Associations of Aerobic Exercise and Alcohol Consumption With Systolic Blood Pressure in Employed Males

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Patterns of alcohol consumption and physical activity were analysed in relation to blood pressure in a group of 522 employed males. Alcohol intake, as well as age and the body mass index, were directly related to systolic blood pressure (SBP) while aerobic exercise was inversely related. Men who exercised occasionally or not at all had a mean (±s.d.) SBP of 120.3 ± 14.3, whereas men who took frequent exercise had a mean SBP of 117.4 ± 12.7 ($P < 0.02$). Among light and moderate drinkers (≤7 ounces/week), increased frequency of exercise was associated with a lower SBP ($b = -0.149$, $P = 0.05$); but we observed no effect among heavy drinkers ($b = -0.036$, P is NS). These findings suggest that the contribution of aerobic exercise towards lowering SBP may be mitigated by heavier use of alcohol.

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Introduction

Drinking of alcoholic beverages and participation in regular aerobic exercise are two social habits on the increase. Since 1970, not only has the *per capita* consumption of beer, wine and spirits risen, but the proportion of abstainers has declined, especially in men [1,2]. Meanwhile, health clubs have proliferated and joggers and bikers are an accepted part of everyday life [1].

Regular consumption of alcohol has been shown to have a direct linear relationship to SBP in some studies [3,4]. Other authors suggest a threshold effect of alcohol intake on blood pressure, with consumption of more than two drinks a day necessary to cause an increase in blood pressure levels [5,6]. The link between regular, vigorous exercise and lower SBP is more tenuous, though regular exercise is recommended by the medical community for reducing blood pressure [3]. A number of studies have reported that the risk of hypertension is lower for those who exercise than for those who do not, although some studies have shown no effect of regular exercise on SBP [7–9].

The purpose of this study was to examine the effects of exercise on the association between SBP and alcohol and exercise.

Methods

We studied 522 men who volunteered for a blood lipid screening at a Milwaukee, Wisconsin company. Physical measurements, blood pressure readings and a blood sample were obtained from the study participants, who also completed a self-administered questionnaire. Participants with a history of hypertension were excluded.

Exercise frequency and weekly alcohol consumption were obtained from questionnaire responses. Alcohol intakes were converted to equivalent ounces of ethanol using values of 4% for beer, 12% for wine and 43% for liquor. Respondents were considered 'non-drinkers' if they claimed to drink no alcohol in a week (n = 68), 'light-to-moderate' drinkers if they drank 7 ounces or less a week (n = 345) and 'heavy drinkers' if they drank more than 7 ounces a week (n = 109).

Participation in aerobic exercise was recorded as times per month. The exercises included hiking, biking, skiing, jogging, running, swimming, handball, tennis and squash. Respondents who did not take exercise, or did so only occasionally (less than seven times a month) were included in the 'infrequent' exercise group (n = 274); those who exercised more frequently than this were 'frequent' exercisers (n = 248).

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Relative body weight was measured as weight/height^2 (body mass index), after conversion of weight from pounds to kilograms (1 lb = 0.454 kg) and height from inches to metres (1 in.= 0.025 m).

T-tests were used to determine the differences in blood pressure between groups. Analysis of variance and multiple regression techniques were also used, and statistical significance was tested with the F-statistic. Values shown are means ± s.d.

Results

The mean age of our study population was 39.0 ± 10.4 years, the mean body mass index was 26.3 ± 3.3 and the mean alcohol intake was 4.2 ± 4.3 oz. per week of absolute alcohol. These men reportedly exercised 9.0 ± 8.6 times per month, had a mean SBP of 118.9 ± 13.6 mmHg and a mean diastolic blood pressure of 72.9 ± 10.9 mmHg. Using multiple regression analysis, the strongest predictors of SBP, in order, were age, the body mass index, alcohol and exercise, with adjusted coefficients equal to 0.257, 0.486, 0.309 and −0.134, respectively. Age, the body mass index and alcohol intake were all directly related to SBP whereas exercise was inversely related. Smoking history and blood lipid values were not significantly related to SBP in this model.

The SBP of non-drinkers and light-to-moderate drinkers were similar at 118.5 ± 13.1 and 118.2 ± 13.8 mmHg, respectively. These groups were combined for further analysis. However, the SBP of heavy drinkers was significantly higher at 121.4 ± 13.1 mmHg ($P < 0.04$).

Systolic blood pressure also differed by exercise frequency group. Non-exercisers had a mean of 122.9 ± 17.3, occasional exercisers had a mean SBP of 119.1 ± 12.6, while frequent exercisers had the lowest mean SBP, 117.4 ± 12.7 mmHg.

To assess whether the effect of alcohol on SBP was different within the exercise groups, a multiple regression model was specified, with SBP as the dependent variable and age, body mass index and alcohol consumption as the independent variables. The slope of the regression of alcohol on SBP for frequent exercisers was identical to the slope for infrequent exercisers but SBP was significantly lower ($P < 0.02$). This indicates that the relative impact of alcohol on SBP was the same, regardless of the frequency of exercise, even though the blood pressure of the frequent exercisers was lower than that of infrequent exercisers. The result also suggests that while frequent exercisers have lower blood pressure, the effect of alcohol is to increase SBP at the same rate as that of infrequent exercisers.

Multiple regression models for exercise frequency on SBP are presented in Fig. 1. Study participants were stratified into two alcohol intake groups, one comprising heavy drinkers and the other comprising non-drinkers and light-to-moderate drinkers because these two subgroups had a similar SBP. In the light-drinker group, increased exercise was associated with decreased SBP (b = −0.149, $P = 0.05$). No beneficial effect of exercise was evident in the heavy drinkers, so that more frequent exercise was not related to lower SBP (b = −0.036, P is NS).

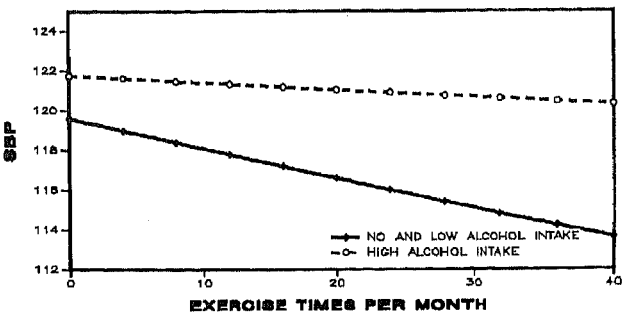

Fig. 1. Regression of systolic blood pressure (SBP) on exercise frequency for men with low and high intakes of alcohol. Regression lines have been adjusted for age and the body mass index.

Discussion

In this study, alcohol intake was significantly associated with increased SBP and aerobic exercise frequency was significantly associated with decreased SBP after adjusting for age and the body mass index. However, with high levels of alcohol intake, the beneficial effects of exercise were not seen. This evidence supports the theory of a 'threshold effect' of alcohol on SBP. High levels of alcohol intake are associated with elevations in SBP, but at low levels of consumption blood pressures are essentially the same as those of non-drinkers.

These findings are supported by those from other cross-sectional studies including Klatsky *et al.* [5] and Criqui *et al.* [6]. In both these studies, a higher SBP was found in heavier drinkers. Klatsky, who postulated a threshold level of regular alcohol use, described a linear relationship between intake and SBP which was particularly evident above two drinks per day. Our smaller sample size did not allow us to detail the relationship at this range of intakes, but the higher mean SBP at two or more drinks per day in our data suggests a similar effect. In Criqui's study [6], SBP was markedly elevated in the men who drank >30 ml/day (equivalent to our heavy drinker category). Criqui also confirmed that the effect of alcohol was independent of exercise by adjusting for the practice of regular exercise in his regression model. Both these earlier studies show that blood pressure remains relatively unaffected at alcohol levels of <7 oz. per week, and our results concur.

Biological mechanisms to explain the role of alcohol in increasing blood pressure have been proposed [10], but the subject is complex and the object of ongoing study. The role of exercise in lowering SBP is even less well explained although some theories have been suggested [7,8].

These data tend to support the medical practice of recommending regular exercise as a part of the therapy regimen for reducing blood pressure in hypertensive individuals. Baseline blood pressure is a strong indicator of the risk of hypertension [4,6] and any reduction in these levels is to be encouraged. Individuals who

exercise regularly may obtain a beneficial effect in lowered blood pressure, but only if their alcohol consumption remains low.

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