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What proportion of on-trade alcohol is served to those who are already potentially intoxicated? An analysis of event-level data.

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Abstract

Objective: Over-service (i.e. venues serving alcohol to intoxicated drinkers) is a major contributor to alcohol-related harm. This paper estimates the proportion of all alcohol sold in on-trade premises in Great Britain that is drunk by people likely to already be intoxicated. Secondary analyses explore variation by age and gender, and from 2009-2017.

Method: We used cross-sectional data from one-week drinking diaries collected continuously from 2009-2017 via a nationally-representative stratified quota sample of 90,968 adults resident in Britain who consumed alcohol in the on-trade across 139,938 occasions. We first identify the amount of pure alcohol consumed in occasions after individuals reach each of three consumption thresholds indicating potential intoxication: at least increasing risk (>48/64g for women/men), at least high risk (>106/128g) and very high risk (>144/192g). We then calculate the proportion of all alcohol consumed in the on-trade each year that is accounted for by consumption beyond these thresholds.

Results: In 2017, of all on-trade alcohol consumed, an estimated, 43.3% was drunk by those who had already drunk to increasing risk levels, 20.5% by those who had already drunk to high risk levels and 10.1% by those who had already drunk to very high risk levels. Greater proportions of the alcohol consumed by women and younger people was consumed beyond these levels, but the proportion did not change substantially from 2009-2017.

Conclusions: Depending on the consumption threshold used, potentially intoxicated drinkers consume between 10% and 43% of pure alcohol drunk in on-trade venues in Great Britain, suggesting over-service is commonplace.

Key words: Alcohol drinking; Alcohol Intoxication; Adult; Cross-sectional studies

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Introduction

Drinking to intoxication increases the risk of harm to drinkers and those around them (Rehm et al., 2017). It also places a burden on the police, ambulance services and emergency departments, especially on weekends when intoxication is commonplace in many bars, pubs and nightclubs (Institute of Alcohol Studies, 2015). A major contributor to this problem is licensed venues serving alcohol to people who are already intoxicated. This can arise directly when intoxicated people buy alcohol for themselves or indirectly when their companions buy alcohol on their behalf.

Targeted efforts to reduce such over-service have been largely unsuccessful (Buvik & Rossow, 2015; Graham et al., 2014; Jones et al., 2011). Most countries have long-standing laws which ban both sales to intoxicated patrons and purchasing alcohol for intoxicated people, but these laws are widely flouted, poorly enforced and rarely used in prosecutions (Lenk et al., 2014; Nicholls & Morris, 2014). An alternative solution is Responsible Beverage Service (RBS) training, but evaluation evidence shows mixed results and suggests RBS is only effective when combined with enforcement and well-designed partnership-working across multiple stakeholders; a requirement that has proved difficult to achieve in most real-world settings (Graham, et al., 2014; Jones, et al., 2011; Moore et al., 2012; Rossow & Baklien, 2010). Given the failure of efforts to reduce over-service, this paper offers a new analytical perspective with a view to stimulating innovative thinking in this area.

Previous research into the extent of over-service has focused primarily on direct over-service by using pseudo-intoxicated patrons (i.e. actors pretending to be drunk). Importantly, this means it has focused on visible intoxication, not intoxication per se. Studies in several countries have found bar-staff serve alcohol to actors portraying high-

levels of visible intoxication (e.g. dropping money, falling asleep, stumbling, slurring, knocking over drinks) on between 50% and 95% of occasions, with figures usually at the higher end of this range (Andreasson et al., 2000; Buvik & Rossow, 2015; Goodsite et al., 2008; Gosselt et al., 2013; Hughes et al., 2014; Lenk et al., 2006; Rydon et al., 1996; Toomey et al., 2016; Toomey et al., 2004; Wallin et al., 2002). Follow-up interviews consistently find that bar-staff noticed the customer was intoxicated but served them anyway (Buvik, 2013; Gosselt, et al., 2013; Rydon, et al., 1996; Toomey, et al., 2004), in some cases replacing drinks the actors spilled or up-selling to ensure the actor purchased more alcohol than they had requested (Hughes, et al., 2014; Rydon, et al., 1996). The reasons given by bar-staff are diverse and include hectic working conditions, conflict avoidance and the maintenance of an exuberant atmosphere; although direct over-service is also frequently observed in quieter conditions. Many studies test for predictors of direct over-service relating to the actor, bar-staff, venue and surrounding neighbourhood, drawing on the extensive literature on 'bad bars' (Graham et al., 2006; Graham & Homel, 2008; Green & Plant, 2007). There is some limited evidence that direct over-service is more common to female actors (Buvik & Rossow, 2015), by younger bar-staff (Buvik & Rossow, 2015; Toomey, et al., 2004), and in poorly lit, disorderly and crowded venues with large proportions of younger or intoxicated patrons (Buvik, 2013; Buvik & Rossow, 2015; Gosselt, et al., 2013; Wallin et al., 2005). One study also found that bars belonging to corporate entities are more likely to over-serve (Toomey, et al., 2016). However, these results are inconsistent across studies and the key finding is that direct over-service to visibly intoxicated patrons occurs routinely in most situations.

An important limitation of the above literature is its methodological uniformity, which facilitates comparison across studies but limits the dimensions of the problem studied and

the diversity of metrics available to characterise it. This may hinder thinking on intervention approaches and design. For example, the focus on *direct* over-service means we know much less about the extent, nature or predictors of *indirect* over-service, while the focus on *visible* intoxication draws attention towards poor serving practices and away from the extent to which general intoxication is central to the economic viability of licensed venues or the practical challenges of avoiding over-service. Pseudo-intoxicated patron studies are also labour-intensive and this necessarily limits the size and diversity of samples. As a result, most analyses suffer from low statistical power, researchers usually only collect data in and around major cities, and few time series datasets are available to assess trends in over-service. Some studies have used alternative methods, such as street intercept surveys (Miller et al., 2014; Moore et al., 2011) or covert observation in bars (Coomber et al., 2017; Graham, et al., 2006), and these point toward similar conclusions regarding the extent of over-service. However, such studies still tend to rely on labour intensive methods that produce cross-sectional data from major urban centres at weekends, with few population-level estimates or data for other settings available.

This study adopts a new approach to studying over-service, which includes both direct and indirect over-service and moves closer to studying intoxication in general. It aims to use occasion-level drinking diary data from a British nationally-representative market research survey to: (i) estimate the proportion of alcohol consumed in on-trade premises (e.g. bars, restaurants, nightclubs) by patrons who have consumed above three consumption thresholds (ii) compare estimates by gender and age, and (iii) examine how estimates change between 2009 and 2017. While the distribution of problems across gender and age

is a basic epidemiological concern, the focus on time trends is of particular interest as on-trade alcohol consumption per capita fell by 14% during this period (British Beer and Pub Association, 2019). This decline coincided with the UK Government's 2012 Alcohol Strategy, which empowered local communities to tackle problems in the night-time economy. It also coincided with and the introduction of new licensing conditions for on-trade venues in 2010 that included prohibitions on irresponsible promotions (e.g. all-you-can-drink deals or dispensing alcohol directly into the mouth), mandatory provision of drinking water and, in a 2014 update, provision of smaller serving sizes on request (HM Government, 2012; Home Office, 2014).

Methods

The University of Sheffield ethics committee reviewed and approved this study (Ref: 017910).

Data

Data come from the 2009-2017 Alcovision survey, a commercial market research product collected by Kantar and used in previous occasion-level research (Ally et al., 2016). Alcovision is a continuous, cross-sectional, retrospective, online survey of approximately 30,000 individuals per year aged 18+ and resident in Great Britain. Alcovision draws quota samples based on age, gender, social class and geographic region from Kantar's online managed access panel. It delivers invitations to participate on set dates that are timed to ensure completion of the survey occurs throughout each month and that each day of the year is included in fieldwork. Alcovision oversamples Scotland residents and 18-34 year-olds to allow detailed analyses of these smaller populations. Kantar then construct sampling

weights based on age-gender groups, social class and geographic region using UK census data.

In addition to providing sociodemographic data, Alcovision participants complete a detailed, one-week, retrospective drinking diary. They are asked to report on the characteristics of their drinking occasions over the last week, with an occasion defined as a significant time-period, such as lunchtime, early evening or late evening. Participants can report a maximum of two on-trade and two-off-trade occasions for each day, working back in time from the day before the survey is completed. The questionnaire asks participants to report on earlier occasions first, so any occasions that are not reported due to the maximum are likely to occur later in the day.

The drinking occasion, not the individual, is our unit of analysis. Following Mustonen et al. (Mustonen et al., 2014), we used information on the start-time and duration of reported drinking occasions to redefine occasions as a period of drinking with no more than two hours between consecutive drinks regardless of location, so that we can examine drinking in mixed on- and off-trade occasions. The 2009 to 2017 Alcovision data include data from 90,968 individuals who consumed alcohol in the diary week across 139,938 on-trade occasions.

Measures

For each of their reported drinking occasions, participants can report alcohol consumption in one off-trade location and up to three on-trade locations. For each location, participants report the drinks they consumed at brand-level (e.g. Carlsberg, Smirnoff), serving or

packaging sizes, and the amount consumed in 'serves'. We convert serves into grams of ethanol using additional information we collected online on products' alcoholic strength.

As a small number of respondents report unrealistically high values, we cap consumption using thresholds informed by consultation with clinicians. The data are structured as brands, nested within occasions, nested within days, nested within weeks and we cap brands, occasions and days at 320g (40 UK units), meaning each diary week cannot involve drinking more than 2,240g (280 UK units).

We address our primary aim by calculating the proportion of on-trade alcohol sold to people who have already consumed above specific thresholds within an occasion. The thresholds are based around multiples of the standard UK definition of binge drinking (NHS, 2020). For men and women respectively, the thresholds are:

- Increased risk (standard definition of binge drinking): 64g and 48g;
- High risk: 128g and 96g;
- Very high risk: 192g and 144g.

These are necessarily arbitrary thresholds as there are no widely-accepted thresholds for occasion-specific risk and we cannot calculate intoxication levels more accurately as Alcovision does not record the necessary data to calculate blood alcohol concentrations (BAC) or monitor changes in BAC levels over time. However, the thresholds are nonetheless useful indicators as there is increasing confidence that drinkers would be significantly intoxicated as the threshold rises. There is also extensive evidence that occasion-level consumption is associated with increased risk of multiple harmful outcomes (Rehm, et al.,

157 2017). Our graphical results provide the opportunity to calculate alternative thresholds for
158 readers who wish to do so.

159 Drinker characteristics used for subgroup analyses are gender (men or women) and age (18-
160 25, 26-35, 36-55 and 56+).

161 *Analysis*

162 Data manipulation for our analysis is designed around UK units (1 unit = 8g ethanol),
163 although we refer to grams or pure alcohol elsewhere for the benefit of international
164 readers. For the population and each subpopulation of interest within each year of data, we
165 assign the units within each occasion a number representing the approximate order in
166 which participants consumed them. We then calculate the proportion of all on-trade
167 alcohol that is consumed beyond each threshold. For example, for increasing risk
168 consumption, we calculate the proportion of on-trade units that are the 7^{th} or higher unit in
169 the occasion for women and the 9^{th} or higher for men. We cannot order the drinks
170 consumed within a location precisely and this prevents us from examining the
171 characteristics of alcohol consumed by potentially intoxicated drinkers (e.g. type of
172 beverage); however, we can identify alcohol consumed in the off-trade prior to drinking in
173 the on-trade. Off-trade alcohol is not included in the numerator or denominator of our
174 proportions, but the first on-trade unit in an occasion may still be the ninth unit overall, and
175 thus contributes to determining the individuals' level of intoxication.

176 Our analytical approach can only accommodate integer numbers of units (i.e. it cannot
177 handle the 7.49^{th} unit). Therefore, where drinks contained a non-integer number of units
178 (e.g. a pint of beer containing 1.8 units), we round to the nearest integer.

We do not present statistical tests of differences as the large sample size means all confidence intervals are small (e.g. maximum 95% CI = ±0.7% for main results in Table 2). As such, any differences in the results that are of practical significance will always be statistically significant.

Results

Prevalence of drinking to intoxication

Table 1 shows the proportion of on-trade occasions within the analytical sample that involve at least increasing, high and very high risk levels of consumption. Data are shown for the sample as a whole, as well as by gender, age and year. Half (50.7%) of occasions involve drinking to at least increasing risk levels, 17.5% involve drinking to at least high risk levels and 8.3% involve drinking to very high levels. Although men are more likely to drink to at least increasing risk levels, similar proportions of men's and women's occasions involve drinking to at least high or very high risk levels. Age differences are small for increasing risk consumption levels, but younger drinkers are more likely to drink to at least high and very high levels. There was no consistent trend over time in the proportion of occasions involving drinking to at least increasing or high risk levels, but the proportion involving drinking to very high risk levels increased slightly from 7.5% to 9.0%.

Proportions of pure alcohol consumed by intoxicated drinkers

Figures 1a-c show for the population in 2009 and 2017, for each gender and for each age-group the proportions of all on-trade pure alcohol that is drunk by those who have already consumed above particular thresholds within that occasion. These figures suggest that over-service is likely to be commonplace across the population, with significant proportions

of on-trade alcohol consumed by those whose consumption levels suggest they are likely to already be intoxicated to varying degrees.

Table 2 shows the proportion of on-trade pure alcohol consumed by drinkers who are already above our consumption thresholds. In 2017, almost half (43.3%) of on-trade alcohol is consumed by drinkers who have already consumed to at least increasing risk levels, 20.5% is consumed by drinkers who have already drunk to at least high risk levels and 10.1% is consumed by individuals who have already drunk to very high risk levels.

For men, the proportions of their total on-trade alcohol consumed after already having drunk to increasing, high and very high risk levels are 41.0%, 18.0% and 7.2% respectively. For women, the equivalent figures are 48.2%, 26.1% and 14.6% respectively. The share of total alcohol consumed by potentially intoxicated drinkers is much greater for younger than older drinkers. For example, the proportion of on-trade alcohol consumed by drinkers already above our increasing risk threshold is 55.2% for 18-25 year-olds and 30.0% for those aged 56 and over. The drop-off in this proportion is particularly marked between the 36-55 and 56+ age groups.

Between 2009 and 2017, the proportion of on-trade alcohol consumed by potentially intoxicated drinkers increased slightly from 42.2% to 43.3% for the increasing risk threshold, from 18.1% to 20.5% for the high risk threshold and from 7.9% to 10.1% for the very high risk threshold. Within subpopulations, the increases over time were largest for women and, in most cases, for those aged between 26 and 55.

223 ***Table 1: Sample size of individuals and occasions and proportion of occasions exceeding consumption***
224 ***thresholds by gender, age and year.***

			On-trade occasions involving at least this level of consumption[c]		
	Individuals[a]	On-trade occasions[b]	Increasing risk	High risk	Very high risk
	N	N	%	%	%
All	90,968	139,938	50.7	17.5	8.3
Gender					
Men (ref)	52,676	87,150	57.0	17.7	7.8
Women	38,292	52,788	39.2	17.3	9.2
Age					
18-25 (ref)	25,672	38,169	54.9	25.8	14.7
26-35	20,900	30,559	52.1	21.8	11.2
36-55	27,762	42,808	53.9	19.6	8.7
56+	16,634	28,402	44.8	9.6	3.4
Year					
2009 (ref)	10,615	17,018	50.8	17.3	7.5
2010	9,973	15,877	51.2	17.4	7.9
2011	10,548	16,692	51.2	18.2	8.6
2012	10,470	16,582	52.0	18.3	8.7
2013	10,295	15,550	50.7	17.2	8.3
2014	10,409	15,788	49.8	17.4	8.2
2015	10,262	15,356	50.1	17.2	8.2
2016	10,033	15,057	50.3	17.1	8.5
2017	8,440[d]	12,018	49.5	17.7	9.0

[a]Respondents who drank during the diary week only.
[b]Including occasions that involved off-trade drinking before or after on-trade drinking.
[c]Increasing risk: >48/64g for women/men; High risk: >96/128g for women/men; Very high risk: >144/192g for women/men.
[d]July 2017 data were lost during processing by Kantar, causing a reduction in the sample size for 2017.

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226

227 ***Table 2: Proportion of on-trade pure alcohol consumed by drinkers who have already drunk up to the***
228 ***increasing, high and very high risk consumption levels by year.***

Year	All (%)	Men (%)	Women (%)	18-25 (%)	26-35 (%)	36-55 (%)	56+ (%)
Increasing risk (>48g for women and >64g for men)							
2009	42.2	41.8	43.4	55.5	47.3	42.3	28.5
2017	43.3	41.0	48.2	55.2	49.1	45.1	30.0
High risk (>96g for women and >128g for men)							
2009	18.1	16.9	21.3	30.2	21.9	16.7	8.1
2017	20.5	18.0	26.1	32.1	25.8	20.9	9.3
Very high risk (>144g for women and >192g for men)							
2009	7.9	6.0	11.1	15.7	13.8	6.5	2.6
2017	10.1	7.2	14.6	17.7	15.5	9.9	3.2

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Discussion

Of all pure alcohol consumed in the on-trade in Great Britain in 2017, we estimate that 43.3% was consumed by those who had already consumed to increasing risk levels, 20.5% was consumed by those had already consumed to high risk levels and 10.1% was consumed by those who had already drunk to very high risk levels. This suggests that direct or indirect over-service to potentially intoxicated patrons is widespread. This is particularly the case for younger adults and likely reflects their increased propensity to drink to intoxication. However, this is not simply a phenomenon associated with early adulthood and is prevalent in all age groups. Over-service is also more common in women's drinking occasions, and increases in over-service between 2009 and 2017 appear larger among women. This may reflect the general increases in women's drinking over the study period or previous evidence of a shift in the distribution of women's drinking, such that a greater share of consumption is now concentrated among heavier drinkers (Holmes et al., 2019).

This is the first study to use occasion-level data from a large representative sample of the general population to provide an indication of the prevalence and time-trends in direct and indirect over-service to intoxicated patrons within the on-trade. However, there are a number of limitations to our analysis. First, the relationship between occasion-level consumption and intoxication varies across the population and is unobserved in this study. We cannot accurately estimate BAC or changes in BAC over an occasion as a measure of intoxication as we do not have data on individual physiology or the timing of each drink consumed. We mitigated this by investigating three levels of consumption linked to the standard UK definition of binge drinking, and presenting these as indicators of potential intoxication. We also present our results graphically as a continuous curve. Although levels

of intoxication may be modest for some drinkers after consuming 48g or 64g of alcohol, it is very likely that drinkers who have consumed over 144g or 192g of alcohol would be intoxicated to a level that should prohibit the direct or indirect purchase of more alcohol. Second, our data are collected using a quota sample of online panel members that, although designed and weighted to provide representative samples of the British population, may still contain biases. Declining response rates to postal and telephone surveys, and the prohibitive costs of face-to-face studies mean online sampling methods are increasingly common within largescale alcohol survey research, despite their limitations (Rehm et al., 2021). Nonetheless, we encourage other researchers with occasion-level datasets to adopt our approach to provide alternative estimates for comparison. Third, the data are also subject to potential self-reporting biases, but the diary design employs techniques that should increase accurate reporting, such as recent recall and capturing contextual details of drinking (Casswell et al., 2002; Greenfield & Kerr, 2008; Stockwell et al., 2008).

Over-service is an important contributor to alcohol-related harm and researchers have presented compelling arguments as to why and how it should be tackled but, as discussed above, prevention efforts to date have had only limited success (Jones, et al., 2011). Our analysis and framing of the problem offers useful insights to guide new work in this area. In particular, it draw attention to both direct (service to potentially intoxicated patrons) and indirect (proxy purchasing for intoxicated patrons) over-service. The latter is particularly relevant in countries like Britain, where round-buying is common, and increases the difficulty of managing and regulating over-service. It also highlights that over-service may occur repeatedly within an individual drinking occasion. As such, it contrasts with previous research using pseudo-intoxicated patrons by framing over-service as a continuous act of

omission by staff rather than a discrete one. A small number of pseudo-intoxicated patron studies have asked actors to make further purchase attempts if the first is successful, but ethical and practical problems regarding what to do with the purchased drinks present challenges for this method (Toomey et al., 1999). Overall, our approach and findings emphasise that addressing over-service means managing the intoxication of patrons in general, rather than simply refusing purchase attempts by visibly intoxicated patrons. The scientific literature is unclear on the extent to which Responsible Beverage Service (RBS) training and related interventions consider these three points. Some papers discuss bar-staff being influenced by the intoxication norms of the venue but our results highlight the importance of fully incorporating into RBS training, if not already present, a focus on managing intoxication levels of all patrons as an on-going process rather than a series of discrete and disconnected choices by staff presented with customers showing greater or lesser symptoms of intoxication. Depending on the venue type, this may include lock-out laws, breathalysing patrons on entry, drinks tokens to limit consumption, restricting up-selling and other quantity-based promotional offers, and careful management of sales practices for 'down-in-one' style drinks (e.g. shots, shooters or bombs).

In Britain, debates about over-service are muted but fall under a broader Government strategy that emphasises the need for a partnership and community empowerment approach, whereby local licensing authorities, police, ambulance services and other public and community bodies work alongside alcohol producers and retailers to manage the excesses of the night-time economy (Community Alcohol Partnerships, 2016; HM Government, 2012). Researchers have not robustly evaluated the effectiveness of this strategy, although our findings suggest it has not markedly affected the rate of over-service

in a period of declining on-trade consumption. The present research can however contribute to the strategy's on-going development by drawing attention to the scale, social patterning and time-trends associated with the problem. It also highlights further concerns regarding the potential need for reform of laws prohibiting over-service with a view to better-reflecting the nature of the problem, as discussed by Nicholls and Morris (2014). Finally, it adds to previous evidence of a conflict of interest embedded within partnership approaches to alcohol policy, whereby commercial actors have a strong financial incentive to continue selling alcohol to those at risk of harm (Bhattacharya et al., 2018).

As noted above, the research literature on over-service is dominated by a relatively uniform research design involving pseudo-intoxicated actors making test purchases. Although robust and informative, other research designs are required to provide a broader perspective and set of metrics. Further exploration of how to use diary data creatively to describe over-service and its associated characteristics appears a promising way forward, particularly for providing large-scale nationally representative evidence. We opportunistically used previously collected market research data, but a more feasible approach for other researchers may be primary data collection via ecological momentary assessment (e.g. recording drinking behaviour in near real-time via smartphone apps). There is an emerging literature on drinking occasions using this method (Kuntsche & Labhart, 2012; Labhart et al., 2013; Monk & Heim, 2014; Thrul et al., 2017), and there is considerable potential for combining multiple forms of data (e.g. GPS, licensing records, ambulance and emergency room records) to develop a robust picture of where, when and how over-service occurs and leads to harmful outcomes. Measures that permit more accurate assessment of intoxication (e.g. height, weight and timing of drinks, or self-reports

of intoxication or intoxication symptoms) would greatly increase the robustness of our approach, while collecting contextual information (e.g. the brand or beverage, location and type of occasion) for alcohol consumed before and after intoxication thresholds would provide greater insight for the design and targeting of prevention efforts.

Conclusion

Depending on the consumption threshold used, drinkers who are potentially intoxicated consume between 10% and 43% of pure alcohol drunk in on-trade venues in Great Britain, suggesting over-service is commonplace. Further data suggest it is particularly common for women and younger drinkers, but there is little evidence that levels of over-service are changing over time.

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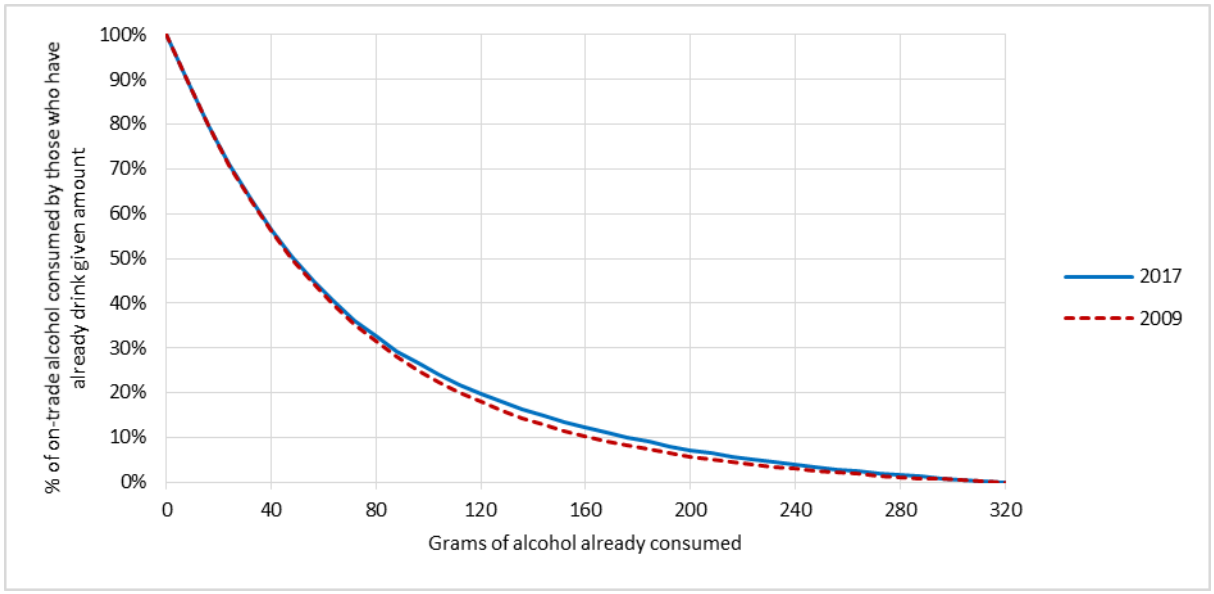
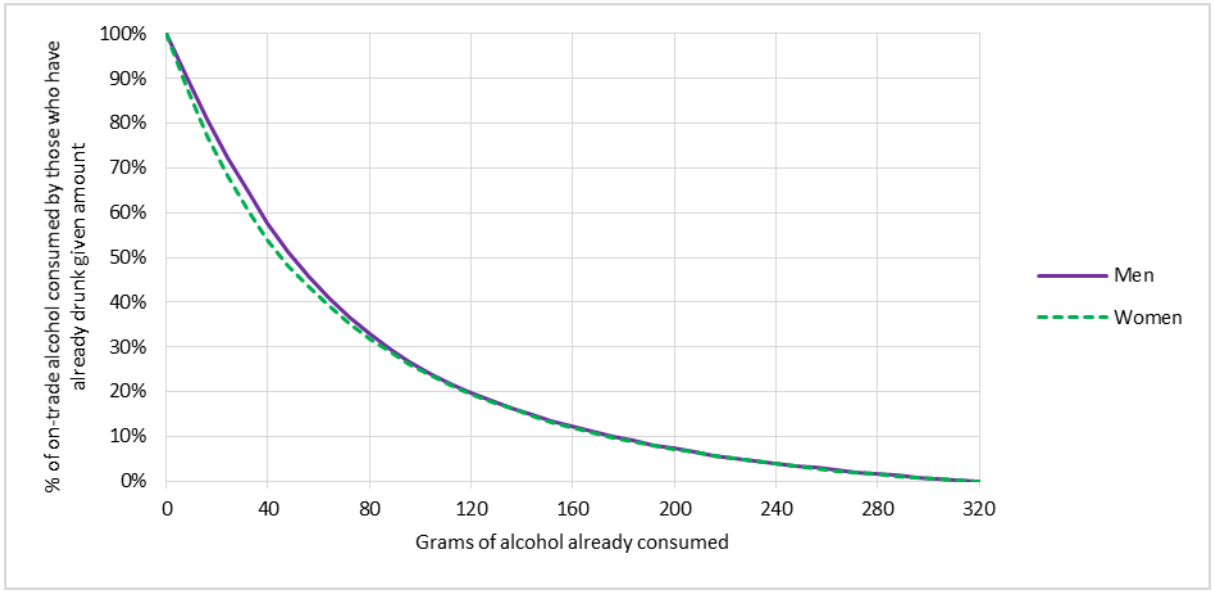
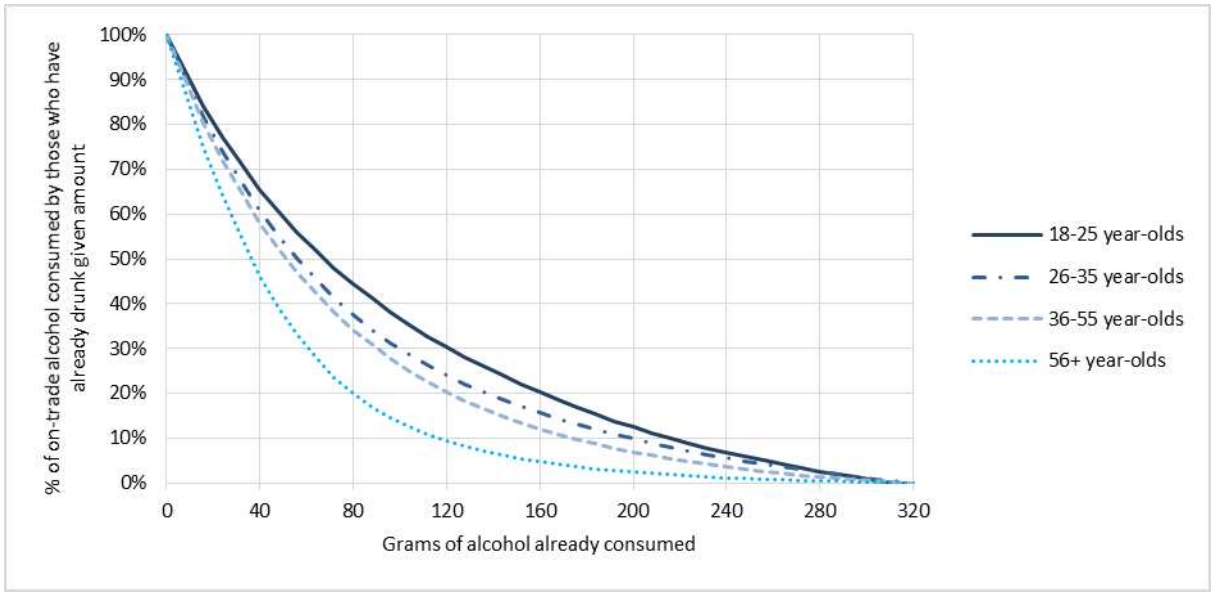

% of on-trade alcohol consumed by those who have already drink given amount
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
40
80
120
160
200
240
280
320
Grams of alcohol already consumed
2017
2009

478


% of on-trade alcohol consumed by those who have already drunk given amount
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
40
80
120
160
200
240
280
320
Grams of alcohol already consumed
Men
Women

479


% of on-trade alcohol consumed by those who have already drunk given amount
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
40
80
120
160
200
240
280
320
Grams of alcohol already consumed
18-25 year-olds
26-35 year-olds
36-55 year-olds
56+ year-olds

480

481 ***Figure 1: Proportion of pure alcohol consumed by those who have already drunk up to certain consumption thresholds***
482 ***(a) in 2009 and 2017; (b) by gender in 2017 and (c) by age group in 2017***

483