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ABSTRACT

Background: Overconsumption of alcohol affects health. Data from men from the West of Scotland Collaborative study were analysed to see how reported alcohol was related to acute and mental health hospital admissions.

Methods: Men (N = 5772) from a prospective cohort study located in 27 workplaces in West and Central Scotland were screened when aged 35–64 in 1970–3. The number of acute and mental health admissions and bed-days were calculated by alcohol category (none, 1–7, 8–14, 15–21, 22–34 and 35 or more units per week) to the end of 2005. Specific causes were coronary heart disease (CHD), stroke, respiratory diseases and alcohol-related.

Results: Men who consumed 22 or more units per week had a 20% higher rate of acute admissions than non-drinkers. The number of bed-days were higher for men drinking eight or more units and increased with consumption, with the highest category having a 58% higher rate of bed-days than non-drinkers. Non-drinkers had the highest admissions for CHD. For stroke, drinkers of 15 or more units had higher admissions and higher number of bed-days and these increased with increasing consumption. Respiratory admissions were higher for drinkers of 22 or more units and bed-days were higher for drinkers of 15 or more units. Alcohol-related admissions and number of bed-days generally increased with consumption. Mental health admissions and number of bed-days were raised for drinkers of 22 or more units with a suggestion of a J-shaped relationship.

Conclusion: Alcohol consumption has a substantial effect on acute and mental health admissions and bed-days.

There is increasing concern regarding the overconsumption of alcohol and its effects on health.[1] One such area is health service resources. A study of the annual costs to society of alcohol misuse in Scotland estimated that 9% of the costs were for healthcare (others being social work services, criminal justice system and emergency services, wider economic costs and human costs) and that 57% of the healthcare costs were for inpatient care.[2] Alcohol-attributable morbidity and mortality accounted for 1.16% of Germany's gross domestic product.[3] It is thus important to know whether people who consume alcohol account for excess hospital resources. Data from men from the West of Scotland Collaborative study were analysed to determine how the amount of reported alcohol was related to acute hospital admissions and mental health hospital admissions.

METHODS

Between 1970 and 1973, 6022 men and 1006 women from a variety of workplaces in Glasgow, Clydebank and Grangemouth completed a questionnaire and attended a health-screening examination.[4] The response rate was 70% for the workplaces for which response rates were available (87% of the sample). There were insufficient events for women to be included and, like earlier analyses of this data set, the analyses were done on men aged 35–64 at screening.[5] After excluding seven men lost to follow-up, the data set consisted of 5772 men. The questionnaire included questions on usual weekly consumption of beer, spirits and wine. These were converted to units of alcohol taking one unit as half a pint of beer, a measure of spirits or a sixth of a bottle of wine. These were the appropriate conversion levels at that time. Total weekly units were then divided into six categories of none, 1–7, 8–14, 15–21, 22–34 and 35 or more. There were other questions on smoking habit, own and father's occupation, age leaving full-time education, car user, number of siblings, home address from which Carstairs deprivation category (an area-based measure) was obtained,[6] angina and bronchitis questionnaires. These have been described previously.[4 5] Father's social class and own social class were obtained from father's and own occupations by use of the contemporaneous Classification of Occupations.[7] Social class ranges from I (highest) to V (lowest) with category III subdivided into III non-manual and III manual. Age leaving full-time education was further classified into four groups: 12–14, 15–16, 17–18 and 19 or over. At the screening examination, a blood sample was taken for measurement of plasma cholesterol, and height and weight were measured and converted to body mass index in kg/m^2 and an electrocardiogram (ECG) was taken. Ischaemia on ECG was defined as any of Minnesota codes 1.1–1.3, 4.1–4.4, 5.1–5.3 and 7.1.[8] The per cent predicted forced expiratory volume in 1 second (FEV_1) was defined as the actual FEV_1 as a percentage of the expected FEV_1.[9]

Ethical permission was given by the Privacy Advisory Committee of NHS Scotland Information Services to link participants to their hospital discharge data from 1972. The Scottish Morbidity Records system is a computerised record of hospital discharges in Scotland, with acute hospital discharges known as SMR1s and mental health hospital discharges known as SMR4s.[10] Discharges were available until the end of 2005 and excluded any occurring before each participant's individual date of screening. Dates of admission and discharge permitted calculation of number of admissions and length of stay (bed-days) for each participant.

For the calculation of number of acute admissions per person, transfer admissions, in which the participant was transferred to another specialty within the episode, were excluded. All other admissions were summed for each person. Length of stay for each admission was calculated by subtracting the date of admission from the date of discharge and adding 1, the addition of 1 to ensure not losing day cases. For transfer admissions, the 1 was not added to ensure no double counting. Total number of bed-days per person were summed for each participant. Admissions and bed-days were recalculated for different causes of admission, taken from the main diagnosis code. The causes were coronary heart disease (CHD) (International Classification of Diseases (ICD) 8 and 9 codes 410–414, ICD10 codes I20–I25), stroke (ICD8 and 9 codes 430–438, ICD10 codes I60–I69, G45), respiratory diseases (ICD8 and 9 codes 460–519, ICD10 codes J00–J99) and alcohol-related causes (ICD8 and 9 codes 141, 143–6, 148–9, 150, 155, 161, 291, 303, 571, 800–999, ICD10 codes C01–C06, C10, C13–15, C22, C32, F10, K70, K74.6, S00–Y98). Alcohol-related causes were cancers of the mouth and pharynx (excluding lip, salivary glands and nasopharynx), oesophagus, liver and larynx; alcoholic psychoses; alcohol dependence syndrome; chronic liver disease and cirrhosis; and external causes.

For the calculation of number of mental health admissions per person from SMR4 records, transfer admissions were excluded. All other admissions were summed for each person. The number of bed-days were calculated by subtracting the date of admission from the date of discharge. In the case of transfer admissions, one was subtracted from this total to ensure no double counting. Total number of mental health bed-days per person were calculated by summing the number of bed-days for each admission for each participant. Any mental health admissions and number of bed-days from SMR1 data were also calculated and added to the SMR4 admissions and number of bed-days. About 17% of the mental health admissions could be broadly categorised as depression or anxiety and about 18% as psychoses.[11]

Dates of any deaths or embarkations from the UK were obtained from the NHS Central Register. Survival time in days was calculated from the date of screening to the end of 2005, or to the date of death or embarkation. These were used to calculate the admissions and number of bed-days per 1000 person-years for each alcohol category. Negative binomial regression was used to relate alcohol consumption to admissions and number of bed-days from screening to the end of 2005 using the statistical package Stata V.10. Negative binomial regression is similar to Poisson regression but can be used when the variance is greater than the mean, as in these analyses in which some participants are more likely to have several admissions (or higher number of bed-days) than others.[12] Analyses were adjusted firstly for age and then for age and other confounders. The ''none'' drinking category was taken as the baseline.

RESULTS

Thirty-two per cent of men reported consuming no alcohol and 9% reported drinking 35 or more units per week (table 1). The median follow-up time was 28 years and the maximum was 35 years. Men drinking 22 or more units per week had a higher rate of acute admissions (age-adjusted rate ratios compared with non-drinkers: 1.24 (95% confidence interval (CI) 1.13 to 1.37) for the 22–34 units category and 1.22 (95% CI 1.10 to 1.35) for the 35+ category). Adjusting for other risk factors (father's social class, own social class, education, deprivation category, cholesterol, body mass index, smoking, angina (by Rose Angina Questionnaire), ischaemic ECG, bronchitis (by MRC Bronchitis Questionnaire), % predicted FEV_1, car use and siblings) attenuated the associations and they remained clearly elevated only for the 22–34 category. Consuming eight or more units weekly was associated with higher number of bed-days and the rates increased as consumption increased, with the highest drinking category having a rate ratio of 1.58 (95% CI 1.37 to 1.83) compared with the non-drinkers. Adjustment for risk factors again attenuated but did not abolish the associations for drinkers of 22 units or more.

Admissions due to CHD were highest in the non-drinkers. They were particularly low for drinkers of 22–34 units. Adjustment for risk factors had the effect of further decreasing the rate ratios for drinkers of 15 or more units. The pattern for bed-days for CHD was similar to admissions, except for the 35+ category in which bed-days were similar to those for the non-drinkers, suggesting a U-shaped relationship. Adjustment attenuated the rate ratios with the 22–34 category having a particularly low rate ratio of 0.43 (95% CI 0.29–0.63).

Admissions due to stroke and the number of bed-days were higher for drinkers of 15 or more units per week, with increasing rates as the amount consumed increased above 15. The number of bed-days for drinkers of 22 or more units were particularly high. After adjustment for all risk factors, rate ratios were still high for drinkers of 22 or more units. Admissions for respiratory diseases were higher for those drinking 22 or more units per week but adjustment for risk factors greatly attenuated this relationship. The increased rate for number of bed-days started with the 15–21 category, and again this was considerably attenuated by adjustment. Alcohol-related admissions and number of bed-days generally increased with consumption and the highest consumers had a three- to fourfold higher rate than non-drinkers. Additional adjustment attenuated the rate ratios but the relationships remained.

Mental health admissions were raised for the 22–34 and 35+ categories. There was a suggestion of a J-shaped relationship, with the two lower drinking categories having lower admissions rates than the non drinkers. Adjustment for risk factors attenuated the rate ratios, which were still strong for drinkers of 35 or more units. The number of mental health bed-days were raised for the 22–34 category (but were not different from the non-drinkers) and the 35 or more category and were still high after adjustment, but not clearly different from the non-drinkers.

DISCUSSION

This study has shown that higher consumers of alcohol have more acute admissions and, more strikingly, higher number of bed-days than lower consumers of alcohol. This was seen for all the individual causes examined, with the exception of CHD in which the non-drinkers had the most admissions and the highest number of bed-days. The protective effect of alcohol on CHD morbidity and mortality has been reported in other studies,[13–15] so the same pattern may be expected with admissions and bed-days. However, higher alcohol consumption could be related to more sudden cardiac deaths with heavy drinkers dying before having an admission for CHD. Evidence for this effect has been seen in men in the British Regional Heart Study, in which sudden cardiac death was highest in heavy drinkers.[16] Although there were reduced admissions for CHD for participants drinking 35 or more units per week, there was no

Table 1 Acute admissions and number of bed-days by reported alcohol consumption in 5772 men aged 35–64 from the West of Scotland Collaborative study

	Units of alcohol per week					
	None	**1–7**	**8–14**	**15–21**	**22–34**	**⩾35**
Number of men	1834	1116	1063	629	627	503
Person-years	46 539	29 194	27 568	15 259	15 041	11 365
All acute admissions						
Total admissions	9904	5931	6005	3304	3815	2812
Admissions per 1000 person-years	212.8	203.2	217.8	216.5	253.6	247.2
Rate ratio adjusted for age (95% CI)	1	0.96 (0.89 to 1.04)	1.05 (0.97 to 1.14)	1.04 (0.95 to 1.15)	1.24 (1.13 to 1.37)	1.22 (1.10 to 1.35)
Rate ratio adjusted for all risk factors* (95% CI)	1	0.98 (0.91 to 1.06)	1.02 (0.94 to 1.10)	0.95 (0.87 to 1.05)	1.14 (1.03 to 1.25)	1.07 (0.96 to 1.19)
Bed-days per 1000 person-years	1985	1742	1879	2322	2428	2865
Rate ratio adjusted for age (95% CI)	1	0.93 (0.83 to 1.03)	1.14 (1.02 to 1.27)	1.30 (1.13 to 1.48)	1.41 (1.24 to 1.61)	1.58 (1.37 to 1.83)
Rate ratio adjusted for all risk factors (95% CI)	1	0.94 (0.84 to 1.05)	1.08 (0.97 to 1.21)	1.12 (0.98 to 1.29)	1.25 (1.09 to 1.43)	1.31 (1.13 to 1.52)
CHD admissions						
Total admissions	940	503	492	264	198	194
Admissions per 1000 person-years	20.2	17.2	17.9	17.3	13.2	17.1
Rate ratio adjusted for age (95% CI)	1	0.87 (0.71 to 1.05)	0.91 (0.75 to 1.11)	0.91 (0.71 to 1.16)	0.65 (0.50 to 0.84)	0.88 (0.67 to 1.14)
Rate ratio adjusted for all risk factors (95% CI)	1	0.91 (0.75 to 1.10)	0.83 (0.68 to 1.01)	0.75 (0.59 to 0.95)	0.52 (0.40 to 0.67)	0.64 (0.49 to 0.84)
Bed-days per 1000 person-years	185	157	162	157	110	178
Rate ratio adjusted for age (95% CI)	1	0.90 (0.66 to 1.22)	0.91 (0.66 to 1.23)	0.94 (0.65 to 1.36)	0.70 (0.48 to 1.01)	1.01 (0.68 to 1.52)
Rate ratio adjusted for all risk factors (95% CI)	1	0.87 (0.64 to 1.18)	0.80 (0.59 to 1.09)	0.74 (0.50 to 1.07)	0.43 (0.29 to 0.63)	0.73 (0.48 to 1.10)
Stroke admissions						
Total admissions	233	162	115	102	104	86
Admissions per 1000 person-years	5.01	5.55	4.17	6.68	6.91	7.57
Rate ratio adjusted for age (95% CI)	1	1.14 (0.88 to 1.47)	0.86 (0.65 to 1.14)	1.36 (1.01 to 1.84)	1.56 (1.16 to 2.12)	1.67 (1.21 to 2.32)
Rate ratio adjusted for all risk factors (95% CI)	1	1.13 (0.88 to 1.47)	0.85 (0.64 to 1.12)	1.31 (0.96 to 1.77)	1.46 (1.07 to 1.98)	1.49 (1.06 to 2.09)
Bed-days per 1000 person-years	151	156	98	198	375	416
Rate ratio adjusted for age (95% CI)	1	1.24 (0.76 to 2.04)	0.64 (0.38 to 1.05)	1.25 (0.68 to 2.28)	2.63 (1.44 to 4.81)	2.48 (1.28 to 4.79)
Rate ratio adjusted for all risk factors (95% CI)	1	1.27 (0.75 to 2.14)	0.66 (0.39 to 1.12)	1.32 (0.71 to 2.44)	2.42 (1.28 to 4.59)	2.39 (1.15 to 4.99)
Respiratory admissions						
Total admissions	492	255	327	176	220	174
Admissions per 1000 person-years	10.6	8.7	11.9	11.5	14.6	15.3
Rate ratio adjusted for age (95% CI)	1	0.82 (0.65 to 1.03)	1.12 (0.89 to 1.40)	1.10 (0.83 to 1.44)	1.38 (1.06 to 1.80)	1.48 (1.11 to 1.97)
Rate ratio adjusted for all risk factors (95% CI)	1	0.97 (0.78 to 1.21)	1.08 (0.87 to 1.34)	0.94 (0.73 to 1.22)	1.19 (0.92 to 1.53)	1.10 (0.83 to 1.45)
Bed-days per 1000 person-years	142	119	191	348	166	361
Rate ratio adjusted for age (95% CI)	1	0.77 (0.53 to 1.10)	1.24 (0.86 to 1.80)	1.71 (1.09 to 2.69)	1.31 (0.84 to 2.05)	2.24 (1.39 to 3.62)
Rate ratio adjusted for all risk factors (95% CI)	1	1.10 (0.77 to 1.57)	1.37 (0.96 to 1.95)	1.46 (0.93 to 2.28)	1.30 (0.84 to 2.01)	1.49 (0.92 to 2.40)
Alcohol-related admissions						
Total admissions	422	294	383	189	308	314
Admissions per 1000 person-years	9.1	10.1	13.9	12.4	20.5	27.6
Rate ratio adjusted for age (95% CI)	1	1.13 (0.92 to 1.39)	1.56 (1.27 to 1.90)	1.41 (1.10 to 1.79)	2.39 (1.90 to 2.99)	3.28 (2.58 to 4.16)
Rate ratio adjusted for all risk factors (95% CI)	1	1.14 (0.93 to 1.41)	1.53 (1.25 to 1.86)	1.26 (0.98 to 1.61)	2.10 (1.67 to 2.65)	2.76 (2.15 to 3.53)
Bed-days per 1000 person-years	109	105	163	142	199	383
Rate ratio adjusted for age (95% CI)	1	1.23 (0.88 to 1.72)	2.02 (1.45 to 2.83)	1.64 (1.09 to 2.46)	2.28 (1.52 to 3.41)	4.26 (2.76 to 6.58)
Rate ratio adjusted for all risk factors (95% CI)	1	1.20 (0.86 to 1.67)	1.80 (1.28 to 2.54)	1.55 (1.03 to 2.34)	1.97 (1.31 to 2.97)	3.58 (2.30 to 5.58)
Mental health admissions						
Total admissions	190	110	90	78	87	111
Admissions per 1000 person-years	4.1	3.8	3.3	5.1	5.8	9.8
Rate ratio adjusted for age (95% CI)	1	0.96 (0.64 to 1.43)	0.86 (0.57 to 1.31)	1.45 (0.90 to 2.33)	1.67 (1.04 to 2.68)	3.02 (1.85 to 4.95)
Rate ratio adjusted for all risk factors (95% CI)	1	1.06 (0.71 to 1.59)	0.91 (0.60 to 1.38)	1.27 (0.79 to 2.04)	1.54 (0.96 to 2.47)	2.48 (1.51 to 4.09)
Bed-days per 1000 person-years	536	370	360	386	1057	1184
Rate ratio adjusted for age (95% CI)	1	0.85 (0.39 to 1.86)	1.02 (0.46 to 2.24)	0.70 (0.28 to 1.80)	2.39 (0.93 to 6.10)	3.18 (1.13 to 8.93)
Rate ratio adjusted for all risk factors (95% CI)	1	1.41 (0.60 to 3.31)	1.15 (0.47 to 2.84)	0.65 (0.22 to 1.93)	2.54 (0.92 to 7.0)	2.61 (0.89 to 7.69)

*All risk factors are age, father's social class, own social class, education, deprivation category, cholesterol, body mass index, smoking, angina by Rose Angina Questionnaire, ischaemic ECG, bronchitis by MRC Bronchitis Questionnaire, % predicted FEV_1, car use and siblings.
CHD, coronary heart disease.

reduction in number of bed-days attributable to CHD. In that high consumption group, the highest numbers of bed-days were seen for the other causes. This would suggest that additional factors associated with the high alcohol consumption may be affecting the seriousness of the illness, the speed of recovery and the ability to be discharged from hospital back into the community.

Adjustment for a range of risk factors generally attenuated the rate ratios; this suggests that other risk factors were contributing to the relationship between alcohol and hospital admissions or number of bed-days. In some categories, adjustment caused the rate ratios to become not clearly distinguishable from the baseline group; for example, for all admissions for the 35+ category and for all bed-days for the 15–21 category. In particular, there was little relationship remaining for respiratory disease after adjusting for these risk factors, which may be expected, as respiratory disease is more likely to be due to smoking than to alcohol consumption. In the respiratory analysis adjusted only for age, alcohol could have been acting as a proxy for smoking, which often occurs with alcohol. The relationship between alcohol and alcohol-related causes remained, however, after adjustment for other risk factors. The mental health admissions were higher for only the 35+ group after adjustment. It is perhaps more useful from a health services utilisation viewpoint to consider the results before full adjustment, as this gives the actual usage by alcohol consumption, but to note from the adjusted results that it is not entirely due to the alcohol consumption. Policy implications of this study are important, because levels of alcohol consumption are increasing and will lead to greater demand on hospital services and NHS costs.[1 17]

Adjustment was not included for blood pressure, although it was measured in the study. This was because alcohol is known to increase blood pressure, and so adjusting for blood pressure would be for a variable in the causal pathway between alcohol and morbidity.[18] Other risk factors which were not measured in this study, such as diet, could have contributed to residual confounding.

Although there is an extensive literature on alcohol consumption and mortality and morbidity, there have been fewer publications on alcohol and health service utilisation. In one, members of the North California Kaiser Permanente Medical Care Program were divided into four groups of abstainers, lighter drinkers (<7 drinks per week), moderate drinkers (7–13) and heavier drinkers (14+).[19] Abstainers had higher hospitalisations and number of bed-days than the three groups of drinkers. These results differed from the current study. One reason suggested for abstainers having the highest rates was the inclusion in the abstainer group of former drinkers, who may have stopped drinking due to illness and would be more likely to require medical care. In the current study, former drinkers were also included in the non-drinkers category, as there was no information available on former drinking habits, but it was a cohort of working men who were sufficiently healthy to be at work. It may therefore have had fewer former drinkers than other studies, which may explain the different results seen here. In the North California Kaiser Permanente study, female heavier drinkers had the highest number of psychiatric outpatient visits, compared with the other three categories, but for men there was no difference between the groups.[19]

In a 15-year follow-up study of Finnish men and women, the numbers of hospital days for non-drinkers were compared with those for drinkers of less than one drink per day and drinkers of one or more drinks per day on average.[20] There was an inverse J-shaped relationship for men, with the non-drinkers having the highest number of hospital days and drinkers of less than one per day the lowest. For women there were no significant differences between the groups. The number of hospital days for male non-drinkers of spirits were higher than for drinkers of spirits. Female drinkers of at least half a bottle of spirits per month had particularly high injury and accident-related hospital days.

In a young cohort of adult twins in Sweden, alcohol consumption was described in grams of 100% alcohol per month (in which 250 g is about four bottles of wine).[21] They reported their alcohol consumption in 1973 and were followed up for all hospital admissions and psychiatric hospital admissions until 1992. Men drinking over 1000 g per month had a relative risk of all admissions of 2.9 compared with men drinking 1–250 g, and women drinking over 750 g had a relative risk of 1.4. The risk increased with increasing levels of consumption, especially in men. For psychiatric admissions, men and women abstainers had increased risks compared with the 1–250 g groups. As consumption increased, psychiatric admissions increased, with men and women in the top categories having a sixfold and fourfold increased risk respectively. These results had similar patterns to the current study. However, a study of Spanish men and women found a negative dose–response relationship between alcohol consumption and having a hospital admission (or hospital emergency) in the previous year.[22] Similarly, a large health maintenance organisation found overall that hospitalisations in the previous year decreased with amount of alcohol consumed, but were higher for non-drinkers, and especially high for non-drinkers with a history of heavy drinking. However, in men only, hospitalisations increased with increasing consumption, and this effect was also seen in the oldest men and women of 70 or over.[23]

A different kind of study on alcohol-attributable morbidity in Canada estimated that the number of alcohol-attributable acute bed-days accounted for 5.8% of all hospital days in 2002 in Canada.[24] The major causes were for neuropsychiatric disorders, cardiovascular disease and unintentional injuries. The number of alcohol-attributable psychiatric bed-days accounted for 1.5% of psychiatric hospital days in Canada in 2002, with the largest contributor being alcohol dependence syndrome. Men accounted for 70% of the psychiatric alcohol-attributable days.

Limitations and advantages

Hospital admissions were from Scottish hospitals only, so participants leaving Scotland may have had admissions which were not known about. Alcohol consumption at screening was used, which could have changed over the follow-up period. Alcohol consumption generally drops as people age.[25] Alcohol consumption was self-reported and may have been under-reported, but was shown to be reliable in a previous study of this cohort.[5] A major advantage is the SMR data, which is not available in this form for much of the UK at present. It enables hospital discharge data to be related simply and accurately to study participants with risk factor information. Another advantage is the long follow-up of the cohort. Lastly, the data on alcohol consumption were reported before the admissions took place. This is an advantage of prospective cohort studies, as it eliminates recall bias which may occur in other studies.

To conclude, this study has shown that, in a cohort of working men, alcohol consumption of over 22 units per week was associated with a higher number of acute admissions and consumption of over eight units per week with more acute bed-days. Consumption of over 22 units per week was also

What is already known on this subject

Deaths from alcohol-related causes have increased markedly in the UK. Alcohol consumption is increasing and healthcare costs due to alcohol consumption are substantial.

What this study adds

Higher consumers of alcohol have more acute and mental health admissions and higher number of bed-days than lower consumers of alcohol. The numbers of bed-days were particularly high (58% higher for acute admissions and three times higher for mental health admissions in the highest consumers) and will have an impact on NHS costs.

associated with a higher number of mental health admissions. The overall effects are substantial, with a 58% higher use of hospital beds seen among the heaviest drinking men. Alcohol consumption has a notable effect on health service utilisation and therefore NHS costs.

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