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Alcohol intake and diet in France, the prominent role of lifestyle

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Aim Moderate alcohol intake is related to a decrease of coronary heart disease. This protective effect may be attributed to ethanol but may also depend on the type of alcoholic beverages. However, these differences may be confounded by lifestyle and diet. We investigated the relationships between alcohol consumption, beverage type preference and socio-economic status, diet and lifestyle.
Methods and results A cross-sectional survey on cardiovascular risk factors and nutrition was carried out from 1995 to 1997 by the French MONICA Centres. A sample of 1110 middle-aged men (45–64 years) was randomly recruited; 12.8% of men were abstainers and 16.3% reported a consumption of $\geqslant 60$ g/d alcohol. Smoking, waist-to-hip ratio and hypertension increased along with the amount of alcohol intake. Physical activity (from 40.9% in abstainers to 23.8% in heavy drinkers, $p = 0.0025$), educational level (from 11.9 ± 4.4 to 11.1 ± 3.8 years, $p = 0.01$), socio-economic status and diet quality index (from 7.1 ± 2.3 to 6.3 ± 2.0, $p < 0.0001$ after multivariate adjustment) decreased along with the increase of alcohol consumption and were higher among wine drinkers than among beer or mixed drinkers. Diet quality index was 7.1 ± 1.9, 6.4 ± 1.8 and 6.6 ± 1.9 among wine, beer and mixed drinkers, respectively ($p = 0.007$ after multivariate adjustment).
Conclusion Moderate alcohol drinkers or wine drinkers have healthy diet and behaviours compared to other drinkers or abstainers. The living area plays a significant role in the dieting behaviours.

Introduction

An inverse association between moderate alcohol intake and ischaemic heart disease has been extensively reported in epidemiological studies and specific alcoholic beverages, like wine or beer, have been proposed to exert a protection against cardiovascular disease.[1–6] However, the relationships between alcohol intake and ischaemic heart disease and the relationships between the types of alcoholic beverage intakes and ischaemic heart disease are complex and confounded by social and cultural factors, lifestyle and diet.[7,8] Barefoot et al.[9]

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suggested that demographically homogeneous samples, but heterogeneous with regard to beverage preference, are the most informative and reliable samples to make comparisons. This may apply to French regions as health and social systems, education, and health policy are centralised systems and relatively homogeneous on the whole territory but diet and alcohol drinking behaviours are strongly varying between regions.[10] Using a cross-sectional population study carried out in three areas of France, we investigated the relationships between the level of alcohol consumption and the beverage type preference with the socio-economic status, diet and lifestyle characteristics of the individuals.

Methods

Population sampling

The goal of the study was to evaluate alcohol intake and beverage preference according to socio-economic parameters, diet and lifestyle in the population. Hence, the design was a cross-sectional population-based study and the sample was randomly selected from the population. A cross-sectional survey on cardiovascular risk factors and nutrition was carried out in 1995–1997 by the three French MONICA Centres (MONItoring of trends and determinants in CArdiovascular disease).[11] A sample of 1110 middle-aged men (45–64 years), living in Lille (Northern France), Strasbourg (North-eastern France) or Toulouse (South-western France) areas, was randomly recruited.[12,13,14] Polling lists (nominal lists for French inhabitants aged over 18 years) available in each town hall of the survey areas were used for sampling in order to carry out a random selection of the general population. Participants were volunteers and received no financial compensation. The response rate reached 60% of the contacted people. The study protocol was approved by an institutional review-committee in agreement with the French Law on Human Biomedical Research. An informed consent to participate in the study was obtained from each subject.

Collected data

Extensive questionnaires were completed by the participants with the help of trained and certified medical staff to collect data on age, socio-economic status, occupational activity, previous medical history, drug intake, cardiovascular risk factors including smoking habits (past and present behaviour and the number of cigarettes, pipes or cigars smoked) and way of life. Education level was assessed by a report of the number of completed years of schooling (from the beginning of the primary school until graduation or school dropout). Four levels of leisure time physical activity were defined: no regular physical activity, light physical activity (i.e., less than once a week), moderate physical activity (i.e., 20 min at least, once or twice a week) and high physical activity (i.e., 20 min at least, three times a week or more). Specific dietary habits of subjects with cardiovascular risk factors were registered.

Clinical measurements

Research nurses, specially trained in agreement with the MONICA protocol,[15] performed clinical measurements. Anthropometrical 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 5-min rest. Measurements were rounded to the nearest 2 mm Hg. The average of the two measurements was used for the statistical analysis.

Assessment of dietary intakes

Food and alcohol intakes were assessed using a food record method.[16] Participants were given oral and written instructions on how to keep a three-consecutive day food intake diary. Every day, they had to record all the food and beverages (types and amounts) they consumed throughout three consecutive days in the week following the exam (two week-days and one week-end day). A few days (from two to four) after the questionnaire completion, each participant was interviewed at home by a certified dietician, in the presence of the person who prepared the meals. Contents of household measures were evaluated by the dietician with a measuring glass. Food estimates were facilitated by the use of photographs showing portion sizes and their respective weight. Recorded data were carefully checked by the dietician who, in order to avoid forgotten or misreported data, submitted a list of various food categories to the participants to check the reliability of the data. For meals that were not taken at home (in restaurants, canteens,...), the cook was contacted and the composition of the dishes and their respective portion size were recorded.

Food data were translated into nutrient values using Renaud and Regal food composition tables.[17,18] For each participant, mean total daily energy intake, mean daily energy intake without alcohol, mean daily macronutrient and alcohol intakes, mean proportions of energy supplied by proteins, fats and carbohydrates in daily energy intake without alcohol, and mean proportion of energy supplied by alcohol in total daily energy intake were estimated by calculating the average of the three days. The validity of energy intake records was assessed by calculating, for each subject, the ratio between total recorded daily energy intake and the estimated basal metabolic rate.[19,20] The basal metabolic rate was estimated according to Schofield's equations based on body weight, age and sex.[21] All the analyses were performed both on the whole sample and after exclusion of the subjects with a ratio below 1.05.

Assessment of alcohol intake

Total alcohol consumption and alcohol intake for each beverage type were assessed according to two methods; first, using a food record method as mentioned above and second by a quantitative questionnaire administered by a specially trained nurse. Moreover, drinking patterns, specifying time and place of consumption, types of beverage and alcohol addiction (CAGE questionnaire),[22,23] 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.

The correlations between alcohol variables obtained from food-record method and typical weekly questionnaire were highly significant. For total alcohol, wine and beer consumptions, Spearman rank correlation coefficients were 0.78, 0.78 and 0.70, respectively. The total alcohol intake per day was, on the average, 28.8 ($\pm$24.0) g/d according to the food record method and 32.8 ($\pm$30.3) g/d according to the weekly quantitative questionnaire. For analysis, weekly questionnaire data were chosen because they took into account all days of the week. The subjects were classified according to their total alcohol intake given by the weekly quantitative questionnaire. In this study, subjects were ranked according to their alcohol intake with a constant interval of 20 g of alcohol intake a day, corresponding approximately to two drinks. Five ordered groups were considered: non-drinkers, 1–19, 20–39, 40–59 and more than 59 g of alcohol consumed per day. Considering alcohol beverage preference, the declared abstainers were excluded. If, at least 70% of the total alcohol consumed was supplied by wine then the subject was categorised as wine drinker, similarly when 70% or more of intake was provided by beer then the subject was classified as beer drinker. For the same subject, when the consumption of beer and wine was less than 20% of the total alcohol intake, the subject was excluded from the analysis. When both beer and wine consumption varied between 20% and 70%, whatever the amount of other alcoholic beverages, the alcohol drinker pattern was considered as mixed preference.

Statistical analysis

Statistical analysis was performed using the SAS statistical software, release 8.2 (SAS Institute Inc., Cary, NC, USA). The variable of interest (alcohol intake) was considered first as continuous and second after categorisation as described in the section where alcohol intake was assessed. Since the results obtained were similar when alcohol was categorised, categorisation was given because it was a patent illustration of the relationships studied. Firstly, a bivariate analysis was performed to select socio-economic and lifestyle parameters associated with alcohol intake and alcoholic beverage drinking pattern. Secondly, the relationship between alcohol intake and diet on the one hand and alcoholic beverage drinking pattern and diet on the other hand was adjusted for confounders that is to say; age, educational level, body mass index, smoking status, physical activity and dieting. Lastly, an additional adjustment was performed for living area, acknowledged to exert an influence on drinking patterns and nutritional behaviours. In bivariate analysis, χ^2 test was used to compare the distribution of qualitative variables between classes of alcohol consumption or types of alcohol preference. Mean values of quantitative variables were compared by one-way analysis of variance. The Shapiro–Wilks and the Levene's tests were used to test the normality of the distribution of residuals and the homogeneity of variances, respectively. When basic assumptions of ANOVA were not satisfied, a logarithmic transformation of the variables was done or a Kruskal–Wallis test was performed. Analysis of covariance was used to adjust group differences upon daily energy intake, nutrient consumption, proportion of energy supplied by macronutrients and food intakes. A first step adjustment was performed systematically for age, education level, body mass index, smoking status, physical activity and dieting, then the living area was also introduced in a second step. Due to the multiple outcome measurements, the level of significance was weighed by the Bonferroni's method; the level of significance used was $p < 0.005$.

A diet-quality index based on nutritional recommendations[24,25], taking into account the traditional diet of France[26,27], was established. Fifteen types of food or food groups were selected to set up the diet scale. A dichotomous codification was used for each food consumed: a score of 1 was assigned when the daily consumption (the mean of the three consecutive record days) of the subject was superior to the median consumption of the population sample concerning the following types of food or food groups (fruit, vegetable, legumes, bread, cereals, fish, meat with less than 10% of fat, milk and soft cheese, added vegetable oil) and 0: when the consumption was below the median consumption of the population sample. Symmetrically for the following types of food (butter, sugar, potatoes, cheese, eggs, meat with fat = 10%), 1 was assigned when the individual's consumption was below the median consumption of the population sample and 0 when the consumption was superior to the median.

Results

Table 1 shows the major characteristics of the subjects according to their class of total alcohol consumption. In this population sample, 12.8% of men reported that they drank no alcohol at all and 16.3% of men reported a consumption equalling at least 60 g alcohol a day. The highest proportion of heavy drinkers lived in the area of Lille (Northern) and the highest proportion of abstainers in the Toulouse area (South-western). Physical activity, the number of years spent in school or the highest level of diploma awarded and the socio-economic status decreased along with the increase of alcohol consumption. The number of cigarettes smoked or the proportion of current smokers, the waist-to-hip ratio, hypertension or the use of hypotensive drugs, the Cage score and γ-glutamyltransferase (GGT) levels and mean corpuscular volume (MCV) increased along with the amount of total alcohol intake.

Table 2 presents the major characteristics of the subjects according to their alcohol type preference. Wine drinkers were older (four years on the average) than beer drinkers. The proportion of wine drinkers was higher in the area of Toulouse, and conversely the proportion of beer drinkers was higher in the Lille and Strasbourg areas. The proportion of cigarette smokers or the number of cigarettes smoked per day, the plasma levels of γ-glutamyltransferase and the Cage score were significantly higher among beer drinkers than among wine drinkers. The proportion of participants following a specific diet for hypertension, hypercholesterolaemia or diabetes was higher among wine drinkers. Subjects who had moderate to high physical activity were significantly fewer in the beer drinker group.

Table 3 gives mean daily intake of energy and selected nutrients expressed as absolute mean value and in proportion of daily energy intake according to total alcohol consumption. Total energy intake increased, whereas energy without alcohol decreased along with higher alcohol intake. Carbohydrate intake decreased and conversely protein and fat increased along with alcohol intake. Mono-unsaturated and saturated fat increased along with alcohol intake, whereas poly-unsaturated fat remained stable. Dietary cholesterol increased and fibre decreased along with alcohol intake. These relationships remained significant after adjustment for confounders (age, level of education, tobacco consumption, physical activity, BMI, dieting and after further adjustment for the living area).

Table 4 shows food consumption, expressed as density (for 1000 kcal/d), across categories of alcohol intake. Heavy drinkers were characterised by a higher intake of

Table 1 Characteristics of the study participants by alcohol consumption ($n = 1100$)

	Alcohol (g/d)					p
	0 ($n = 142$)	1–19 ($n = 313$)	20–39 ($n = 275$)	40–59 ($n = 190$)	>59 ($n = 180$)	
Age (y)	51.2 (7.1)	53.0 (7.5)	53.3 (7.5)	54.7 (7.3)	54.7 (6.8)	<0.0001
Schooling (y)	11.9 (4.4)	12.4 (3.9)	11.6 (3.7)	11.8 (3.5)	11.1 (3.8)	0.011
Tobacco consumption (cig/d)[a]	4.8 (10.5)	2.6 (7.3)	3.4 (8.6)	5.1 (10.0)	7.7 (12.8)	<0.0001
BMI (kg/m^2)	26.9 (4.6)	27.2 (4.0)	26.8 (3.3)	27.5 (4.3)	27.5 (4.2)	0.21
WHR	0.94 (0.08)	0.95 (0.06)	0.96 (0.06)	0.96 (0.06)	0.97 (0.06)	0.001
GGT (UI/l)[b]	54.8 (43.7)	53.1 (46.3)	61.2 (62.5)	76.0 (89.7)	99.2 (89.3)	<0.0001
MCV (fl)	90.2 (3.9)	90.6 (3.9)	91.5 (4.2)	92.0 (4.1)	93.4 (4.9)	<0.0001
Centre (%)						<0.0001
Lille	28.2	27.2	33.9	31.0	51.9	
Strasbourg	32.4	41.1	36.5	39.7	24.3	
Toulouse	39.4	31.6	29.6	28.5	23.8	
Physical activity (%)	40.9	38.6	31.1	30.4	23.8	0.0025
Smoking (current) (%)	23.2	14.2	19.1	27.8	34.3	<0.0001
Dieting (%)	23.9	22.8	20.6	21.7	30.0	0.93
Socio-economic status (%)						0.0006
White collars	22.5	31.3	24.2	27.8	18.8	
Intermediate	25.4	33.2	26.4	30.4	24.9	
Blue collars	52.1	35.4	49.5	41.8	56.4	
Cage (%)						
Definition 1	13.2	11.4	23.4	31.5	49.4	<0.0001
Definition 2	6.6	4.9	13.6	19.0	29.7	<0.0001
Employed (%)	62.0	66.1	65.0	62.9	55.3	0.16
Large city (%)	38.7	28.2	31.8	37.1	45.9	0.002
Drug (%)						
Hypotensive	12.7	14.9	15.2	24.7	25.4	0.0008
Lipid-lowering	15.5	12.7	15.5	13.4	17.7	0.59
Antidiabetic	4.2	6.6	3.6	5.8	3.9	0.43
Risk factors (%)						
Hypertension	28.2	31.3	28.2	38.7	44.2	0.002
Dyslipidaemia	46.5	46.5	47.7	48.9	56.4	0.26
Diabetes	7.0	7.3	4.7	8.3	8.8	0.45

BMI: body mass index; WHR: waist-to-hip ratio; GGT: γ-glutamyltransferase; MCV: mean corpuscular volume.
Physical activity (i.e., 20 min at least, once or twice a week or more).
Smoking (current cigarette smoker).
Cage definition 1 (at least two positive answers).
Cage definition 2 (at least three positive answers).
Hypertension: drugs or SBP $\geqslant$160 or DBP $\geqslant$95 mm Hg.
Dyslipidaemia: drugs or total cholesterol $\geqslant$6.2 mmol/l.
Diabetes: drugs or blood glucose $\geqslant$7.8 mmol/l.
[a] Kruskal–Wallis test.
[b] log transformed data.

meat rich in fat and a lower consumption of cereal, fruit, soft cheese and sugar. The diet quality index score decreased from moderate alcohol drinkers (1–19 g/d) to heavy drinkers from 7.1 (2.0) to 6.3 (2.0), respectively. A similar trend was observed in the subjects with a score <6, with a more than double percentage of heavy drinkers (37.6) when compared with moderate drinkers (16.1%). Globally, the differences between classes of alcohol intake remained significant after adjustment for age, level of education, tobacco consumption, physical activity, BMI, dieting and after further adjustment for the living area.

Table 5 shows the mean daily intake of energy and selected nutrients, expressed as absolute value, and in proportion to daily energy intake according to beverage drinking preferences. Energy intake was about 9% higher among beer drinkers than among wine drinkers. This difference remained significant after adjustment for age, level of education, tobacco consumption, physical activity, BMI, dieting and total alcohol consumption. Energy supplied by protein was higher and the energy from fat lower among wine drinkers than among beer drinkers. Dietary cholesterol and fibre intake was higher among wine drinkers than in the other groups.

Table 6 gives food consumption according to beverage preferences. Consumption of vegetables, fruits, bread, soft cheese and eggs was significantly higher and potatoes consumption significantly lower among wine drink-

Table 2 Characteristics of subjects by alcohol beverage drinking pattern ($n = 930$)

	Mean (SD)			p
	Beer preference ($n = 92$)	Mixed consumption ($n = 258$)	Wine preference ($n = 580$)	
Total alcohol (g/d)	35.4 (26.7)	43.7 (35.0)	36.3 (26.7)	
% of alcohol from beer	76.5 (21.5)	40.3 (14.6)	3.3 (5.5)	
% of alcohol from wine	6.2 (7.2)	51.2 (15.1)	86.6 (15.2)	
% of alcohol from aperitifs	16.5 (20.6)	7.8 (8.8)	9.6 (13.8)	
Age (y)	50.9 (7.0)	52.5 (7.9)	54.8 (7.0)	<0.0001
Schooling (y)	11.3 (3.7)	12.2 (4.0)	11.8 (3.7)	0.15
Tobacco consumption (cig/d)[a]	6.8 (11.8)	4.6 (9.8)	3.6 (9.1)	0.0084
BMI (kg/m^2)	27.9 (4.7)	26.9 (3.7)	27.2 (3.8)	0.11
WHR	0.96 (0.07)	0.96 (0.06)	0.96 (0.06)	0.92
GGT (UI/l)[b]	75.2 (78)	74.4 (72)	65.6 (72)	0.046
MCV (fl)	91.7 (5.2)	91.5 (4.3)	91.7 (4.1)	0.68
Centre (%)				<0.0001
Lille	53.7	40.1	28.0	
Strasbourg	45.2	54.9	27.9	
Toulouse	1.1	5.0	44.1	
Physical activity (%)	17.2	24.4	38.0	<0.0001
Smoking (current) (%)	30.1	24.4	19.8	0.048
Dieting (%)	11.8	18.3	23.9	0.012
Socio-economic status (%)				0.31
White collars	21.5	25.2	27.5	
Intermediate	30.1	26.0	30.4	
Blue collars	48.4	48.8	42.1	
Cage (%)				
Definition 1	31.9	29.3	23.6	0.095
Definition 2	24.2	16.6	12.7	0.013
Employed (%)	69.9	66.4	60.5	0.093
Large city (%)	36.6	30.9	35.6	0.41
Drug (%)				
Hypotensive	14.0	15.7	21.0	0.082
Lipid-lowering	14.0	11.5	15.7	0.26
Antidiabetic	1.1	5.0	5.1	0.22
Risk factors (%)				
Hypertension	36.6	34.0	33.5	0.85
Dyslipidaemia	52.7	48.1	49.4	0.75
Diabetes	2.2	6.9	7.4	0.18

BMI: body mass index; WHR: waist-to-hip ratio; GGT: γ-glutamyltransferase; MCV: mean corpuscular volume.
Physical activity (i.e., 20 min at least, once or twice a week or more).
Smoking (current cigarette smoker).
Cage definition 1 (at least two positive answers).
Cage definition 2 (at least three positive answers).
Hypertension: drugs or SBP $\geqslant$160 or DBP $\geqslant$95 mm Hg.
Dyslipidaemia: drugs or total cholesterol $\geqslant$6.2 mmol/l.
Diabetes: drugs or blood glucose $\geqslant$7.8 mmol/l.
Abstainers were excluded.
[a] Kruskal–Wallis test.
[b] log transformed data.

ers than among beer drinkers. The diet quality index was higher among wine drinkers than among beer drinkers with an intermediate value for drinkers in the "mixed preference" group. These differences remained significant after adjustment for age, educational level, physical activity, smoking, BMI, diet and total alcohol consumption. However, all of them became non-significant after additional adjustment for the living area.

Although the proportion of under-reporters, i.e., subjects with a low energy intake record (ratio between their recorded total daily energy intake and their estimated basal metabolic rate < 1.05) decreased from abstainer group to heavy drinker group (19.7%, 12.8%, 13.1%, 11.5% and 8.3%, respectively), the exclusion of these subjects did not affect significantly any of the results. Considering the alcohol drinking pattern, the

Table 3 Energy and selected nutrients reported by alcohol consumption ($n = 1100$)

	Alcohol (g/d)					p non-adjusted	p adjusted[a]
	0 ($n = 142$)	1–19 ($n = 313$)	20–39 ($n = 275$)	40–59 ($n = 190$)	>59 ($n = 180$)		
Total alcohol (g/d)	–	10.1 (5.3)	29.2 (5.7)	49.4 (5.7)	85.9 (24.8)		
% wine from total alcohol	–	61.8 (34)	71.5 (29)	71.8 (30)	63.3 (30)		
% beer from total alcohol	–	18.1 (26)	19.5 (27)	19.5 (27)	26.1 (28)		
% aperitif from total alcohol	–	19.2 (27)	8.3 (12)	7.9 (12)	9.9 (16)		
Total energy (kcal/d)	2290 (664)	2389 (601)	2433 (568)	2601 (634)	2707 (667)		
Energy without alcohol (kcal/d)	2290 (664)	2322 (597)	2217 (569)	2261 (633)	2099 (619)	0.001	0.0086
Macro-nutrients (g/d)							
Protein	94 (24)	95 (24)	94 (24)	95 (22)	91 (28)	0.42	0.52
Vegetable protein	25.9 (9.6)	27.2 (8.8)	24.8 (8.4)	25.1 (8.3)	22.7 (8.9)	<0.0001	<0.0001
Fat	102 (35)	103 (33)	102 (32)	105 (34)	99 (34)	0.58	0.31
Poly-unsaturated fat	17.5 (8.6)	17.9 (8.4)	16.5 (8.0)	17.1 (8.3)	16.4 (9.6)	0.24	0.40
Mono-unsaturated fat	35.6 (13.0)	36.6 (12.9)	36.7 (12.3)	37.9 (13.8)	36.0 (13.2)	0.51	0.13
Saturated fat	40.1 (15.9)	40.2 (14.7)	40.4 (14.5)	41.4 (15.1)	39.0 (14.3)	0.63	0.38
Carbohydrate	250 (87)	253 (79)	231 (69)	235 (84)	210 (75)	<0.0001	<0.0001
Poly-saccharide	150 (59)	156 (52)	144 (52)	143 (51)	130 (57)	<0.0001	<0.0001
% of energy from							
Protein	16.9 (3.3)	16.7 (3.1)	17.2 (3.3)	17.2 (3.4)	17.6 (3.5)	0.05	0.14
Fat	39.8 (6.4)	39.9 (6.2)	41.1 (5.8)	41.3 (6.1)	42.5 (6.4)	<0.0001	<0.0001
Carbohydrate	43.3 (6.7)	43.3 (6.6)	41.7 (6.3)	41.4 (6.6)	39.9 (7.1)	<0.0001	<0.0001
Poly-saccharide	26.1 (6.7)	26.8 (5.8)	25.9 (6.1)	25.4 (6.1)	24.3 (6.7)	0.0005	0.0002
Poly-unsaturated fat	6.8 (2.8)	6.9 (2.7)	6.7 (2.6)	6.8 (2.7)	6.9 (2.9)	0.75	0.78
Mono-unsaturated fat	14.0 (2.9)	14.1 (3.0)	14.8 (3.0)	14.9 (3.1)	15.4 (3.1)	<0.0001	<0.0001
Saturated fat	15.6 (4.0)	15.5 (3.4)	16.3 (3.2)	16.3 (3.5)	16.7 (3.6)	0.0008	0.0025
Density							
Dietary cholesterol (mg/1000 kcal)	208 (80)	200 (71)	214 (66)	217 (69)	226 (94)	0.003	0.017
Fibre (g/1000 kcal)	6.2 (3.8)	6.0 (3.6)	5.7 (3.6)	5.7 (3.8)	5.8 (3.5)	0.58	0.14

[a] Adjusted for age, schooling, tobacco consumption, physical exercise, body mass index and dieting.

Table 4 Selected food and food groups reported by alcohol consumption ($n = 1100$)

Density (g/1000 kcal)	Alcohol (g/d)					p non-adjusted	p adjusted[a]
	0 ($n = 142$)	1–19 ($n = 313$)	20–39 ($n = 275$)	40–59 ($n = 190$)	>59 ($n = 180$)		
Meat (⩾10% of fat)	40.4 (30.7)	35.7 (25.1)	45.5 (29.4)	44.2 (29.2)	56.9 (34.3)	<0.0001	<0.0001
Meat (<10% of fat)	36.8 (27.6)	39.4 (27.6)	39.1 (31.7)	40.3 (30.8)	39.2 (35.2)	0.88	0.81
Fish	20.6 (29.6)	19.4 (25.1)	19.4 (23.7)	25.1 (32.3)	20.6 (23.5)	0.14	0.18
Vegetables	97.4 (69.1)	93.8 (60.8)	93.6 (60.0)	87.0 (58.8)	91.5 (68.3)	0.60	0.29
Fruit	86.3 (88.9)	77.5 (60.6)	69.5 (60.1)	67.6 (67.7)	59.9 (68.4)	0.002	0.005
Bread	56.8 (29.6)	60.1 (30.4)	59.6 (29.9)	55.6 (28.3)	56.2 (31.4)	0.34	0.19
Cereal	27.3 (21.9)	29.1 (22.9)	24.9 (19.4)	25.9 (21.0)	20.1 (17.6)	<0.0001	0.006
Butter	6.4 (5.7)	6.3 (5.6)	6.5 (6.4)	7.0 (6.0)	6.5 (6.1)	0.78	0.81
Milk and cottage cheese	99.4 (91.6)	86.2 (68.1)	72.5 (75.3)	64.0 (65.6)	51.8 (66.1)	<0.0001	<0.0001
Cheese	17.7 (15.2)	18.5 (12.9)	20.3 (15.4)	20.0 (13.8)	21.0 (15.1)	0.17	0.26
Eggs	10.9 (13.1)	10.0 (12.0)	11.1 (12.6)	11.4 (11.5)	12.1 (13.5)	0.44	0.71
Added vegetable fat	8.1 (4.8)	8.4 (4.9)	7.9 (5.0)	7.9 (4.9)	8.5 (5.5)	0.63	0.66
Potatoes	52.3 (45.8)	49.1 (39.6)	57.2 (48.5)	55.3 (43.4)	68.9 (47.2)	<0.0001	0.02
Legumes	2.5 (6.9)	3.0 (10.0)	2.7 (7.3)	3.2 (8.1)	4.0 (9.2)	0.50	0.75
Sugar	19.3 (16.7)	15.9 (10.6)	14.7 (10.8)	15.5 (9.9)	14.2 (11.6)	0.0006	<0.0001
Diet quality index	7.1 (2.3)	7.4 (2.0)	7.1 (2.0)	6.7 (2.1)	6.3 (2.0)	<0.0001	<0.0001
% of subjects with score <6	26.1	16.1	22.7	29.4	37.6	<0.0001	

[a] Adjusted for age, schooling, tobacco consumption, physical exercise, body mass index and dieting.

Table 5 Energy and selected nutrients reported by alcohol drinking pattern ($n = 930$)

	Mean (SD)			p non-adjusted	p adjusted[a]
	Beer preference ($n = 92$)	Mixed consumption ($n = 258$)	Wine preference ($n = 580$)		
Total energy (kcal/d)	2671 (816)	2580 (648)	2450 (572)	0.0002	0.018
Energy without alcohol (kcal/d)	2421 (796)	2276 (623)	2196 (560)	0.0013	0.018
Protein (g/d)	93 (23)	94 (26)	94 (24)	0.90	0.64
Vegetable protein (g/d)	26.4 (9.8)	25.0 (8.4)	25.3 (8.8)	0.34	0.43
Fat (g/d)	111 (37)	107 (35)	99 (31)	<0.0001	0.0071
Poly-unsaturated fat (g/d)	18.1 (9.8)	17.6 (8.9)	16.8 (8.2)	0.22	0.44
Mono-unsaturated fat (g/d)	39.5 (13.3)	38.2 (13.4)	35.8 (12.8)	0.004	0.059
Saturated fat (g/d)	44.2 (18.1)	42.2 (15.1)	38.8 (13.9)	0.0002	0.0079
Carbohydrate (g/d)	263 (111)	234 (74)	232 (72)	0.0008	0.003
Poly-saccharide (g/d)	154 (64)	143 (50)	145 (53)	0.25	0.52
% of energy from					
Protein	16.0 (3.1)	16.7 (3.2)	17.5 (3.2)	<0.0001	<0.0001
Fat	41.3 (5.3)	42.1 (5.9)	40.5 (6.3)	0.0026	0.035
Carbohydrate	42.6 (6.3)	41.2 (6.3)	42.0 (6.9)	0.11	0.12
Poly-saccharide	25.0 (5.8)	25.3 (5.9)	26.2 (6.2)	0.064	0.23
Poly-unsaturated fat	6.7 (3.1)	6.9 (2.7)	6.8 (2.7)	0.96	0.71
Mono-unsaturated fat	14.8 (2.7)	14.9 (2.7)	14.6 (3.2)	0.20	0.58
Saturated fat	16.3 (3.3)	16.5 (3.3)	15.8 (3.5)	0.023	0.17
Density					
Dietary cholesterol (mg/1000 kcal)	200 (63)	205 (66)	217 (79)	0.024	0.0022
Fibre (g/1000 kcal)	4.4 (2.8)	4.3 (3.1)	6.6 (3.7)	<0.0001	<0.0001

[a] Adjusted for age, schooling, tobacco consumption, physical exercise, body mass index, dieting and alcohol consumption.

Table 6 Selected food and food groups reported by alcohol beverage drinking pattern ($n = 930$)

Density (g/1000 kcal)	Mean (SD)			p non-adjusted	p adjusted[a]
	Beer preference ($n = 92$)	Mixed consumption ($n = 258$)	Wine preference ($n = 580$)		
Meat (⩾10% of fat)	47.9 (34.1)	43.5 (28.6)	43.8 (29.6)	0.41	0.52
Meat (<10% of fat)	38.2 (32.3)	40.7 (29.8)	39.5 (31.3)	0.78	0.62
Fish	15.7 (20.2)	18.4 (29.1)	22.6 (25.1)	0.013	0.078
Vegetables	67.8 (50.5)	77.5 (50.3)	101.3 (64.3)	<0.0001	<0.0001
Fruit	61.8 (65.7)	53.3 (55.4)	78.8 (65.5)	<0.0001	<0.0001
Bread	52.3 (27.9)	52.9 (25.9)	61.7 (31.4)	<0.0001	0.0036
Cereal	24.0 (21.3)	24.9 (22.0)	25.9 (20.3)	0.62	0.61
Butter	5.6 (5.4)	6.1 (5.8)	6.8 (6.2)	0.088	0.13
Milk and soft cheese	54.7 (58.4)	62.9 (64.3)	77.3 (73.7)	0.001	0.035
Cheese	18.5 (15.8)	19.7 (15.1)	19.7 (13.5)	0.75	0.84
Eggs	10.2 (11.6)	8.5 (11.3)	12.1 (12.7)	0.0005	0.0006
Added vegetable oil	7.8 (6.1)	8.0 (4.8)	8.3 (5.0)	0.69	0.79
Potatoes	69.4 (47.0)	61.2 (48.8)	52.5 (42.6)	0.0004	0.0013
Legumes	1.6 (3.9)	2.7 (7.3)	3.6 (9.9)	0.079	0.11
Sugar	16.7 (12.7)	13.9 (10.1)	15.3 (10.5)	0.062	0.062
Diet quality index	6.4 (1.8)	6.6 (1.9)	7.1 (1.9)	<0.0001	0.007
% of subjects with score <6	32.3	31.3	20.3	0.0006	

[a] Adjusted for age, schooling, tobacco consumption, physical exercise, body mass index, dieting and alcohol consumption.

percentages of subjects who reported low energy diet were similar in the three groups (10.9% in the beer preference group, 10.9% in the mixed preference group and 12.4% in the wine preference group) and the results did not change significantly when these subjects were excluded from the analysis.

Discussion

Our study evaluated quantity of alcohol intake and beverage preferences according to the socio-economic status, diet and lifestyle characteristics in a large and representative sample of 1100 adult men originating from three different regions in France. In this population sample, the groups of moderate drinkers (total alcohol, between 1 and 19 g of pure ethanol a day) and wine drinkers were associated with a healthier diet than the others. The moderate drinkers belonged more often to the upper social class, with the highest percentage of white collars and the highest mean educational level. This more favourable nutritional behaviour was also associated with other healthier behaviours. The percentage of current cigarette smokers in this group of drinkers did not reach 15%, two-fold lower than excessive drinkers, that is to say a consumption of 40 g a day of total alcohol or more. Furthermore, moderate drinkers involved in moderate or high physical activity were significantly more numerous than excessive drinkers. The prevalence of other cardiovascular risk factors, such as hypercholesterolaemia and diabetes, except for hypertension which is highly and positively associated with the increase of alcohol intake, was similar in the various classes of alcohol consumption. Thus, moderate drinkers combine healthier behaviours with reduced level and frequency of cardiovascular risk factors depending on the individuals' behaviours. These associations, between alcohol intake and healthier behaviours, were comparable in the three geographical regions (Northern, North-eastern and South-western).

Lifestyle differences between alcohol drinkers and abstainers or across classes of alcohol consumption were also observed in other populations but different results were reported.[28–33] In the Dutch population, moderate drinkers did not seem to comply with healthier diet but in contrast a strong and positive relationship was observed between alcohol consumption and smoking habits.[28]

Results similar to ours were reported in the UK population showing that increasing alcohol intake was associated with a decrease in the amount of carbohydrate (in percentage from energy and in grams per day), and that moderate drinkers (1–9 g/d of alcohol) had a higher consumption of fibre, cereal, polyunsaturated fat and a lower percentage of cigarette smokers.[30] In the same way, in the Californian population (USA), moderate male-drinkers consumed significantly less fat, protein, carbohydrate and cholesterol than other drinkers.[31]

In our study, when alcoholic beverage preferences were considered, wine drinking was associated with a smaller percentage of current smokers (the number of cigarettes smoked was on average lower) and practised more physical activity. Moreover, the consumption of vegetables and fruit and the diet quality index was higher among wine drinkers compared to beer drinkers or drinkers in the "mixed preference" group. The differences between these groups of alcoholic beverages remained significant after adjustment for age, socio-economic status, cigarette smoking, physical activity and BMI, but became non-significant when the living area of the studied subjects was included in the statistical analyses, showing the significant role played by the geographical factor in the dieting behaviours in France. As a matter of fact, the living area and the alcoholic beverage preference were strongly associated and the specific role played by each of these two factors was very difficult to interpret. It shows, however, the essential influence of the regional culture in the determination of dietary behaviours. Few studies focused on the relationships between types of alcoholic beverages, diet and health status. Our results were in agreement with previous findings, in particular with a study was carried out in a Danish population[7] where wine drinking was associated with healthy diet when compared with other alcoholic drinks. In particular, wine drinking was associated with higher intake of fruit, fish, vegetables, salad and olive oil. Similarly, in a US population, subjects who preferred wine were associated with healthier diets than subjects who preferred beer, spirits or had no preference. Moreover, wine drinkers were less likely to smoke.[9]

It seems obvious that healthy dietary habits and healthy behaviours are correlated with moderate alcohol consumption and wine preference. Moreover, it is actually striking to observe that 10 years after the study carried out in the same regions, using the same methodology and in the same age-range, the crucial role played by the living area remains identical and determines the choice of foods and alcoholic drink preferences.[10,34] Social and environment backgrounds, and therefore the geographical factor in itself, seem to influence nutritional behaviours much more than other socio-economic factors such as the occupational status, the educational level or the number of years spent in school. Moreover, other unhealthy behaviours (tobacco consumption and sedentarity) when significantly associated with excessive alcohol drinking seem to be less involved than the geographical factor in the choice of food or drinks.

Our study has several limitations. The amount of alcohol intake was estimated by self-reported consumption and the reliability of the self-reported alcohol consumption is a common drawback of studies on alcohol intake. Questionnaires with very detailed reports of alcohol intake for each day of the week and for each type of alcoholic beverage do limit the risk of underestimation.[35,36] The frequency questionnaire seems to be adequate enough to report reliable intake of different types of alcohol.[37]

The positive linear relationship observed between plasma levels of GGT, MCV and the ordered groups of alcohol consumption, the increase in the number of positive answers to the CAGE questionnaire and the good ranking relationship between alcohol intake issued from the two methods of estimation led us to think that despite potentially underestimated quantities of alcohol intake, the classification according to the quantity of alcohol consumption was not too much altered and thus misclassification was limited.

The 3-consecutive-day food record method used to assess food intake has some limitations in particular due to the seasonal availability of some foods, particularly vegetables and fruit (production, availability, price, etc.) and consequently it influences dietary behaviour. In this study, the proportions of winter periods when the food intake was recorded were similar according to alcohol consumption, varying from 49% to 51% in winter periods for total alcohol consumption, and between 45%

and 52% for beer and wine beverage preferences, respectively. Moreover, a further adjustment for the season in the analyses did not change the results significantly.

A study has shown that energy intake was over-reported among heavy drinkers.[38] In our study, energy intake (without alcohol) decreased along with higher alcohol intake. Consequently, energy intake among excessive alcohol drinkers should be considered as lower than the mean values observed. Over- or under-reported energy intake may be influenced by food record or recall method used to assess dietary intakes and by the sociocultural characteristics of the population, and particularly to what extent heavy drinkers were sociologically perceived in the population.

As we can see, the proportion of positive answers to the CAGE questionnaire, definition 1 and 2, was higher in abstainers than in moderate alcohol consumers (1–19 g/d), and so was the GGT level, revealing that a number of abstainers were probably actual alcohol drinkers or former alcohol drinkers who had stopped alcohol consumption for medical reasons. Lastly, due to the high number of tests performed, false positive results cannot be excluded.

It is probable that the differences between cardiovascular morbidity and mortality rates in the MONICA registers in France[39] can originate partly from the nutritional behaviours specific to each region. From 1985 to 1994, in men aged 35–64 years, standardised CHD mortality rates per 100 000 inhabitants were in average 172, 141 and 91 in Lille, Strasbourg and Toulouse, respectively. For the same age-range, standardised coronary event rates were 298, 292 and 233 per 100 000 men in Lille, Strasbourg and Toulouse, respectively. The level of the score of the diet quality index was higher and the prevalence of smokers was lower in moderate drinkers (1–19 g/d) comparatively to the two adjacent groups of alcohol drinkers, that is to say abstainers and the group of alcohol drinkers 20–39 g/d. This distribution could be connected with the J-shaped curve relationship observed between alcohol consumption and coronary mortality rates. Our study is far from being an exhaustive study on nutritional behaviour since in France, food consumption is not the mere satisfaction of biological needs but plays an important role in the individual social living, whatever the living area. All the following aspects: frequency, composition, duration, place, organisation of the meals and food origins, etc. are seldom taken into account in dietary surveys, where only food and nutrient quantity and quality are considered. Food consumption analyses should not only take into account food in plates, but should also consider the eating context.[40] The clustering of healthy behaviours can be observed in many situations. For example, in France, 30% of adults enjoy gardening, more particularly in the areas excluding large cities. And if, for them, it is a hobby, it is also a means to grow fruits and vegetables for their own consumption, the garden being both a kitchen- and a flower- garden.[41] Thus, these people have physical activities and consume vegetables and fruits. Lastly, populations' concerns with food and health are very different. Generally speaking, it seems that the Northern European and American populations are more inclined to associate food with health and not with pleasure, which is in total contradiction with the French people's frame of mind. Food is a critical contributor to physical well being, a major source of pleasure, worry and stress.[42]

In conclusion, we showed that in the populations living in the three French areas studied, higher alcohol consumption was related to less numerous healthy profiles and behaviours. Moreover, healthy behaviours were more often observed in the wine drinker group than in the other groups. Low morbidity and mortality rates associated with alcohol consumption and wine drinking could originate from healthy behaviours, diet and lifestyle, potential confounders of these relationships. Is the association of alcohol consumption with a lower incidence and mortality of cardiovascular diseases simply a surrogate and only a proxy for the influence of other healthy behaviours on the coronary risk or does alcohol intake play a major role in the reduction of morbidity and mortality from cardiovascular diseases? It seems difficult to draw a firm conclusion even if, in the light of consistent and extensive reports of clinical, biological and epidemiological studies, the effect of moderate alcohol intake and wine consumption may add to the beneficial effects attributed to other behaviours such as physical activity, non-smoking, and a more balanced diet.

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