Saliva alcohol concentrations in accident and emergency attendances

T Simpson, N Murphy, D F Peck

Abstract

***Objectives*—Although alcohol is known to play a key part in accidents, no UK study has assessed alcohol concentrations in a comprehensive sample of accident and emergency (A&E) attenders. This study set out to do this, and examine the relation between alcohol concentrations and the severity, type and circumstances of presentation, and the sociodemographic characteristics of patients.**

***Methods*—A survey was conducted of all new A&E attenders (aged 10 years or over). Two 24 hour periods for each day of the week were covered in 6, 7 or 11 hour sessions over a two month period. Alcohol concentrations were assessed from saliva samples using a disposable device. Data were collected from 638 attenders, of whom 544 provided saliva samples; the remainder refused or were unable to participate.**

***Results*—Positive saliva alcohol readings were obtained in 22% of attenders (95%CI 19% to 26%); this increased to 25% if others were included (for example, those who refused to participate but were judged to be intoxicated). Alcohol was associated with 94% of incidents of self harm, 54% of non-specific/multiple complaints, 47% of collapses, 50% of assaults, and 50% of patients admitted to hospital. Higher concentrations of alcohol were found from Friday to Sunday, between midnight and 0900, and in patients aged 41 to 60. Among people with positive alcohol results, those attending with a companion had higher concentrations than those attending alone. There were no significant differences between men and women in alcohol concentrations.**

***Discussion*—These findings show that alcohol use is an important factor in A&E attendance, but it should not be assumed that there is a causal relation between alcohol use and injury. Several accident related and sociodemographic variables were predictive of alcohol use before attending. The overall level of prediction was too weak to permit accurate identification of drinkers for screening purposes, but routine alcohol concentration assessments may be justified in the high risk groups identified in this study. A&E departments may be convenient and fruitful settings for brief interventions with early problem drinkers.**

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In the Highlands 15% of men and 4% of women drink in excess of recommended limits of 28 units and 21 units per week respectively.[1] Alcohol intoxication is frequently associated with injuries from falls, fires, drownings, overdoses, poisonings, occupational accidents and violence.[2 3]

Much of the research into alcohol and accidental injury has been conducted in North America. A risk function analysis study has shown that risk of injury increases even at low levels of consumption and that alcohol use is more common in injured patients; those with a history of heavy drinking have more severe injuries when admitted to hospital.[4] A large scale prospective study found that problem drinkers were more likely to suffer injury than matched controls[5]; and a survey of emergency room attenders aged 10 to 21 years reported that 5% tested positive for alcohol, increasing to 11% among 17 to 21 year olds (a positive result was found in a child as young as 10 years).[6] Finally, a study of the incidence of alcohol use among sub-critically injured emergency room patients found that 21% had positive saliva alcohol results; the authors noted the likelihood that refusers may have a higher rate of alcohol use than participants.[7]

This area has been relatively neglected in the UK, with a few notable exceptions. One UK study found that 42% of patients who presented to an accident and emergency (A&E) department with mild head injury and concussion were found to have positive blood alcohol levels.[8] An Edinburgh study reported that 32% of evening attenders at an A&E department had a blood alcohol concentration over 80 mg%.[9] A study in Hull reported that 14% of all A&E attendance was alcohol related, which increased to 24% between 2000 and midnight, and 46% between midnight and 0600.[10]

The value of previous research studies in the UK is limited because they have concentrated on specific types of injuries at selected times or have relied solely on clinical signs of intoxication, a method that is known to be unreliable.[7] The involvement of alcohol in the presentation may therefore be an underestimated possibility in A&E attenders. It seems that no UK survey has been carried out that has reported objectively measured alcohol levels in a comprehensive and representative sample of all new patients attending an A&E department. This study aimed to fill this gap by conducting a project in Raigmore Hospital, Inverness, in the Highland region of Scotland. The Raigmore A&E department recorded 25 335 patient attendances in 1995/96 and has an

immediate catchment population of approximately 100 000.

We decided to measure alcohol concentrations from saliva samples. This method has many advantages: saliva is readily available; the test is easily administered and is acceptable to patients; the procedure is non-invasive and relatively non-intrusive; it is devoid of legal connotations; and results are rapidly obtained. The saliva method correlates at over +0.90 with blood and breath alcohol measurements.[11]

Methods

All new patients attending the A&E department during the sampling period were informed of the study and given an information sheet. The study extended over an eight week period from mid-February to mid-April. Two 24 hour periods were covered for each day of the week, in 6, 7 or 11 hour sessions.

New patients aged 10 years or over were asked to participate. For those under 16 the accompanying adult was also asked to give consent for the child to be tested. Patients were excluded if they were direct medical referrals via A&E, GP referrals only for a radiological examination, uninvited returns, or if they were critically injured or unable to give informed consent.

Patients meeting these criteria were asked to read the information sheet and to agree to take part. A five minute interview was conducted to record the following information: age; sex; occupation; whether local or visitor; whether attending alone or accompanied; the nature of the complaint (for example, damage to eye or non-specific complaint); the origin of the complaint (for example, assault or self harm); disposal (for example, discharged or admitted to ward); place of occurrence; perceived responsibility for the incident; and the day and time of attendance. Full details of these independent variables can be found in table 1. Finally, any drug use in the preceding 24 hours, and the time of the last alcoholic drink, were noted.

Names and other identifying information were not recorded, nor were they sought. For patients who were incapacitated or who withheld consent, clinical judgment of intoxication was noted by the attending clinical staff. Similar information to the above (as far as it could be judged) was also noted for these patients.

After clarifying that the patient had not taken food or fluids in the preceding 10 minutes, the researcher placed a swab in the mouth and a sample of saliva was collected. Saliva alcohol concentrations were measured using either the QED A-150 or the QED A-350 enzymatic test device (Enzymatics Incorporated). The first has a detection range of 10 mg% to 150 mg% and the second a detection range of 20 mg% to 350 mg%. In this method, saliva is collected on a cotton wool swab placed in the mouth for 30 to 60 seconds until the swab is thoroughly saturated; it is then inserted into a small receptacle at the base of a capillary tube. Alcohol concentrations are determined by noting colour change on a thermometer-like scale printed on the tube. The swab and tube are disposable. The researcher measured and recorded the saliva alcohol concentration in a separate area of the department, away from waiting and clinical areas. The results were totally confidential and were not divulged to anyone.

Results

During the complete study period 3318 new patients aged 10 and over attended the A&E department. During the sampling times, there were 728 attenders who met the criteria for inclusion. At times of high clinical activity it was not possible to approach all patients and 90 were "lost" to the study, the majority during the first week of the study. Of the remaining 638, there were 39 refusals to participate (6%), of whom 18 (46%) were judged to be clinically intoxicated. Forty nine patients were incapacitated or unable to participate, of whom 14 (28%) were judged to be clinically intoxicated. Six tests were discarded because of equipment failure.

ALCOHOL CONSUMPTION

The saliva test was successfully administered to the remaining 544 patients. Their mean age was 35.5 (SD 18.02, range 10 to 96). Sixty one per cent were male. None had ingested food or fluid in the 10 minutes before the sample was taken. Positive alcohol concentrations were obtained in 122 patients (22%, 95%CI 19% to 26%). The data were skewed, accordingly the median and interquarterile range were calculated; the median was 60, the interquarterile range was 40 to 160.

One hundred and twenty patients attended the department on the day after their injury, of whom 19 admitted consuming alcohol before the incident. This mirrors the prevalence of alcohol use in those attending promptly. Fourteen patients with positive saliva alcohol concentrations reported that they had ingested alcohol after the injury, and had consumed none beforehand. If adjustments are made in line with these reports, the overall rate of alcohol use before injury is nearly 25% (122 positives, plus 18 intoxicated who refused, plus 14 intoxicated who were incapacitated, plus 19 late attenders who admitted consumption, less 14 who consumed after the injury, totalling 159 out of 638 or 24.9%). These adjustments were not incorporated in the analyses reported below, the main statistical tests being based on the saliva data.

DATA REDUCTION AND ANALYTICAL METHODS

As anticipated the majority of subjects had zero alcohol concentrations. This resulted in a markedly skewed distribution, prohibiting the use of parametric statistical methods; accordingly the alcohol data were recoded into categories and the main analyses were conducted using χ^2. Four hundred and twenty two patients had zero concentrations (78%), 70 had concentrations between 1 mg% and 80 mg% (13%), 27 between 81 and 180 mg% (5%), and 25 over 180 mg% (4.6%). Any categorisation can be seen as arbitrary. These

Table 1 Alcohol positive patients in relation to demographic and attendance factors

	Total tested (n)	*Positive (n)*	*Positive (%)*
Age (n=544)			
10–17	101	7	7
18–25	107	24	22
26–40	168	43	26
41–60	117	34	29
61–96	51	14	27
Sex (n=544)			
Male	330	78	24
Female	214	44	21
Alone (n=541)			
Alone	180	73	41
Accompanied	361	46	13
Occupation (n=539)			
Prof/Manage/Tech	93	16	17
Skilled manual	83	26	31
Semi-skilled manual	55	12	22
Non-skilled	48	9	19
Clerical	25	4	16
Unemployed	133	42	31
School/college	102	8	8
Day (n=544)			
Mon–Thu	277	50	18
Fri–Sun	267	76	28
Time (n=544)			
0901–1230	101	10	10
1231–1700	186	21	11
1701–2000	97	23	24
2001–2400	103	36	35
0001–0900	57	32	56
Nature of complaint (n=537)			
Head and face	75	21	28
Eye	42	5	12
Upper limb	146	29	20
Torso	64	9	14
Lower limb	145	20	14
Multiple/non-specific	65	35	54
Origin of complaint (n=496)			
Fall	148	38	25
Something in eye	37	4	11
Sport	70	6	8
Knocked out	105	14	13
Self harm	18	17	94
Assault	36	18	50
Aches and pains	45	6	13
Collapse	21	10	47
RTA (non-pedestrian)	16	2	12
Disposal (n=541)			
Discharged	366	65	17
Followed up	108	20	18
Admitted	67	34	51
Place (n=517)			
Home	174	46	26
School/work	118	8	7
Leisure	150	27	18
Public place	75	34	45

categories were adopted for the following reasons: 0 mg% because it is of key interest; up to 80 mg% because it represents the UK legal limit for driving; and the other two categories in order to have balanced numbers to facilitate data analysis.

All the independent variables were already categorical except "age". This was categorised as follows: 10–17, 18–25, 26–40, 41–60, and over 60. The seven categories in the variable Day of week were reduced to two categories, Friday to Sunday (the days of heaviest drinking) versus the rest of the week. To gain a clear idea of the magnitude of the associations between the variables as well as the statistical significance levels, χ^2 values were converted into the corresponding correlation statistic, the contingency coefficient (C). For those patients whose alcohol concentrations were above zero (n=122), the alcohol data remained skewed, accordingly a non-parametric test (Kruskal-Wallis) was used to examine subgroup differences.

The independent variables consisted of two kinds: the four key variables where significant effects were expected (age, sex, day of week, and time of day); and the seven variables that were exploratory with no firm expectations (local or visitor, alone or accompanied, disposal, nature of complaint, origin of complaint, who was considered responsible, and the circumstances of the presentation). Bonferroni corrections were applied to the tests, whereby the conventional significance level (<0.05) was divided by the number of analyses with each kind of independent variable, in order to reduce type 1 errors. Statistical analyses were carried out using Minitab,[12] or Instat.[13]

ASSOCIATION BETWEEN ALCOHOL CONCENTRATIONS AND INDEPENDENT VARIABLES

Table 1 shows the association between the sociodemographic and attendance factors and positive saliva alcohol concentrations.

PERCENTAGES

Some of the overall percentages in table 1 are striking. For example, positive alcohol concentrations were obtained in 94% of cases of self harm (95%CI 73 to 100), 50% of cases of assault (95%CI 33 to 67), 47% of cases of "collapse" (95%CI 26 to 70), 45% of injuries received in a public place (95%CI 34 to 57), and in 51% of patients admitted to hospital (95%CI 38 to 63). However, the data must be interpreted with caution as indicated by the wide confidence intervals.

The χ^2 test was used to examine differences in the four saliva alcohol concentrations in relation to the independent variables. For the variables Day of week, Disposal, and Place the alcohol categories were combined (positive versus negative result) to overcome the problem of low expected frequencies. No significant associations were found for three variables: sex (χ^2 (3) = 0.824, p = 0.844), local/visitor (χ^2 (3) = 1.113, p = 0.774), and alone/accompanied (χ^2 (3) = 10.301, p = 0.016, NS after Bonferroni correction). For the remaining independent variables significant differences were found in alcohol concentrations, as shown in table 2.

Table 2 Significant cross tabulations with higher saliva alcohol categories using full sample

Variable	*χ^2*	*df*	*p*	*Contingency coefficient*	*Category associated with higher alcohol levels*
Age	39.40	12	0.0006	0.260	Aged between 41 and 60
Occupation	43.15	18	0.0080	0.272	Unemployed
Day of week	7.71	1	0.0055	0.118	Attend Friday to Sunday
Time of day	59.60	3	0.0001	0.315	Attend 8pm to 9am
Nature of complaint	70.10	15	0.0001	0.340	Multiple complaints; non-specific complaints
Origin of complaint	126.14	24	0.0001	0.450	Self harm; collapse; assault
Disposal	36.87	2	0.0001	0.253	Admitted to a ward
Place	42.76	3	0.0001	0.276	Public places

Patients with the following characteristics were likely to have consumed alcohol before attending the A&E department: aged 41 to 60 years; unemployed; attending at the weekend or overnight; with multiple or non-specific injuries; admitted to a ward; presenting with self harm, collapse or assault; and injured in public places. For those patients who had positive saliva tests (n=122), non-significant differences (Kruskal-Wallis, after Bonferroni correction) in alcohol concentrations were obtained for all independent variables, except alone/accompanied. Patients attending alone had lower alcohol concentrations (n=73, median=60) than accompanied attenders (n=46, median=100), H=8.25, df=1, p=0.004.

Discussion

Several findings of clinical interest emerged in this study. Twenty five per cent of all new A&E attenders had recently consumed alcohol. It is noteworthy that the majority had consumed a small amount. A minority (15%) had consumed over 80 mg%; this is in contrast with the usual perceptions of alcohol use in A&E attenders. However, the inherent delay between injury/complaint and subsequent A&E attendance means that the recorded alcohol concentrations should be regarded as an underestimate of the actual amount consumed.

There was a strong association between alcohol use and attending because of assault and self harm. This supports previous research focused on these clinical conditions. However, the association between alcohol use and attending because of "collapse" or "non-specific" complaints was unexpected; patients in these clinical categories also had a high probability of hospital admission. These findings are sufficiently intriguing to warrant further investigation.

There was also an association between alcohol ingestion and an incident having occurred in a public place, possibly because such incidents may be more likely to come to the attention of the emergency services.

One quarter of all domestic incidents in the study were associated with alcohol ingestion. This is clinically important as accidents in the home are a significant contributory factor to overall population mortality. Over the age of 35 there is a significantly increased mortality from home accidents in Scotland, relative to England and Wales. For example, the 1993 Scottish mortality rate per 100 000 for accidental falls between the ages of 45 and 54, was 6.6 (males) and 3.2 (females). The corresponding figures for England and Wales were 3.2 and 1.5.[14] The reasons for this are unknown and are presumably multifactorial, but alcohol use may be a key factor.

Only seven under age drinkers were identified among the 112 young people aged from 10 to 17 who attended the A&E department during the study period. This is consistent with other research findings, but is at variance with media perceptions of adolescent alcohol abuse. While there is strong evidence that Scottish adolescents do drink regularly,[15] it seems that they do not attend the A&E department to the same degree as other age groups for alcohol related injury. A possible reason may be that parents feel less embarrassed to take their children to a general practitioner, than to the more public location of a hospital.

The difference in alcohol concentrations between positive patients attending alone (median = 60) and those attending accompanied (median = 100) is striking, but may be parsimoniously interpreted as indicating that the most inebriated would have difficulties in getting to the A&E department without help.

As anticipated from previous studies, a disproportionate number of patients with positive alcohol concentrations attended at weekends and at night.

The non-significant difference between males and females, in terms of the category of saliva alcohol levels, was surprising; similarly, among those who had ingested alcohol, there was no significant difference in levels of alcohol between men and women; the medians were 77 and 50, respectively. This is consistent with reports that alcohol consumption in women in the UK has been increasing; men continue to drink more than women, but women may suffer similar alcohol related problems at lower consumption levels.[16] The reasons for the lack of sex differences should be explored further to determine if the finding is replicable and not simply a "rogue" result.

Although several variables were found to be significantly associated with alcohol concentrations using the χ^2, further analyses involving the conversion of χ^2 to the contingency coefficient (C) indicated that the magnitude of the associations is only in the low to moderate range, the highest being C=0.450. There may therefore be no accurate and powerful way of predicting, for screening purposes, which patients from among all the attenders at an A&E department are likely to have recently consumed alcohol. Using the predictors in this study would result in too many false positives. Routine testing on all new attenders would therefore be wasteful and expensive (the saliva test costs approximately £5.50 per administration), but potentially cheaper methods such as skin patch tests for alcohol are under development.[17]

However, high levels of saliva alcohol were noted in patients with non-specific complaints, and in attendance arising from self harm, collapses, and assault; assessments of alcohol concentrations in these circumstances would be more justifiable. The contribution of alcohol could then be taken into account when making difficult diagnostic and treatment decisions, which may be particularly helpful in attenders with non-specific complaints.

Most patients (94%) cooperated in the study. This high level of compliance suggests that the results may be viewed as valid and dependable, in a Highland context. However, the question arises as to how far the results can be generalised to other NHS A&E departments. The Highlands of Scotland have an unusual health profile in several respects[1]; notably and for present purposes, there is a high death rate from accidents and suicides,

and there is a high prevalence of alcohol related disease. These results will therefore need to be replicated in other areas before general conclusions can be drawn, and before wide ranging recommendations can be made; however to the extent that these results are similar to the results of previous studies in the UK and North America, major discrepancies with any future UK studies should not be anticipated.

On a note of interpretative caution, it cannot be logically infered that a positive alcohol test in an A&E patient means that the complaint is alcohol related; having ingested alcohol may have been irrelevant to the circumstances of the complaint. To investigate a causal link would require a larger study incorporating case-control methods, relating levels in attenders to levels in a comparable sample from the general public.

Nevertheless it is reasonable to assume a degree of causality for some patients. Allowing this assumption, the A&E department may be an ideal base for detection and intervention services geared towards minimising alcohol related harm, A&E attendance often being the first point of contact with health services.[18] Previous work has tended to focus on identifying problem drinkers, who are a minority among A&E attenders.[19] This study suggests that one should focus equally on the much larger number of light and moderate drinkers whose drinking patterns may increase the risk of injury or illness. Furthermore, there is compelling evidence that minimal intervention services for alcohol problems in general hospitals can produce major savings in health care costs.[5] Whether such counselling services should be immediately available to alcohol positive patients during their A&E attendance, or whether follow up appointments should be offered, is open to debate.

This study may also have relevance at policy making and management levels. The results could be used as a baseline in the evaluation of the effects of public health initiatives to reduce population alcohol consumption. They could also be used to illustrate part of the picture of the health and financial costs of excessive drinking, thereby strengthening the case for improved clinical intervention services. Finally, they provide pointers as to the most appropriate targets amongst A&E attenders for that intervention.

Contributors
Noelle Murphy contributed to initial design, conducted relevant administration and prepared staff in the A&E department, advised on what data to analyse, supervised data collection, and commented on all drafts. David Peck contributed to initial design, helped to supervise data collection, supervised and conducted statistical analyses, and wrote early drafts. Tracy Simpson collected all data, entered all data, conducted statistical analyses with assistance from David Peck, helped to write first draft, and commented on later drafts. Noelle Murphy will act as guarantor.

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