31.5		35.6		38.9		57.0		
East	23.4		33.9		32.7		29.4		18.7		
South	51.2		34.6		31.7		31.7		24.3		
Current smoker (%)	23.4		15.8		20.6		36.1		46.7		<0.001
Physical activity (%)†	39.3		38.2		33.8		30.2		21.5		<0.01
Drugs (%)											
antihypertensive	10.3		12.5		15.3		20.1		22.4		<0.001
hypolipidaemic	15.7		14.3		16.1		15.2		11.2		NS
antidiabetic	3.7		5.4		3.4		4.4		6.5		NS
Occupational activity (%)	87.3		94.6		94.4		96.4		86.9		<0.001

*Standard deviation; †intense physical activity, 20 min, three times a week or more.

Measurements rounded to the nearest 2 mm Hg. The average of the two measurements was used for the statistical analysis.

Questionnaire
Questionnaires reporting demographic and socioeconomic factors, educational level and years of schooling, occupational activity, previous medical history, smoking habits (including past and present behaviour and the number of cigarettes, pipes or cigars smoked) drug intake and physical activity were administered by interviewers at the health screening centre or at home.

Blood sample collection and biological analysis
A blood sample was collected after a minimum fasting period of 10 hours, kept in tubes at room temperature and centrifuged within three hours. Serum tubes were stored at –80°C temperature. All biological analyses were performed in a central laboratory. Lipid and lipoprotein parameters were analysed two weeks after the blood sample had been drawn. Glucose, triglycerides (TG) and total cholesterol were measured by enzymatic reagents, on an automated analyser (Dade-Behring, Les Ulis, France), as described in Marques-Vidal *et al*.[17] High density lipoprotein cholesterol (HDL-c) was assayed following a prior precipitation of ApoB/ApoE containing lipoproteins with phosphotungstic acid and magnesium (Roche-Diagnostics, Meylan, France). Low density lipoprotein cholesterol (LDL-c) was calculated according to Friedewald *et al*.[18] Apolipoprotein A-I (Apo A-I) and Apolipoprotein B100 (ApoB) were determined by first order immunoprecipitation in an automated analyser (Cobas-Mira, Roche-Diagnostics).

Statistical methods
Statistical analyses were performed using the SAS statistical software release 6.12.[19] A statistical analysis was conducted among men and women separately because the drinking patterns and the amount of alcohol intake were very different. The statistical significance of the difference between the groups was tested by the χ^2 test for categorical variables and by one way analysis of variance for continuous ones. For variables with skewed distribution, analysis was performed after logarithmic transformation. The influence of the type of alcohol on lipid and lipoprotein parameters was analysed with a multivariate linear model after adjustment for confounding variables. The heterogeneity of adjusted β estimators was tested using the *F* test. An ANCOVA statistical analysis was performed (abstainers were excluded) to compare the mean values of blood concentrations of lipids, lipoproteins and apolipoproteins between the different groups (subjects who consumed wine only, alcohol beverages other than wine, wine and other alcohol beverages) after adjustment for confounding factors.

RESULTS
In this population sample, 36.7% of women and 15.4% of men reported that they drank no alcohol at all. Conversely 6.8% of men consumed at least 80 g alcohol a day and 31.3% of men drank 40 g or more per day. In women, only 4% consumed 40 g alcohol or more per day. For men, wine accounted for 66.2%, beer 16.8% and aperitifs 13.2% of total alcohol. For women, wine accounted for 63.7%, beer 6.8% and aperitifs 18.4% of total alcohol.

Table 1 shows the main characteristics of men in relation to their total alcohol intake. The percentage of beer increased with the amount of total alcohol intake and the percentage of aperitifs was twice higher in the light drinkers than in the other groups of alcohol drinkers. Men, who were heavy drinkers, were older than abstainers and they were more prevalent in the north than in the east and in the south. The number of years spent in school was on average higher among subjects with light alcohol consumption or abstainers. Mean levels of systolic and diastolic blood pressures, waist to hip ratio and fasting blood glucose increased significantly with alcohol consumption. The amount of total alcohol intake was positively associated with the percentage of current smokers and inversely correlated with the percentage of men who had intense physical activity. An increase in the proportion of men taking antihypertensive drugs was associated with a rise of alcohol intake.

In the same way, the proportion of heavy drinkers in women was higher in the north than in the east and in the south (table 2). We found significant differences related to alcohol intake, for body mass index, waist to hip ratio, fasting glucose and physical activity.

In men, after adjustment for confounding variables, mean blood levels for HDL-c, triglycerides and Apo A-I increased

Table 2 Alcohol consumption (g/d) and clinical and socioeconomical parameters in women

	0 n=563		1–19 n=708		≥20 n=264		
	mean	SD*	mean	SD	mean	SD	p
Alcohol consumption (g/d)	–	–	7.9	7.1	34.6	14.4	
Beverages (% from total alcohol)							
wine	–	–	61.8	35.4	68.9	33.4	
beer	–	–	15.3	27.7	20.7	31.3	
aperitifs	–	–	21.6	28.5	9.6	15.4	
spirits	–	–	0.5	2.5	0.6	2.8	
Age (y)	50.3	8.8	49.9	8.5	51.1	8.1	NS
Years of schooling (y)	11.4	3.7	11.8	3.6	11.4	3.5	NS
Systolic pressure (mm Hg)	128.8	20.5	128.4	19.0	130.4	17.7	NS
Diastolic pressure (mm Hg)	79.8	11.4	79.2	10.8	80.4	10.4	NS
Waist to hip ratio	0.82	0.07	0.82	0.08	0.83	0.07	<0.01
Body mass index (kg/m^2)	26.5	5.7	25.4	4.8	25.6	4.9	<0.001
Fasting glucose (mmol/l)	5.36	1.29	5.23	0.92	5.45	1.29	<0.05
Centre (%)							<0.001
North	27.2		38.0		51.5		
East	31.1		33.2		23.9		
South	41.7		28.8		24.6		
Current smoker (%)	15.6		16.1		17.8		NS
Physical activity (%)†	24.9		20.6		13.3		<0.001
Drugs (%)							
antihypertensive	19.4		16.7		17.4		NS
hypolipidaemic	12.0		12.3		11.0		NS
antidiabetic	4.1		2.4		5.3		NS
Occupational activity (%)	72.6		76.3		68.6		NS

*Standard deviation; †intense physical activity, 20 min, three times a week or more.

significantly in relation with the rank of each group of total alcohol consumption. In women, for HDL-c and Apo A-I identical results were obtained and for triglycerides, highest blood concentrations were observed in abstainers and when alcohol consumption was greater than 20 g a day (data not shown).

Table 3 shows the relations between the type of alcohol and the blood lipid concentrations. Coefficients of multiple linear model were adjusted for antihypertensive, antidiabetic and hypolipidaemic drugs, for centre, age, body mass index, smoking habits, systolic blood pressure, years of schooling, fasting blood glucose, physical activity and occupational activity. In both sexes, total cholesterol and HDL-c were positively associated with wine consumption. HDL-c was positively associated with beer in men and aperitif consumption in women. In both sexes a positive association was observed between beer and triglycerides. When homogeneity of β coefficients of the linear regressions was tested, no significant differences were found in men. In women, significant difference (p<0.05) was noticed for HDL-c. Similar results were obtained for Apo A-I.

Tables 4 give adjusted means of lipid levels according to three patterns of alcohol intake : wine drinkers exclusively, a mixed pattern (including wine or beer or aperitif or cider or spirits) and subjects who drank all types of alcohol, except wine. This analysis was carried out after exclusion of abstainers. In men, only blood concentrations of triglycerides remained significantly different between the three groups (p<0.01) after adjustment for total alcohol consumption and several confounding factors. In women, after adjustment for confounders, no significant difference was observed for studied blood lipids.

DISCUSSION

This cross sectional study shows a positive association of HDL-c or Apo A-I with alcohol intake. This association seems to put into evidence a continuous dose dependent relation in

Table 3 Coefficients of linear regression of blood lipids upon intake of types of alcohol

	Men n=1581					Women n=1535				
	β*	SE	p†	F‡	p§	β	SE	p	F	p
Total cholesterol				0.57	NS				1.47	NS
Wine	0.0040	0.001	<0.001			0.0061	0.002	<0.05		
Beer	0.0017	0.002	NS			–0.0030	0.004	NS		
Aperitif	0.0045	0.004	NS			0.0099	0.008	NS		
Spirits	–0.0058	0.020	NS			–0.0294	0.056	NS		
HDL cholesterol				1.54	NS				3.23	<0.05
Wine	0.0021	0.001	<0.001			0.0044	0.001	<0.001		
Beer	0.0015	0.001	<0.05			–0.0009	0.002	NS		
Aperitif	0.0017	0.001	NS			0.0098	0.004	<0.01		
Spirits	–0.0109	0.007	NS			0.0174	0.024	NS		
Triglycerides				2.48	NS				1.73	NS
Wine	0.0011	0.001	NS			0.0011	0.001	NS		
Beer	0.0029	0.001	<0.001			0.0051	0.002	<0.01		
Aperitif	0.0004	0.002	NS			0.0003	0.003	NS		
Spirits	–0.0180	0.009	<0.05			–0.0089	0.021	NS		

Adjusted for antihypertensive, antidiabetic, hypolipidaemic drugs, centre, age, smoking, systolic blood pressure, fasting blood glucose, years of schooling, physical activity, body mass index and occupational activity. *β coefficient corresponding to an increase of 1 g of alcohol intake; †significance of β coefficients; ‡test of equality of β coefficients; §significance of the test of equality.

Table 4 Drinking patterns and blood lipid levels among drinkers

Blood lipids		Wine only mean	Wine only SE	Other beverages* mean	Other beverages* SE	Wine+other beverages† mean	Wine+other beverages† SE	p
Men		n=203		n=103		n=1031		
HDL cholesterol (mmol/l)	A‡	1.35	0.03	1.23	0.04	1.34	0.02	<0.05
	B§	1.29	0.04	1.21	0.04	1.30	0.03	NS
Triglycerides (mmol/l)¶	A	1.31	0.04	1.49	0.05	1.26	0.03	<0.01
	B	1.41	0.05	1.55	0.06	1.34	0.04	<0.01
Women		n=241		n=124		n=607		
HDL cholesterol (mmol/l)	A	1.66	0.03	1.55	0.05	1.68	0.03	<0.05
	B	1.53	0.05	1.51	0.06	1.58	0.05	NS
Triglycerides (mmol/l)¶	A	1.02	0.03	1.03	0.04	0.98	0.02	NS
	B	1.04	0.04	1.01	0.05	1.00	0.04	NS

*All types of beverages except wine; †all types of beverages; ‡adjusted for hypolipidaemic drugs, centre and total alcohol consumption; §adjusted for antihypertensive, antidiabetic, hypolipidaemic drugs, centre, age, waist to hip ratio, smoking, systolic blood pressure, years of schooling, physical activity and total alcohol consumption; ¶performed after log transformation.

both men and women. On the other hand, triglycerides increased when alcohol consumption reached 40 g/day in men whereas, in women, no obvious trend was observed when total alcohol intake increased. The small percentage of women consuming more than 40 g/day of alcohol (4%) could account for the different pattern concerning the alcohol-triglycerides relation found in men. This graded response of HDL-c with alcohol consumption and the rise of triglyceride with a daily alcohol intake of 40 g, has been reported in a similar study carried out in a Japanese population sample of men aged 35–59 years.[20] The results of our report are consistent with a majority of epidemiological studies describing a positive relation between HDL-c and alcohol consumption.[4 21–27]

The relations between the types of beverages and blood lipids were tested in a linear regression model and according to three patterns of alcoholic beverages. In the first approach the results showed that HDL-c was associated positively with wine and beer in men, and in women with wine and aperitif consumption. For both sexes, these beverages represented the highest proportion of alcohol intake. In men, wine and beer together represented 86% of the total alcohol intake, and in women, wine and aperitifs reached 82%. Therefore, we can suggest that the association between alcohol and HDL-c (similar relation with Apo A-I) was influenced more by the amount of alcohol in the different types of beverages than by the types of beverages in themselves. The specific influence of a given alcoholic beverage on HDL-c seems rather hypothetical. In any case, the demonstrated influence of alcoholic beverages on HDL-c results from the specific role of ethanol. The potential additive effect of wine [5 9] against ischaemic heart diseases, or of beer [7 8] or of any type of alcoholic beverages [9] is probably not mediated by HDL-c metabolism.

On the other hand, we found a positive association between beer and triglycerides in men and in women. It seems that the quantity of alcohol alone cannot account for this relation, as the proportion of alcohol supplied by beer, when compared with other beverages was low in women and just a little higher in men than in women.

In the second approach, considering wine compared with non-wine consumption, we tried to assess whether blood lipids were associated with drinking patterns. After adjustment for total alcohol intake, centre and hypolipidaemic drugs, the results showed that the HDL-c levels were significantly higher for wine consumers versus non-wine consumers. When adjustment was performed for other covariates, differences between drinking patterns were reduced and the relation became non-significant. The finding was consistent for men and women. In contrast, after adjustment for the same parameters, triglyceride level in men remained significantly higher in non-wine drinkers despite attenuated differences between the three groups. In women, the lack of relation between triglycerides and drinking patterns was in agreement with the low amount of total alcohol intake.

Thus, the relations between the different types of beverages and HDL-c or Apo A-I could be largely explained by standard of living, sociocultural factors and the balance between the amount of the different types of alcohol intake and the preference beverage.

Globally in this study, the amount of total alcohol intake was positively associated with age, tobacco consumption, body mass index, waist to hip ratio, and negatively with years of schooling. When considering the different types of alcoholic beverages, it has been shown that in populations where wine is not the main alcoholic beverage, wine drinkers had a healthier lifestyle and a lower risk factor profile when compared with other drinkers.[28–30] It was shown that moderate consumption of wine was associated with good subjective health also.[31] In this study similar traits were found in wine drinkers. Body mass index was lower and the proportion of alcohol supplied by wine was higher in the subjects who had physical activities and a higher educational level. By contrast, beer drinkers were associated with a higher proportion of current smokers, a higher proportion of men, a lesser physical activity and a higher waist to hip ratio.

The area of residence was also one of the main determining factors for the choice of alcoholic beverage as it was reported 10 years ago.[32] Beer was mainly consumed in the north of France and wine in the south whatever the sex. In this study, beer represented 31% and wine 56% of total alcohol intake for men living in the north. By contrast, in the south, wine accounted for 87% and beer 5% of total alcohol intake. A similar pattern was found for women. Aperitifs were consumed mainly in the north and spirits in the east of France.

In France, wine is the most common and the most popular alcoholic beverage. Its wide range of prices makes it affordable whatever the socioeconomic status of the population. In this population sample, among alcohol consumers, the proportion of people who did not consume wine was very low, 7.7% and 12.7% of men and women respectively. Even among the mixed consumption pattern, wine was preponderant and represented 66% of total alcohol intake. Therefore, we can assume that familial, social and cultural environments influence the choice of alcoholic beverages. These results suggest that lifestyle standards connected with wine preference are associated with a better blood lipid profile.

Furthermore, one of the main factors influencing blood lipids that is not taken into account in this study is the diet. A recent publication concerning a survey carried out in

Key points

- Total alcohol consumption is positively associated with high density lipoprotein and triglycerides.
- The influence of any specific alcoholic beverage on blood lipids is not demonstrated.
- A more favourable blood lipid profile is observed among wine consumers with the highest lifestyle standards.

Denmark reported that wine drinking was associated with a higher intake of fruit, vegetables and olive oil for cooking.[15] Nutritional habits and cardiovascular risk factors were investigated comparing a French population with a Northern Irish population. The conclusion was identical: wine drinkers had a healthier dietary pattern than other alcoholic beverage consumers.[33]

Moreover, a possible bias related to misreported alcohol intake leading to misclassified subjects was considered by comparing reported alcohol consumption with γ-glutamyltransferase, mean corpuscular volume and CAGE questionnaire. The comparison of mean values of alcohol consumption across the ordered groups of γ-glutamyltransferase, mean corpuscular volume and the CAGE questionnaire showed a significant graded relation (data not shown). The same analyses were then performed for HDL-c, Apo A-I and triglycerides. The results showed that the relations found with these markers were consistent with the findings in the alcohol groups. These relations when compared to the alcohol questionnaire were more consistent with mean corpuscular volume for HDL-c and Apo A-I and with γ-glutamyltransferase and the CAGE questionnaire for triglycerides.

CONCLUSION

In a French population sample, total alcohol intake was positively correlated with HDL-c, Apo A-I and triglycerides in both men and women. A specific influence on lipids by a given alcoholic beverage was not demonstrated clearly. However, nutritional habits, lower cardiovascular risk and higher social status linked to a wine consumption pattern could induce a more favourable blood lipid profile. In contrast, high alcohol intake is associated with high blood pressure, high waist hip ratio, the rise of triglyceride levels and unfavourable lifestyle behaviours such as smoking habits and low physical activity.

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