
Article

Heavy Drinkers and the Potential Impact of Minimum Unit Pricing—No Single or Simple Effect?

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Abstract

Aims: To explore the potential impact of a minimum unit price (MUP: 50 pence per UK unit) on the alcohol consumption of ill Scottish heavy drinkers.

Methods: Participants were 639 patients attending alcohol treatment services or admitted to hospital with an alcohol-related condition. From their reported expenditure on alcohol in their index week, and assuming this remained unchanged, we estimated the impact of a MUP (50 ppu) on future consumption. (Around 15% purchased from both the more expensive on-sale outlets (hotels, pubs, bars) and from off-sales (shops and supermarkets). For them we estimated the change in consumption that might follow MUP if (i) they continued this proportion of 'on-sales' purchasing or (ii) their reported expenditure was moved entirely to off-sale purchasing (to maintain consumption levels)).

Results: Around 69% of drinkers purchased exclusively off-sale alcohol at <50 ppu. Their drinking, post MUP, may reduce by a mean of 33%. For this group, from a population of very heavy, ill consumers, we were unable to show a differential effect across multiple deprivation quintiles. For other drinkers there might be no reduction, especially if after MUP there were many products priced close to 50 ppu. Moving away from on-sales purchases could support, for some, an increase in consumption.

Conclusions: While a proportion of our harmed, heavy drinkers might be able to mitigate the impact of MUP by changing purchasing habits, the majority are predicted to reduce purchasing. This analysis, focusing specifically on harmed drinkers, adds a unique dimension to the evidence base informing current pricing policy.

Short Summary: From drink purchasing data of heavy drinkers, we estimated the impact of legislating £0.50 minimum unit price. Over two thirds of drinkers, representing all multiple deprivation quintiles, were predicted to decrease alcohol purchasing; remainder, hypothetically, could maintain consumption. Our data address an important gap within the evidence base informing policy.

INTRODUCTION

The detrimental impact of alcohol misuse on Scottish health and society has received considerable attention within the media and the research literature. In 2015 there were over 1150 alcohol-related deaths (around 22 per week) ([National Records for Scotland, 2015](#)).

Associated economic costs were estimated to be around £7.5 billion per annum in a recent cost of illness study which considered costs linked to healthcare, social care, crime and lost productivity, etc. ([Johnston *et al.*, 2012](#)), that is approximately £1660 for every Scottish adult aged 16 years or over. One response from the Scottish

Government has been the passing of the Alcohol (Minimum Pricing) (Scotland) Act 2012 (Scottish Parliament, 2012), which recommends the setting of a minimum unit price (MUP) for alcohol (one UK unit equals 8 gm/10 ml ethanol), presently favoured at 50 pence (£0.5: US\$0.64) per UK unit (50 ppu). However, the date of implementation remains uncertain due to legal challenges. Amongst those advocating the benefits of MUP, there is acceptance that it cannot be promoted as a single solution, rather it will contribute in an array of initiatives to target alcohol misuse in Scotland (Alcohol Health Alliance, 2016; Scottish Government, 2016).

Scotland is not unique in advocating a minimum pricing policy to address alcohol misuse and an international body of research has emerged over recent years providing persuasive evidence of consequent public health benefits (Purshouse *et al.*, 2010; Ludbrook *et al.*, 2012; Stockwell *et al.*, 2012a, 2013; Brennan *et al.*, 2014; Cousins *et al.*, 2016; Meier *et al.*, 2016). The potential societal benefits of MUP for Scotland were estimated in modelling by Sheffield University (Meng *et al.*, 2012; Angus *et al.*, 2016) utilizing data provided by health surveys, household spending surveys, population-level sales data, meta-analyses of epidemiological data and administrative health and health economic data.

A 50 ppu MUP was associated with a potential fall in overall consumption of 3.5% with the concomitant harm reduction over the initial 20-year period being estimated at 2036 fewer deaths and 38,859 fewer hospitalizations. Harmful drinkers were predicted to experience the greatest reduction in consumption (around 246 UK units per annum). Ludbrook *et al.* (2012) have recognized the importance of considering the impact of socioeconomic status on individual responsiveness to MUP and indeed Angus *et al.* (2016) proposed that amongst those drinking the most (i.e. harmful drinkers) 15.3% fewer deaths per annum would occur for those in poverty, but only 4.4% fewer if not in poverty (Poverty being defined as an individual having an equivalized household income below 60% of the population median).

In Scotland, survey data suggest that the heaviest 10% of drinkers are responsible for 46% of alcohol consumed (Beeston *et al.*, 2016). These drinkers are, by implication, those who suffer the greatest alcohol-induced harm and the most likely to be significantly impacted by MUP. Appreciation of their likely response to MUP is a key piece of evidence in the public health debate around the utility of MUP. In their modelling work highlighting the potential benefits of MUP on consumption levels and harm indices, Angus *et al.* (2016) employed a definition of harmful drinkers as exceeding 50 UK units for men and 35 units for women per week. Previous research with heavy, harmed drinkers seen at NHS settings in the UK (Black *et al.*, 2011, 2014; Sheron *et al.*, 2014) where mean consumption was 198, 215 and 145 UK units per week, respectively, has highlighted the extent to which the mean consumption for the recorded week was well in excess of these definition thresholds, in fact as many as 4–6 times. By way of contrast, in the 2013 Scottish Health Survey (Scottish Government, 2014), for those drinkers within the ‘harmful’ category (exceeding 35/50 UK units for women/men, respectively), the mean weekly consumption was 69.4 units. An additional point of note is that the informing population health survey data relates to householders. Heavy drinkers are likely under-represented for they can be hard to contact due to lifestyle factors or may decline to participate. In this study we aim to address this gap and inform the debate around the likely impact of MUP on the heaviest consumers by presenting data relating to the purchasing habits of drinkers from each of the multiple deprivation quintiles, harmed as a consequence of consumption and recruited within

healthcare settings. We explore the potential impact of a minimum unit price (MUP: 50 pence per UK unit) on the alcohol consumption of our sample of ill Scottish heavy drinkers as a whole and when stratified by SIMD (Scottish Index of Multiple Deprivation) quintiles.

METHODS

Data collection and primary analyses are described by Black *et al.* (2014) and Gill *et al.* (2015a, 2015b). In summary, between December 2011 and October 2012 consecutive outpatients and day patients whose health had been harmed by alcohol consumption (based on clinician’s assessment) were recruited from Scottish NHS clinics, at settings within two major Scottish cities, Edinburgh and Glasgow. Together these cities comprise approximately one third of the Scottish population. Following the initial approach by the clinician, site specific interviewers described the study in detail and obtained consent. They also administered the questionnaires (Black *et al.*, 2014).

Exclusion criteria were—being under 18 years old, unable to understand the questions or give understandable answers in English, evidence of clinically significant memory impairment, e.g. Korsakov’s Dementia, being unwilling to be contacted for three further follow-up interviews (this relates to a follow-up study not reported here). In addition, advice from clinicians at each site was taken where patients were unsuitable for inclusion due to separate clinical issues.

Approval was obtained from Regional Ethics Committees (REC reference 08/S1101/9).

Interviewers administered a questionnaire (Black *et al.*, 2014) which documented the participant’s most recent 7 days of drinking using the time line follow-back method (Sobell and Sobell, 1996) or their most typical week. Participants’ self-reported alcohol consumption and expenditure including the type, volume, brand (when known) of beverage, cost and location of purchase (‘on-sales’: bar, pub, hotel, restaurant, etc., or ‘off-sales’: supermarket, corner shop, off-licence shop, etc.). The interviews were not time limited and interviewers clarified detail where necessary. Manufacturers’ and supermarkets’ websites were checked to confirm prices. Gender and postcode were documented, the latter acting as a proxy for socioeconomic status using the Scottish Index of Multiple Deprivation (SIMD) (Scottish Government, 2012a, 2012b). The 2012 SIMD divides Scotland into 6505 small geographical areas called datazones containing approximately 350 households identified by postcode. Each datazone is assigned a rank of relative deprivation based on seven domains (employment, income, health, education, geographic access to services, crime and housing). We used our participant’s postcode to record the SIMD rank by quintile: 1 = most deprived, 5 = least deprived.

Definitions of drinker groups

We have no knowledge of how retailers would price their alcohol sales if MUP was introduced. It is conceivable that, to maintain sales (and continue to attract ‘footfall’ in the shop or supermarket), many drinks could be priced at or just above the minimum price/unit. We also recognize, however, that products above the MUP threshold could also increase in price, i.e. ‘premiumisation’ could occur whereby producers increase drink prices of higher quality products to maintain a price differential over low quality products. In this analysis, to estimate the change in consumption that might occur in our population of heavy drinkers, we chose a conservative approach and estimated what could happen to consumption, assuming our

drinkers' expenditure remained unchanged and if they could now purchase alcohol at 50 ppu but no less. Thus, we have assumed an elasticity of -1.0 , i.e. that consumption will reduce in direct proportion to price increase.

Four groups of drinker types have been identified in our sample. Group A are drinkers who purchased exclusively from pubs, clubs, hotels and bars (on-sales). We reasoned that their pattern of drinking would be unchanged—MUP will not affect on-sales' prices which are already well over 50 ppu.

For drinkers purchasing exclusively from off-sales, we examined the effect separately for those who were currently paying on average at or above MUP, i.e. 50 ppu or more (Group B) and those currently purchasing on average less than 50 ppu (Group C). In both groups we assumed their current expenditure per index week would not change. For Group B, apparently resistant to the proposed level of MUP (50 ppu), we calculated the percentage of this group who would however reduce consumption if MUP was instead set at higher levels, namely, 60 ppu and 70 ppu. In Group C, all theoretically currently susceptible to MUP at 50 ppu, we estimated the potential impact of a 50 ppu price by calculating the reduction in units purchased if expenditure was unchanged, and the consequent change in consumption. We present this data by multiple deprivation quintile.

For drinkers purchasing from both on- and off-sales outlets (Group D) we recognize that they may have more flexibility when responding to MUP. They could lessen its impact by reducing their more expensive on-sales purchasing and switching all their monies to off-sale purchasing, or alternatively they may choose for reasons of sociability, etc. to maintain on-sales purchasing, with theoretically only their off-sale purchasing being subject to MUP. We present data for both scenarios. As above, we have estimated the effects, assuming their overall expenditure on alcohol remains as recorded for their index week; we present the findings by multiple deprivation quintile.

Data analysis

Data were analysed using SPSS version 21. Descriptives (mean and standard deviation) for the average (index week consumption (UK units), price paid and expenditure) are presented by group and SIMD, multiple deprivation quintile. In Group C (those drinkers predicted to be susceptible to MUP) the most and least deprived were compared for predicted consumption change and price paid with the Mann–Whitney U -test. For Groups B to D, The Jonckheere–Terpstra test was employed to test for price paid trend across the multiple deprivation quintiles, one sided. An alpha value of 0.05, two-sided, was considered significant. (Numbers in Group A were too low to permit further analysis.)

RESULTS

Of the patients identified as eligible by clinicians, 150 refused to participate and, in 20 cases, the researcher had concerns and terminated the interview. Completed Interviews were obtained for 639 patients (response rate 79%).

Data relating to the estimated changes in consumption after a hypothetical MUP of 50 ppu are presented in Table 1.

As already stated, Group A ($n = 19$) who were defined as those purchasing exclusively in on-sale outlets are expected to be unaffected by a MUP of 50 pence, no change in consumption is predicted post MUP. The average mean price (SD) paid by this group was 113 (19) pence per unit. Since the lowest mean unit price paid was 71 pence (for beer), raising the level of MUP by 10 or 20 pence

is unlikely to impact on this group's consumption. No drinkers belonged to the least deprived quintile.

Group B are defined as those purchasing exclusively from off-sales but already paying a mean price of 50 ppu or more ($n = 84$). Theoretically this group (13% of all drinkers) would also be unaffected by MUP set at 50 ppu and no change in consumption is predicted. (However, for interest, we calculated that if MUP was raised to 60 ppu and they continued to spend the same sum on alcohol, 74% were predicted to reduce consumption, and 95% of drinkers would do so at 70 ppu (not shown in Table)). We did detect evidence of a significant trend in price paid across quintiles with rising average price paid, being linked to decreasing deprivation ($T_{JT} = 1471.5, z = 2.18, P = 0.015$; 1-tailed).

Group C, which accounted for the majority (68.5%, $n = 438$) of our sample, was also defined as purchasing exclusively from off-sale outlets, but had been paying a mean price of less than 50 ppu. If it is assumed that their expenditure remains unchanged, all would decrease consumption, and the predicted mean percentage fall in consumption varies from 28.0% (deprivation quintile 5, the least deprived) to 34.8% (deprivation quintile 1). The estimated effect across multiple deprivation quintiles is shown in Table 1. The Jonckheere–Terpstra test for trend across multiple deprivation quintiles was not significant for unit price ($T_{JT} = 34539.5, z = 1.498, P < 0.07$; 1-tailed) or for percentage fall in consumption ($T_{JT} = 30410.5, z = -1.408, P < 0.08$; 1-tailed). We also compared the least deprived quintile with the most deprived quintile; they did not differ significantly in terms of average unit price paid (Mann–Whitney $U = 2810.5, z = -1.516, P = 0.129$) or percentage change in consumption (Mann–Whitney $U = 2826.5, z = -1.473, P = 0.141$). Since Group C, by definition, are those most likely to be acutely affected by MUP, we also explored the impact of MUP on consumption in terms of UK definitions of 'harmful drinker'. The percentage in Group C consuming below the UK threshold of harmful drinking for males (50 UK units/week) was estimated to increase from 3% to 9.1% following MUP.

In Group D (15.3%, $n = 98$), defined as those who purchased from both on-sale and off-sale outlets, a range of possible responses to MUP can be proposed. At one extreme, drinkers could react by maintaining their more expensive consumption within on-sale settings with only their off-sale purchasing being affected by MUP. At the other extreme they could direct all expenditure to subsidize their purchasing from off-sale outlets post MUP. In the former case 65% would decrease consumption post MUP, in the latter case 21% would do so. In both scenarios some drinkers (already paying in excess of 50 ppu for their off-sale drinks) could in theory increase consumption post MUP (see Table 1).

The Jonckheere–Terpstra test for trend across multiple deprivation quintiles was not significant for unit price ($T_{JT} = 1928.0, z = 0.601, P = 0.268$; 1-tailed)

If we assign a zero percentage change in consumption to drinkers in Groups A and B following MUP, and total the predicted changes in consumption for drinkers in Group C plus one or other of the two possible scenarios for Group D we calculate an average consumption fall of between 23.8% and 24.8% or 59.7–61.8 UK units per week for the entire sample of 639 participants.

DISCUSSION

The key contribution made by the present study to the evidence base currently informing debate is the better description of the potential response of a relatively under researched treatment sample to policy

Table 1. Impact of MUP at 50 ppu in differing groups of heavy drinkers, by SIMD deprivation quintile (*assuming expenditure remains unchanged*)

Drinker group (<i>n</i>)	SIMD deprivation quintile	% of quintile (<i>n</i>)	Descriptors of recorded consumption					
			Average index week consumption (UK units)		Average Price Paid (ppu)		Expenditure (£)	Average Price Trend across quintile (<i>P</i> value)
			Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	
All (<i>n</i> = 639)	1 (most deprived)	47.1% (301)						
	2	19.9% (127)						
	3	15.5% (100)						
	4	9.1% (58)						
	5 (least deprived)	8.3% (53)						
Group A: drinkers purchasing exclusively from on-sale settings (<i>n</i> = 19)								
	1	2.3% (7)	93.9 (60.2)	25.7–178.9	117 (20.4)	94–154	104.06 (60.35)	Low numbers
	2	4.7% (6)	115.1 (87.4)	10.2–226.7	120 (13.2)	100–133	146.52 (117.15)	
	3	5% (5)	155.2 (170.6)	57.6–457.5	103 (22.7)	71–128	158.68 (181.00)	
	4	1.7% (1)	89.4		98		87.50	
	5							
Group B: drinkers purchasing exclusively from off-sale settings but each paying a mean price of 50 ppu or more (<i>n</i> = 84)								
	1	14.0% (42)	155.6 (95.3)	19.7–393.8	55 (5)	50–69	84.24 (50.05)	0.015
	2	7.9% (10)	118.4 (78.6)	18.8–285.5	57 (10)	50–82	66.08 (43.00)	
	3	11% (11)	182.4 (121.5)	50.4–413.4	60 (9)	50–79	110.26 (83.73)	
	4	15.5% (9)	117.5 (91.4)	35.0–315.0	56 (6)	50–65	64.29 (46.88)	
	5	22.6% (12)	91.8 (48.0)	28.1–175.7	60 (8)	50–74	52.70 (24.86)	

									Predicted impact of MUP assuming <i>all</i> off-sales purchases are priced at 50 ppu		
									Mean (SD) maximum UK units which could be purchased post MUP (Expenditure/£0.5)	Mean (SD) percentage change in consumption post MUP	
										Decrease	Increase
Group C: drinkers purchasing exclusively from off-sale settings but each paying a mean price of less than 50 ppu (<i>n</i> = 438)											
	1	72.4% (218)	249.7 (141.1)	24.9–813.4	33 (10) ^a	11–49	80.31 (52.04)	n.s.	160.6 (104.1)	–34.8 (20.6)	
	2	74.0% (94)	200.4 (115.9)	31.5–656.3	33 (11)	13–49	64.77 (41.59)		129.5 (83.2)	–33.5 (21.1)	
	3	61.0% (61)	272.3 (207.8)	18.8–1203.0	34 (11)	11–49	84.88 (59.03)		169.8 (118.1)	–32.4 (22.5)	
	4	58.6% (34)	213.8 (141.5)	21.2–705.2	34 (11)	17–49	66.03 (39.21)		132.1 (78.4)	–32.9 (21.5)	
	5	58.5% (31)	181.3 (88.9)	9.8–420.0	36 (7)	16–45	62.94 (31.60)		125.9 (63.2)	–28.0 (14.2)	
Group D: drinkers purchasing from both off- and on-sales settings (<i>n</i> = 98)											
Potential response 1: drinkers will continue to purchase at previous levels in on-sale settings and only off-sale purchasing will be subject to MUP at 50 ppu ^a	1	11.3% (34)	213.5 (102.9)	27.2–422.3	63 (19)	21–100	133.90 (86.93)	n.s.	185.6 (96.5)	–19.0 (15.6) <i>n</i> = 26	+13.2 (10.4) <i>n</i> = 7
	2	13.4% (17)	224.8 (165.2)	44.0–717.5	72 (33)	29–145	136.52 (88.44)		207.3 (151.3)	–23.5 (17.9) <i>n</i> = 8	+27.3 (43.2) <i>n</i> = 9
	3	23.0% (23)	206.4 (91.0)	29.5–405.3	65 (22)	29–104	131.30 (82.79)		193.6 (102.8)	–16.5 (14.2) <i>n</i> = 17	+38.6 (30.5) <i>n</i> = 5
	4	24.1% (14)	142.5 (84.1)	28.0–310.3	64 (28)	39–125	80.83 (43.54)		125.4 (67.0)	–16.6 (11.9) <i>n</i> = 10	+42.7 (66.9) <i>n</i> = 3
	5	18.9% (10)	113.0 (52.5)	43.5–188.2	80 (26)	34–113	82.28 (32.63)		116.8 (48.2)	–17.8 (13.0) <i>n</i> = 3	+19.8 (14.1) <i>n</i> = 7
Potential response 2: drinkers will purchase only in Off-sale settings post MUP at 50 ppu ^b	1			As above					267.8 (173.9)	–24.0 (21.8) <i>n</i> = 8	+42.8 (27.9) <i>n</i> = 25
	2								273.0 (176.9)	–30.4 (10.9) <i>n</i> = 3	+59.0 (62.1) <i>n</i> = 14
	3								262.6 (165.6)	–21.3 (14.1) <i>n</i> = 5	+43.2 (38.0) <i>n</i> = 18
	4								161.7 (87.1)	–17.0 (5.4) <i>n</i> = 4	+44.9 (57.1) <i>n</i> = 10
	5								164.6 (65.3)	–22.8 <i>n</i> = 1	+77.7 (35.8) <i>n</i> = 8

^aFor *n* = 3 drinkers there was no change in consumption.

^bFor *n* = 2 drinkers there was no change in consumption.

change impacting on alcohol selling price. The consumption of the majority (72–78%) of our sample of ill, heavy drinkers, according to the assumptions we have made, is predicted to be reduced if a MUP of 50 ppu was implemented. However, it is important to stress that even amongst these very heavy consumers there are individuals whose purchasing, with MUP set at 50 ppu, may not be affected (despite possibly buying some individual drinks below 50 ppu). We have identified three groups who fall into this category (accounting for around 22–28% of our sample). Theoretically, these drinkers may be able financially to resist any reduction in their alcohol purchasing following MUP instigation. They comprise: drinkers purchasing exclusively from off-sale outlets but paying on average in excess of 50 ppu, secondly those consuming alcohol entirely within on-sale outlets, and finally, around one third of those purchasing at both on and off-sale outlets. The final group of drinkers, we suggest, have the option of maintaining their consumption levels at no additional cost by ‘trading differently’ rather than trading down; transferring their purchasing from on-sales to off-sales. Thus, around one quarter of our drinkers may be immune to the impact of MUP but, nevertheless, all are drinkers who had been sufficiently harmed by their alcohol intake to necessitate attendance at an NHS setting. Certainly those who have advocated the introduction of a MUP accept that it is only one of many strategies required to reduce harms caused by alcohol (Alcohol Health Alliance, 2016). Our findings endorse this view. There may also be a case for introducing a higher level of MUP than 50 ppu.

Of those potentially vulnerable to MUP, i.e. purchasing exclusively within off-sale settings below MUP, several strategies could, theoretically, buffer the impact of MUP: some might be more able to source additional funds by whatever means to sustain consumption, or access other sources of alcohol, e.g. internet purchasing, cross border purchasing, illicit/illegal/substitute alcohol or turn to psychoactive drugs.

Clearly, trading down to cheaper options to maintain consumption would not, after MUP, be an option (Black *et al.*, 2014). Some participants referred to illicit alcohol, but expressed unease around its health risks. Whether or not this view is maintained post MUP merits investigation. Stealing alcohol or drinking non-beverage alcohol were infrequently reported by 115 dependent drinker participants in Falkner *et al.*'s (2015) study from New Zealand while Stockwell *et al.*'s (2012b) qualitative study from Canada involving 15 dependent homeless drinkers documented 2 drinkers who would resort to stealing alcohol and 2 who would use non-alcohol beverages when faced with a shortage of funds. We cannot speculate on the ability of our drinkers to increase spending to maintain consumption, for apart from SIMD we have no separate measure of income. Indeed in our sample of drinkers only four individuals (less than 1%) reported stealing alcohol. Certainly, some participants' only income was social security benefits. Close relatives and friends were reported by some as alternative sources of funds while others, conversely, had their funds controlled by relatives (O'May *et al.*, 2016).

Holmes *et al.* (2014) suggest that harmful drinkers on low incomes purchase most alcohol at less than MUP, consequently they would be most affected by MUP. However, for the group (C) currently paying less than 50 ppu, we were not able to show, in the types of very heavy drinkers we sampled and in the limited number of patients, a different effect between multiple deprivation quintiles. (We did not attempt to collect data on our participants' incomes.)

Angus *et al.* (2016), using data from the Scottish Health Survey which recruits adult householders, employed modelling software to estimate the impact of a 50 ppu price on the consumption of

harmful drinkers and computed an annual reduction of 246.2 units (i.e. 4.7 units per week), with those in poverty reducing by 680.9 units (13.1/week), those not in poverty 180.9 units (3.5/week). These figures are lower than ours, because our drinkers were typically drinking extremely heavily. Angus *et al.* (2016) estimated that heavy drinkers in poverty would spend £88.00 less on alcohol per annum, while those not in poverty would spend £20.00 more in the same period. Our calculations have not considered the possibility that heavy drinkers would reduce expenditure on alcohol post MUP (and thus markedly reduce consumption). On the other hand, the type of drinker who might want to maintain the level of consumption despite MUP is the addictive drinker. O'May *et al.* (2016) in this sample documented accounts of purchasing alcohol specifically to self-medicate to avert withdrawal seizures, i.e. the drivers impacting on sourcing alcohol may not only be economic.

We have already noted that a key strength of this study is the provision of data relating to drinkers who are unlikely to be adequately represented in general population health surveys; thus, the drinkers most acutely affected by MUP may be poorly represented in modelling studies. Certainly our data provide some interesting contrasts in this regard. Angus *et al.* (2016) suggest that harmful drinkers (their heaviest drinking group) drank 80% of their alcohol from off-sales (our group 95%), paid a mean price of around 67 ppu (our group mean = 43.8 ppu) and sourced around 44–62% of purchases below 50 ppu (our group 80%). They report an annual consumption of 3498 units (i.e. 67.3 per week) with weekly intake rising to 86.5 units for those in poverty. In our group the mean intake in the recorded week was 215.5 units. Baseline expenditure of around £45.38 per week contrasts with that of our participants' £84.40. Other differences are noted in regard to cider consumption: the mean price paid per unit was around 42 ppu (our group 23.4 ppu) with ciders accounting for around 6% of all intake (34.4% in our group), wine 33% (6.7% in our group) and spirits around 27% (32.7% in our group). The possibility that the impact of MUP on the consumption of heavy drinkers may be greater than that proposed by Angus *et al.* (2016) merits further study. Gender differences in relation to drink preferences and purchase place may also be relevant in predicting responses to policy changes and deserve attention as reported by Meier *et al.* (2009) from analysis involving data from the annual Expenditure and Food Survey and the General Household Survey. Our findings reported previously are consistent with this view (Gill *et al.*, 2015b); female harmful drinkers purchased almost exclusively from off-sale outlets (99%: Meier *et al.* 88%) but differ in favouring spirits and white cider for over 60% of purchases whereas in the Meier *et al.* (2009) analysis a similar preference was evident for wine.

The generalizability of our findings can be questioned. We have not interviewed the ill heavy drinkers who are not seen by services, or those at an earlier stage in their drinking career who do not yet require medical services. In relation to accuracy of recall and honesty of reporting, the interview took as long as required and time was allowed to explore ambiguities in recall with a very low rate of missing data, which is one of the strengths of this study. The index week consumption figures which we report are consistent with those recorded from similar types of drinker in our pilot study (Black *et al.*, 2011) and in an English setting (Sheron *et al.*, 2014) and New Zealand (Falkner *et al.*, 2015). We are not implying that a drinker's yearly alcohol expenditure can be calculated from our data, i.e. that this drinking pattern occurred every week. Certainly, some participants provided detail of a regular, consistent, weekly pattern of consumption. For others the recorded index week may have been

followed by periods of clinic attendance, hospitalization, treatment, money shortage, etc.

We accept that our assumption of an elasticity of -1.0 is open to debate, a more nuanced approach is, however, unsupported by existing evidence relating to the heaviest drinkers, typically excluded from population health surveys, as described here. (For discussion of alcohol elasticities see Meng *et al.*, 2014, Osterberg, 2012). Furthermore, we did not record income and we cannot reliably predict how participants will finance more expensive alcohol following the instigation of MUP should they wish to maintain their consumption level. Our previous work (O'May *et al.*, 2016) documented accounts from drinkers who advised that alcohol was purchased after necessities had been financed while, for others, drink took precedence over other outgoings. We have already mentioned how alcohol dependence might influence a more reasoned decision around purchasing.

In conclusion, we suggest that MUP will impact on the majority of the drinkers in our sample, but to differing extents. For some, it may simply mean a change of purchasing venue. But for those currently purchasing below MUP, we have shown, crucially, that this group contains over 50% of the drinkers from each of the five multiple deprivation quintiles. They sourced off-sale alcohol at between, on average, 33 and 36 pence per unit and theoretically would face, around a one third fall in consumption. How this fall in consumption impacts on clinical symptoms is unknown; however, because those most deprived suffer higher rates of social and medical harms (Bellis *et al.*, 2016) those groups may well be seen to gain more, in terms of reducing harms, than other groups.

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CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

- Alcohol Health Alliance (2016) Written Response on the 2003 Licensing Act to the House of Lords. <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/licensing-act-2003-committee/licensing-act-2003/written/36695.html> (22 June 2017, date last accessed).
- Angus C, Holmes J, Pryce R, *et al.* (2016) *Model-based appraisal of the comparative impact of Minimum Unit Pricing and taxation policies in Scotland. An adaptation of the Sheffield Alcohol Policy Model version 3.* Sheffield: ScHARR, University of Sheffield. https://www.shef.ac.uk/polopoly_fs/1.5653737/file/Scotland_report_2016.pdf (22 June 2017, date last accessed).
- Beeston C, McAdams R, Craig N, *et al.* (2016) Monitoring and Evaluating Scotland's Alcohol Strategy. Final Report. Edinburgh: NHS Health Scotland.
- Bellis MA, Hughes K, Nicholls J, *et al.* (2016) The alcohol harm paradox: using a national survey to explore how alcohol may disproportionately impact health in deprived individuals. *BMC Public Health* 16:111. 10.1186/s12889-016-2766-x.

- Black H, Gill J, Chick J. (2011) The price of a drink: levels of consumption and price paid per unit of alcohol by Edinburgh's ill drinkers with a comparison to wider alcohol sales in Scotland. *Addiction* 106:729–36.
- Black H, Michalova L, Gill J, *et al.* (2014) White cider consumption and heavy drinkers: a low-cost option but an unknown price. *Alcohol Alcohol* 49:675–80.
- Brennan A, Meng Y, Holmes J, *et al.* (2014) Potential benefits of minimum unit pricing for alcohol versus a ban on below cost selling in England 2014: modelling study. *Br Med J* 349:g5452. 10.1136/bmj.g5452.
- Cousins M, Mongan D, Barry J, *et al.* (2016) Potential impact of minimum unit pricing for alcohol in Ireland: evidence from national alcohol diary survey. *Alcohol Alcohol* 51:734–40.
- Falkner C, Christie G, Lifeng Z, *et al.* (2015) The effect of alcohol price on dependent drinkers' alcohol consumption. *N Z Med J* 128:9–17.
- Gill J, Chick J, Black H, *et al.* (2015a) Alcohol purchasing by ill heavy drinkers; cheap alcohol is no single commodity. *Public Health* 129:1571–8.
- Gill J, Chick J, Black H, *et al.* (2015b) The enigma of 'harmful' alcohol consumption; evidence from a mixed methods study involving female drinkers in Scotland. *Perspect Public Health* 136:34–42.
- Holmes J, Meng Y, Meier PS, *et al.* (2014) Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. *Lancet* 383:1655–64.
- Johnston MC, Ludbrook A, Jaffray A. (2012) Inequalities in the distribution of the costs of alcohol misuse in Scotland: a cost of illness study. *Alcohol Alcohol* 7:725–31.
- Ludbrook A, Petrie D, McKenzie L, *et al.* (2012) Tackling alcohol misuse: purchasing patterns affected by minimum pricing for alcohol. *Appl Health Econ Health Policy* 10:51–63.
- Meier P, Purshouse R, Brennan A. (2009) Policy options for alcohol price regulation: the importance of modelling population heterogeneity. *Addiction* 105:383–93.
- Meier PS, Holmes J, Angus C, *et al.* (2016) Estimated effects of different alcohol taxation and price policies on health inequalities: a mathematical modelling study. *PLoS Med* 10.1371/journal.pmed.1001963.
- Meng Y, Hill-McManus D, Brennan A, *et al.* (2012) *Model based appraisal of alcohol minimum pricing and off-licensed trade discount bans in Scotland: a Scottish adaptation of the Sheffield Alcohol Policy Model (v2): Second update based on newly available data.* Sheffield: University of Sheffield, ScHARR. http://www.sheffield.ac.uk/polopoly_fs/1.1565031/file/scotlandjan.pdf (22 June 2017, date last accessed).
- Meng Y, Brennan A, Purshouse R, *et al.* (2014) Estimation of own and cross price elasticities of alcohol demand in the UK: a pseudo-panel approach using the Living Costs and Food Survey 2001–2009. *J Health Econ* 34: 96–103.
- National Records for Scotland (2015) Alcohol related deaths website. <https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/alcohol-related-deaths/main-points> (22 June 2017, date last accessed).
- O'May F, Gill J, Black H, *et al.* (2016) Heavy drinkers' perspectives on minimum unit pricing for alcohol in Scotland: a qualitative interview study. *SAGE Open* Jul-Sep:1–10. 10.1177/2158244016657141.
- Osterberg E. (2012) Pricing of alcohol. WHO/Europe. http://www.euro.who.int/__data/assets/pdf_file/0004/191371/11-Pricing-of-alcohol.pdf (19 June 2017, date last accessed).
- Purshouse RC, Brennan A, Taylor KB, *et al.* (2010) Estimated effect of alcohol pricing policies on health and health economic outcomes in England: an epidemiological model. *Lancet* 375:1355–64.
- Scottish Government. (2012a) *Scottish Index of Multiple Deprivation 2012.* Edinburgh: National Statistics. <http://simd.scotland.gov.uk/publication-2012/> (22 June 2017, date last accessed).
- Scottish Government. (2012b) *The Scottish Government SIMD Postcode Lookup.* <http://www.scotland.gov.uk/Topics/Statistics/SIMD/SIMDPostcodeLookup> (22 June 2017, date last accessed).
- Scottish Government (2014) *The Scottish Health Survey 2013: Volume 1: Main Report.* Edinburgh: Scottish Government. <http://www.gov.scot/Publications/2014/12/9982> (19 June 2017, date last accessed).

- Scottish Government (2016) Minimum Unit Pricing. <http://www.gov.scot/Topics/Health/Services/Alcohol/minimum-pricing> (22 June 2017, date last accessed).
- Scottish Parliament. (2012) *Alcohol (Minimum Pricing) (Scotland) Act 2012*. Edinburgh: Scottish Parliament. Available at: http://www.legislation.gov.uk/asp/2012/4/pdfs/asp_20120004_en.pdf (22 July 2017, date last accessed).
- Sheron N, Chilcott F, Matthews L, *et al.* (2014) Impact of minimum price per unit of alcohol on patients with liver disease in the UK. *Clin Med* **14**: 396–403.
- Sobell LC, Sobell MB. (1996) *Timeline Followback: User's Guide*. Toronto: Addiction Research Foundation.
- Stockwell T, Zhao J, Giesbrecht N, *et al.* (2012a) The raising of minimum alcohol prices in Saskatchewan, Canada: impacts on consumption and implications for public health. *Am J Public Health* **102**:e103–10.
- Stockwell T, Williams N, Pauly B. (2012b) Working and waiting: homeless drinkers' responses to less affordable alcohol. *Drug Alcohol Rev* **31**:823–4.
- Stockwell T, Zhao J, Martin G, *et al.* (2013) Minimum alcohol prices and outlet densities in British Columbia, Canada: estimated impacts on alcohol-attributable hospital admissions. *Am J Public Health* **103**:2014–20.