

The Influence of Alcohol on Blood Pressure

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Report to the Alcohol Education & Research Council

May 2007

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1 Summary

1.1 Background

Alcohol is a major cause of preventable death in England and its misuse has major impacts on the economy (costing up to £6.4bn) and health services (£1.7m). Hypertension is an important preventable risk factor for cardiovascular disease, the leading cause of mortality in the UK. In England, the prevalence of hypertension in 2002 was 37% in men and 34% in women. Despite substantial evidence on the relationship between alcohol and blood pressure, many questions remain. There is considerable variation on the reported nature of the relationship, that is, whether it is linear, J- or U-shaped or if there is a threshold effect; uncertainty whether it is affected by pattern of drinking, type of beverage, gender, age or ethnicity. The aims of this study are to describe recent trends in alcohol consumption and blood pressure in England and the association between them and thus provide information relevant to the development of appropriate health education strategies and targeted policies to reduce harmful effects of alcohol on health.

1.2 Methods

1.2.1 The Health Survey for England

We used data from 10 years (1994-2003) of the Health Survey for England (HSE), a series of annual surveys, commissioned by the Department of Health, designed to measure health and health-related behaviour in people living in private households. Data were available on socio-demographic characteristics, general health, smoking, alcohol and fruit and vegetable consumption, height, weight and blood pressure measurements, and blood and saliva samples.

1.2.2 Alcohol consumption

Data on alcohol consumption were used to estimate average weekly consumption as well as the level of 'binge' drinking - drinking a large amount within a short period. Two drinking guidelines/limits were used to define drinking categories: (a) sensible weekly drinking, defined as drinking <14 units/week (women) or <21 units/week (men); and 'binge drinking', defined as drinking >6 units in a day (women) or >8 units in a day (men).

1.2.3 Blood Pressure

Blood pressure measurements as well as information on all prescribed medication, including anti-hypertensive drugs was available. The definition of hypertension used is in accordance with recent guidelines, that is, blood pressure=140/90 mmHg, or on treatment with antihypertensive drugs.

1.3 Results

1.3.1 Trends

Weekly alcohol consumption

There were small decreasing trends in the numbers of current drinkers, over the period, though with a possible upturn in the last year, 2003. Corresponding increases were seen in the numbers of non- and ex-drinkers. Increases in non-drinkers were predominantly seen among young men.

Among drinkers the amount consumed per week increased. The average increase per year was 0.20 (0.16-0.24) units per week for women, and 0.13 (0.04-0.23) units per week for men ($p=0.07$ for gender difference). Consumption among male drinkers remained considerably higher than among female drinkers, with mean weekly consumption levels in 2002 of 19.8

and 8.5 units respectively (data not available for 2003). The increase in consumption, for both sexes, was restricted to wine intake.

Patterns of drinking

Among men drinkers overall, 56.9% adhered to both weekly and daily guidelines, compared to 71.8% of women (Table 1), in spite of the lower thresholds for women. Among those not adhering to one or both guidelines, both sexes most commonly exceeded the recommended weekly consumption (18.0% of men drinkers and 13.8% of women drinkers) without reporting binge drinking in the previous week. The least common pattern was to binge drink yet remain within weekly guidelines.

Patterns of adherence to guidelines varied strongly according to age, ethnicity, region, living alone, and socioeconomic factors such as car access, tenure, and qualification.

1.3.2 Relationship between alcohol consumption and blood pressure

Average consumption

Mean SBP among women was lowest among those drinking 8-28 units of alcohol per week. After adjusting for age and other potential confounders, the group with the lowest SBP was that drinking up to 7 units/wk. Non-drinkers had a significantly higher SBP, raised on average by 1.64 (0.74;2.54) mm Hg, and SBP also rose as weekly alcohol consumption rose above seven units, with an average increase of nearly 5 mmHg in those drinking above 42 units/wk.

For men, mean SBP was lowest amongst non-drinkers. In the adjusted model, SBP was lowest among non-drinkers, ex-drinkers and those drinking up to 7 units per week, after which it rose with alcohol consumption, with an average increment of 4.39 (3.69;5.10) mmHg in those drinking 50 or more units/week.

The risk of hypertension among men drinking 1-7 units/week (the baseline) was not significantly different from the risk among non-drinkers, ex-drinkers or those drinking <1 unit/week, nor among those drinking up to 14 units/week. However, risk rose monotonically with alcohol intake above 7 units per week, with an odds ratio of 1.76 (1.58-1.96) in those drinking over 50 units/week.

Among women, the risk of hypertension was lowest amongst those drinking 1-7 units/week. Non-drinkers, and those drinking above 14 units/week had significantly higher risks, with the odds doubling in those drinking 43-49 units/week.

Pattern of drinking

Risks of hypertension for both men and women were highest in those who exceeded weekly guidelines, especially if they also exceeded daily limits. For men, there was also a raised risk if exceeding daily guidelines only, but for women there was a marginally reduced risk in this group.

1.4 Conclusions

There were clear associations between drinking and raised blood pressure, with particular risks if exceeding weekly guidelines. For women, a beneficial effect of moderate drinking was seen, but not for men. For both sexes, the risk increased significantly above 14 units per week.

2 Introduction

Determinants of hypertension

The relationship between alcohol consumption and blood pressure, and the association between high levels of consumption and incidence of hypertension has been demonstrated in men and women in several countries.¹⁻⁴ Decreased alcohol intake has been reported to lead to a dose-response reduction in blood pressure.⁵ Other determinants of hypertension are age, relative weight², body composition and ethnicity.³

Shape of relationship between alcohol consumption and blood pressure

It is established that heavy drinking is associated with increased risk of hypertension but results are inconsistent at light and moderate levels of alcohol consumption. Fuchs¹ demonstrated a non-linear association among men aged 45-64 years. J-shaped associations were reported in 18-24 year olds from a largely Italian-American community in the US⁶ and in women aged 25-42 years.⁷ A study in Japan⁸ reported a non-linear relationship between changes in blood pressure and alcohol consumption with a threshold at 18ml ethanol/ day.

Effect of pattern of drinking

Pattern of alcohol intake is likely to be a major contributing factor in the complex effects of alcohol on cardiovascular disease.⁹ A British study¹⁰ found higher blood pressure in heavy weekend drinkers than in moderate daily drinkers, although total weekly intakes were similar in both groups. In a large multi-centre study, Marmot¹¹ showed that, compared to non-drinkers, heavy drinkers with high variability of intake had greater blood pressure differences than those with low variability. In contrast, a smaller study in Finland¹² showed that daily heavy drinking had more detrimental effects on blood pressure than heavy binge-type weekend drinking.

Other influences

Fuchs¹ reported that, although low to moderate alcohol consumption does not appear to increase risk of hypertension in whites, it is associated with an increased risk in black men. Other factors reported to influence blood pressure include low birth weight;¹³ parental social class and adult body mass index.¹⁴ Recent studies have demonstrated that the relationship between alcohol and heart disease risk varies according to gender and area¹⁵ and its association with all cause mortality varies by age.¹⁶ Similar variability by age, gender and ethnicity may exist in the relationship between alcohol and blood pressure.

A meta-analysis¹⁷ of the relationship between alcohol and health concluded that further studies are needed to assess the role of drinking patterns and other factors in determining level of risk. A recent review¹⁸ of the contribution of alcohol on overall burden of disease concluded that the generalisability of the results was limited by methodological problems of the underlying studies. The government's Alcohol Harm Reduction Strategy for England (www.strategy.gov.uk), while outlining measures to reduce harmful drinking and associated health and social problems, concluded that additional research is needed on changing patterns of drinking, their social determinants and their contribution to health problems.

Aims and Objectives

The aims of this study are to describe recent trends in alcohol consumption and the relationship between alcohol consumption and blood pressure.

The objectives are to:

- i. Use the annual Health Survey for England (HSE) datasets to examine trends and associations between alcohol consumption and blood pressure by age and sex.
- ii. Assess the impact of the pattern of consumption on the alcohol-blood pressure relationship.

3. Methods

3.1 The Health Survey for England

The Health Survey for England (HSE) is a series of annual surveys commissioned by the Department of Health, designed to measure health and health related behaviour in people living in private households. Members of a stratified random sample (drawn from the Postcode Address File), socio-demographically representative of the English population (typically 16,000 adults aged 16 and over and 4,000 children) are invited to participate every year. The annual household response rate is around 75%. The survey includes visits by an interviewer and a nurse. A set of core elements is included every year with special topics included in selected years. Core topics include socio-demographic characteristics, general health, smoking, drinking and fruit and vegetable consumption, height, weight and blood pressure measurements, and blood and saliva samples. Special topics include cardiovascular disease, physical activity, accidents and lung function. In some years the size of the general population sample is reduced and a boost sample used to increase the proportion of respondents from certain population groups, e.g., selected minority ethnic groups; young people; and older people.

Data were obtained for the years 1994-2003, comprising records for 122,809 adults (aged 18+). Data were only included for the general population (core surveys). The subsets of the HSE surveys, designed to boost observations in certain sectors of the population (e.g. the elderly), were excluded.

3.2 Alcohol consumption

Data on alcohol consumption are collected during the face-to-face interviews for those aged 18 or over, and as part of a self-completion questionnaire for 16 and 17 year-olds. Since its inception the survey has included a set of separate questions for wine, beer and spirits, designed to estimate average weekly consumption. New questions were introduced in 1998 about consumption of alcohol in the past seven days. Problem drinking and physical dependence are assessed using a self-administered (modified CAGE) questionnaire.

Respondents were classified according to the amount they drank per week. This was an estimate, derived by the HSE, based on answers to several questions on drinking – questions on whether the respondent drinks, and on how much of various types of drink they consume.

One unit of alcohol is 10 ml by volume, or 8 g by weight, of pure alcohol. For example:

- One unit of alcohol is equal to:
 - Half a pint of ordinary strength beer, lager, or cider (3–4% alcohol by volume),
 - A small pub measure (25 ml) of spirits (40% alcohol by volume),
 - A standard pub measure (50 ml) of fortified wine such as sherry or port (20% alcohol by volume).

Wording of questions used to derive drinking status, from the 1994 survey:

A: I am now going to ask you a few questions about what you drink - that is if you drink. Do you ever drink alcohol nowadays, including drinks you brew or make at home?

B: Could I just check, does that mean you never have an alcoholic drink nowadays, or do you have an alcoholic drink very occasionally, perhaps for medicinal purposes or on special occasions like Christmas and New Year?

C: Have you always been a non-drinker, or did you stop drinking for some reason?

Questions were then asked about various types of drinks. The following question was asked about usual wine consumption, for example:

"How often have you had a drink of wine including babycham and champagne during the last twelve months? SHOWCARD"

- 1 Almost every day
- 2 Five or six days a week
- 3 Three or four days a week
- 4 Once or twice a week
- 5 Once or twice a month
- 6 Once every couple of months
- 7 Once or twice a year
- 8 Not at all in the last 12 months

From 1998 onwards, questions were asked about alcohol consumption on days during the last week. One group of questions asked about the number of different types of drinks consumed on the heaviest-drinking day, for example, "How many small cans of normal beer did you drink on that heaviest day last week?" A derived HSE variable then gave an estimate of the number of units of alcohol consumed on the heaviest drinking day.

Measures and classifications of alcohol consumption used in these analyses are as follows:

- 1) Classification as never-drinker, ex-drinker or current drinker.
- 2) Usual weekly consumption in units:

Current drinkers were classified into those drinking the following number of units per week:

- <1
- 1-7 (the baseline group)
- 8 -14
- 15 - 21
- 22 – 28
- 29 – 35
- 35 – 42
- 43-49
- 50+

3) Drinking pattern. Two drinking limits were used to define drinking categories: (a) sensible weekly drinking, defined as drinking <14 units/week (women) or <21 units/week (men); and 'binge drinking', defined as drinking >6 units in a day (women) or >8 units in a day (men).

Four categories of drinkers were then defined: (a) those who drink within both limits; (b) those who binged on at least one day last week, but do not usually exceed weekly guideline; (c) those who usually exceed weekly limit, but did not binge on any day last week, and (d) those who exceed both limits.

3.3 Blood Pressure

Blood pressure was measured by a nurse using an automated device and a standard protocol. Information on all prescribed medication, including anti-hypertensive drugs, was also available. The definition of hypertension used here in accordance with recent guidelines,¹⁹ that is, blood pressure=140/90 mmHg, or on treatment with antihypertensive drugs.

3.4 Statistical analysis

Logistic and linear regression were used for the data analyses. Analyses were conducted using STATA SE version 7. The model incorporated robust standard errors at small area (primary sampling unit) level, to take account of non-independence of observations within areas and households.

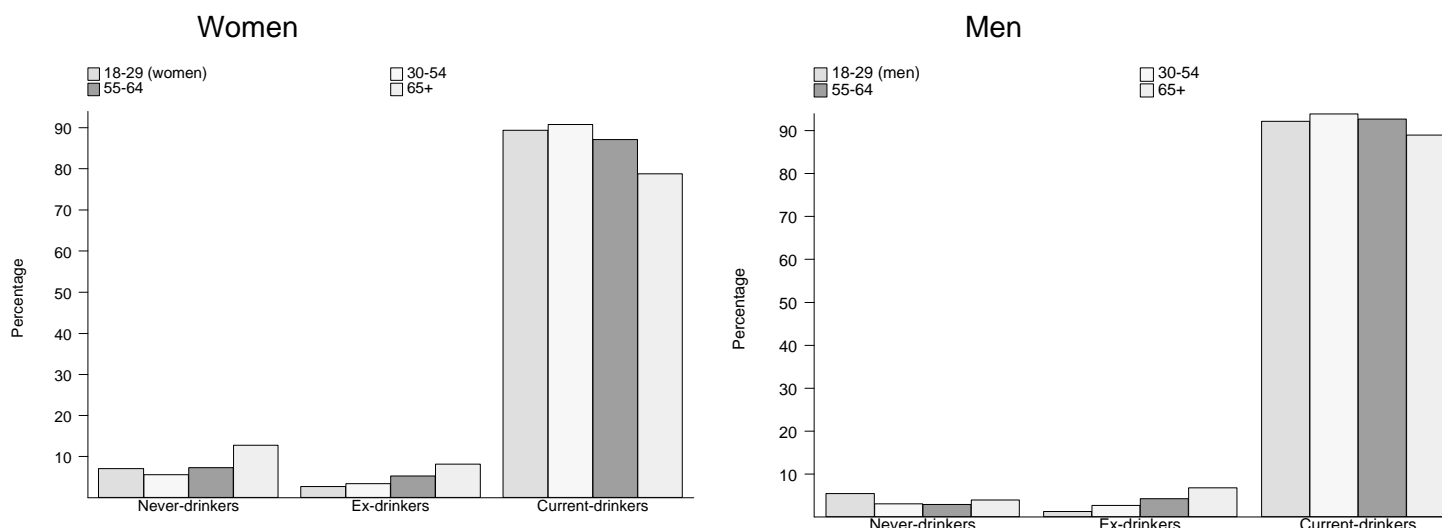
All regression analyses were adjusted for age and sex (except where performed separately by age and/or by sex).

4 Results

4.1 Trends

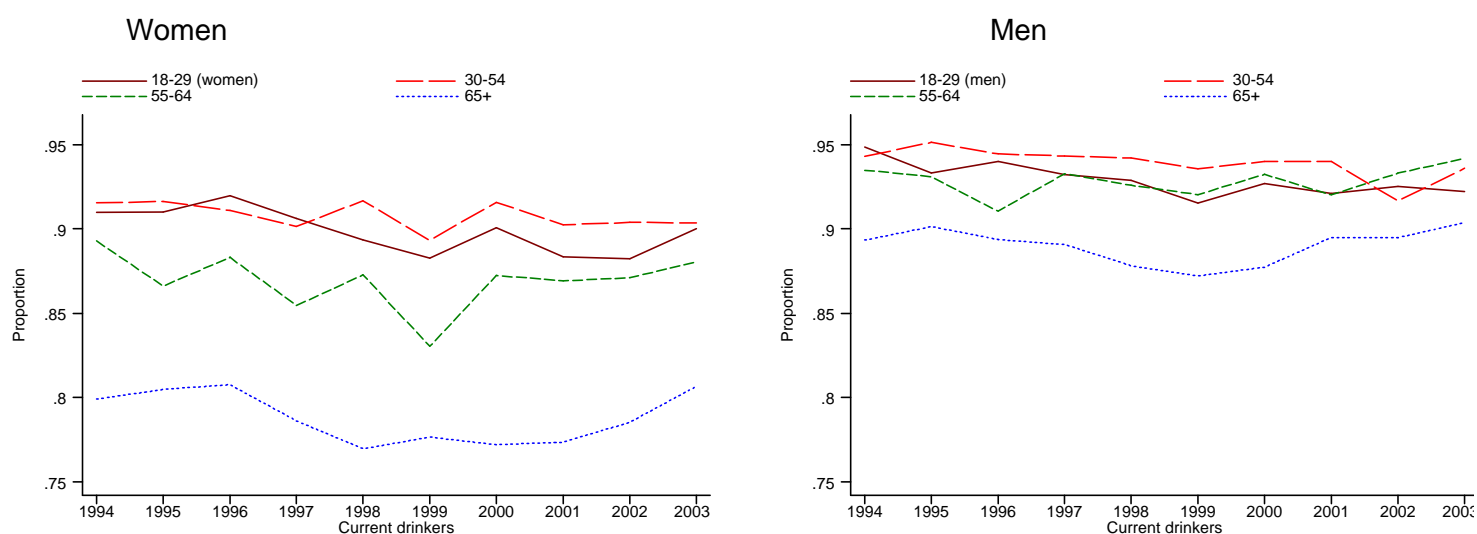
4.1.1 Proportions of non-drinkers, ex-drinkers and drinkers

Figure 1: Drinking status by age group



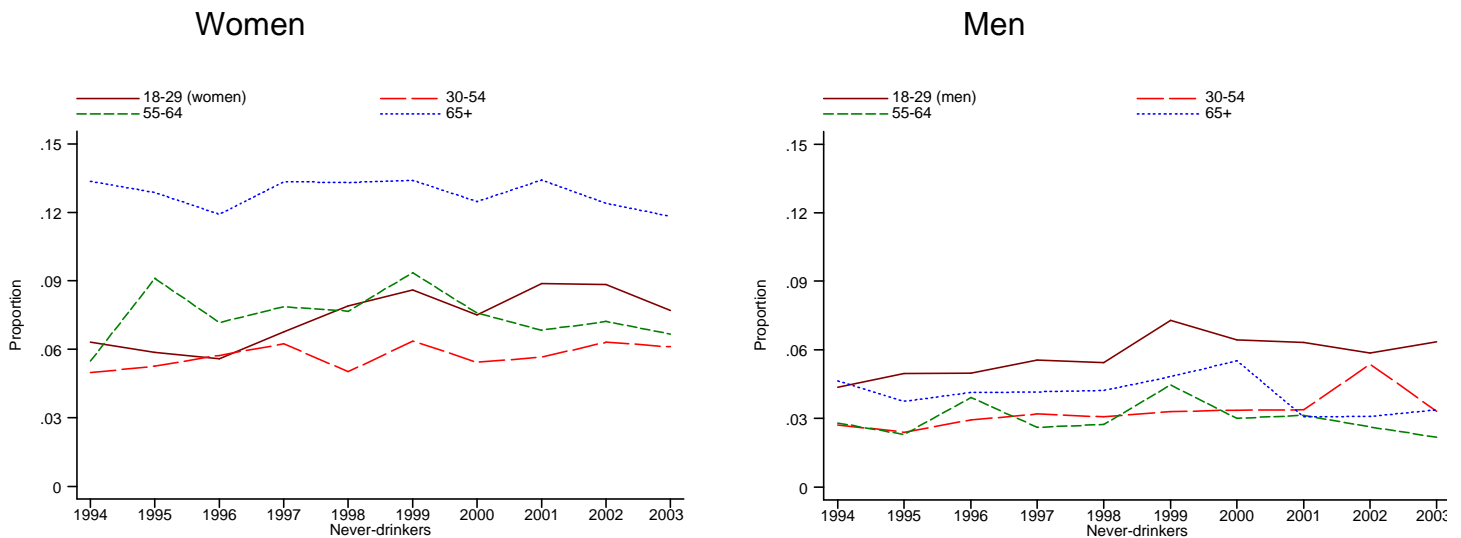
Of the 122,809 adults, 5.9% defined themselves as never-drinkers, 4.1% as ex-drinkers, and 89.6% as current drinkers. Fewer women than men defined themselves as current drinkers (87.3% vs 92.4%, see Figure 1). For both men and women the 65+ age group included the lowest proportion of current drinkers and the 30-54 age group the highest. More women than men were ex-drinkers (4.6% vs 3.5%). The proportion of ex-drinkers rose by age, with a steeper increase among men than among women. More than twice as many women reported being never-drinkers than men (7.7% vs 3.7%), with the highest proportion being among the 65+ age group for women (12.8%) and among the 18-29 age group for men (5.5%).

Figure 2: Trends in 'current drinking' by age group



Although the proportions varied little by year (Figure 2), there was a small, decreasing trend over time in the proportion of current drinkers (though with an apparent upturn in 2003), with an age-sex-adjusted odds ratio per year of 0.985 (95% CI 0.976 - 0.995).

Figure 3: Trends in 'never drinking' by age group



There were corresponding increasing trends in the proportions of never drinkers (Figure 3) and ex-drinkers, with odds ratios 1.014 (1.000-1.030) and 1.015 (1.005 - 1.025) respectively.

4.1.2 Weekly alcohol consumption

Among drinkers, the age-standardised mean weekly number of units of alcohol consumed was 19.1 for men, and 7.8 for women. Average consumption increased slightly over time, by 0.20 (0.16-0.24) units per week per year for women, and 0.13 (0.04-0.23) units per week per year for men ($p=0.08$ for difference between men and women). Consumption among male drinkers remained considerably higher than among female drinkers, with mean weekly consumption levels in 2002 of 19.8 and 8.5 units respectively (data not available for 2003).

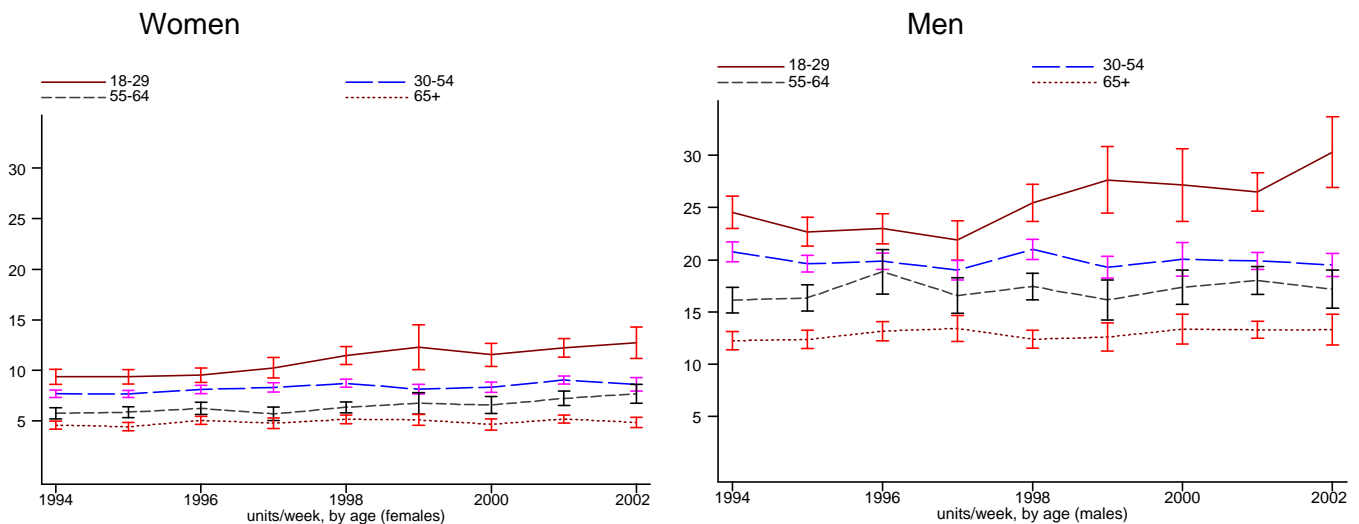
Table 1: Weekly alcohol consumption (units) among drinkers by age group.

	Age group (years)			
	18-29	30-54	55-64	65+
Women: Number	9585	24782	6786	10378
Mean weekly consumption	10.62	8.28	6.38	4.85
Change in weekly consumption per year (mean, 95% CI)				
Unadjusted	0.47 (0.34;0.60)	0.16 (0.10;0.22)	0.21 (0.12;0.31)	0.06 (0.00;0.12)
Adjusted ¹	0.40 (0.28;0.52)	0.15 (0.09;0.21)	0.17 (0.07;0.26)	0.00 (-0.05;0.06)
Men: Number	8182	21609	6544	8676
Mean weekly consumption	24.90	19.98	17.21	12.84
Change in weekly consumption per year (mean, 95% CI)				
Unadjusted	0.67 (0.40;0.95)	-0.07 (-0.20;0.05)	0.13 (-0.07;0.32)	0.12 (-0.02;0.25)
Adjusted ¹	0.67 (0.40;0.95)	-0.07 (-0.19;0.05)	0.11 (-0.10;0.32)	0.09 (-0.04;0.22)

¹Adjusted for ethnicity, living as lone adult, qualification, age, car, tenure, years in education.

Age was a strong and consistent predictor of weekly alcohol consumption, for both men and women, with the number of units inversely related to age group (Table 1).

Figure 4: Trends in alcohol consumption (units per week)

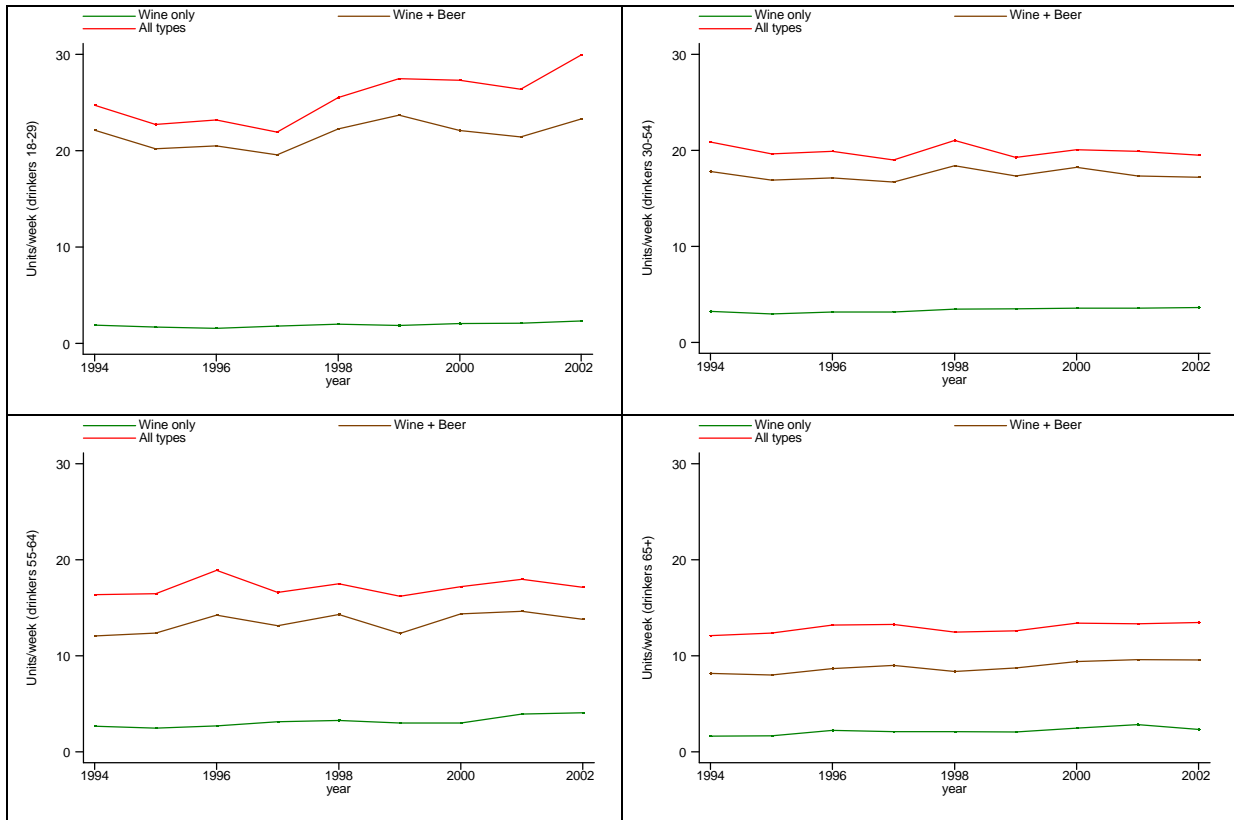


Time-trends in consumption (Figure 4) differed by age ($p < 0.0001$ for both sexes). For men, the fastest increase, of 0.67 (0.40-0.95) units per week per year, was seen in the youngest age group. There was little change in the other age groups. For women there were significant increases in all age-groups, except for those aged 65 and above. The largest

increase of 0.47 units per week per year (0.34 to 0.60) was in the 18-29 age-group. Adjustment for a number of possible confounders made little difference.

4.1.3 Beverage type

Figure 5: Trend in beverage type by age-group in men, adjusted for age as linear term



Among men, there was no change in beer consumption, but an increase in wine consumption, in all age groups between 1994 and 2002 (Figure 5).

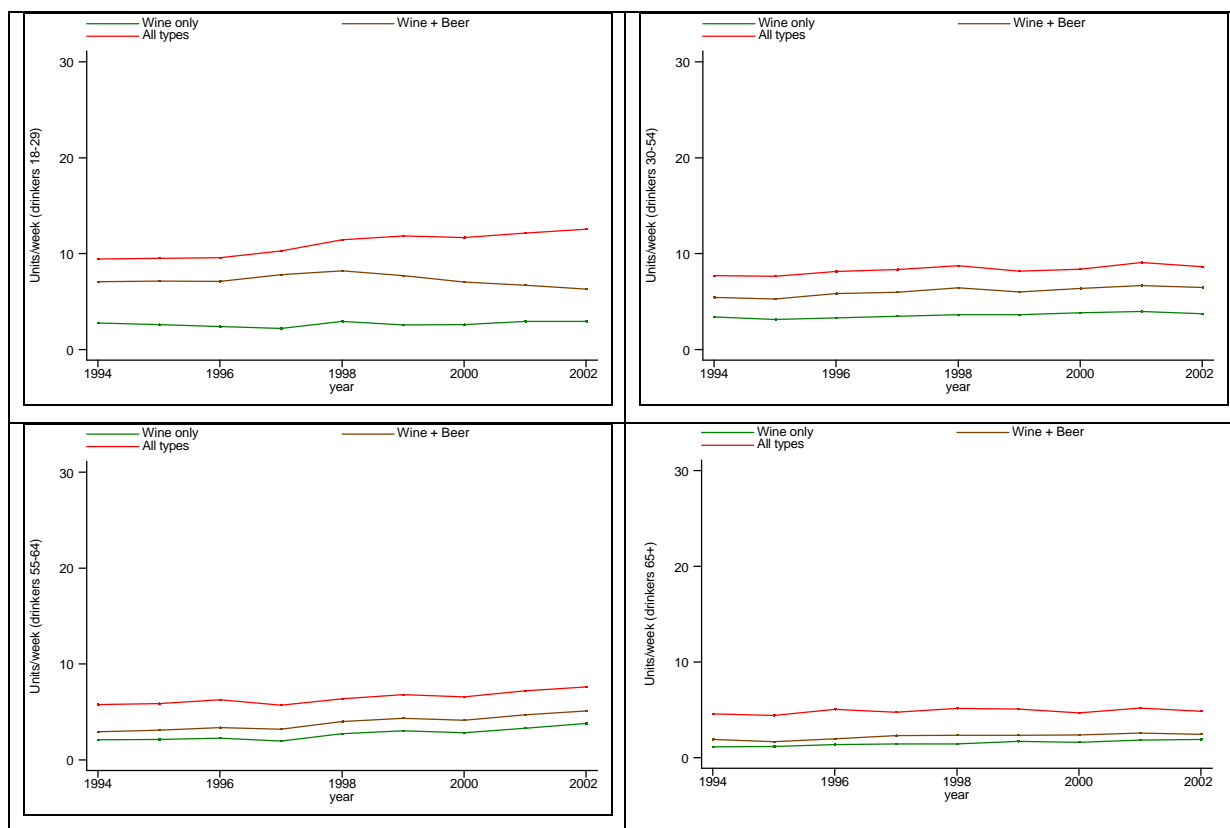
Table 2: Change in alcohol consumption per year in men by beverage type (units/week) stratified by age group.

1994-2002	Change in units/week per year (95% Conf. Interval)		
	Wine	Beer	Other
18-29	0.058 (0.021 to 0.096) [*]	0.122 (-0.094 to 0.338)	0.442 (0.362 to 0.522) [*]
30-54	0.075 (0.040 to 0.110) [*]	-0.040 (-0.152 to 0.072)	-0.097 (-0.140 to -0.054) [*]
55-64	0.180 (0.121 to 0.240) [*]	0.079 (-0.078 to 0.235)	-0.163 (-0.254 to -0.071) [*]
65+	0.133 (0.092 to 0.173) [*]	0.054 (-0.046 to 0.154)	-0.066 (-0.132 to -0.0004) [*]

* p<0.05

Other alcoholic beverages increased in the youngest age group but decreased in other age groups (Table 2).

Figure 6: Trend in beverage type by age group in women, adjusted for age as linear term



As with men, the largest change among women during this period was the increase in ‘other’ alcoholic beverages in those aged 18 to 29 (Figure 6, Table 3). Beer consumption decreased in women aged 18 to 29, but increased in women aged 30 to 64. Wine consumption increased in women aged 30 and above between 1994 and 2002.

Table 3: Change in alcohol consumption per year in women by beverage type (units/week) stratified by age group.

1994-2002	Change in units/week per year (95% Conf. Interval)		
	Wine	Beer	Other
18-29	0.037 (-0.004 to 0.079)	-0.082 (-0.150 to -0.015)*	0.471 (0.403 to 0.538)*
30-54	0.095 (0.064 to 0.125)*	0.072 (0.034 to 0.110)*	-0.010 (-0.037 to 0.016)
55-64	0.202 (0.156 to 0.247)*	0.061 (0.020 to 0.102)*	-0.057 (-0.111 to -0.003)*
65+	0.100 (0.075 to 0.125)*	0.006 (-0.014 to 0.026)	-0.044 (-0.087 to -0.001)*

* p<0.05

4.1.4 Patterns of drinking

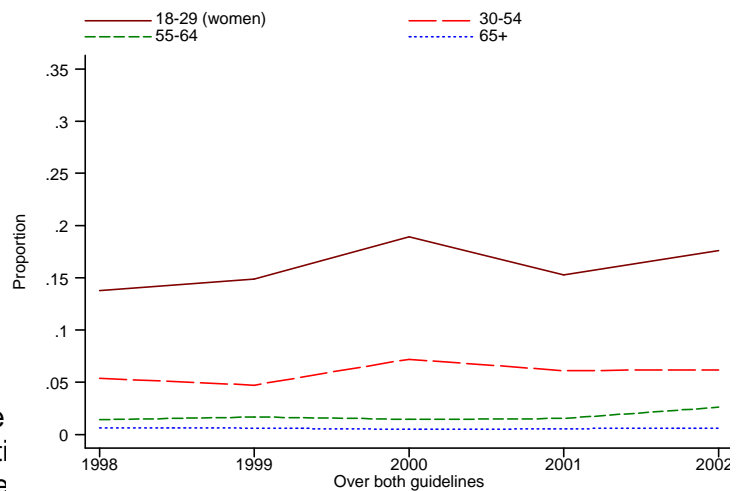
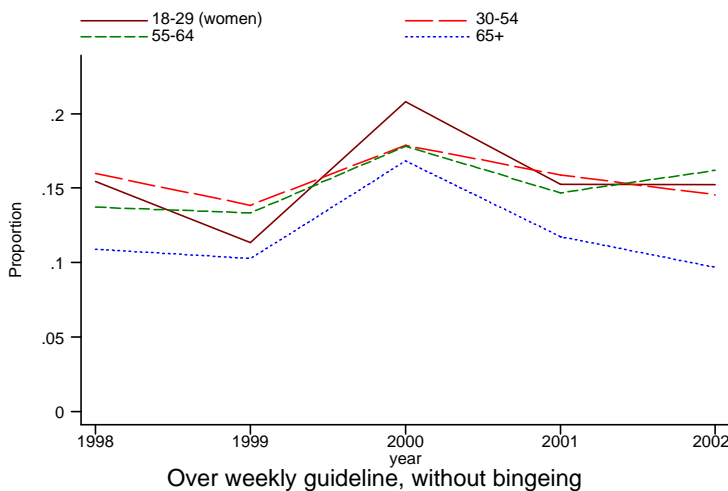
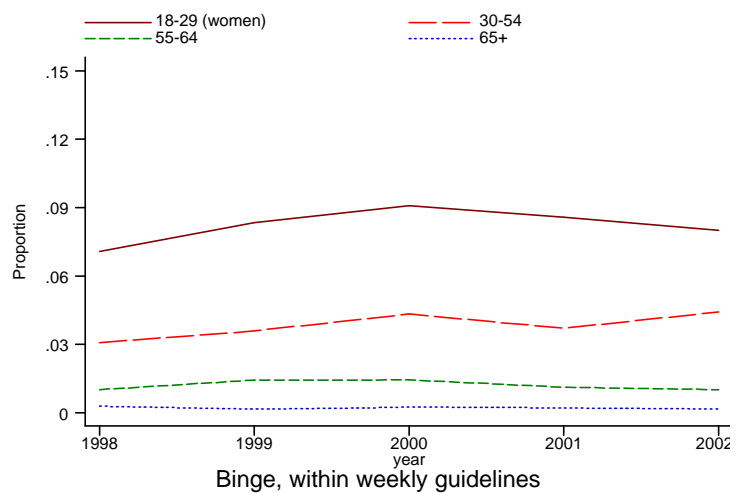
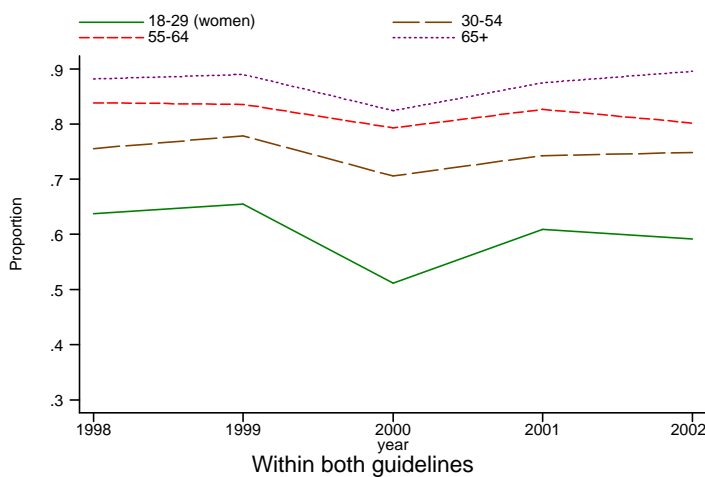
Among men drinkers overall, 56.9% adhered to both weekly and daily limits, compared to 71.8% of women (Table 4), in spite of the lower thresholds for women. Among those not

adhering to one or both limits, both sexes most commonly exceeded the recommended weekly consumption (18.0% of men drinkers and 13.8% of women drinkers) without reporting binge drinking in the previous week. The least common pattern was to binge drink yet remain within weekly guidelines

Table 4: Proportion (%) drinking according to weekly and daily limits

Exceeding daily limits (binge drinking)		Exceeding weekly limits	
		No	Yes
Men			
No		56.9	18.0
Yes		6.7	14.6
Women			
No		71.8	13.8
Yes		3.2	5.6

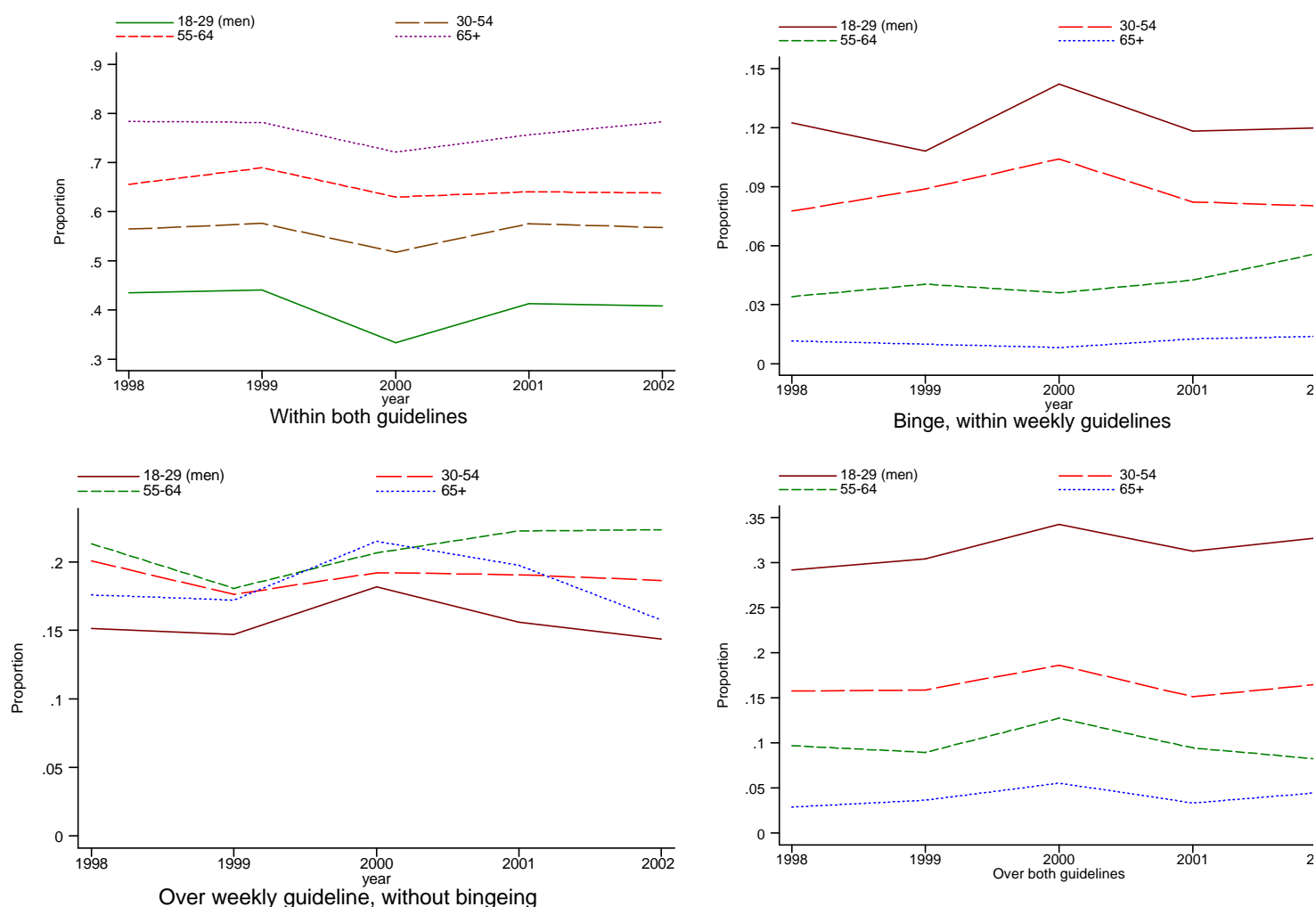
Figure 7: Trends in drinking behaviour in women, by age group



keeping within weekly guidelines (OR 1.06 (1.01-1.11) per year), and those over both sets of limits (OR 1.06 (1.01-1.10) per year). There was no trend in those over the weekly limit but not binge-drinking.

These time trends did not vary according to presence or absence of other adults, not by educational qualification. Nor were interactions between age-group and year statistically significant, though the downward trend in drinking within limits was restricted to those under 65 (OR in 18-25 year-olds 0.95 (0.90-0.99) per year). Similarly, increases in the proportion drinking outside both sets of guidelines was restricted to those under 65, and significant only for those under 55, and the increasing proportion of binge-drinking (within weekly guidelines) was restricted to those aged under 55, and greatest in those aged 30-54 (OR 1.08 (1.01-1.15) per year).

Figure 8: Trends in drinking behaviour in men, by age group



Among male drinkers, for whom drinking outside guidelines was already more prevalent, time trends in the proportions exceeding limits were not statistically significant over the period (Figure 8). However, some patterns among males were very similar to those seen in females, notably the increase in drinkers aged 18-29 exceeding both guidelines.

Table 5: Odds ratios for the risk factors in the four drinking behaviour groups. (plus odds ratio for trend, for age), in mutually adjusted model. Except for odds ratios for age-group, two additional terms are added: linear age, and the interaction of this with age-group. Each drinking behaviour group was analysed separately.

	Men				Women			
	Drinking within both limits	Exceeding daily limits only	Exceeding weekly limits only	Exceeding both limits	Drinking within both limits	Exceeding daily limits only	Exceeding weekly limits only	Exceeding both limits
Age group (years)								
18-29	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30-54	1.94 (1.77-2.12)	0.61 (0.53-0.70)	1.31 (1.17-1.47)	0.41 (0.37-0.45)	1.81 (1.66-1.98)	0.44 (0.37-0.52)	1.08 (0.97-1.21)	0.36 (0.32-0.41)
55-64	2.72 (2.43-3.06)	0.30 (0.24-0.37)	1.54 (1.34-1.77)	0.23 (0.20-0.27)	2.69 (2.35-3.07)	0.12 (0.08-0.18)	1.12 (0.96-1.32)	0.10 (0.08-0.14)
65+	4.77 (4.21-5.41)	0.08 (0.06-0.12)	1.38 (1.19-1.60)	0.08 (0.06-0.10)	3.73 (3.23-4.31)	0.03 (0.01-0.05)	1.01 (0.86-1.19)	0.03 (0.02-0.05)
Trend (change in odds per 10 years increase in age)	1.33 (1.30-1.36) p<0.001	0.64 (0.62-0.67) p<0.001	1.09 (1.07-1.12) p<0.001	0.63 (0.61-0.65) p<0.001	1.29 (1.26-1.33) p<0.001	0.53 (0.50-0.57) p<0.001	1.03 (1.00-1.06) p=0.08	0.53 (0.50-0.55) p<0.001
Ethnicity								
White	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-White	2.61 (2.17-3.13)	0.55 (0.39-0.79)	0.70 (0.56-0.87)	0.31 (0.23-0.42)	2.65 (2.13-3.31)	0.61 (0.39-0.94)	0.44 (0.34-0.58)	0.35 (0.23-0.54)
Region								
N East	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
N West	1.04 (0.90-1.20)	1.02 (0.81-1.27)	0.99 (0.82-1.19)	0.94 (0.78-1.13)	1.09 (0.92-1.28)	0.81 (0.60-1.10)	1.13 (0.92-1.40)	0.76 (0.59-0.99)
Yorks & Humber	1.03 (0.89-1.19)	0.85 (0.66-1.09)	1.05 (0.87-1.27)	0.99 (0.82-1.20)	1.06 (0.89-1.26)	0.82 (0.59-1.15)	1.20 (0.97-1.50)	0.72 (0.55-0.96)
E Midlands	1.41 (1.21-1.64)	0.74 (0.57-0.95)	0.99 (0.81-1.21)	0.66 (0.54-0.82)	1.41 (1.18-1.69)	0.59 (0.41-0.85)	1.07 (0.85-1.33)	0.47 (0.35-0.65)
W Midlands	1.36 (1.17-1.59)	0.63 (0.48-0.82)	1.13 (0.92-1.38)	0.64 (0.52-0.79)	1.45 (1.21-1.73)	0.52 (0.36-0.75)	1.07 (0.85-1.34)	0.48 (0.35-0.64)
East	1.73 (1.50-2.00)	0.66 (0.51-0.84)	0.76 (0.63-0.92)	0.65 (0.53-0.79)	1.45 (1.23-1.72)	0.81 (0.59-1.12)	0.87 (0.70-1.08)	0.55 (0.41-0.73)
London	1.44 (1.24-1.69)	0.64 (0.49-0.84)	1.09 (0.90-1.32)	0.60 (0.48-0.75)	1.30 (1.09-1.55)	0.56 (0.39-0.80)	1.24 (0.99-1.55)	0.46 (0.34-0.63)
S East	1.57 (1.37-1.81)	0.57 (0.44-0.73)	1.02 (0.85-1.23)	0.58 (0.48-0.70)	1.29 (1.09-1.52)	0.52 (0.37-0.72)	1.22 (1.00-1.50)	0.49 (0.36-0.65)
S West	1.58 (1.36-1.83)	0.67 (0.52-0.86)	0.94 (0.78-1.14)	0.59 (0.48-0.72)	1.49 (1.24-1.79)	0.51 (0.35-0.74)	1.05 (0.84-1.32)	0.43 (0.32-0.59)
Living with other adult								
Yes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No	0.78 (0.71-0.85)	0.98 (0.82-1.17)	1.08 (0.97-1.20)	1.45 (1.28-1.63)	0.96 (0.87-1.06)	1.10 (0.89-1.37)	0.92 (0.82-1.04)	1.21 (1.02-1.44)
Access to car								
Yes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No	0.81 (0.73-0.90)	1.09 (0.91-1.31)	1.09 (0.97-1.23)	1.24 (1.08-1.43)	1.06 (0.95-1.18)	0.97 (0.77-1.22)	0.86 (0.75-0.98)	1.18 (0.97-1.43)
Housing tenure								
Owner	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rent from LA ¹	1.04 (0.94-1.15)	0.96 (0.80-1.16)	0.89 (0.79-1.01)	1.08 (0.94-1.25)	1.14 (1.02-1.28)	1.18 (0.95-1.48)	0.75 (0.66-0.86)	0.97 (0.80-1.18)
Rent privately	0.86 (0.77-0.96)	0.88 (0.72-1.07)	1.11 (0.97-1.28)	1.21 (1.05-1.39)	0.77 (0.68-0.88)	1.18 (0.92-1.52)	1.09 (0.94-1.27)	1.50 (1.23-1.81)
Qualifications								
High ²	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Low ³	1.15 (1.06-1.24)	1.14 (0.99-1.31)	0.79 (0.72-0.87)	0.99 (0.89-1.10)	1.29 (1.18-1.41)	1.18 (0.97-1.43)	0.68 (0.61-0.76)	0.99 (0.84-1.16)

¹LA= local authority, ²GCSE grades A to C or above, ³GCSE Grade D or below

For both sexes, age was strongly associated with drinking pattern (Table 5). The proportion of 'moderate drinkers' (those adhering to both daily and weekly limits) increased steeply with age. This increase was steeper among men than women, with the odds among men of adhering to limits in the 65+ group nearly five times that in the 18-29 group.

The proportions of 'binge-drinkers' (i.e. over daily but not weekly limits) and 'excessive heavy-drinkers' (those exceeding both daily and weekly limits) decreased sharply with age (particularly for women). Among women, with each additional ten years of age, the odds of being a binge-drinker or a heavy drinker was approximately halved.

Trends across age were less pronounced among 'steady excessive drinkers' (those exceeding weekly limits, but not daily limits). For both men and women, this drinking behaviour was more frequent among those aged 55-64, with odds ratios of 1.54 (1.34-1.77) for men (55-64 vs 18-29 year olds) and of 1.12 (0.96-1.32) for women.

Drinking behaviour was also strongly related to ethnicity, with white drinkers more likely to exceed daily, weekly or both limits than non-whites. For both men and women, the odds of adhering to both limits in non-white drinkers was over 2.5 times that in white drinkers.

There were strong regional differences in adherence. Those in the northern regions (North West, York & Humber, and particularly the North East) were least likely to drink moderately. Among male drinkers, the odds of being a moderate drinker in the Eastern region was 1.73 (1.50-2.00) times that in the North East; for women, the odds in the South West was 1.49 (1.24-1.79) times that in the North East. Binge-drinking and excessive heavy drinking were correspondingly lower in the southern regions than in the north. There appeared little regional pattern in 'steady excessive' drinking.

Women who were the sole adult in their household were more likely to be heavy drinkers than those living with another adult, with an odds ratio of 1.21 (1.02-1.44). For men this odds ratio reached 1.45 (1.28-1.63) – and, correspondingly, men living with another adult were more likely to drink within both limits than those living alone. Associations between living alone and the other drinking categories were weaker.

Men with no car access were more likely to drink above limits than those with car access – in particular, to be heavy drinkers (OR 1.24 (1.08-1.43)), and less likely to be moderate drinkers (OR 0.81 (0.73-0.90)). For women, the pattern was somewhat different. Women with no car access were less likely to be moderately excessive drinkers than those with car access (OR 0.86 (0.75-0.98)), while there was weak evidence that they were more likely to be excessive heavy drinkers (OR 1.18 (0.97-1.43)).

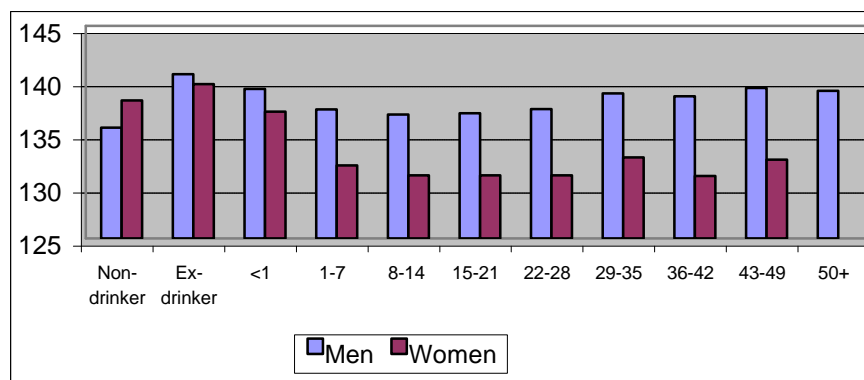
For both sexes, living in privately rented accommodation was associated with excessive heavy drinking, with an odds ratio (compared to being a home owner) of 1.50 (1.23-1.81) for women and 1.21 (1.05-1.39) for men. Renting from the local authority was inversely associated with steady excessive drinking (OR 0.75 (0.66-0.86), compared to being a home owner for women, 0.89 (0.79-1.01) for men), and, for women only, was associated with drinking within both limits (OR 1.14 (1.02-1.28)).

Those with low levels of educational qualifications were more likely to drink within limits (OR 1.15 (1.06-1.24) for men, 1.29 (1.18-1.41) for women), and less likely to be steady excessive drinkers (OR 0.79 (0.72-0.87) for men, 0.68 (0.61-0.76) for women).

4.2 Relationship between alcohol consumption and blood pressure

4.2.1 Mean blood pressure and alcohol consumption

Figure 9: Mean Systolic Blood Pressure (mm Hg) and alcohol consumption (units/week)

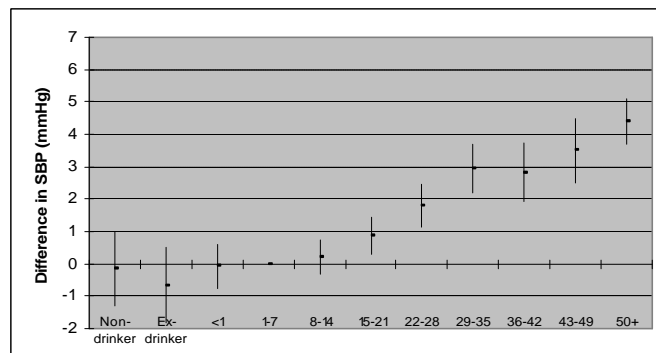
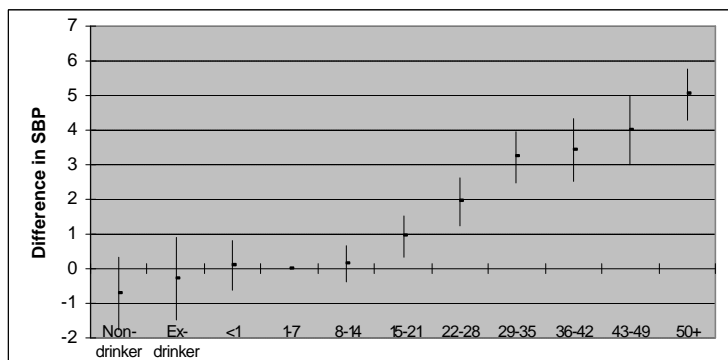


Mean systolic blood pressure (SBP) was lower among women than men, except among non-drinkers (Figure 9). Among women, mean SBP was lowest among those drinking 8-28 units of alcohol per week while among men, it was lowest amongst non-drinkers.

Figure 10: Difference in SBP with units of alcohol consumed per week, relative to intake of 1-7 units/ week in men

Age-adjusted

Fully adjusted¹

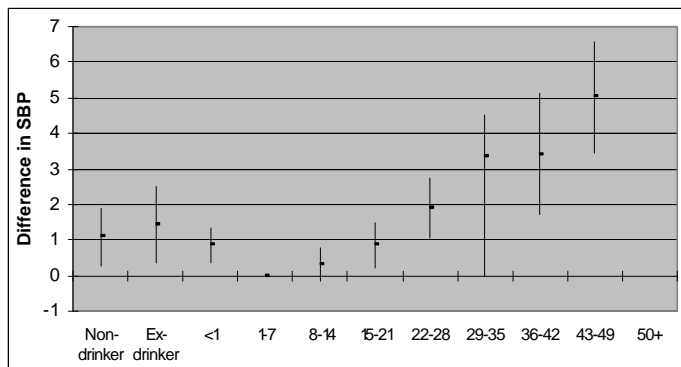


¹Adjusted for age, BMI, access to car, tenure, year, years of education, ethnicity, region, qualification and single-adult household.

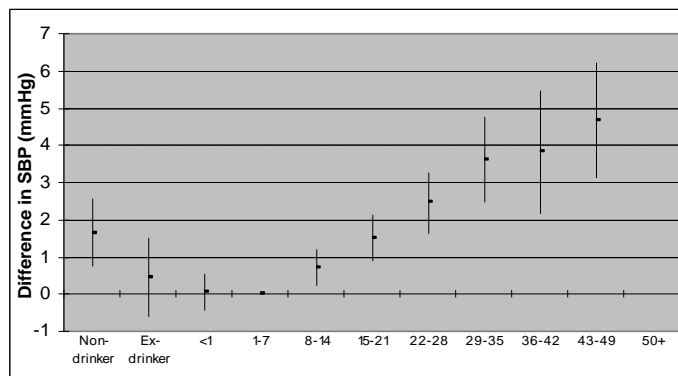
For men, in the adjusted model, SBP is lowest among non-drinkers, ex-drinkers and those drinking up to 7 units per week, after which it rises with alcohol consumption, with an average increment of 4.39(3.69;5.10) mmHg in those drinking 50 or more units/week (Figure 10).

Figure 11: Difference in SBP with units of alcohol consumed per week, relative to intake of 1-7 units/ week in women

Age-adjusted



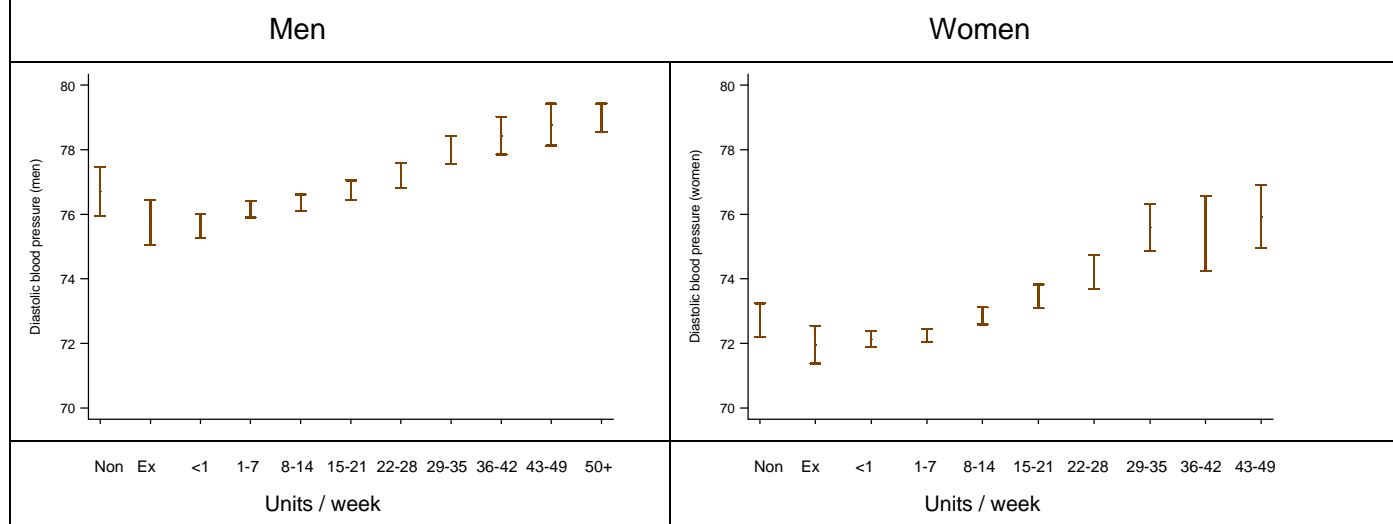
Fully adjusted¹



¹Adjusted for age, BMI, access to car, tenure, year, years of education, ethnicity, region, qualification and single-adult household.

In a model adjusting for age and other potential confounders (Figure 11), mean SBP among women is lowest in those drinking up to 7 units/wk. Non-drinkers have a significantly higher SBP, raised on average by 1.64(0.74;2.54) mm Hg, and SBP also rises as weekly alcohol consumption rises above seven units, with an average increase of nearly 5 mmHg in those drinking above 42 units/week.

Figure 12: Mean diastolic blood pressure, by weekly alcohol consumption (fully adjusted¹)



¹Adjusted for age, BMI, access to car, tenure, year, years of education, ethnicity, region, qualification and single-adult household.

For men, diastolic blood pressure (DBP) was lowest, on average, amongst ex- and occasional-drinkers, that is, those drinking <1 unit/week (Figure 12). Compared to a baseline of those drinking 1-7 units/week, mean DBP in these groups was 0.41 (-0.31 to 1.14), and 0.52 (0.07 to 0.96) units lower respectively. Mean DBP in never-drinkers was 0.55 (-0.25 to 1.34) units higher than baseline. DBP rose as consumption exceeded 7 units/week, reaching a mean excess of 2.84 (2.34 to 3.34) units in those drinking 50 or more units.

A similar pattern was seen for women, though DBP in occasional drinkers was no lower than in the baseline group (1-7 units/week). Mean DBP in never-drinkers was 0.47 (-0.09 to 1.03) units higher than the baseline, and DBP again rose with consumption above 7 units/week to reach an excess of 3.68 (2.68 to 4.67) units in those drinking above 42 units.

4.2.2 Hypertension and average weekly alcohol consumption

The risk of hypertension among men drinking 1-7 units/week (the baseline) was not significantly different from the risk among non-drinkers, ex-drinkers or those drinking <1 unit/week, nor among those drinking up to 14 units/week (Table 7). However, risk rose monotonically with alcohol intake above 7 units per week, with an odds ratio of 1.76 (1.58-1.96) in those drinking over 50 units/week.

Among women, the risk of hypertension was lowest amongst those drinking 1-7 units/week. Non-drinkers, and those drinking above 14 units/week had significantly higher risks, with the odds doubling in those drinking 43-49 units/week.

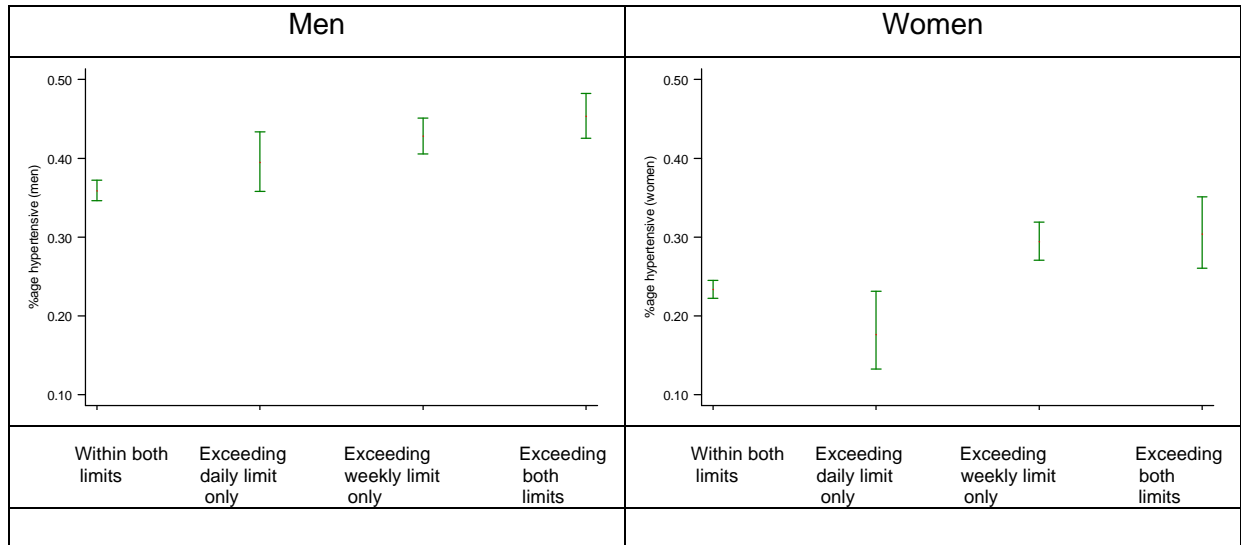
Table 6: Odds ratio for hypertension by weekly alcohol consumption in units

	Non-drinker	Ex-drinker	Average weekly consumption (units)								
			<11	1-7	8-14	15-21	22-28	29-35	36-42	43-49	50+
Men											
All cases N (%)	491 (39.72)	669 (55.61)	1837 (49.54)	3327 (42.98)	2690 (41.14)	1972 (40.49)	1331 (42.24)	1056 (43.56)	597 (44.32)	548 (46.80)	1206 (46.46)
Odds ratio (95% CI)	0.98 (0.86-1.12)	1.20 (1.05-1.37)	1.03 (0.94-1.13)	1.00	0.99 (0.93-1.07)	1.07 (0.99-1.16)	1.24 (1.13-1.36)	1.31 (1.18-1.45)	1.44 (1.27-1.64)	1.60 (1.40-1.83)	1.77 (1.60-1.96)
Cases in adjusted model N (%)	440 (38.97)	559 (53.34)	1627 (48.15)	3041 (42.14)	2483 (40.24)	1834 (39.81)	1248 (42.01)	998 (43.13)	568 (43.89)	511 (45.95)	1146 (46.51)
Odds ratios:											
Age adjusted	0.99 (0.86-1.14)	1.15 (1.00-1.33)	1.02 (0.93-1.12)	1.00	0.99 (0.92-1.06)	1.08 (0.99-1.17)	1.28 (1.16-1.41)	1.32 (1.19-1.47)	1.44 (1.27-1.65)	1.59 (1.39-1.83)	1.83 (1.65-2.03)
Fully adjusted*	0.94 (0.80-1.10)	1.10 (0.95-1.28)	0.99 (0.90-1.09)	1.00	1.01 (0.93-1.09)	1.08 (0.99-1.18)	1.28 (1.16-1.41)	1.31 (1.17-1.46)	1.37 (1.20-1.57)	1.56 (1.35-1.80)	1.76 (1.58-1.96)
Women											
All cases (%n)	1432 (47.11)	952 (51.16)	4569 (44.87)	4331 (32.46)	2089 (29.08)	1011 (29.35)	476 (29.27)	264 (32.43)	97 (27.25)	79 (34.05)	98 (28.49)
Odds ratio	1.23 (1.11-1.37)	1.19 (1.05-1.35)	1.15 (1.07-1.22)	1.00	0.95 (0.88-1.02)	1.04 (0.94-1.15)	1.23 (1.07-1.42)	1.49 (1.24-1.79)	1.48 (1.13-1.94)	2.07 (1.48-2.88)	1.77 (1.35-2.32)
Cases in adjusted model N (%)	1216 (45.58)	793 (49.32)	4055 (43.45)	3933 (31.61)	1908 (28.14)	930 (28.71)	441 (28.69)	248 (31.75)	92 (27.14)	74 (33.48)	85 (26.65)
Odds ratios:											
Age adjusted	1.26 (1.13-1.41)	1.19 (1.04-1.37)	1.14 (1.07-1.22)	1.00	0.94 (0.87-1.02)	1.05 (0.94-1.16)	1.23 (1.07-1.42)	1.46 (1.21-1.77)	1.53 (1.15-2.03)	1.97 (1.40-2.76)	1.68 (1.26-2.24)
Fully adjusted*	1.20 (1.06-1.36)	1.04 (0.90-1.19)	1.02 (0.95-1.09)	1.00	1.02 (0.94-1.10)	1.17 (1.05-1.30)	1.39 (1.20-1.61)	1.62 (1.33-1.97)	1.69 (1.27-2.25)	2.04 (1.44-2.87)	1.67 (1.24-2.25)

Odds ratios adjusted for BMI, only adult in household, region, car access, ethnicity, tenure, qualification, and years of education, 10 year age band.

4.2.3 Pattern of drinking

Figure 13: Proportion hypertensives according to pattern of drinking (fully adjusted¹)



¹Adjusted for age, BMI, living alone, region, car access, smoking, ethnicity, tenure and qualification

Among male drinkers, the proportion of hypertensives was lowest among those drinking within both weekly and daily limits (Figure 13). Relative to this group, the odds ratio of hypertension among binge drinkers was 1.17 (0.99 to 1.38), and among steady excessive and heavy excessive drinkers were 1.34 (1.20 to 1.49) and 1.48 (1.30 to 1.69) respectively.

Odds ratios for hypertension among the female steady excessive and heavy excessive drinkers were similar to those for men, but binge drinkers had a reduced risk of hypertension relative to moderate drinkers, with an odds ratio of 0.70 (0.50 to 0.99).

5 Public Health Implications

In accordance with other studies, this report shows a clear association between alcohol consumption and blood pressure. Systolic blood pressure (SBP) rose as weekly alcohol consumption rose, with an average increase of nearly 5 mmHg in those drinking above 42 (women) and 50 (men) units/wk, compared to those who drank between one and seven units/week. However, a J-shaped association between SBP and alcohol was only seen in women. Similarly, the risk of hypertension in women was lower amongst those drinking 1-7 units/week than in non-drinkers and in those drinking above those levels, while in men no risk increase was observed in those drinking up to 14 units/week. These results need to be taken into account when making recommendations on how many alcoholic drinks a hypertensive person should be allowed when weighing up risks and benefits. It is clear that a reduction in alcohol intake reduces blood pressure and hence cardiovascular risk. In our study, the risks of hypertension for both men and women were highest in those who exceeded weekly guidelines, especially if they also exceeded daily limits. Hence heavy drinkers should be encouraged to reduce their amount of alcohol consumption and would benefit from a reduction to between one and seven units/week. However, stopping drinking altogether may not be beneficial.

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7. Acknowledgements

We would like to thank members of the steering group, Professor Neil Poulter and Ian White for helpful discussions, and the Alcohol Education Research Council for funding the study.

8. Presentations and Papers

1. Initial results were presented by Kiran Nanchahal and Sam Pattenden at an internal London School of Hygiene & Tropical Medicine seminar series in December 2005.

1. Abstract and poster presented at the World Congress of Cardiology, Barcelona, 2-6 September 2006.

P734 : Patterns of alcohol consumption and blood pressure

Authors:

K. Nanchahal, S. Pattenden, P. Primatesta, B. Thom

Topic(s):

Hypertension

Background

Alcohol consumption is a major cause of preventable morbidity and mortality. Hypertension is an important preventable risk factor for cardiovascular disease. We used data from the Health Survey for England (1994-2003), a series of annual population surveys designed to ascertain health and health related behaviour to examine patterns of alcohol consumption and blood pressure.

Methods

Data were available for 122,809 adults. `Sensible' weekly drinking was defined as drinking ≤ 14 units/week (women); ≤ 21 units/week (men) and binge drinking as consuming > 8 units of alcohol at a single occasion for men and > 6 units for women. People were grouped into four categories: a) drinking within `sensible' weekly amount: a1) not binge drinking, a2) binge drinking; b) drinking above `sensible' weekly amount: b1) not binge drinking, b2) binge drinking. Hypertension was defined as having blood pressure above 140/80 mmHg or taking antihypertensives.

Results

Non-linear relationships were found between blood pressure and average weekly alcohol consumption in both men and women. Among men, relative to those who drank 1-7 units/week, the odds of hypertension increased with increasing weekly consumption from 1.28 (1.16-1.41) among those who consumed 22-28 units/week to 1.76 (1.58-1.96) in men who drank above 50 units/week. There was no significant increase in odds of hypertension in non-drinkers. Among women, the odds ratio was 1.17 (1.05-1.30) in those who drank 15-21 units/week, 1.67 (1.24-2.25) in women who consumed 50 units/week or more and 1.20 (1.06-1.36) in non-drinkers. The number of days on which alcohol was consumed in the previous week had little effect on the risk of hypertension in women. Among men, the odds ratio for drinking seven days a week relative to none was 1.32 (1.12-1.56), after adjusting for weekly consumption and other possible confounders. The proportions (%) of people in groups a1, a2, b1, b2 were 56.9, 6.7, 18.0, 14.6 for men and 71.8, 3.2, 13.8, 5.6 for women, respectively. The odds of hypertension were higher in both men and women who drank above the `sensible' weekly amount; the association with binge drinking within `sensible' weekly amount was less clear.

Conclusions

A J-shaped curve in men and a U-shaped one in women describes the association between alcohol and hypertension in this population. In men, binge drinking increases the risk of hypertension, over and above the effect of average weekly drinking. These results have important implications for health promotion and emphasise the value of screening for alcohol consumption in medical settings

Patterns of alcohol consumption and blood pressure

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Introduction

- Alcohol consumption is a major cause of preventable morbidity and mortality.
- Hypertension is an important preventable risk factor for cardiovascular disease.

Aims

To describe the relationship between patterns of alcohol consumption and hypertension.

Methods

Participants: 122,809 adults aged 18-74 years, without a history of CVD, who participated in the Health Survey for England in 1994-2003, a series of annual nationwide household based cross-sectional surveys of a representative sample of the population.

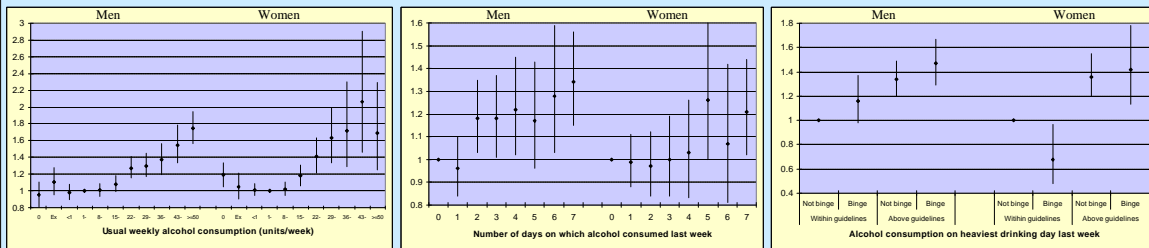
Hypertension: Blood pressure $\geq 140/90$ mmHg or on anti-hypertensives

Alcohol consumption:

- Guidelines (units/week)
 - Women ≤ 14
 - Men ≤ 21
- Binge drinking (units/occasion)
 - Women > 6
 - Men > 8

Results

Adjusted¹ Odds Ratios for hypertension by measures of alcohol consumption



¹Adjusted for age, body mass index, lone adult, region, car, smoking, ethnicity, tenure, qualifications (Number of days last week: +units/ week)

Conclusions

- Relationships between hypertension and amount of alcohol consumed, as well as frequency of drinking, are non-linear in both men and women
- In men, binge drinking increases the risk of hypertension, over and above the effect of average weekly drinking
- These findings have important implications for health promotion and emphasise the value of screening for alcohol consumption in medical settings

2. Paper submitted for publication to the journal, Alcohol and Alcoholism:

Pattenden S, Nanchahal K, Primatesta P, Thom. Self-reported never-drinkers in England 1994-2003: characteristics and trends in adults aged 18-54 years.

3. Papers in preparation:

Kiran Nanchahal, Paola Primatesta, Betsy Thom, Sam Pattenden. Patterns of alcohol consumption and blood pressure

Kiran Nanchahal, Paola Primatesta, Betsy Thom, Sam Pattenden. Characteristics of young people according to patterns of drinking