Original Research

Relationship Between Alcohol Consumption and Control of Hypertension Among Elderly Greeks. The Nemea Primary Care Study

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Key words: **Arterial pressure, ethanol, Greece, old age.**

Background: The aim of this study was to evaluate the significance of alcohol intake in relation to blood pressure control in treated subjects and to determine if there is a causative link between alcohol and inadequate control of hypertension.

Methods: Our study population comprised 637 elderly individuals who reside in Nemea and in four other villages located in Corinthia, Peloponnesus, of which 615 were included in the analysis. The average age was 73.5±6.15 years. A special epidemiological questionnaire was completed by each participant and the blood pressure (BP) was measured according to a predefined protocol. Odds ratios were calculated and adjusted for potential confounders.

Results: The overall prevalence of hypertension was 69.1%, 70.7% in men and 67.0% in women. In total, 11% of the hypertensives were not aware of having hypertension. Of those who were aware of having hypertension 91.0% were being treated. Among treated hypertensives 49.1% had systolic BP<140 mmHg and diastolic BP<90 mmHg. Only heavy drinking (>300 g/week) was found to be related with hypertension control.

Conclusions: Our study showed that the level of control among the elderly, in a Greek population, is positively associated with alcohol intake only for heavy drinking. The role of alcohol consumption in hypertension in the elderly needs further investigation.

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The high prevalence of systemic hypertension and its progressive association with multiple adverse sequelae confer great potential importance on any modifiable trait influencing blood pressure.[1] Alcohol has been linked with systemic hypertension in a considerable number of cross-sectional and prospective studies and consequently has become a major focus of interest in recent decades as a modifiable risk factor. In some epidemiological studies a linear dose-response relationship has been established, sometimes starting with a consumption threshold of 3 drinks per day (30 g of ethanol).[2-10] In others, the relationship has been nonlinear, especially in women, and some authors have speculated that ingestion of smaller quantities of alcohol may reduce blood pressure.[4,11-15] These discrepancies may reflect differences in investigational design, methods, and populations. The elderly make up a group of the general population with specific traits. Comorbid conditions and medical interactions are expected to make any alcohol use harmful. Only a few studies have addressed the relationship between alcohol and hypertension in the elderly, and most of them have shown a strong association between hypertension prevalence and alcohol intake.[16,17]

In this study, the relation of alcohol consumption with the prevalence of hypertension, as well with the rate of control, was investigated in the elderly population of Nemea. Nemea is a famous wine producing town in the Peloponnesus region of Greece, and alcohol consumption is included in its residents' daily eating pattern. The aim of our study was to evaluate the significance of alcohol intake in relation to blood pressure control in treated subjects, and to determine whether there is a plausible causative link between alcohol and inadequate control of hypertension.

Methods

Sampling

The data for this study came from a program for the detection of cardiovascular risk factors in the elderly organised by the Nemea Health Centre.[18] Our study population comprised all those individuals who participated in that program, who reside in Nemea and in the villages of Koutsi, Leontio and Psari, located in Corinthia, Peloponnesus, at a distance of 120 km from Athens. Primary health care physicians of Nemea's Medical Centre carried out the study during the spring of 2000.

The target population, based on a 1991 population census in the area, was 1044 subjects. All the population was invited to participate through a campaign in the local mass media (radio, newspapers). A total of 637 subjects agreed to participate in the study; 22 were rejected because of incomplete data, and finally 615 participants were included in the analysis.

Semi-structured interviews were conducted with all participants. The data collected included demographic characteristics, history of hypertension, smoking habits, alcohol intake, antihypertensive medication, other drug treatment and self reported chronic medical conditions. The interview also included more specific information related to the diagnosis and treatment of hypertension.

During the latter half of the interview, clinic blood pressure, body weight and height were measured.

Ascertainment of alcohol intake

All the participants were asked about their intake of alcoholic beverages for the past two years prior to the study, with emphasis on the last one month. Questions about the number and kind of alcoholic beverage were asked. From these the average total amount of alcohol was calculated using the equation:
alcohol intake (g/week) =
$(0.04B\times12 + 0.15W\times4 + 0.45L\times1.5)$ oz $\times$ 28.35 g/oz,
where B, W, L, are the numbers of glasses of beer, wine and liqueur consumed during a week.[19] Subjects were classified into four groups according to the total amount of alcohol consumption per week (<10 g/w, <150 g/w, <300 g/w, ≥300 g/w).

Smoking status

For the purposes of the present study, subjects were classified, according to their current smoking status, into four groups: those who had never smoked, ex-cigarette smokers and two groups of current smokers (<20 and ≥20 cigarettes/day).

Blood pressure measurement

Blood pressure was measured using a standard mercury sphygmomanometer (Speidel & Keler, GmbH+ CoKG) with an appropriate cuff size. Three sitting blood pressure measurements were taken for each subject, after five minutes' rest and at least thirty minutes without smoking, with the cuff on the patient's left arm, and with a two-minute interval between measurements (Korotkoff phase V for diastolic blood pressure). Average systolic and diastolic blood pressure were calculated for each subject. Participants with elevated blood pressure measurements were invited to attend a second clinic visit after 7-14 days to have their blood pressure re-measured. The average blood pressure of the second visit was used as the criterion for the diagnosis and control of hypertension.

Definitions

Hypertension in our survey was defined using the criteria of JNC VII (systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, or current treatment with antihypertensive drugs).[1] Treated hypertension was defined as the current use of antihypertensive medication, as determined by a review of all medication taken. The definition of controlled hypertension was systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg in subjects taking antihypertensive medication.

Diabetes mellitus (DM) was self reported and defined as current use of anti-diabetic treatment. Hyperlipidaemia was defined as total cholesterol >240

mg/dl (6.2 mmol/L) or current treatment with lipid lowering drugs.

Statistical Analysis

Data were expressed as mean ± standard deviation. Student t-tests and one-way analysis of variance (ANOVA) were used for intra- and inter-group comparisons of continuous variables. Bonferroni's correction for multiple comparisons was applied where appropriate. Pearson's chi-square test was used to compare differences between groups. The odds ratio (OR) was calculated for contingency tables (2 × 2). Linear regression analysis was performed using the systolic blood pressure and diastolic blood pressure as dependent variables and the demographic and clinical characteristics as independent variables. Logistic regression analysis with the backward stepwise approach was employed to identify variables associated with hypertension and with good control versus poor control of hypertension. Relative risks (RR) were calculated from logistic regression models. Any p-value <0.05 (two-tailed) was considered statistically significant. The data were analysed using a statistical software package (SPSS, Chicago IL, USA).

Results

Demographic data

The overall response rate was 637/1044 (61.0%). The proportion of male participants who responded (364/518, 70.2%) was greater than that of females (251/526, 47.7%, $p<0.05$).

Finally, 615 (58.9%) subjects were included in the analysis. Table 1 shows the demographic and clinical characteristics of our sample, classified by sex. The mean age ± SD was 73.5 ± 6.1 years (range 65-99 years); 364 (59.2%) were men and 251 (40.8%) were women. Mean BMI was 26.4 ± 3.8 kg/m^2 (range 19-43 kg/m^2). Diabetes mellitus was reported by 14.7% (n=90) of the participants and hyperlipidaemia by 41.2%. Of the total population only 13.3% were current smokers.

The distribution of blood pressure measurements was approximately Gaussian and the mean values were 140.4 ± 19.9 mmHg and 81.2 ± 10.2 mmHg for systolic and diastolic blood pressure, respectively. Statistically significant differences in systolic and diastolic blood pressure were found between the alcohol intake categories. Linear regression models, using age, sex, family history of hypertension, body mass index (BMI), hyperlipidaemia, diabetes mellitus, smoking status and alcohol intake as independent variables, examined the association with systolic and diastolic blood pressure. Variables associated with systolic blood pressure were age (B=0.368, t=2.794, p=0.005), family history (B=3.200, t=2.006, p=0.045), and alcohol intake (B=4.840, t=4.413, p=0.0001), while for diastolic blood pressure associations were found with BMI (B=2.262, t=3.820, p=0.0001), sex (B=2.426, t=2.590, p=0.01), and alcohol intake (B=3.138, t=5.642, p=0.0001).

Table 1. Demographic and clinical characteristics (analysis by sex).

Variable	Total	Male	Female	p
N (%)	615	364 (59.2)	251 (40.8)	
Age (years)	73.5 ± 6.1	73.9 ± 5.8	73 ± 6.5	0.058
SBP (mmHg)	140.4 ± 19.9	141.6 ± 18.8	138.7 ± 21.4	0.075
DBP (mmHg)	81.2 ± 10.2	80.70 ± 10.1	81.96 ± 10.3	0.133
BMI (kg/m^2)	26.4 ± 3.85	26.6 ± 3.63	26.1 ± 4.15	0.175
≤25 (%)	260 (42.3)	143 (55)	117 (45)	0.028
25<...<30 (%)	277 (45)	180 (65)	97 (35)	
≥30 (%)	78 (12.7)	41 (52.5)	37 (47.5)	
Family history (%)	283 (46)	165 (58.3)	118 (41.7)	0.681
Diabetes mellitus (%)	90 (14.8)	55 (60.5)	36 (39.5)	0.792
Hyperlipidaemia (%)	253 (41.1)	143 (56.5)	110 (43.5)	0.279
Smoking status:				0.0001
No (%)	396 (64.4)	161 (40.6)	235 (59.4)	
Previous (%)	137 (22.3)	128 (93.4)	9 (6.6)	
Mild (%)	52 (8.5)	45 (86.5)	7 (13.5)	
Heavy (%)	30 (4.9)	30 (100)	0	

SBP – systolic blood pressure; DBP – diastolic blood pressure; BMI – body mass index; SD – standard deviation.

Table 2. Demographic and clinical characteristics (analysis by alcohol status).

Variable	Drinking habits				p
	None	Mild	Medium	Heavy	
Total (%)	229 (37.4)	311 (50.7)	45 (7.3)	28 (4.6)	
Sex:					0.0001
Male (%)	92 40.2)	207 (66.6)	41 (91.1)	22 (78.6)	
Female (%)	137 (59.8)	104 (33.4)	4 (8.9)	6 (21.4)	
Age (years)	73.2 ± 6.5	73.9 ± 5.9	73.1 ± 5.3	73.3 ± 6.1	0.953
SBP (mmHg)	137.6 ± 19	140.1 ± 18.9	148.8 ± 23.3	153.7 ± 25.2	0.0001
DBP (mmHg)	80.0 ± 10.6	80.7 ± 9.4	86.5 ± 9.2	87.5 ± 13.2	0.0001
Known hypertensives:					0.102
Yes (%)	121 (52.8)	182 (58.3)	29 (64.4)	11 (39.3)	x^2=6.206
No (%)	108 (47.8)	129 (41.5)	16 (35.6)	17 (60.3)	
Diabetes mellitus:					0.799
Yes (%)	36 (15.7)	46 (14.0)	5 (11.1)	3 (10.7)	x^2=1.010
No (%)	193 (84.3)	265 (85.2)	40 (88.9)	25 (89.3)	
Hyperlipidaemia:					0.32
Yes (%)	95 (41.5)	126 (40.5)	15 (33.3)	17 (60.7)	x^2=5.615
No (%)	134 (58.8)	185 (59.5)	30 (66.7)	11 (39.3)	
Total hypertensives:					p for trend=0.02
Yes (%)	146 (63.8)	217 (70)	37 (82.2)	24 (85.7)	x^2=10.005015,
No (%)	83 (36.2)	93 (30)	8 (17.8)	4 (14.3)	x^2=10.45
Obesity:					0.0001
Yes (%)	144 (62.9)	220 (70.7)	37 (82.2)	19 (67.9)	x^2=23.7
No (%)	85 (37.1)	91 (29.3)	8 (17.8)	9 (32.1)	
BMI (kg/m^2)	26.2 ± 4.3	26.6 ± 3.3	26.9 ± 3.4	24.3 ± 4.7	0.031 x^2=4.6
Controlled hypertensives (%)	66/146 (45.2)	86/217 (39.6)	9/37 (24.3)	7/24 (29.2)	0.076 x^2=6.8

Abbreviations as in Table 1.

Hypertension prevalence, awareness, treatment and control

The overall prevalence of hypertension was 425/615 (69.1%, 95% confidence interval, CI: 66.5-71.6); the prevalence was 70.7% in men and 67.0% in women. In total, 11.0% (47/425) of the hypertensive respondents were not aware of having hypertension (Table 2). Higher rates of awareness were noted in women than in men. Of those who were aware of having hypertension (N=378), 344 (91%) were being treated. Among treated hypertensive patients (N=344), 49.1% had systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg. Among diabetic hypertensive patients (n=60/90, 66.6%), 9 (15%) were not aware of having hypertension, 50 (83.3%) were being treated, 26 (52%) had systolic blood pressure <140 mmHg and diastolic blood pressure <90 mmHg, and 4 (8%) had systolic blood pressure <130 mmHg and diastolic blood pressure <80 mmHg. The mean blood pressure in diabetic patients was 140.6 ± 21.8 mmHg and 80.3 ± 10.2 mmHg for systolic blood pressure and diastolic blood pressure, respectively.

Sex, age, family history, smoking status, diabetes mellitus, hyperlipidaemia, BMI and alcohol intake were examined in a logistic regression analysis for their potential to predict hypertension. Variables associated with hypertension were age (Wald=7.83, p=0.0005), BMI >30 kg/m^2 (Wald=15.14, p=0.0001, RR=1.803 95%CI: 1.357-2.180) and family history of hypertension (Wald=20.095, p=0.0001, RR=1.720 95% CI: 1.357-2.180).

Sex, age, family history, smoking status, diabetes

mellitus, hyperlipidaemia, BMI and alcohol intake were examined in a logistic regression analysis for their potential to predict good control of hypertension. A statistically significant interaction (p=0.0081) was found only for heavy drinking (>300 g/week: B=-1.003, Wald=7.021, RR=0.365, 95%CI: 0.173-0.755).

Table 2 shows the demographic and clinical characteristics of our sample, classified by alcohol consumption status.

Discussion

The mechanism through which alcohol raises blood pressure remains elusive. Alcohol consumption seems to be related with blood pressure elevation, not through long-term structural alterations, but by neural, hormonal, or other reversible physiological changes.[20] Clinical trials have demonstrated that the association between intake of alcohol and higher blood pressure is causal and occurs within a matter of weeks or less.[21] In our study, the participants were questioned about their drinking pattern for the last two years, which is believed to be a long enough period for estimating the effects of alcohol consumption on blood pressure.

We found that systolic and diastolic blood pressure rates were positively associated with alcohol intake. The level of control among the elderly was positively associated with alcohol intake only for heavy drinking, which is consistent with previous studies.[22,23] Some of the resistance may be due to poor compliance with medication in heavy drinkers, but there may also be true interference that decreases the effects of some medications.[23,24] Mild to moderate alcohol consumption did not affect blood pressure control in our study, a finding that has also been described previously.[25]

The prevalence of hypertension in the elderly was not associated with alcohol intake in any dose. The relationship of alcohol consumption with hypertension in young and middle-aged people has been well established in a great number of studies. However, this relationship has not been sufficiently investigated in the elderly. MacMahon et al showed that the association of alcohol drinking with hypertension is much stronger in older than in younger men.[9] In another study of volunteers aged 60-87 years, stepwise multiple regression showed that higher blood pressure was associated with alcohol intake, greater BMI, coffee drinking and measures of irritability.[26] However, Bridevaux et al found that mortality in the elderly was not positively associated with alcohol intake and concluded that "it may be unnecessary to advise elderly patients with chronic medical conditions not to drink, particularly if they screen negative for problem drinking".[27]

In an attempt to explain the discrepancy between our results from elderly subjects and observations from younger people in previous studies, the following hypotheses are suggested. Firstly, alcohol consumption weakens the association between hyperinsulinaemia, insulin resistance and hypertension[28] and therefore counteracts the elevation of blood pressure caused by that relationship. This beneficial effect could exist in the elderly, but not in younger people who have no insulin resistance conditions. Secondly, alcohol may cause hypertension by affecting the autonomic nervous system.[29] However, alterations in the sympatho-adrenal function that occur during ageing may cause older people to have a different reaction to factors triggering their autonomic system than do younger individuals.[30]

It should also be mentioned that alcohol consumption in Greece, and especially in rural areas, is usually combined with the so-called "Mediterranean" diet, due to which Greeks seem to enjoy important health advantages.[31] A couple of glasses of wine with meals on a regular basis is the most frequent form of alcohol consumption, rather than heavy binges.[32] The drinking pattern and its relation with cardiovascular problems have been addressed recently. Drinking mostly outside mealtimes has been reported to significantly increase the risk of hypertension compared to drinking mostly with food.[33] These findings may be of major importance, as they imply that the pattern, and not the quantity of alcohol consumption is associated with increased cardiovascular risk. Therefore, it is possible that dietary factors related with alcohol consumption, as well as drinking patterns among elderly Greeks, modify the typical alcohol-hypertension relationship observed in other studies.

The validity of self-reported alcohol consumption has also been questioned. However, an underestimation of alcohol intake across the entire cohort, or selectively in heavy users, could have resulted in an underestimation of the level of alcohol consumption at which blood pressure starts to increase, but it would not have changed the slope of the association.[9] Another consideration in evaluating studies of alcohol and disease is that drinking habits change over time. If persons who consume high levels of alcohol at baseline decrease their intake during follow up to

a greater extent than persons who drink less, prospective studies will underestimate the risk associated with alcohol intake. However, if alcohol affects blood pressure through short-term mechanisms, two years is considered to be an adequate period of follow up. Finally, the possibility that the presence of hypertension and other conditions could have influenced the pattern of alcohol consumption (sick-quitter hypothesis) was addressed by taking into account in the multivariate analysis possible confounding variables, such as diabetes mellitus, hyperlipidaemia, smoking status, body-mass index and family history.

Conclusions

Our study showed an association between alcohol use and blood pressure, but not with the prevalence of hypertension in the elderly. The control of hypertension was associated only with heavy alcohol consumption. These results, if replicated, have implications for the manner by which the effects of alcohol consumption are addressed to the public, and especially to the elderly. Increased cardiovascular risks have been attributed mainly to heavy occasional drinking. In contrast, regular drinking, which seems to be the most common mode of alcohol consumption among Greeks, has been reported to be cardioprotective.[34] Therefore, strict advice to elderly Greeks about ceasing alcohol consumption may not be absolutely necessary. However, encouraging older persons who do not drink or who only drink occasionally to take up regular drinking is not wise, as regular drinking has been linked with increased non-cardiovascular mortality and morbidity.[34] The role of alcohol consumption in hypertension in the elderly needs further investigation, and future studies should focus on the pattern of alcohol consumption, dietary patterns, physical activity and other parameters that may alter the alcohol hypertension relationship in this age group.

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