



Alcohol pricing and purchasing among heavy drinkers in Edinburgh and Glasgow

Current trends and implications for pricing policies

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Executive summary

This is a study of the alcohol purchasing behaviour of patients with alcohol-related conditions at NHS settings in Edinburgh and Glasgow. In 2011/12, 639 drinkers were recruited and invited to complete two questionnaires at baseline: one exploring consumption, and a second exploring experiences of alcohol-related problems. Participants completed further questionnaires during three follow up phases approximately six months apart. In addition, 20 individuals took part in face-to-face, semi-structured qualitative interviews before the final study phase.

227 participants were re-interviewed at the first follow-up, 165 at the second, and 145 at the third. Women accounted for 28% of the sample. Attrition (that is, the number of participants who dropped out) was an anticipated, but major, issue for this study. The reasons for this varied and maintaining contact with participants was challenging, due to fluctuating personal circumstances. Some participants who had adopted abstinence were unwilling to repeat the interviews. Another key factor was loss due to death: during the 2-3 years of the study, 105 (16.4%) participants died.

The baseline sample had a mean age of 45.6 years, and 71.7% were male. Levels of alcohol consumption among participants were very high, with a median weekly consumption of 184.8 UK units. Participants generally bought alcohol cheaply, with a median price paid in the index week of 39.7pence per unit. 95% of all purchases were made in off-licences and the median weekly expenditure was £70. The most popular drinks were vodka and white cider.

Comparison with pilot data collected in 2008/09 showed that a fall in the affordability of alcohol had been off-set by this type of very heavy drinkers switching to cheaper products. White cider was an important buffer: its cheap unit price (average £0.17 per unit) allowed it to be used as a fallback drink when finances were restricted. It is already recognised that very heavy drinkers tend to buy alcohol cheaply; our findings demonstrate that, as long as cheap alcohol is available, falling affordability is cushioned by trading down.

Men drank significantly more than women in deprivation quintiles 1, 2 and 4, but not in quintiles 3 and 5 (5 being least deprived). Among women, the association between alcohol consumption and harm was influenced by two key factors: increased deprivation and being recruited in Glasgow rather than Edinburgh. In this, the study findings reflected a phenomenon sometimes referred to as the 'Glasgow effect', in which health outcomes across a wide range of measures are worse for people living in Glasgow than elsewhere (Grey and Leyland, 2008).

Women were half as likely as men to be a white cider drinker. Those in the least deprived group were one-fifth as likely to drink white cider as those in the most deprived group. No evidence was identified which confirmed anecdotal reports in the literature suggesting an enhanced health harm associated with white cider consumption in particular. Health risks are more likely to be associated with the high levels of ethanol consumption among white cider drinkers (which were

significantly higher than non-white cider drinkers). The health risk of the alcohol intake reported by participants (equivalent to 4-5 times the UK definition of harmful consumption) is likely to be compounded by smoking. 70% of participants smoked, with a median of 20 cigarettes (one pack) per day.

In one-to-one interviews, participants were asked about the potential impact of alcohol policies, including minimum unit pricing (MUP). Responses showed some misunderstanding of proposed alcohol policies, but also a concern that the removal of very cheap alcohol would compromise the budgets of addicted drinkers. However, there was no mention of an intention to steal or buy illicit alcohol were prices to rise.

Background

Over recent decades, Scotland's rising rates of social and health harms related to alcohol have been out of step with most Western countries. Decreasing real prices and increasing availability of alcohol are widely believed to have contributed to this (SHAAP, 2007; Meier et al., 2009; Meier et al., 2010). A growing body of evidence shows that legislation affecting the sale of alcohol, especially by increasing price, can help to reduce associated harms. There is extensive international literature on the price elasticity of demand for alcohol, which has been reviewed in meta-analyses by Wagenaar et al. (2009) and by Gallet (2007). These conclude that, across several countries, alcohol has a median elasticity of -0.51 and -0.497 respectively, implying that a 10% rise in price might be expected to reduce the overall demand for alcohol in a population by about 5%. Scottish-based research has shown that cheap alcohol is purchased by all income groups with the highest income households purchasing the most off-sales of alcohol (Ludbrook, 2010). Our own pilot research arrived at similar findings (Black et al., 2011). Several influential bodies have endorsed the call for a minimum price per unit of alcohol (8g or 10 ml of pure ethanol) to be introduced across the UK. These include the British Medical Association, Scottish Health Action on Alcohol Problems, the National Institute for Clinical Excellence, as well as the Chief Medical Officer of England. In June 2012, the Alcohol (Minimum Pricing) Scotland Act was passed by the Scottish Parliament, introducing a minimum price of 50p per unit. However, this legislation has been subject to legal challenge by the alcohol industry, and a final ruling at the European Court Of Justice is still awaited at the time of writing.

To have an effect on health indicators, such as hospital admission rates or mortality rates for alcohol-related diagnoses, such pricing measures must reduce the recruitment of new drinkers to the number of those drinking alcohol in a pattern or amount likely to cause harm, in addition to moderating the drinking patterns of already established heavy drinkers.

In part, the effects of pricing measures can be monitored by sequential general population surveys aimed at detecting changes in the prevalence of heavy drinkers. However, very heavy drinkers (who account for most of the hospital admissions and deaths related to alcohol) are under-represented in such survey data - because such individuals may be hard to contact and if contacted are less likely to agree to participate (Leifman, 2002). This is recognised by many researchers as one reason why general population surveys of drinking account for only some 50% of national sales (e.g. Stockwell et al., 2004; Kerr and Greenfield, 2007). This research addresses that gap by focussing specifically on the purchasing behaviours and attitudes of very heavy drinkers.

In 2008-9, we interviewed one cohort of patients admitted to medical, surgical and psychiatric wards, or referred for assessment at Lothian hospitals, with alcohol-related harm to health (n=377) (Black et al., 2011). Participants reported purchasing alcohol extremely cheaply, from as little as 9p per unit, and on average at considerably less (43p per unit) than the average Scottish price paid per unit, which, according to 2007 sales data, was 72p per unit. That difference was partly due to participants purchasing most (93%) of their alcohol at off-licences, but also

because they paid less (34p per unit) than the mean Scottish off-licence purchase price of 40p per unit. These patients did not report drinking illicit, substitute or stolen alcohol.

The design of the present project was informed by this pilot work and the database was also accessed in the subsequent analysis. We originally intended to extend our Edinburgh study to include Glasgow drinkers, and to monitor a sample of this heavy drinking group prospectively, adopting a pre-post design for a period of three years to encompass the introduction of MUP under the 2012 legislation. The industry challenge to MUP had obvious implications for our study design and it was adjusted accordingly. It was decided that since recruitment at baseline had exceeded expectations (n=639 instead of projected n=500), the study should continue according to the original timeline. The 2008-09 study design was enhanced to include a small number of face-to-face interviews, adapted to permit greater exploration of the views of this poorly described group of drinkers in relation to alcohol policy and personal consumption behaviours.

Two other recent pieces of legislation may have impacted on the sale of alcohol during the course of our study. The first was the Licensing (Scotland) Act 2005, which was implemented in 2009 (Scottish Parliament, 2009). This created a new licensing framework for alcohol retail, imposed a ban on irresponsible promotions in the on-trade, placed restrictions on place of display in the off-trade, and introduced the protection of public health as a licensing objective. The second was the Alcohol etc. (Scotland) Act 2010 (Scottish Parliament, 2010), which was implemented two months before our study began (October 2011). This imposed a ban on quantity discounts in off-sales and restrictions on the display and promotion of off-sales.

In the period 2009-13 there has been a shift towards higher prices for alcohol sold in the off-trade sector in Scotland. This time period has also been associated with falling incomes linked to the economic downturn (Beeston et al., 2014).

In addition to the data provided by our 2008-09 study, the analysis of the present work has made extensive reference to ongoing annual reports produced by the Monitoring and Evaluating Scotland's Alcohol Strategy (MESAS) work programme (e.g. Beeston et al., 2014). This group has had access to alcohol retail sales data provided by the Nielsen Company (Nielsen) and CGA Strategy (CGA) partnership. From these reports we have been able to access important data relating to sales to the Scottish population by sector (off and on-trade) and by drink type.

Research Design and Methods

Participants were recruited from December 2011 through to October 2012. The original design proposed a longitudinal study with data collection time-points pre- and post- the introduction of MUP. When the implementation of MUP was postponed, the design was modified to a simple follow-up of the cohort recruited at baseline with three interviews at approximately six months intervals.

In addition 20 participants completed one-to-one audio-recorded interviews (during the third phase of data collection), exploring their knowledge and attitudes to government alcohol policy and the effects of price and purchase location on their, and others', drinking.

The study was set in two Scottish cities: Edinburgh and Glasgow. Patients admitted with a diagnosis of a physical or psychiatric alcohol-related illness were recruited in NHS alcohol services, outpatient and day patient clinics and acute hospitals.

Exclusion criteria were:

- Under 18 years old
- Unable to understand the questions or give understandable answers in English
- Evident clinically significant memory impairment e.g. Korsakov's Syndrome
- Unwilling to be contacted for three further follow-up interviews
- Clinical advice that patients were unsuitable for inclusion due to separate clinical issues.

Following completion of the consent form, research interviewers administered a questionnaire (Black et al., 2011) that documented the participant's most recent seven days of drinking using the time line follow-back method (Sobell and Sobell, 1996) or their most typical week. Recorded items were:

- Type, volume and brand (when known) of beverage
- Cost and location of purchase
- Estimations of time spent drinking
- Number of drinking days in the week

In addition, the questionnaire permitted capturing the *reasons* for the choice of any drink consumed. The interviews were not time limited and interviewers were able to probe and clarify detail where necessary.

Age, gender and postcode were documented, the latter acting as a proxy for socioeconomic status using the Scottish Index of Multiple Deprivation (SIMD) (Scottish Government, 2012). The 2012 SIMD divides Scotland in to 6,505 geographical areas called datazones containing approximately 350 households identified by postcode. Each datazone is assigned a rank of relative deprivation based on several domains (employment, income, health, education, geographic access to services, crime and housing). We used our participants' postcode to record the SIMD rank by quintile.

Participants also completed the Alcohol Related Problems Questionnaire (ARPO) (Patience et al., 1997). This is an eleven-point questionnaire used to assess severity of alcohol related problems. Scores ranged from zero to eleven, with the highest score indicating the greatest number of problems. During the interview, participants were asked about illness associated with their drinking – although, due to ethical constraints, it was not possible to verify self-reported illness with clinical notes. In addition, reports of illicit drug use, consumption of alcohol purchased outside Scotland, stolen alcohol or illicit alcohol were recorded.

A similar questionnaire was adopted for interviews conducted at the three follow-up time-points. However, this was amended to include additional questions relating to:

- Reported *change* in drinking pattern (changes to favoured drink type, amount consumed, frequency of drinking) over last 6 months or since last interview
- Impact of alcohol price on purchasing of other items
- State benefits received
- Details of alcohol treatment status.

If participants reported being abstinent they were asked whether the price of drinks had influenced this choice.

Participants could opt to complete the follow-up interviews by telephone. In addition, participants were asked to consent to having their data linked to their NHS medical records, allowing for more effective data linkage. Participants were offered an incentive of a £10 voucher for a high street chemist outlet payable on completion of this, and subsequent, interviews.

Participants were asked at the time of their third quantitative interview, about 18 months after recruitment, whether they would be willing to take part in an additional semi-structured face-to-face interview to explore their experiences and views about recent alcohol policy changes, including the proposed introduction of MUP. 20 participants were recruited, ten from each of the two cities. Participants were purposively selected on the basis that they had been drinking heavily at their third interview, and that the average price they were paying at that time was less than 50p per unit. Care was taken to ensure that they were approximately representative of the total sample by gender, social deprivation quintile and age.

Of the 20 interviewed, five were not drinking but had reported drinking at some stage in the six-month period prior to, or at, interview. The mean age was 48.3 years, and five interviewees were female. Reported consumption per week (past seven days, or typical drinking week) at third interview ranged from 28 to 256.26 units and all social quintiles were represented, broadly mirroring the distribution in the larger study.

The interviews were transcribed verbatim by the first author, and during this process initial thoughts and ideas were noted down as an essential part of the analytic process (Riessman, 1993). Thematic analysis was conducted, as described by Braun and Clarke (2006). All the transcripts were read multiple times to identify categories of relevance to the research aims, and emerging themes and commonalities were noted. These categories were then grouped according to consistency in topic, as well as in relation to the research aims, and themes were thereby constructed, representing recurring topics. Verification of coding was confirmed by a second research team member and the pair had iterative discussions regarding the construction of themes and their interpretation. The constant comparative method was used to help identify reasons for patterns and contradictions in the data.

Favourable ethical opinion was granted by NHS Lothian Regional Ethics Committee (REC reference 08/S1101/9) and approval was gained from the relevant R&D departments and Caldicott Guardians.

Findings

Interviews were conducted with 639 patients. Clinicians refused on behalf of 73 patients who met the study inclusion criteria but were deemed unfit for interview for various reasons. In addition, 89 patients identified by clinicians refused to participate prior to receiving detail relating to the study, 61 refused after this point, one refused during the interview and, in 20 cases, the researcher had concerns about the mental or physical state of the subject and terminated the interview. In total, 244 of those originally deemed eligible by clinicians, did not participate, see figure 1. For further details relating to recruitment by NHS site, and in total, see Table 1.

Overview of consumption at baseline interview.

Baseline data were recorded on 639 heavy drinkers: Glasgow (n=345) and in Edinburgh (n=294). Median consumption was 184.8 (IQR=162.2) UK units /week paying a mean of 39.7 pence per alcohol unit.

Weekly consumption by males (median=196.0 (IQR 167.5) units) was significantly higher than that of females (median=157.6 (IQR 159.8) units) (U=31921.0 (P<0.001)).

The three most popular drinks were vodka (26.5% of all units purchased), beer (19.8%) and white cider (24.4%). For females, vodka accounted for the greatest proportion of units consumed (40.6%), for males this drink was white cider (25.9% of all sales). Whisky, a spirit drink traditionally associated with Scotland, accounted for only 4.8% of purchases.

Smoking was reported by 70.1% (n=448) of drinkers.

Off-sales accounted for 95% of purchases, of which 85.2% of units were purchased at a price of less than 50 pence per UK unit. 34.4% of all units were purchased from supermarkets, 48.9% from corner shops, 8.5% from off-licences and 3.2% other outlets e.g. petrol stations.

Figure 2 provides a comparison between the distribution of price per unit for all drinks bought by participants in off-sale outlets and MESAS data (Beeston et al., 2013) relating to the price distribution of alcohol sold through the off-trade to the general population in Scotland (also in 2012). In the latter case the largest proportions of UK units were sold at 35-44.9p per unit. In contrast, our participants purchased the largest proportions of their drinks within the 15-19.9p and 35-39.9p per unit price bands.

Figure 1: Summary of study recruitment and follow-up

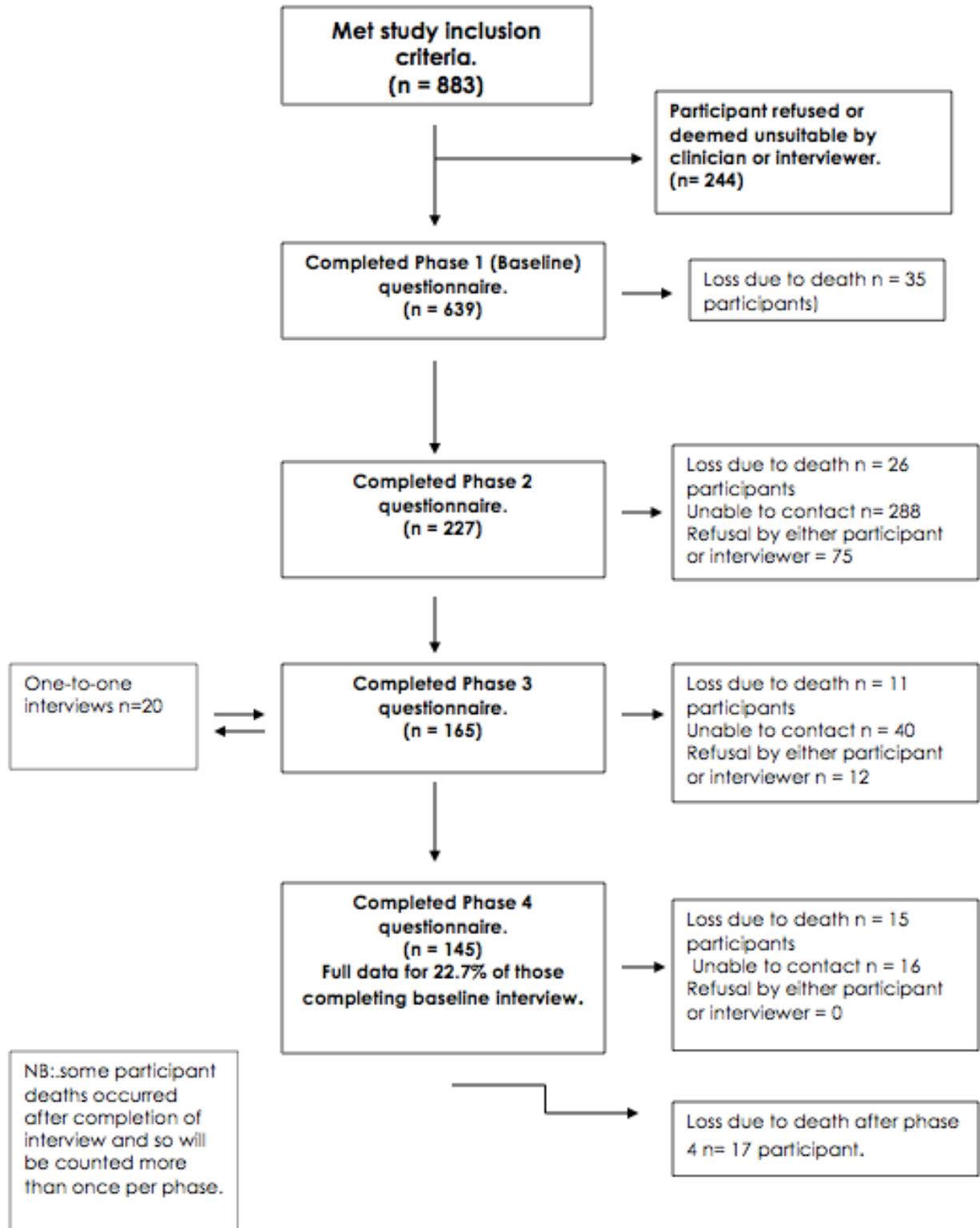


Table 1: Study recruitment

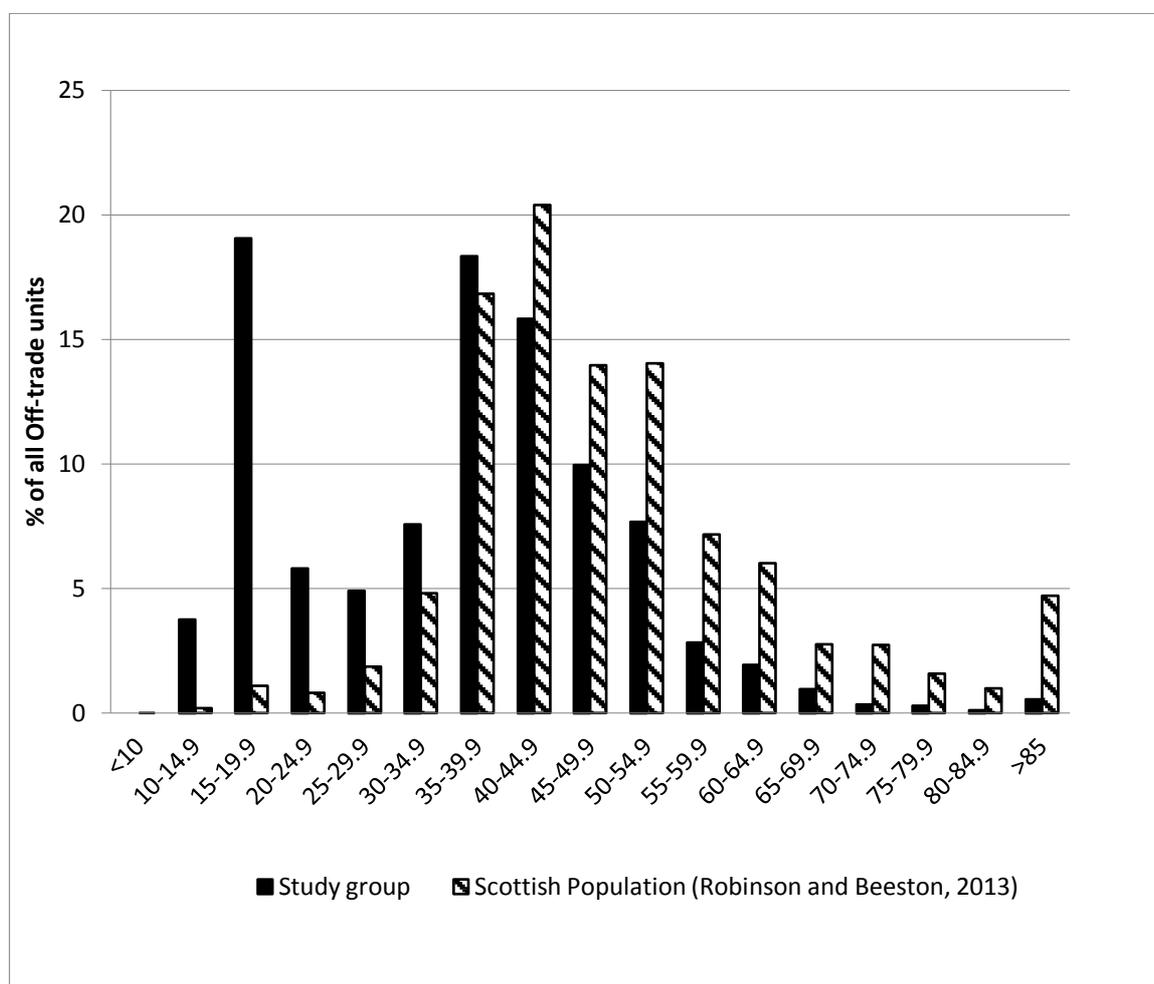
	EDINBURGH						GLASGOW						TOTAL
	REHIP	REHOP	RIE	WGH	ETP	TOTAL	GGDP	GGIP	GGOP	GRIIP	GGG	TOTAL	
<i>Eligible for study but refused at initial recruitment (by clinician, participant or interviewer)</i>	27	43	73	13	3	159	3	12	5	63	2	85	244
PHASE 1 recruitment (BASELINE) interviews occurred between (including) 06.12.11-23.10.12	151	62	66	14	1	294	119	102	14	102	8	345	639
Deaths between these dates	3	1	9	2	0	15	4	8	0	7	1	20	35
PHASE 2 interviews occurred between (including) 12.11.12-20.08.13	41	24	17	4	0	86	60	43	9	27	2	141	227
Deaths between these dates	3	0	5	4	0	12	5	3	0	6	0	14	26
unable to contact (following repeat attempts)	83	32	22	3	0	140	43	39	3	58	5	148	288
refused (participant or interviewer)	18	5	14	2	1	40	11	14	2	7	1	35	75
PHASE 3 interviews occurred between (including) 30.07.13-05.03.14	27	17	12	3	0	59	45	32	8	21	0	106	165
Deaths between these dates	2	1	2	1	0	6	2	1	0	1	1	5	11
unable to contact (following repeat attempts)	11	4	3	0	0	18	7	9	1	4	1	22	40
refused (participant or interviewer)	2	2	1	0	0	5	6	0	0	1	0	7	12
PHASE 4 interviews occurred between (including) 17.02.14-07.10.14	22	17	9	3	0	51	37	29	8	20	0	94	145
Deaths between these dates	5	1	2	0	0	8	3	1	0	3	0	7	15
unable to contact (following repeat attempts)	5	0	1	0	0	6	7	2	0	1	0	10	16
refused (participant or interviewer)	0	0	0	0	0	0	0	0	0	0	0	0	0
Deaths post recruitment	1	1	2	0	0	4	2	4	0	6	1	13	17
TOTAL (deaths)	14	4	20	7	0	45	16	17	0	23	3	59	104

Table 2: Deaths by recruitment site

	EDINBURGH						GLASGOW						TOTAL
	REHIP	REHOP	RIE	WGH	ETP	TOTAL	GGDP	GGIP	GGOP	GRIIP	GGG	TOTAL	
PHASE 1	3	1	9	2	0	15	4	8	0	7	1	20	35
PHASE 2	3	0	5	4	0	12	5	3	0	6	0	14	26
PHASE 3	2	1	2	1	0	6	2	1	0	1	1	5	11
PHASE 4	5	1	2	0	0	8	3	1	0	3	0	7	15
Post phase 4	1	1	2	0	0		2	4	0	6	1	13	17
TOTAL	14		20	7	0	45	16	17	0	23	3	59	104

REHIP REHOP: Royal Edinburgh Hospital in-patients, and out-patients; RIE Royal Infirmary Edinburgh in-patients; WGH Western General Hospital Edinburgh in-patients; GGDP, GGIP, GGOP Gartnavel Royal day-, out- and in-patients; GGRIP Glasgow Royal Infirmary in-patients; GGG Gartnavel General Hospital In-patients

Figure 2: Price distribution of drinks purchased as off-sales by study group (2012) compared to Robinson and Beeston (2013)



Our participants purchased 53.6% of their vodka units below 40p per unit, for the wider Scottish population this figure was 29% (Beeston et al., 2013). Vodka accounted for 26.7% of all units consumed (off and on-sales) with a median (IQR) unit off-sale price of 41p per unit.

The highest proportion of beer sales for our 2012 sample was actually above 50p per unit, within the 50-54.9p price band. Compared to the general population, our drinkers purchased proportionally more beer at the higher price bands between 40 and 59.9p per unit.

Using postcode, we derived the Scottish Index of Multiple Deprivation (SIMD) (Scottish Government, 2012) rank for each of our drinkers as a proxy for socioeconomic status. This permitted grouping by deprivation quintile. Age was not significantly different between quintiles. Quintile 1 (most deprived) accounted for the majority of participants (47%) and contained the highest proportion of drinkers purchasing exclusively from off-sales.

Quintile 3 was characterized by the highest mean consumption and the highest percentage of units purchased in on-sale settings, the lowest percentage of drinkers purchasing exclusively from off-sale outlets and, not surprisingly, the highest expenditure for the recorded drinking week.

White cider, the cheapest drink available in off-sales accounted for approximately one quarter of the consumption of each quintile apart from quintile 5 (least deprived) who drank proportionately less white cider but proportionally more vodka.

White cider drinkers (see Black et al. 2014)

In the 639 patients, 161 (25%) reported consuming any white cider in their most recent or 'typical' week of drinking. Of these, 72 participants drank white cider exclusively (WCE) and 89 drank white cider in addition to other drink types (AWC). 478 participants consumed no white cider (NWC).

White cider drinkers represented 25.2% of participants yet consumed 33.0% of the total units. White cider drinkers consumed significantly more alcohol (median =249.38 units, (IQR=207.9)) than the no white cider group (median = 173.6 units (IQR=162.9)) ($p<0.001$). The AWC group drank more units than the WCE group ($p=0.04$).

As noted above, men consumed significantly more alcohol than women overall. Among non-white cider drinkers men drank a median of 182 units (IQR 148.6) and women a median of 138 units (IQR 138.1; $p=0.001$). However, among white cider drinkers men and women consumed similar numbers of units.

All white cider was purchased exclusively at off-sales outlets: 77.25% of white cider units were purchased at independent licenced grocers, 12.7% from supermarkets and 10.0% from other off-licences (drinks retailers, garages and newsagents).

The median ARPQ score for the combined groups of white cider drinkers was higher (more problems reported) than that of the non-white cider drinking group ($p < 0.001$). The median score for the AWC group was also higher than that of the exclusive WCE drinkers ($p = 0.009$).

Exploratory logistic regression suggested an association between greater unit intake and white cider consumption. Females had approximately half the odds of males of being in the any white cider group. For every increase of a year in age, the odds of being in the any white cider group were reduced slightly (for an increase of 10 years the odds are halved approximately). No significant associations were found for city, ARPQ score, weekly cigarette consumption, self-report of haematemesis, or SIMD (overall). However, there was a significant effect for the least deprived compared to most deprived, with the least deprived having a fifth of the odds of consuming white cider.

When comparing the two cohorts recruited in Edinburgh, white cider accounted for 22.7% of all units bought in 2012 compared to 15.9% in 2008. The total number of exclusive white cider drinkers increased from 4.2% ($n = 16$) in 2008 to 9.2% ($n = 27$) in 2012. The characteristics of these two groups of drinkers are summarised in Table 3. In the intervening four years there is evidence of a rise in the median price they paid for white cider (from 14 to 17 pence per unit) and, as might be predicted, median expenditure on white cider. Median intake of white cider in these drinkers increased from 157.5 units to 174.4 units, however, this increase was not significant ($p = 0.326$). The proportion of women recruits in these two intakes was similar; around one third.

Smoking was defined in terms of tobacco use and equivalencies were applied for those who smoked tobacco in the form of roll-ups rather than filter cigarettes (NHS Greater Glasgow & Clyde, 2013). Of the total sample 70% ($n = 447$) reported tobacco use, smoking the equivalent of a mean of 18.6 ($SD = 11.5$) cigarettes per day (see Table 3). 66% of non-white cider drinkers were also smokers. Within each of the white cider drinking groups proportionately more people reported smoking; 83% in the AWC group and 81% in the WCE group. When estimates were made of tobacco smoked in roll-ups, there was no significant difference between the smokers in the three groups in relation to the number of cigarettes smoked per day ($p = 0.102$).

Participants were asked to state their reasons for purchasing white cider (all responded). The majority reported that it was chosen because of its cheapness (82.5%). One participant advised that it was cheaper than heroin while others alluded to its role as a 'buffer' being used as a fallback drink when funds were low.

Table 3: Heavy drinkers reporting any white cider consumption in Edinburgh, 2008-9 and 2012

	Edinburgh 2008 n = 66	Edinburgh 2012 n = 66	Significance
Age (years) (Mean (SD))	43.1 (10.8)	40.8 (8.5)	ns
percentage male	74.2%	75.8%	-
Total alcohol consumption (UK units in the week) (Median (IQR))	268.0 (245.6)	248.4 (207.4)	ns
White cider consumption (UK units in the week) (Median IQR))	157.5 (159.38)	174.4 (135.0)	ns
Unit price for all alcohol purchased (Median (IQR))	21.0 (10.0)	20.0 (10.0)	ns
White cider unit price (Median (IQR))	14.0 (3.0)	17.0 (2.0)	p<0.001
Expenditure due to alcohol (£) (Median (IQR))	47.9 (62.6)	49.99 (38.5)	ns
Expenditure on white cider only (£) (Median (IQR))	22.1 (23.69)	29.9 (25.9)	p=0.011
Percentage of units consumed as WC (Median (IQR))	71.7 (52.8)	86.0 (46.5)	ns

White cider and toxic effects

Oft-repeated comments linking white cider consumption with an adverse effect on the stomach prompted testing whether there was an association between white cider consumption and self-reported haematemesis; this was significant ($p=0.008$). Our participants' comments were consistent with anecdotal evidence linking white cider to specific health hazards, typically affecting the gut (Goodall, 2011). They perceived it to be more pernicious than other alcoholic beverages. Following assurance of a small additional grant from Queen Margaret University we set out to examine this hypothesis and contacted researchers based in Germany with expertise in toxicological analysis. Nine apple and pear cider samples (brands reported at interview by our participants) were chemically analysed for constituents and contaminants.

Results showed that none of the products exceeded regulatory or toxicological thresholds for acetaldehyde, but its regular occurrence in cider was detected. To provide a quantitative risk assessment, data relating to participants in our study who drank exclusively white cider (n= 72) and vodka (n=95) were compared and the intake of acetaldehyde was estimated using probabilistic Monte-Carlo type analysis. The cider consumers were indeed found to ingest more than 200-times the amount of acetaldehyde consumed by vodka consumers. The margins of exposure (MOE: dose of substance considered to be at toxic threshold, divided by estimated intake of the substance, so smaller the value of MOE = the greater the risk) of acetaldehyde were 224 for the cider and over 220,000 for vodka consumers. However, if the effects of ethanol were considered in a cumulative assessment of the combined MOE, the effect of acetaldehyde was minor and the combined MOE for both groups was 0.3. In summary the contribution of ethanol metabolism to total risk greatly outweighed that of directly ingested acetaldehyde (See Lachenmeier et al. 2015).

Female heavy drinkers

Questionnaires were completed by 181 women (gender ratio in the original sample; was 2.5:1). 40.3% of these were associated with the most deprived quintile, SIMD quintile. For quintiles 2 through to 5 the respective figures were 22.1%, 15.5%, 10.5% and 11.6%. Median consumption in the recorded week was 157.6 units (IQR=159.8). Deprivation quintile 1 recorded the highest median consumption but was only significantly higher than quintile 4 ($p = 0.031$). Some women (n=66) reported consumption >200 units, (median consumption=262.5 units (IQR=96.33)). It is noteworthy that while, as referred to above, males overall drank significantly more alcohol than females, this pattern was not repeated in quintiles 3 and 5.

The most deprived group reported the highest ARPO score, being significantly higher than that of quintiles 3, 4 and 5 but not 2.

Three drinks were particularly popular both in terms of number of drinkers and total units consumed: vodka (40.6% of all units) white cider (18.3%) and white wine (15.4%), accounting for 74.4% of all units consumed in the recorded week. Median unit prices were 17p (white cider), 41p (vodka), and 50p (white wine) per unit. Unit price paid varied little across deprivation quintiles. Only white cider (lowest unit price) was not consistently popular (zero consumption by quintile 5). Some drank one beverage exclusively: vodka (n=42 women) white cider (n=12) white/rose wine (n=28).

Location of Purchase

Shops, supermarkets and off-licences, as opposed to pubs, bars and restaurants dominated purchasing. 98.9% of units were purchased via off-sales (compared to 93.4% among men).

Smoking and other substance use

Just under 70% of women smoked, the highest percentage from quintile 1 (82%, n=60). Smokers spent significantly more on alcohol in the recorded week: £71.39 compared to £44.73 among non-smokers ($U=2398.50$, $z=-3.468$, $p=0.001$, $r=-0.258$). Some women (n=35) reported the use of substances apart from alcohol (controlled drugs, controlled medications (not prescribed) or over-the-counter medication used to enhance the effects of alcohol). Cannabis was the most popular, taken on at least one day in the recorded week by 11% of all women. No illicit alcohol consumption was reported.

Mediators of the relationship between consumption and harm

During the period 2012 - 2015, 25 female participants died (13.8% of the total). The mean (SD) age at death was 49.1 (10.8) years.

Several variables were found to be univariably significantly associated with ARPQ score. These were: age, any drug use, cigarettes smoked per day, unit price, total units consumed, frequency of consumption, consuming white cider or not and SIMD (split into two categories, namely, (i) most deprived versus (ii) other 4 quintiles combined). These variables were then employed to inform a multivariable model. This model indicated a significant association with ARPQ for, weekly consumption, age and city deprivation. Specifically more problems were associated with being younger and drinking more in the week, while those in both Edinburgh SIMD groups ('most deprived' and other 4 quintiles combined) reported fewer problems than those drinkers within the most deprived SIMD group in Glasgow. The model accounted for around 32% of the variation in ARPQ score.

Thus, amongst women, two important influential factors mediated the association between alcohol consumption and harm: increased deprivation and living in Glasgow rather than Edinburgh. Thus, our findings display evidence of what is often called 'the Glasgow effect': in which poor health outcomes are more pronounced in Glasgow than other places (Walsh et al., 2010).

Qualitative interviews

Qualitative interviews provided insight into the experiences, practices and perspectives of heavy drinkers. They showed the complex, and occasionally contradictory, choices, decisions and mechanisms worked through by these heterogeneous alcohol-dependent individuals to ensure an alcohol supply. Strategies reported by participants were wide-ranging, sometimes tried and tested, and at other times, reactive.

We identified several themes that elucidated participants' everyday behaviours within their local environment:

- Drinking patterns
- Key triggers (particularly following a period of abstinence)
- Sourcing alcohol
- Support/lack of support
- Substitution
- Sharing of resources
- Borrowing
- Cutting down
- Preventing seizures/self-medicating.

Alcohol price affected our participants' lives, the majority for whom sourcing cheap alcohol locally was a priority. Despite recent changes to the welfare system, usually resulting in reduced income, and an economic downturn, most participants were still able to maintain their level of consumption, especially those who were drinking the cheaper drinks, namely white cider and vodka. However, a consequence was a reduction in food purchasing and heating, as was falling into or increasing current debt. Some participants coped by pooling or sharing resources, either money or alcohol, with other drinkers in a similar situation. There was very little evidence of substituting other substances for alcohol or consumption of illicit alcohol in our sample.

Our data showed a range of views and awareness regarding existing and proposed alcohol policies, and also a varied perception of their effects, both real and hypothesised. From the view of our respondents, abolishing multi-buy promotions (Alcohol etc. (Scotland) Act 2010) (Scottish Parliament, 2010) had not reduced purchasing, and therefore, consumption of alcohol. One reason for limited impact could be that one or two respondents reported they were not short of money. For others, the Licensing Act 2005 (Scottish Parliament, 2009) and the Alcohol etc. (Scotland) Act (Scottish Parliament, 2010) had little acknowledged bearing on their day-to-day lives, and they planned to continue to obtain the cheapest alcohol, however possible, including finding a way around legislation.

Several respondents struggled to understand the concept of MUP, still talking of trading down, using white cider as a fall back, or making more of an effort to track down special offers. They had not taken on board the fact that they would be paying 50p for *each* unit of alcohol, and therefore, the higher the number of units they consume, the higher the cost. The majority of the participants lived from day to day, sometimes from hour to hour, and were generally not able to plan ahead, let alone take account of legislation that might not be implemented for years, if at all. Their attitude was that they would deal with any issues if and when MUP, to many of them a vague and obscure concept, was in place. However, for the majority of people we interviewed, who have a high frequency of purchasing and high expenditure owing to the high volumes purchased, the impact of MUP would be immediate, particularly for the white cider and cheap vodka drinkers.

Overall, our participants did not feel that any existing or proposed alcohol policy would help them reduce their consumption, but that the introduction of, for example, MUP, might reduce the likelihood of younger people developing the same drinking patterns and harms that they had.

Many subjects reported what was essentially addiction to ethanol: *“my consumption would be the same, whether I was going for beer, wine, or vodka, the consumption, the units, would still be consumed”* [P20, female]. While for some a reduction in income had led to reducing alcohol consumption, for others it meant switching to a cheaper brand or type of alcohol:

“I have been buying cheaper drink, em, because access to money has been more difficult. Because my husband.... if I do have a relapse, he'll take my card off me, and you know, whatever money I've got, I go for the cheaper option rather than going for the nice bottle of wine that I would usually go for” [P4, female]

For several, changes to welfare had reduced their income,

“I've lost out on one of my benefits that I had ... when my husband passed away, I've been cut down by about, something like £70 - £80 a week. So it's a lot of money”. [P6, female].

Several subjects said fear of withdrawal seizures was the imperative in maintaining their consumption and the need to keep a steady source. The Government's recent legislation delaying sale of alcohol till 10am had caused some addicted drinkers difficulties.

With regards to Government MUP proposals there was widespread misunderstanding

“I don't think there's anything else the politicians can do. If they introduce minimum pricing, then, they'll just, they'll still drink the alcohol, em, or they'll bepooling their money to get the stronger stuff, if that's what they want”. [P14, male]

Another comment revealed a better understanding about the effects of MUP, but was only an opinion: *“ ... poor people that have got an alcohol problem, they're just going to end up buying illegal alcohol, and that's all they will probably do.”* [P5, male]

There was suspicion regarding illicit alcohol:

“I know it sounds funny, but em, I'm scared of what I put in my body. I know if it's on sale in a supermarket, then it's relatively safe. I wouldn't know what I'd be buying, and I wouldn't know what was in it, and that would scare me. Which sounds mad because obviously you're putting poison into your body”

anyway, but I wouldn't buy it, because of the fear of what was in it" [P4, female].

Another, whose knowledge regarding illicit alcohol had been acquired from TV, said
" ... I know what to look for ... if the label was squint ... Contraband and that, I would never dream of going near that, even though it's dirt cheap... I'm too worried about my health!" [laughs] [P6, female]

Outlet density and ubiquity was mentioned, *"Everywhere sells it, you cannae get away from it. It's in every shop where I stay, it's in every single shop ... it's in your face every time you walk in."* [P18, male]

"I would just say that there's too many places that you can actually buy alcohol ... Years ago, you couldnae buy alcohol out of [newsagent named], eh, it was just a paper shop, and that, ken ... even like, you get flyers through the door now from Indians, or Chinese, or chippies sell alcohol now ... so when you're buying takeaways ... " [P17, male]

Conclusions

Drinkers in this study routinely purchased alcohol at far below the proposed minimum price of 50p per unit. Our drinkers reported a mean purchasing price for all drinks of 39.7p per unit while white cider was purchased at a mean unit price of 17p. Furthermore, we have highlighted the important buffering power of cheap, particularly white, ciders, to maintaining alcohol intake levels when the affordability of other products falls. Qualitative work revealed the considerable efforts expended by drinkers in order to maintain alcohol purchasing and to source cheap alcohol. Participants commented on the high density of outlets in the immediate environment of the home.

Our participants display two characteristics identified in the Scottish population as a whole but in a more pronounced manner:

- A preference for off-sale purchasing. 95% of drinks purchased by our participants were bought through off-licences as compared to 69% for the general Scottish population (Beeston et al., 2013)
- A predilection for cheap vodka. In 2012 in Scotland 2.4 times more vodka was sold in the price band 35-9.9ppu than in England and Wales (Beeston et al., 2013). Amongst our participants 76% of vodka was purchased within this price range, and 17.5% even more cheaply.

While off-sales dominated purchases of alcohol, supermarkets were not the most favoured source of alcohol for the Glasgow participants. In addition we found evidence that suggests the multi-buys of beer sold by supermarkets may be outwith the budget of some our drinkers who, consequently could not purchase cheap beer, and often paid more than 50p per unit. This finding may represent evidence of

an impact of the ban on quantity discounts where the single item was not offered for sale at the unit price. Supermarkets may have circumvented the legislation by simply not offering the single item for sale and selling only multipacks of, for example, 24 cans. The required cash outlay, or physical size of these multipacks, may make them less available to our very heavy-drinking sample.

We found no evidence of extensive purchasing of illicit alcohol or sourcing from outwith Scotland. At baseline, only one Glasgow patient reported purchasing an illicit spirit from 'a man in the street'. We estimated roughly the equivalent of a quarter bottle (0.175L). At phase 2 one person bought a bottle of vodka from a neighbour which he thought was sourced 'abroad', another had consumed a bottle of homemade wine. At phase 3 there were no reports of alcohol being purchased illegally but one person had some homebrew beer. No reports were recorded at phase 4. Qualitative interviews did reveal that alcohol (or substitute liquids) was offered for sale – some on the doorstep. Less than 1% of participants reported stealing alcohol.

Deprivation is a very important factor in relation to vulnerability to alcohol-induced harm (Centre for Public Health, 2015). Our study contains evidence consistent with a 'Glasgow effect', in which harms are experienced far more acutely in areas of deprivation even where consumption patterns are similar.

Many participants showed a limited understanding of the impact of MUP. This highlights a need for further education in this area. Should a 50p minimum unit price be introduced, its impact will be most acutely felt by those predominantly drinking cheap cider and vodka. Heavy-drinking consumers of wine and beer will be less affected, as they already purchase a proportion of their drink at this level or above.

Some interviewees recalled that the policy restricting sales of alcohol to after 10 am had an impact on their vulnerability to withdrawal symptoms. They described the strategies employed to source sufficient alcohol 'for the next day' to maintain drinking at a level that would prevent them experiencing symptoms. This suggests that the potential negative impacts of policy developments on heavy drinkers need to be considered in advance. Serious dangers may be faced by the heaviest drinkers should MUP be introduced with insufficient pre-emptive allocation of resources to services.

As noted around 70% of participants smoked. Both alcohol and cigarette use have a negative impact on health. While some cigarettes were smoked as 'roll-ups', and would be cheaper, the price of one cigarette (typically 40 pence) is very close to the mean unit price of alcohol purchased by our drinkers. Both substances are addictive and arguably the introduction of MUP may have the unintended consequences of requiring the drinkers on the lowest income to choose between smoking and alcohol, or increasing the smoking of non-filter cigarettes or the trade of smuggled cigarettes.

Anecdotal reports presented within the grey literature had alluded to the possibility that white cider was particularly damaging to health, specifically being associated with gut problems. Unsolicited comments from participants in the present work were indeed consistent with these views. While preliminary analysis of our data implied a link between white cider consumption and self-reported hematemesis, this was no longer significant after controlling for other factors. Our previous work (Gill et al., 2010) had reported low levels of protective antioxidant chemicals in 'white/clear' alcoholic drinks and, after securing additional funding, we tested our hypothesis that white and cheap amber ciders may be particularly damaging to health. Our findings confirm the presence of a carcinogenic chemical (acetaldehyde) in these drinks - but within acceptable levels. The results of further analysis comparing data gathered from vodka and white cider drinkers suggests that the main risk to health is posed by the high dose of ethanol and its subsequent metabolism in the body. The likely additive contribution made by cigarettes is also relevant, particularly as 70% of our drinkers smoked, compared to around 21% of the general population in Scotland (Bromley et al., 2014).

Several factors relating to consumption among female heavy drinkers give cause for concern:

- The high dose of alcohol. Female drinkers in our study were consuming around 4.5 times the current threshold for harmful consumption in the UK. For some quintile groupings, consumption among women was not significantly different from that of men.
- Smoking prevalence. Around four out of five women smoked in the most deprived quintile.
- Preference for three 'white' drinks; vodka, white cider and white wine. Arguably, the absence of protective anti-oxidant compounds contributes to the additive risk to health of drink volume and pattern of consumption (Gill et al., 2010).

Limitations

We have some confidence in our findings. There is welcome consistency between the descriptors of the drinking behaviour of this sample of Scottish heavy drinkers and the cohort we recruited by the same procedures three years earlier in Edinburgh. We do recognise, nevertheless, that our data relate to those heavy drinkers who have made contact with services. We cannot comment on the purchasing habits of those drinkers who are also harmed through their consumption but are not in contact with medical services. We must also acknowledge the potential for change in socioeconomic status, i.e. the possibility that some drinkers in the most deprived category may be there due to social drift, consequential to their drinking.

Implications for policy and practice

1. Our findings add some weight to the public health argument for the introduction of a minimum unit pricing for alcohol on two counts:

- Currently, alcohol at less than 50p per unit makes a significant contribution to the consumption of heavy drinkers across the deprivation quintiles
- Minimum unit pricing would remove the trading down option, particularly for cheap cider sales

In this population there is currently little theft or use of illicit alcohol, and our participants did not see this as a likely consequence of MUP. However, they were often unclear as to the impact of MUP on their purchasing and we have not shown that switching to illicit or stolen alcohol is ruled out.

It was already known that heavy drinkers in contact with services buy cheaply. We learnt that, as long as cheap alcohol is available, falling affordability is cushioned by trading down to white (and amber) cider and cheap vodka.

2. Our findings also suggest that the level proposed for the minimum unit price (50 pence) in Scotland should be reviewed if the impact on consumption predicted by modelling studies is to be achieved. Beer and wine drinkers amongst our sample of heavy drinkers regularly pay more than 50p per unit for alcohol purchased within off-sale settings.

3. Off-sale settings provide the majority of the alcohol sold to this group of drinkers.

4. While MUP was not implemented during the course of the study, participants showed misunderstanding of proposed alcohol policies and concern that removal of cheap alcohol would compromise the budgets of addicted drinkers, though an intention to steal or buy illicitly was not mentioned. Participants' skill at recognising the need to self-medicate, and to ensure that they had sufficient alcohol to prevent withdrawal symptoms occurring during the hours when alcohol was not on sale, attest to the need to ensure key support for alcohol services preceding and following the introduction of MUP.

5. The particular needs of female heavy drinkers merit consideration. For some subgroups of heavy-drinking women, mean consumption actually exceeded that of men. The high levels of alcohol intake coupled with cigarettes combine to increase the risk of premature health harm.

6. Although this study was not designed to examine access to, and effectiveness of, treatment for alcohol problems the high death rate The high death rate draws attention to this as a policy issue.

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