ALCOHOL AND CANCER TRENDS: INTERVENTION SCENARIOS

PROJECTING TRENDS IN ALCOHOL CONSUMPTION AND ALCOHOL-RELATED HARM IN ENGLAND FROM 2015 TO 2035 AND ESTIMATING THE IMPACT OF POTENTIAL MINIMUM UNIT PRICING AND TAXATION POLICIES USING THE SHEFFIELD ALCOHOL POLICY MODEL VERSION 3.1

The University Of Sheffield.

CANCER RESEARCH UK

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CANCER RESEARCH UK

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FOREWORD

I am delighted to introduce this report investigating the impact that alcohol could have on cancer outcomes over the next twenty years.

Alcohol consumption is responsible for 5.9% of all global deaths and is linked to more than 60 health conditions including 7 types of cancer. It is associated with around 12,800 cases of cancer annually in the UK. Cancers linked to alcohol include bowel and breast, two of the most common cancers, as well as oesophageal which is one of the hardest to treat. Although there have been some recent declines in alcohol consumption in the UK, per capita consumption is still more than double what it was in the 1960s. As a result we are seeing increasing numbers of alcohol-related cancers.

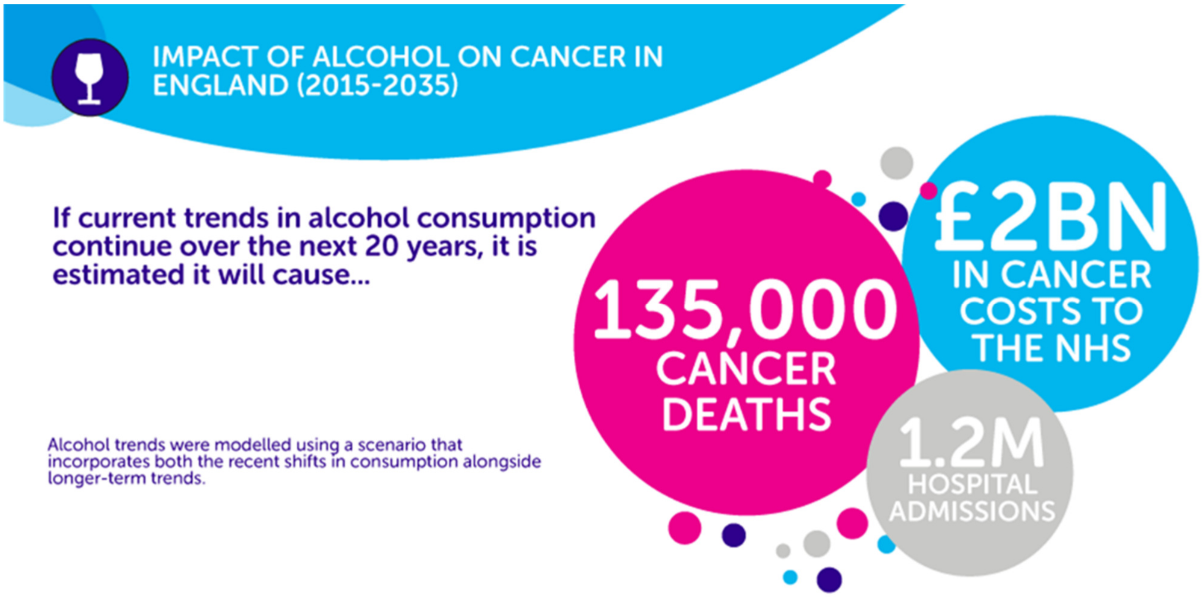
This report, based on data generated from the internationally utilised Sheffield Alcohol Policy Model, shows that in England alcohol is projected to cause 135,000 cancer deaths over the next 20 years. This will place a huge burden on NHS, with estimated alcohol attributable cancer costs of £2bn. Oesophageal cancer is expected to be impacted the most, both in terms of hospital admissions and mortality.

The NHS Five Year Forward View highlighted the need for action on all major health risks, including alcohol use. These findings are strong reminder of why population level alcohol interventions are vital for the sustainability of the health service. As such, this study also modelled a number of different policy interventions aimed at reducing alcohol related harm, including setting a minimum unit price below which alcohol cannot be sold. In Scotland a bill was passed in 2012 to bring in a 50p minimum unit price, and a recent court decision found that this policy does not breach European law. The data presented in this report clearly shows that this type of policy is an effective measure for preventing not only cancer, but also other alcohol attributable harms to society.

This report was commissioned by Cancer Research UK's Policy Research Centre for Cancer Prevention. This new Centre is part of Cancer Research UK's commitment to support high quality research to help build evidence to inform policy development on topics relevant to cancer prevention, including alcohol.

Professor Linda Bauld
Director of the Institute for Social Marketing, University of Stirling and Cancer Prevention Champion, Cancer Research UK

EXECUTIVE SUMMARY



Alcohol is a significant contributor to the global burden of mortality and disease. It has been linked to over 200 health conditions,[1] including, heart disease, stroke, diabetes and seven types of cancer.[2] In the UK, alcohol is linked to around 12,800 cancer cases annually.[3] It is also implicated in a wide range of social problems, particularly crime and workplace absences. These health and social problems impose a substantial burden on public services.

Prevention has formed a key part of the NHS Five Year Forward View,[4] supporting comprehensive, hard-hitting and broad-based national action for all major health risks, including alcohol use. Furthermore, the 2015 Cancer Strategy for England called for a radical upgrade in prevention and public health to reduce further cancer incidence.[5]

Cancer Research UK commissioned the University of Sheffield to investigate how trends in alcohol consumption would affect future rates of alcohol-related harm, including cancer outcomes, and how alternative policy interventions would reduce this harm. This was undertaken using the Sheffield Alcohol Policy Model (SAPM); an advanced population simulation model designed to forecast the impact of different alcohol policies on alcohol consumption and related harm.

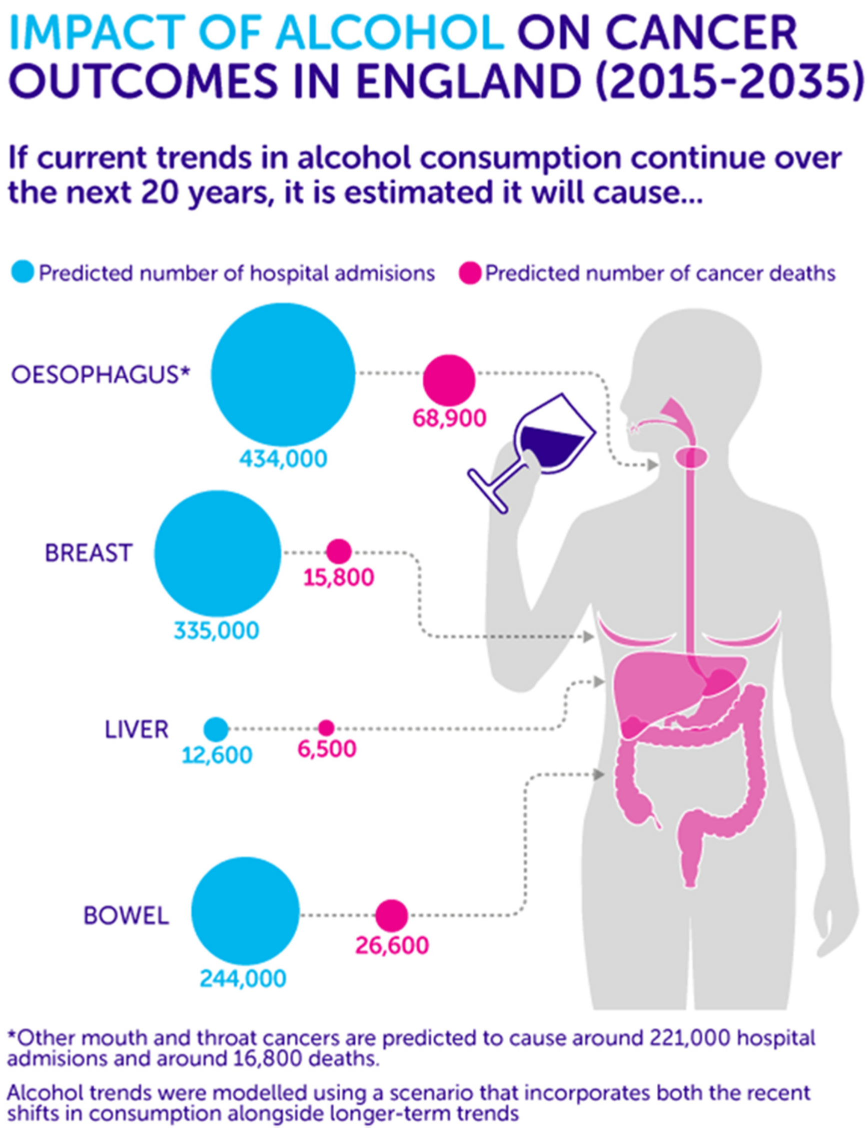
ALCOHOL AND CANCER

Alcohol trends were estimated across the whole population for England in 2015-2035. Using a scenario that incorporates both the recent shifts in consumption alongside longer-term trends, the average consumption is estimated to be 14.6 units/week per drinker and the abstention rate 20.7%.

Under this scenario, between 2015 and 2035 alcohol consumption in England is estimated to cause:

- **253,000 deaths, including 135,000 cancer deaths**
- **17.5 million hospital admissions, including 1.2 million for cancer**
- **£53 billion in costs to the NHS, including £2 billion in cancer costs**

In both relative and absolute terms, and for both mortality and admissions, the biggest increase in the burden of alcohol-related cancers is for oesophageal cancer. This is followed by bowel, other mouth and throat, breast and then liver cancers.



MINIMUM UNIT PRICING

Different alcohol pricing policies were modelled, to predict their impact on alcohol consumption and therefore on alcohol harm, including a 50p minimum unit price for alcohol. The Scottish Parliament passed a bill in 2012 to bring in this policy in Scotland.[6] The measure has been subject to a legal challenge by the alcohol industry but in October 2016 the policy was found to be compatible with EU law by the Scottish Court of Session.[7] Previous research has shown that this policy will reduce average consumption in Scotland by 3.5% (0.5 units/week) and annual alcohol attributable mortality by 7.4% (121 deaths/year) [8]

This research shows that a 50p minimum unit price in England would result in the following over the next 20 years:

- **Reduce all alcohol-attributable deaths by 7,200, including cancer deaths by 670**
- **Reduce all alcohol-attributable hospital admissions by 386,000, including 6,300 for cancer admissions**
- **Reduce healthcare costs by £1.3 billion**

Furthermore the effects on consumption and therefore alcohol-attributable mortality are largest among harmful drinkers and only modest among moderate drinkers.

Therefore minimum unit pricing is an effective approach to reducing alcohol consumption and alcohol-related harm.

CONTENTS

1. INTRODUCTION

Alcohol is a major contributor to the UK's burden of mortality and disease and is the country's 6th leading cause of disability adjusted life-years.[9] It has been identified as a cause of over 200 health conditions, including, heart disease, stroke, diabetes[1] and seven types of cancer[3] (Figure 1). Overall, alcohol is linked to around 12,800 (4.0%) of cancer cases in the UK annually.[3] Alcohol is also implicated in a wide range of social problems, particularly crime and workplace absences. In combination, these health and social problems impose a substantial burden on public services and the wider economy. The costs of alcohol are disputed,[10] but the most widely cited estimate is provided by the UK Government. This states that the total cost of alcohol-related harm in England and Wales is £21bn per year and comprises £3.5bn in NHS costs, £11bn in costs from alcohol-related crime and £7.3bn in costs to the wider economy.[11]

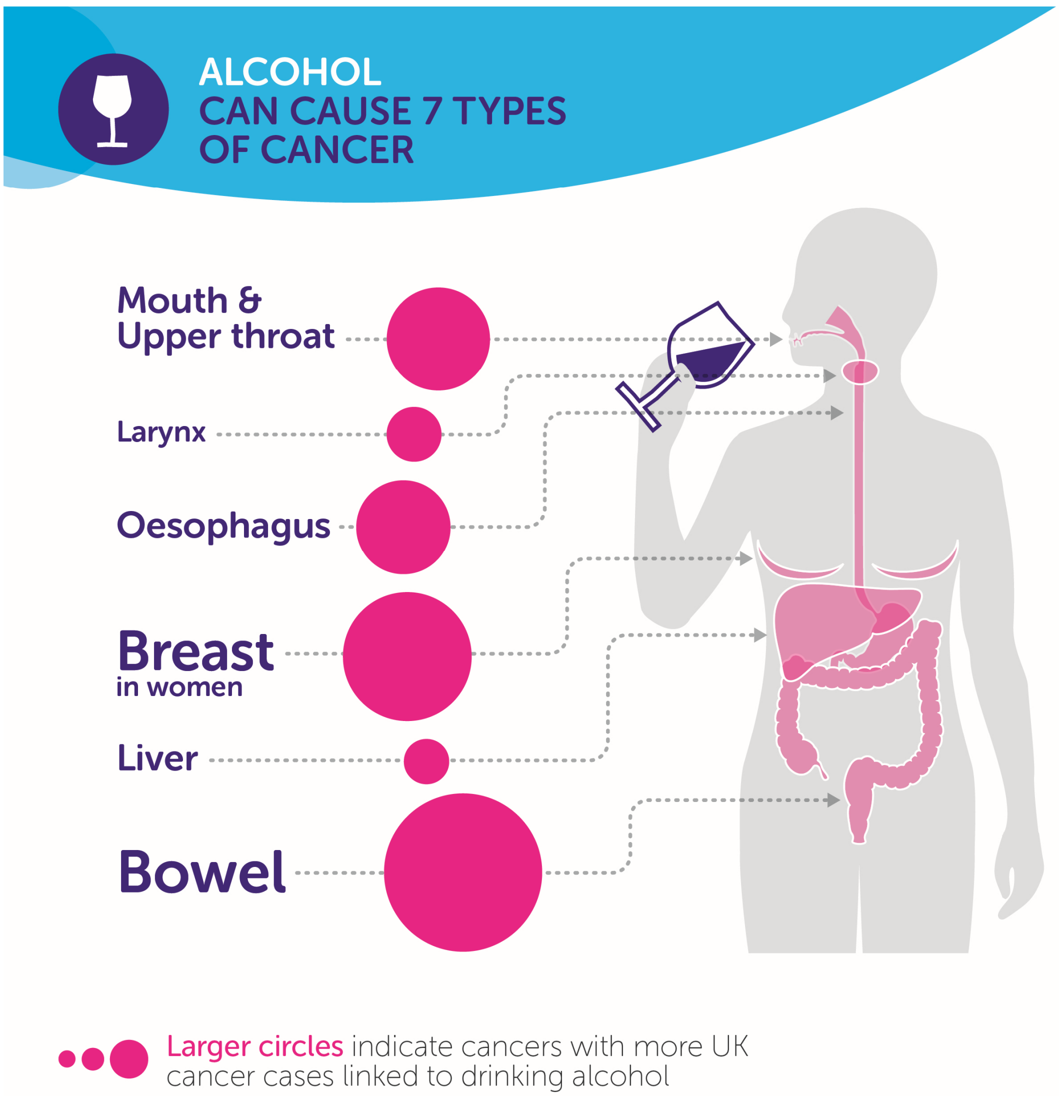


FIGURE 1 ALCOHOL IS LINKED TO SEVEN DIFFERENT TYPES OF CANCER

2. AIMS

This study aims to provide evidence on the extent of alcohol-related health and social problems which may be faced by England in the future. Although precise predictions cannot be made, it examines a range of potential scenarios to understand how different future trends in alcohol consumption may impact public health, including levels of alcohol-related cancer, and wider social concerns. The report also examines how acting today may reduce problems in the future and presents estimates of the potential effects of specific policy interventions. We focus particularly on the example of alcohol pricing policies as these are prominent in UK public debate, can be straightforwardly analysed with available data and are recommended by WHO as among the best-evidenced and most effective interventions available to policy makers.[12] Other recommended policies such as restrictions on alcohol marketing, reducing the retail availability of alcohol and provision of early intervention in primary care and treatment services are not examined here but are also likely to be effective options for reducing the future burden of alcohol-related harm.

Therefore, the study has two over-arching aims:

1. To estimate future levels of alcohol consumption and alcohol-related harm in England in scenarios where we do nothing and where we enact hypothetical policies which reduce consumption today.
2. To estimate future levels of alcohol consumption and alcohol-related harm in England if we introduce specific alcohol pricing policies today.

These aims build on our previous analyses of alcohol consumption trends[13] and detailed analyses of alcohol pricing policies, particularly minimum unit pricing.[14-17] For each analysis of alcohol-related harm, we present results for overall and cancer-related deaths and hospital admissions due to alcohol, alcohol-related crimes and workplace absences and the costs associated with these harms.

3. METHODS

3.1 FORCASTING FUTURE ALCOHOL ATTRIBUTABLE HARMS

To estimate future levels of alcohol consumption and alcohol-related harm, we must first understand the existing trends in alcohol consumption. Figure 2 illustrates the historic trend in population alcohol consumption over the course of the 20th and early 21st centuries.[18] This shows the significant shifts which have occurred over this period, with consumption falling rapidly up to and during the First World War, from 11 litres of pure alcohol per adult in 1900 to 3.6 litres in 1918. Consumption rebounded somewhat in the post-war years, but returned to around 4 litres per person by the early 1930s and remained at this level until the start of the 1960s. From this point, consumption levels rose rapidly to 6.9 litres by 1975 and then more gradually to around 8 litres until the late 1990s, when they rose again, peaking at 9.5 litres per adult in 2004. Since this peak, mean consumption has fallen back to late 1990s levels, driven particularly by a sharp decline in the drinking of young people.[19]

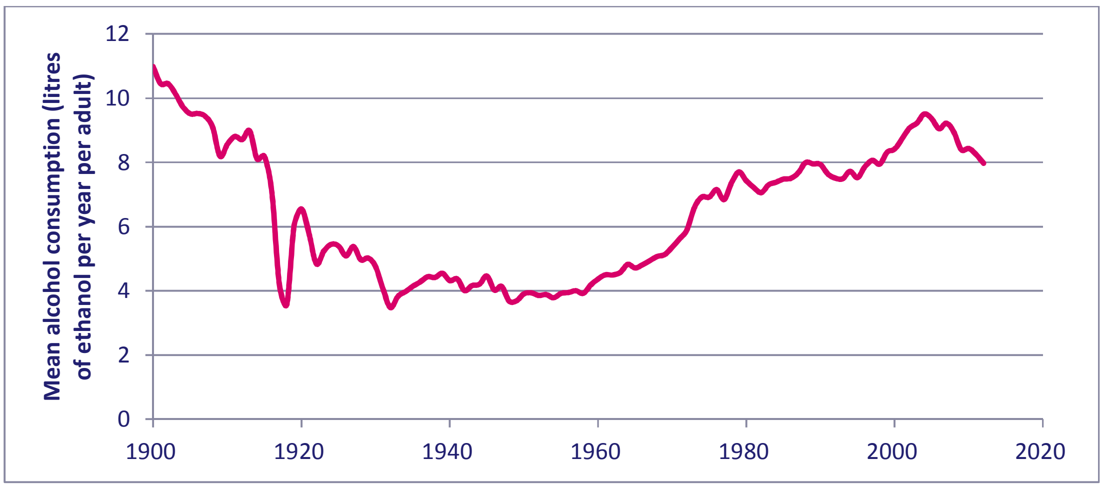


FIGURE 2 TRENDS IN ALCOHOL CONSUMPTION

These trends complicate the estimation of future levels of alcohol consumption as there is not a long-term trend which can be projected straightforwardly into the future. Further complications are introduced by periods where abstinence and consumption are both rising and where consumption levels among male and female drinkers and among younger and older drinkers are going in opposite directions.[13,20] To account for this complexity, we estimate future trends in abstinence rates and alcohol consumption levels separately, male and female trends separately and we use an age-period-cohort (APC) approach to account for the complex differences in trends between age groups. An APC approach breaks down population-level trends into:

- **Age effects** which describe how drinking changes as people get older;
- **Period effects** which describe how the whole population changes its drinking over time and;
- **Cohort effects** which describe how drinking changes from one birth cohort to the next.

In this report, the sex-specific APC analysis of abstention and consumption trends helps us to understand what has happened in the past and then we use the results to project trends in drinking forward 20 years from a baseline year of 2015 to 2035 under a series of different scenarios which are explained below. This allows us to estimate abstinence and consumption levels in 2035. We then use the Sheffield Alcohol Policy Model (SAPM),[17,21] a policy analysis tool which analyses the relationship between levels of drinking and levels of alcohol-related harm, to estimate levels of general and cancer-specific alcohol-related harm between 2015 and 2035 under the different scenarios.

3.1.1 SCENARIOS ANALYSED

Although our modelling process helps to capture what has happened in the past, the absence of a consistent long-term trend in alcohol consumption means it is still challenging to estimate what might happen in the future. Therefore, we begin by analysing a set of four 'do nothing' scenarios which explore how trends in alcohol consumption and alcohol-related harm might develop in the absence of any intervention. The scenarios were selected to include increases and decreases in future consumption of varying degrees and, in some cases, reflect plausible explanations for the recent falls in consumption. None of these scenarios should be interpreted as *predictions* of what will happen in the future. Instead, they should be seen as illustrative examples of how the future could look under different conditions, what the implications of those conditions would be for alcohol-related harm and what the plausible range of future outcomes might be.

The four do nothing scenarios are summarised below and the methods for estimating these using our APC approach are summarised in Table 1. Note that the summaries below are simplified for comprehensibility and that separate period and cohort effects are estimated for consumption and abstinence and for males and females. Thus the final projections are based on a combination of multiple estimated trends rather a simple trend across the consumption data shown in Figure 2.

1. **No change:** Everyone drinks at the same level as they do after accounting for the aging of cohorts with different consumption and abstinence levels (this age trend is modelled automatically by SAPM and cannot be removed). This is an unlikely real-world scenario as consumption has tended to trend up and down over time but it provides a reference point against which readers can compare the other scenarios.
2. **Overall trend:** Abstention and consumption trends will follow the average trend seen from 1978 onwards which includes periods of rising and falling consumption. This represents a scenario where the long-term increase in consumption was reversed by factors such as the 2008 economic crises but, as the economy recovers, upward pressure on consumption levels may increase and we may observe a trend midway between the periods of rising and falling consumption.
3. **Long-term trend:** Abstention and consumption trends will be similar to those seen before consumption began to decline in 2004. This represents a scenario where the recent decline in consumption was only a temporary interruption in the long-term rising trend, potentially brought about by economic constraints.[22]
4. **Recent trend:** We assume that abstention and consumption trends will continue as they have during the period in which consumption has been declining. In this scenario, we are assuming the long-term rise in consumption ceased permanently in 2004 and a new long-term downward trend began.

TABLE 1: AGE, PERIOD AND COHORT EFFECT ASSUMPTIONS FOR DO NOTHING SCENARIOS

Scenario	Age effects	Period effects	Cohort effect
No change	Automatically modelled by SAPM	No period effect	No cohort effect
Overall trend	Automatically modelled by SAPM	Linear period effect estimated based on APC results for 1978-80 to 2013 periods	Linear cohort effect estimated based on APC results for 1952-56 to 1992-95 cohorts
Long-term trend	Automatically modelled by SAPM	Linear period effect estimated based on APC results for 1978-80 to 2000-05 periods	Linear cohort effect estimated based on APC results for 1952-56 to 1977-81 cohorts
Recent trend	Automatically modelled by SAPM	Linear period effect estimated based on 2006-10 to 2013 periods	Linear cohort effect estimated based on APC results for 1982-86 to 1992-95 cohorts

We then proceed to a second set of scenario analyses which are policy-oriented and examine the effect on future levels of alcohol-related harm of hypothetical policy interventions which reduce alcohol consumption by 1%, 5%, 10%, 20% and 50% in 2015. The long-term impact of these interventions is estimated using as a baseline the 'Overall trend' scenario which is described above. The overall trend scenario is used as it incorporates the recent shifts in trends into the estimation process while also accounting for the longer-term trends. We do not believe that any of the scenarios is correct per se, but the overall trend scenario represents a conservative mid-point assumption within the range of possibilities.

3.1.2 DATA SOURCES

APC Modelling data

The majority of the data for the APC modelling come from the English sample of the General Household/Lifestyle Surveys (GHS) 1978-2010, which are nationally representative, cross-sectional surveys of Great Britain. Alcohol consumption questions were only asked every two years, with the exception of 2004 (the questions were asked in 2005 instead). Since the GHS was discontinued after 2011, the Health Survey for England (HSE) provides equivalent data on alcohol consumption, for the years 2011, 2012 and 2013. The methods of the GHS and HSE are sufficiently similar to prompt no major concerns regarding the compatibility of the data. Overall, the GHS and HSE provide 238,385 observations spanning 20 survey years.

Projection of future trends data

Baseline population demography and all-cause mortality rates by age and gender come from the Office for National Statistics, while the baseline alcohol consumption data to which period and cohort effects are applied within SAPM comes from HSE 2013. Baseline condition-specific alcohol-related mortality and morbidity data comes from published analysis of hospital and mortality registers,[23] combined with evidence published by the Office for National Statistics on the relationship between socioeconomic status and alcohol-related harm.[24] Baseline crime rates are taken from Office for National Statistics data on police recorded crime[25], adjusted for the gap between recorded and actual crimes[26] and for alcohol-attribution [27,28]. Workplace absence data comes from the Labour Force Survey 2007-2012 combined with evidence on the level of alcohol involvement in absenteeism[27,29].

3.1.3 MODELLING METHODOLOGY

The APC models are regression models which estimate the likelihood of an individual being an abstainer and the average weekly consumption level of drinkers based on the survey year, the individual's birth year and their age plus a number of other measures such as their education level, ethnicity and which part of the country they live in. The full methods and results of the APC modelling are presented in Appendix 1. These results are used, within SAPM, to estimate abstention and consumption levels and alcohol-related harm levels (including health, crime and workplace harms plus associated costs) in 2035 under the four do nothing scenarios outlined in section 3.1.1.

For the five policy scenarios where we reduce consumption by a fixed percentage in 2015, we reduce each individual's baseline alcohol consumption by that percentage and then, again, use the APC results to estimate abstention and consumption levels and harm levels in 2035. As explained above, in these five policy scenarios, we only estimate future trends using the 'Overall trend' scenario. For more details on the methodology including the key assumptions see Appendix 1.

3.2 ALCOHOL POLICY ANALYSIS

Having estimated potential levels of alcohol-related health, crime and workplace harms in 2035, their associated costs, and how these would be different if we reduced consumption today, we now turn to specific alcohol pricing policies as examples of policies which may deliver such reductions and which can be analysed straightforwardly using SAPM. Our analyses of alcohol pricing policies update and expand those previously undertaken using SAPM (v.3.1) to include the most recent alcohol consumption data (HSE 2013), new purchasing and pricing data for the period from 2010-2013 (from the Living Costs and Food Survey[30]) and to present results for policy impacts on alcohol-attributable cancers.

3.2.1 SCENARIOS ANALYSED

We analysed two sets of alcohol pricing policies to explore their impacts on alcohol consumption and cancer. The first set of policies is a range of Minimum Unit Pricing (MUP) policies ranging from 50p to 70p per unit, which set a floor price below which no alcohol may be sold. For example, an MUP of 50p would mean a pint of beer containing two units could not be sold for less than £1.00 while a bottle of wine containing 9.5 units could not be sold for less than £4.75. The second set of policies are taxation increases and include one-off increases in alcohol taxation of between 1% and 10%, a reinstatement for five years of the

2% above inflation annual rise in alcohol duty known as the 'duty escalator' which was scrapped in 2014 and combinations of duty rises together with a five year duty escalator. Each of these tax increases is above inflation and in all scenarios we assume prices and taxes remain constant in real terms outside of the effect of the intervention. This gives 11 scenarios in total:

- 50p MUP
- 55p MUP
- 60p MUP
- 65p MUP
- 70p MUP
- 1% tax increase
- 5% tax increase
- 10% tax increase
- Duty escalator
- 5% tax increase + duty escalator
- 10% tax increase + duty escalator

3.2.2 DATA SOURCES AND MODELLING METHODOLOGY

The key data sources for SAPM pricing analyses include the most recent available year of alcohol consumption survey data from the 2013 HSE; alcohol purchasing and price data from the Living Costs and Food Survey (formerly the Expenditure and Food Survey) from 2001-2013; baseline population demography and all-cause mortality data from the Office for National Statistics; cause-specific mortality and morbidity data broken down by age and gender[23]; evidence on socioeconomic gradients in alcohol-related harm[24]; Office for National Statistics recorded crime figures[25]; evidence on the relationship between recorded and actual crimes[26] and the involvement of alcohol [27,28]; workplace absence data from the Labour Force Survey 2007-2012 and evidence on the level of alcohol involvement in absenteeism [27,29]. A detailed explanation of these data, how they are used within SAPM and the full methodological details of SAPM and its use for modelling MUP and taxation policies are provided in our most recent comprehensive summary of the modelling process and is not reproduced here. [17 appendix,27]

In brief, data on individuals' spending and consumption of different alcoholic drinks are used to estimate how their consumption and spending would change in response to different kinds of price increases. SAPM is designed to account for the likelihood that drinkers who buy a lot of cheap beer may respond differently to drinkers who buy a small amount of expensive wine. The model estimates changes in both average weekly consumption and the amount consumed on the heaviest drinking day in the last week by drinkers. SAPM then combines these changes in consumption with evidence on how the risks of mortality and hospitalisation from 43 different health conditions, of committing 20 different alcohol-related crimes and of being absent from work change with increasing or decreasing consumption. This allows the model to estimate resulting levels of alcohol-related harm in the population and accounts for different baseline rates and risk of harm for different age groups and for males and females. Finally, SAPM applies standard financial costs to each health condition, crime and workplace absence to allow a monetary value to be placed on the changes in levels of alcohol-related harm. These methods are explained in more detail across a series of scientific journal articles and reports.[16,21,23,31,32]

4. PROJECTED ALCOHOL AND CANCER TRENDS

4.1 ALCOHOL AND CANCER TRENDS OVER THE NEXT 20 YEARS

Cancer mortality and hospital admissions due to alcohol were estimated to increase in each of the alternative scenarios. The scale of increase in deaths ranged between 6.5% (Recent trend) and 12.7% (Overall trend) and the increase in cancer admissions ranged between 2.8% (Recent trend) and 9.0% (Overall trend). However, overall deaths due to alcohol did not go up in all scenarios with estimates ranging between a 6.1% decrease (Long-term trend) and a 5.0% increase (Overall trend). Similarly, alcohol-related hospital admissions in 2035 were estimated to be between 1.4% lower (Recent trend) and 11.1% higher (Overall trend). The somewhat counter-intuitive estimate that alcohol-related cancer deaths and admissions will rise while overall alcohol-related deaths and admissions are falling reflects an increase in the size of the population at risk from cancer as fewer people die from the effects of alcohol at younger ages as a consequence of rising abstention and falling consumption levels in these groups. For a full breakdown of alcohol-attributable health outcomes by each scenario, see Appendix 1.

TABLE 2: ESTIMATED CANCER OUTCOMES IN 2015-2035 IN ENGLAND UNDER ALTERNATIVE SCENARIOS

Scenario	Overall Trend	Long-term trend	Recent trend	No change
Health outcomes: mortality				
All deaths from alcohol-attributable conditions	252,947	238,337	239,700	243,036
All deaths from alcohol-attributable cancers	134,636	133,435	133,213	133,684
Health outcomes: hospital admissions				
All admissions from alcohol-attributable conditions	17,450,325	16,315,576	16,200,270	16,696,538
All admissions for alcohol-attributable cancers	1,245,677	1,233,806	1,232,215	1,236,239

The overall projected impact of alcohol on cancer outcomes from 2015-2035 was calculated for each of the alternative scenarios (Table 2). As outlined in Section 3.1.3, the following analyses in this report are all based on the 'Overall trend' scenario (Figure 3) as this combined evidence from both the recent changes in consumption as well as the longer-term trends and it also represents a conservative assumption within the range of possibilities.

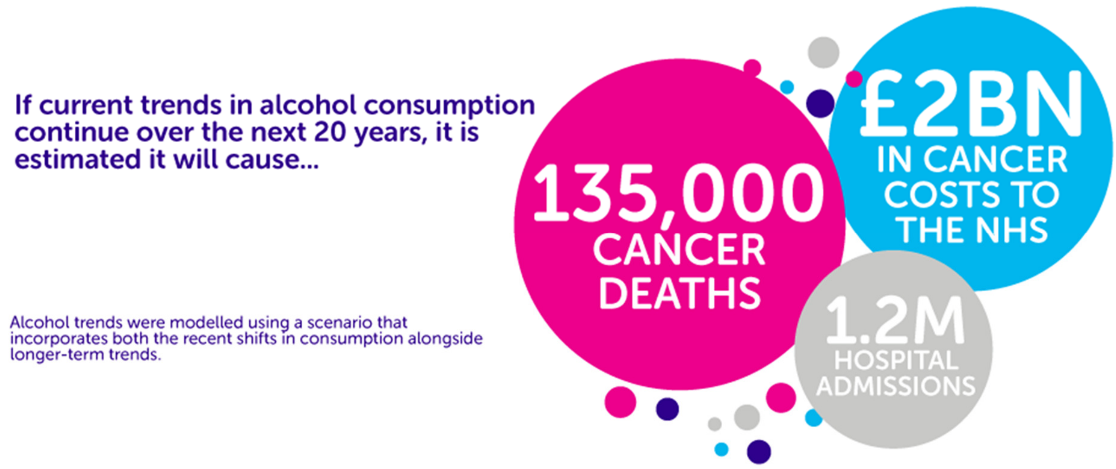


FIGURE 3: SUMMARY OF ESTIMATED ALCOHOL-ATTRIBUTABLE HEALTH OUTCOMES IN ENGLAND BETWEEN 2015 AND 2035, BASED ON THE 'OVERALL TREND' SCENARIO

In both relative and absolute terms and for both mortality and admissions, the biggest increase in the burden of alcohol-related cancer is for oesophageal cancers. This is followed by bowel cancer, other mouth and throat cancers, breast cancer and liver cancer. The breakdown of cancer outcomes, by cancer types, for the 'Overall trend' scenario is shown in Figure 4.

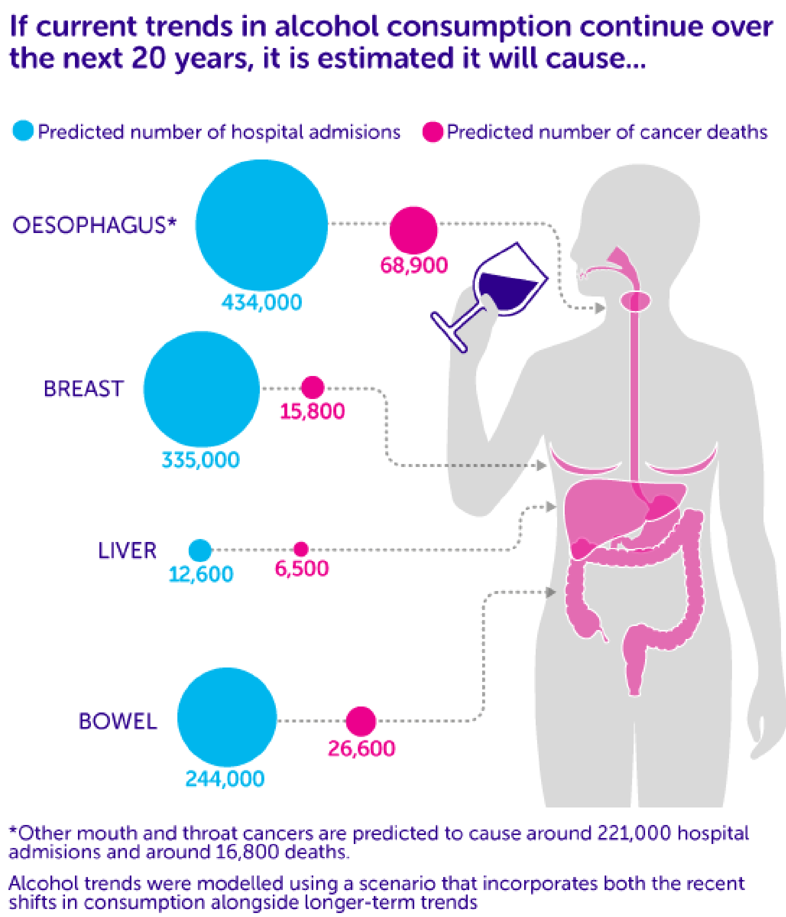


FIGURE 4: SUMMARY OF ESTIMATED ALCOHOL-ATTRIBUTABLE CANCER OUTCOMES BY CANCER TYPE IN ENGLAND (2015 AND 2035) BASED ON THE 'OVERALL TREND' SCENARIO

4.2 ALCOHOL AND CANCER TRENDS UNDER DIFFERENT INTERVENTION SCENARIOS

Compared to a scenario where we do nothing, reducing alcohol consumption today is estimated to lead to substantial reductions in both total and cancer mortality and hospital admissions due to alcohol. Table 3 presents the estimated impact on health outcomes in 20 years for five intervention scenarios where consumption is reduced by 1%, 5%, 10%, 20% and 50% at baseline. For example, a 10% reduction in alcohol consumption today would lead to 21.0% fewer deaths due to alcohol and 6.6% fewer cancer deaths due to alcohol in 2035 compared to the Overall trend scenario.

TABLE 3 ESTIMATED CHANGES IN HEALTH OUTCOMES IN ENGLAND IN 2035 FOLLOWING A REDUCTION IN CONSUMPTION IN 2015

Scenario			In 20 years with no change (baseline)	Effect of decrease in alcohol consumption in 2015				
				1%	5%	10%	20%	50%
Health outcomes: mortality								
All deaths from alcohol-related conditions		**Absolute**	12,778	-300	-1,283	-2,684	-4,436	-10,122
		Relative		-2.3%	-10.0%	-21.0%	-34.7%	-79.2%
All deaths from alcohol-related cancers		**Absolute**	7,097	-55	-228	-468	-1,009	-2,398
		Relative		-0.8%	-3.2%	-6.6%	-14.2%	-33.8%
of which:	**Oesophageal cancer**	**Absolute**	3,674	-30	-134	-275	-576	-1,387
		Relative		-0.8%	-3.6%	-7.5%	-15.7%	-37.7%
	Other mouth and throat cancer	**Absolute**	887	-8	-36	-71	-147	-346
		Relative		-1.8%	-7.9%	-15.7%	-32.2%	-77.0%
	Colorectal cancer	**Absolute**	1,369	-10	-39	-79	-175	-422
		Relative		-0.7%	-2.8%	-5.8%	-12.8%	-30.9%
	Liver cancer	**Absolute**	333	-2	-9	-19	-41	-102
		Relative		-0.7%	-2.7%	-5.7%	-12.4%	-30.7%
	Breast cancer	**Absolute**	835	-4	-10	-24	-70	-140
		Relative		-0.5%	-1.2%	-2.9%	-8.4%	-16.8%
Health outcomes: hospital admissions								
All admissions from alcohol-related conditions		**Absolute**	891,299	-12,197	-63,233	-135,312	-219,245	-503,342
		Relative		-1.4%	-7.1%	-15.2%	-24.6%	-56.5%
All admissions for alcohol-related cancers		**Absolute**	65,005	-468	-2,067	-3,992	-8,493	-20,030
		Relative		-0.7%	-3.2%	-6.1%	-13.1%	-30.8%
of which:	**Oesophageal cancer**	**Absolute**	23,032	-194	-867	-1,756	-3,652	-8,834
		Relative		-0.8%	-3.8%	-7.6%	-15.9%	-38.4%
	Other mouth and throat cancer	**Absolute**	11,483	-116	-480	-932	-1,905	-4,524
		Relative		-1.9%	-8.1%	-15.8%	-32.3%	-77.6%
	Colorectal cancer	**Absolute**	12,504	-88	-347	-702	-1,551	-3,723
		Relative		-0.7%	-2.8%	-5.6%	-12.4%	-29.8%
	Liver cancer	**Absolute**	646	-4	-17	-34	-76	-186
		Relative		-0.7%	-2.6%	-5.3%	-11.7%	-28.8%
	Breast cancer	**Absolute**	17,340	-66	-356	-567	-1,309	-2,764
		Relative		-0.4%	-2.1%	-3.3%	-7.5%	-15.9%

In each intervention scenario, the percentage reductions in alcohol-related cancer mortality and hospital admissions tend to be smaller than the percentage reduction in overall alcohol-related mortality and hospital admissions. Again, the relative and absolute cancer reductions for both mortality and hospital admissions are largest for mouth and throat cancers.

Figure 5 shows the trend over the next 20 years in overall deaths from alcohol-related cancers under the modelled intervention scenarios. As there is a lag estimated to be at least 10 years between changes in consumption and changes in cancer risk,[33] we do not see cancer rates begin to reduce until 2026. In fact, as reducing consumption also reduces the risk of death from other health conditions, greater reductions in consumption are estimated to lead to marginally higher cancer rates in the short term, as more people survive to ages when cancer is more prevalent. However, this increase is more than offset in the long term by significant reductions in cancer deaths in the 20th year post-intervention. In practical terms, this means efforts to reduce alcohol-related cancers may appear unsuccessful in the short-term before delivering long-term benefits.

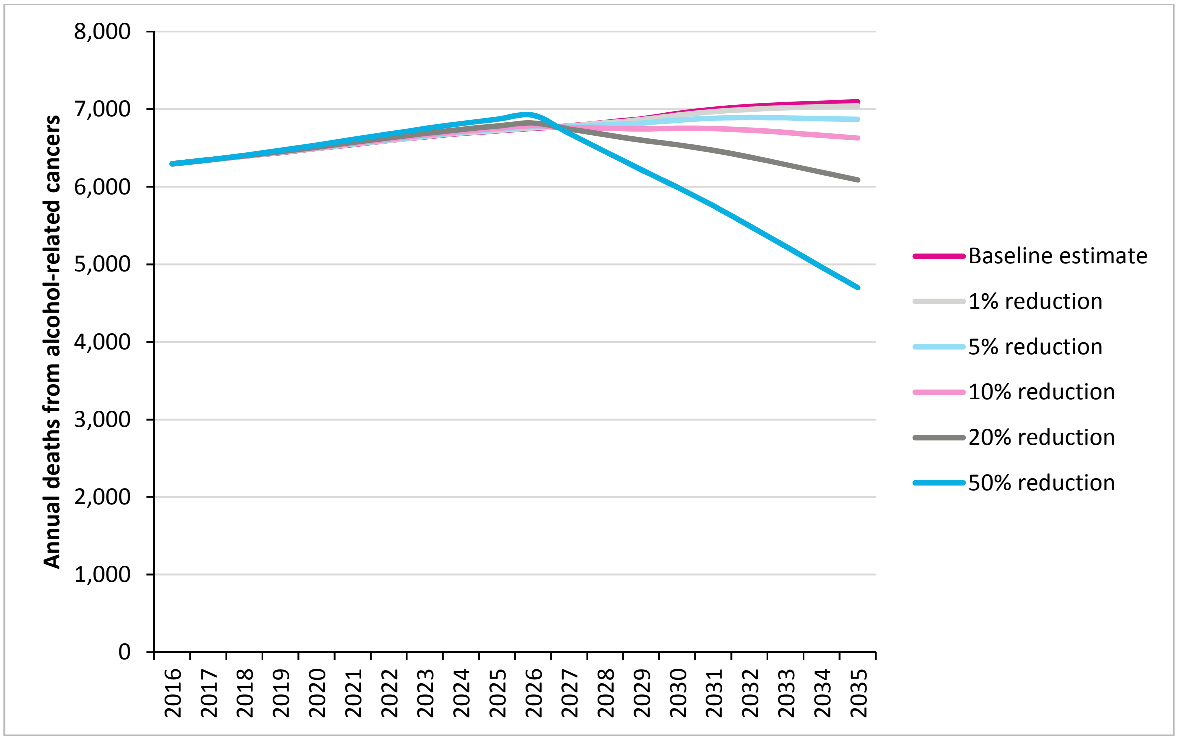


FIGURE 5 ESTIMATED TRENDS IN ANNUAL ALCOHOL-ATTRIBUTABLE CANCER DEATHS IN ENGLAND FOLLOWING A REDUCTION IN CONSUMPTION

4.3 THE COSTS OF ALCOHOL TO SOCIETY

Reducing alcohol consumption by 10% today is estimated to lead to 2.7 million fewer crimes and 13.3 million fewer days absent from work over the next 20 years relative to doing nothing under the Overall trend scenario (Table 4). The costs of alcohol to the NHS over those 20 years would be an estimated £53bn lower with £2bn of this being reduced costs of cancer.

TABLE 4 ESTIMATED CHANGES IN CRIME AND WORKPLACE OUTCOMES AND RELATED COSTS IN ENGLAND OVER THE NEXT 20 YEARS FOLLOWING A REDUCTION IN CONSUMPTION IN 2015

Scenario			Over 20 years with no change (baseline)	Effect of decrease in alcohol consumption in 2015				
				1%	5%	10%	20%	50%
Total alcohol-related criminal offences (1,000s)		**Absolute**	31,321	-270	-1,353	-2,688	-5,206	-12,471
		Relative		-0.9%	-4.3%	-8.6%	-16.6%	-39.8%
Total alcohol-related days of workplace absence (1,000s)		**Absolute**	167,040	-1,253	-6,612	-13,288	-25,890	-60,676
		Relative		-0.7%	-4.0%	-8.0%	-15.5%	-36.3%
Total cost (millions)	**Direct healthcare costs**	**Absolute**	53,494	-815	-3,507	-6,543	-12,105	-27,598
		Relative		-1.5%	-6.6%	-12.2%	-22.6%	-51.6%
	of which cancer-related	**Absolute**	2,049	-2	-11	-23	-49	-116
		Relative		-0.1%	-0.5%	-1.1%	-2.4%	-5.7%
	Costs of crime	**Absolute**	93,579	-834	-4,107	-8,129	-15,776	-37,461
		Relative		-0.9%	-4.4%	-8.7%	-16.9%	-40.0%
	Costs of lost productivity	**Absolute**	10,669	-82	-424	-847	-1,651	-3,818
		Relative		-0.8%	-4.0%	-7.9%	-15.5%	-35.8%

The relative impact of alcohol on the health sector, criminal justice system and on the workplace is illustrated in Figure 6.

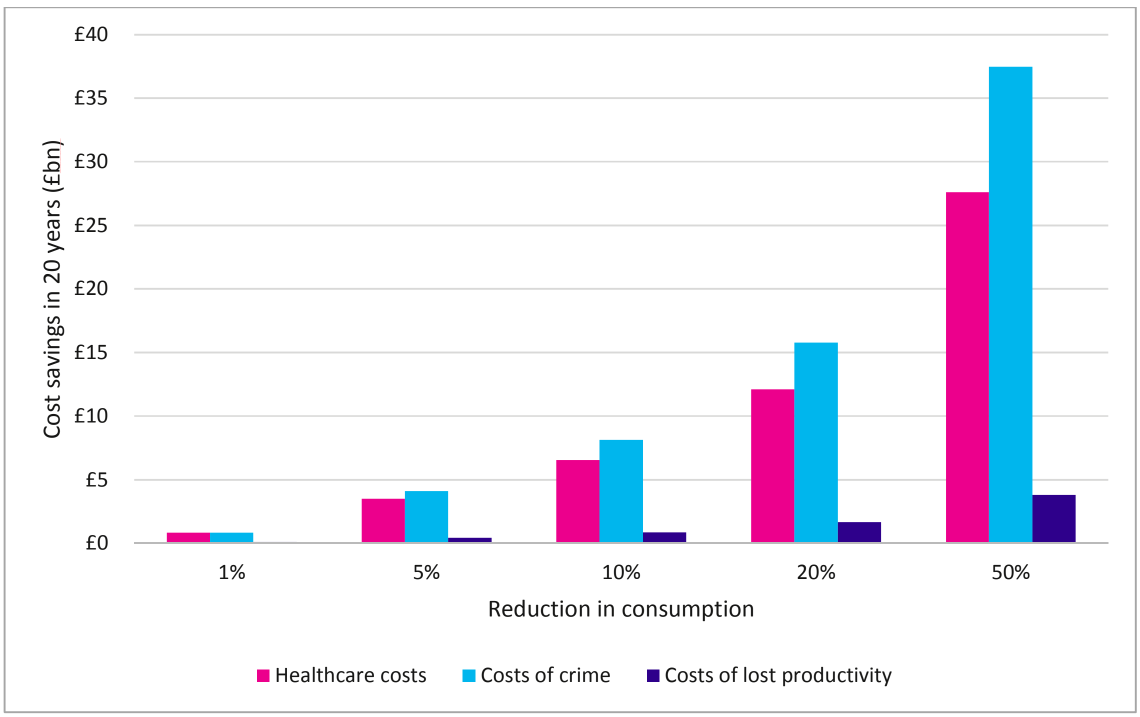


FIGURE 6 ESTIMATED CUMULATIVE REDUCTIONS IN COSTS TO SOCIETY (£BN) IN ENGLAND OVER 20 YEARS FOLLOWING A REDUCTION IN CONSUMPTION IN 2015

5. IMPACT OF POLICY OPTIONS

5.1 ESTIMATED EFFECTS OF ALTERNATIVE PRICING POLICIES ON ALCOHOL CONSUMPTION

Figure 7 presents the estimated impact of alternative pricing policies on alcohol consumption and spending on alcohol. All modelled policies are estimated to reduce alcohol consumption and increasing levels of MUP and taxation lead to greater reductions in consumption and larger increases in spending in the population. However, for the smallest tax increases modelled, the effects on consumption are marginal. The results also highlight that although spending increases are larger under MUP policies, they are modest, relative to their impact on consumption, when compared to taxation policies.

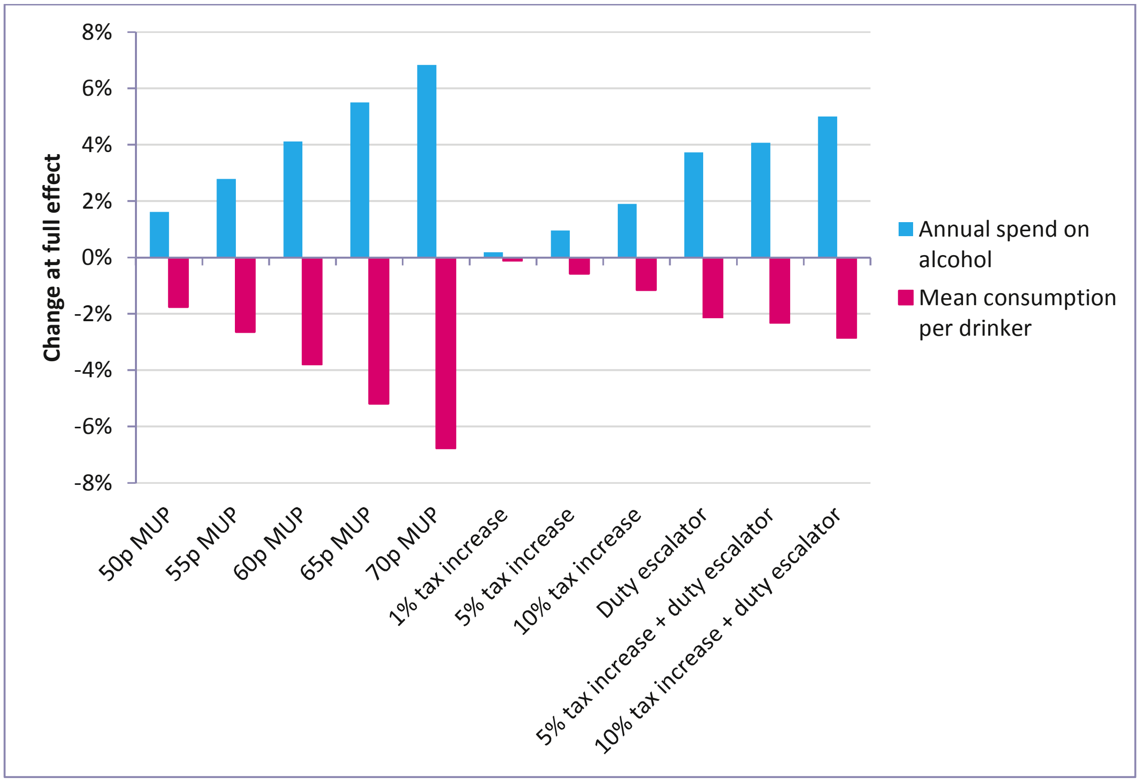


FIGURE 7 RELATIVE CHANGES IN CONSUMPTION AND SPENDING IN ENGLAND UNDER ALTERNATIVE PRICING POLICIES

A 50p MUP is estimated to reduce alcohol consumption by more than the modelled tax policies that exclude a duty escalator, with an estimated reduction in consumption among drinkers of 1.8% (0.2 units per week) and an increase in spending of 1.6% (£10 per year).

5.2 ESTIMATED EFFECTS OF ALTERNATIVE PRICING POLICIES ON ALCOHOL RELATED CANCERS

All modelled policies reduce alcohol-attributable mortality and cancer mortality, but higher MUPs and large tax increases lead to larger reductions in mortality. In contrast, the smallest tax increases modelled are estimated to have only marginal effects (Figure 8). For example, a 50p MUP is estimated to be around three times as effective at reducing alcohol-related deaths as a 5% tax increase (4.3% vs. 1.4%).

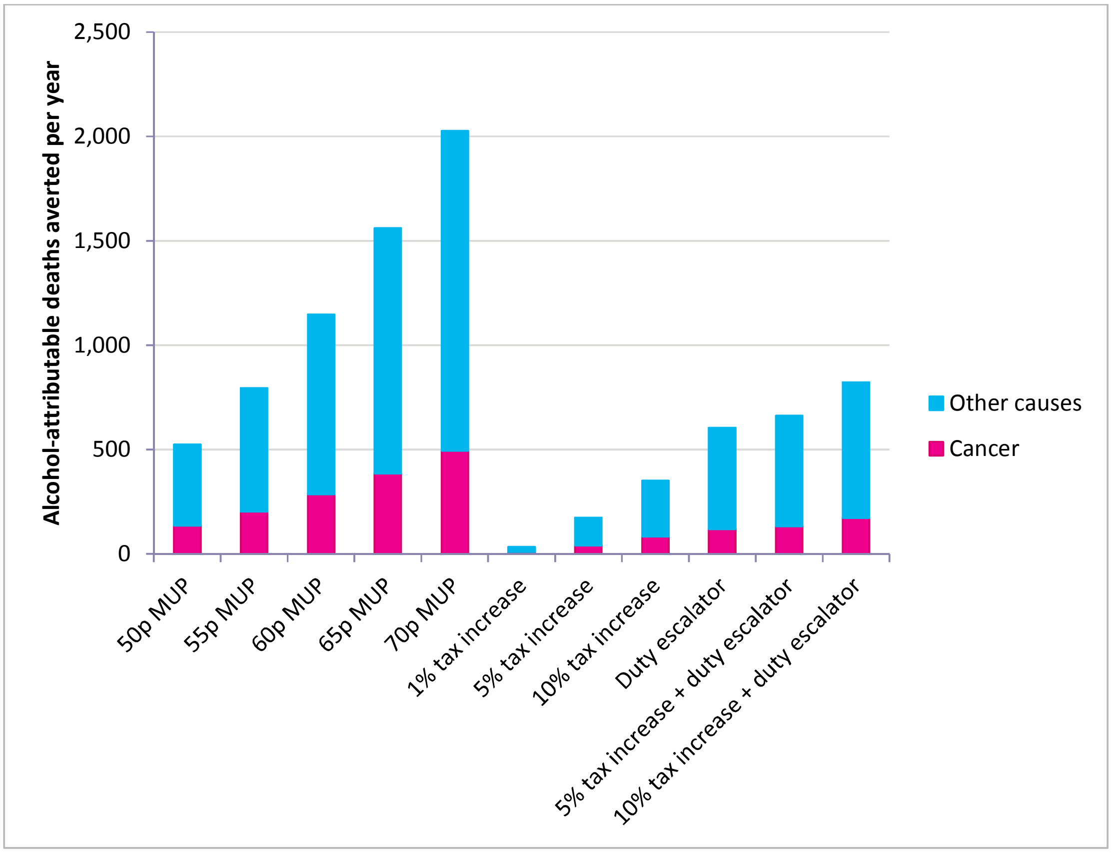


FIGURE 8 ESTIMATED NUMBERS OF ANNUAL ALCOHOL-ATTRIBUTABLE DEATHS IN ENGLAND AVERTED BY CAUSE UNDER ALTERNATIVE PRICING POLICIES

The impact of the pricing policies on cancer outcomes varies by cancer types. In all policy scenarios, the largest decrease in mortality is seen for oesophageal cancer. For example a 50p MUP will save an estimated 674 lives due to cancer over a 20 year period, of which 392 will be from oesophageal cancer (Table 5). A full breakdown of the impact of all pricing policies on cancer outcomes can be seen in Appendix 2

TABLE 5 ESTIMATED CANCER OUTCOMES IN 2015-2035 IN ENGLAND UNDER A 50P MUP POLICY

			Baseline	50p MUP
Alcohol-attributable deaths over 20 years		Absolute	240,039	-7,165
		Relative		-3.0%
Alcohol-attributable cancer deaths over 20 years		Absolute	133,522	-674
		Relative		-0.5%
Of which:	Oesophageal cancer	Absolute	68,327	-392
		Relative		-0.6%
	Other mouth and throat cancer	Absolute	16,710	-122
		Relative		-0.7%
	Colorectal cancer	Absolute	26,427	-117
		Relative		-0.4%
	Liver cancer	Absolute	6,455	-26
		Relative		-0.4%
	Breast cancer	Absolute	15,604	-18
		Relative		-0.1%
Health outcomes: hospital admissions				
Alcohol-attributable hospital admissions over 20 years		Absolute	16,496,664	-385,785
		Relative		-2.7%
Alcohol-attributable cancer hospital admissions over 20 years		Absolute	1,235,325	-6,311
		Relative		-2.0%
Of which:	Oesophageal cancer	Absolute	430,315	-2,605
		Relative		-0.6%
	Other mouth and throat cancer	Absolute	219,063	-1,767
		Relative		-0.8%
	Colorectal cancer	Absolute	242,351	-1,110
		Relative		-0.5%
	Liver cancer	Absolute	12,552	-50
		Relative		-0.4%
	Breast cancer	Absolute	331,043	-779
		Relative		-0.2%

5.3 ESTIMATED EFFECTS OF ALTERNATIVE PRICING POLICIES ON SOCIETAL COSTS

Figure 9 presents the estimated impact of all modelled pricing policies on alcohol-related crime, workplace absence and alcohol-attributable costs. These results again highlight the general effectiveness of alcohol pricing policies and the increased effectiveness of MUP policies related to taxation. For example, a 50p MUP is estimated to reduce alcohol-related crime by 2.4%, workplace absences by 2.0% and healthcare and crime costs by £1.3bn and £2.2bn respectively over a 20 year period.

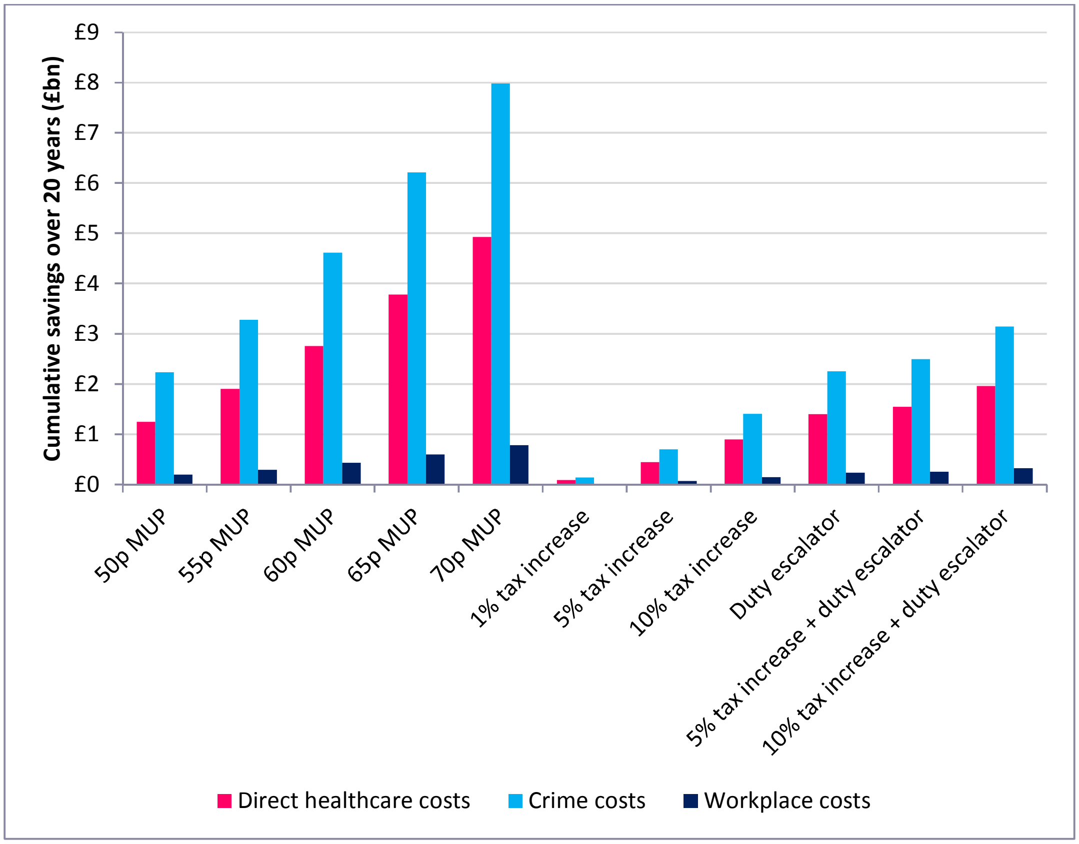


FIGURE 9 ESTIMATED SAVINGS IN COSTS TO SOCIETY (£BN) IN ENGLAND 2015-2035 UNDER ALTERNATIVE PRICING POLICIES

5.4 ESTIMATED EFFECTS OF ALTERNATIVE PRICING POLICIES ON DIFFERENT POPULATION SUBGROUPS

The modelled alcohol pricing policies lead to larger consumption reductions among men than among women and this gap is greater for MUP than taxation policies, as shown in Figure 10. This reflects the fact that heavy drinking males buy more of the cheap alcohol affected by MUP than heavy drinking females.[34] For example, a 50p MUP is estimated to reduce male consumption by 2.5% (0.4 units per week) compared to 0.5% (0.1 units per week) for female consumption.

The difference in effectiveness between the modelled MUP and taxation options is greater for men than for women. A 50p MUP is estimated to reduce men's consumption by a greater amount than all but the most extreme taxation policies; however, for women, the difference in effectiveness between these policies is much smaller.

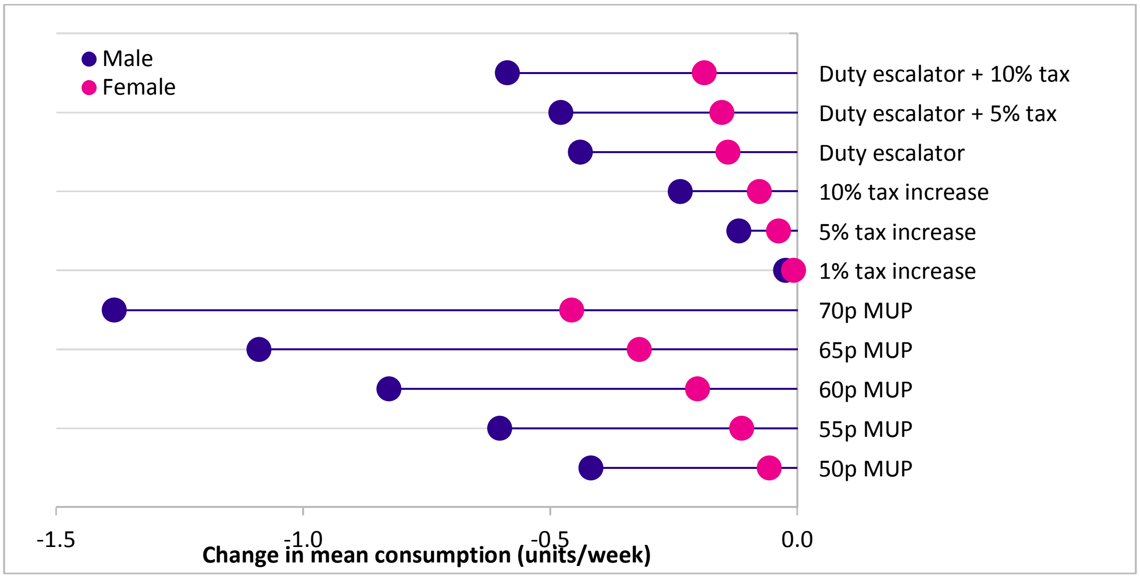


FIGURE 10 ESTIMATED CHANGES IN MEAN CONSUMPTION IN ENGLAND BY GENDER UNDER ALTERNATIVE PRICING POLICIES

Figure 11 shows the estimated reductions in consumption for each pricing policy by drinker groups:

- **Moderate drinkers** are men drinking 21 or fewer units per week and women drinking 14 or fewer units per week.
- **Hazardous drinkers** are men drinking between 21-50 units per week and women drinking 14-35 units per week.
- **Harmful drinkers** are men drinking more than 50 units per week and women drinking more than 35 units per week.

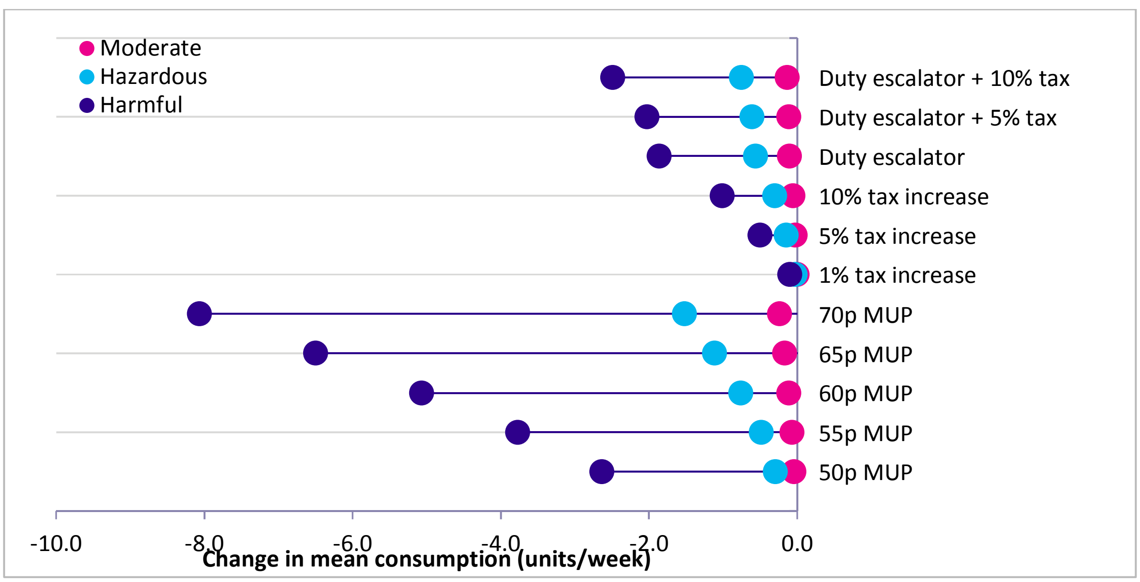


FIGURE 11 ESTIMATED CHANGES IN MEAN CONSUMPTION IN ENGLAND BY DRINKER GROUP UNDER ALTERNATIVE PRICING POLICIES

Taxation policies have more similar effects across consumption groups than MUP policies, as shown in Figure 11. MUP policies have a much greater impact on harmful drinkers and, compared to the smaller taxation increases, have a slightly larger impact on moderate drinkers.

Figure 12 shows a similar pattern to the sex-specific consumption changes in Figure 10, with the greatest reduction in alcohol-attributable deaths in men for all modelled policies. Again, for women, the difference in effectiveness between MUP and taxation policies is more modest than for men. As with the consumption results, this is due to heavy drinking women consuming less of the low cost and high strength alcohol which is affected by MUP than men.

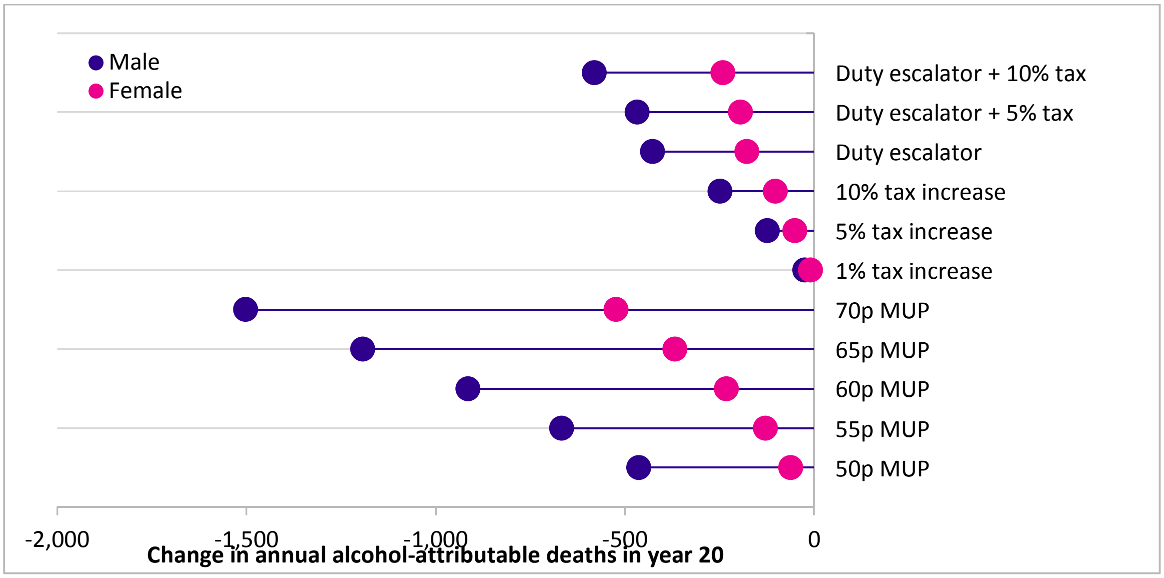


FIGURE 12 ESTIMATED CHANGES IN ANNUAL ALCOHOL-ATTRIBUTABLE DEATHS IN YEAR 20 IN ENGLAND BY GENDER UNDER ALTERNATIVE PRICING POLICIES

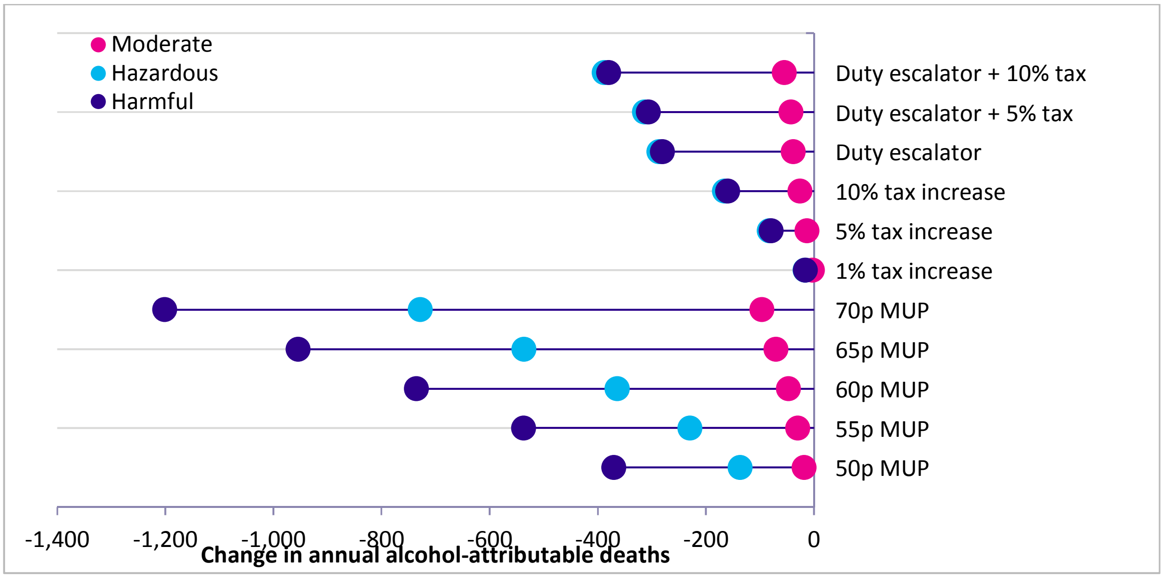


FIGURE 13 ESTIMATED CHANGES IN ANNUAL ALCOHOL-ATTRIBUTABLE DEATHS IN ENGLAND BY DRINKER GROUP UNDER ALTERNATIVE PRICING POLICIES

Results by drinker group, in Figure 13, show that while MUP policies lead to greater absolute reductions in alcohol-related mortality among harmful drinkers than hazardous drinkers, the effects of taxation policies do not differ substantially between these two groups.

The majority of alcohol-related deaths are among men with 8,261 deaths per year (4,194 from cancer) compared to 3,904 deaths per year (2,105 from cancer) for women. Figure 14 breaks down by gender the reductions in total and cancer-specific mortality due to alcohol for the 11 modelled pricing policies. The results for alcohol-related cancer mortality are similar to those total alcohol-related mortality; however, the proportion of averted deaths which are from cancer is greater under MUP than taxation policies. This is particularly true for women, with 23.3% of deaths averted being from alcohol related cancers under a 60p MUP compared to 15.4% for a 10% tax increase, 12.4% for a duty escalator and 13.4% for a 10% tax increase plus duty escalator.

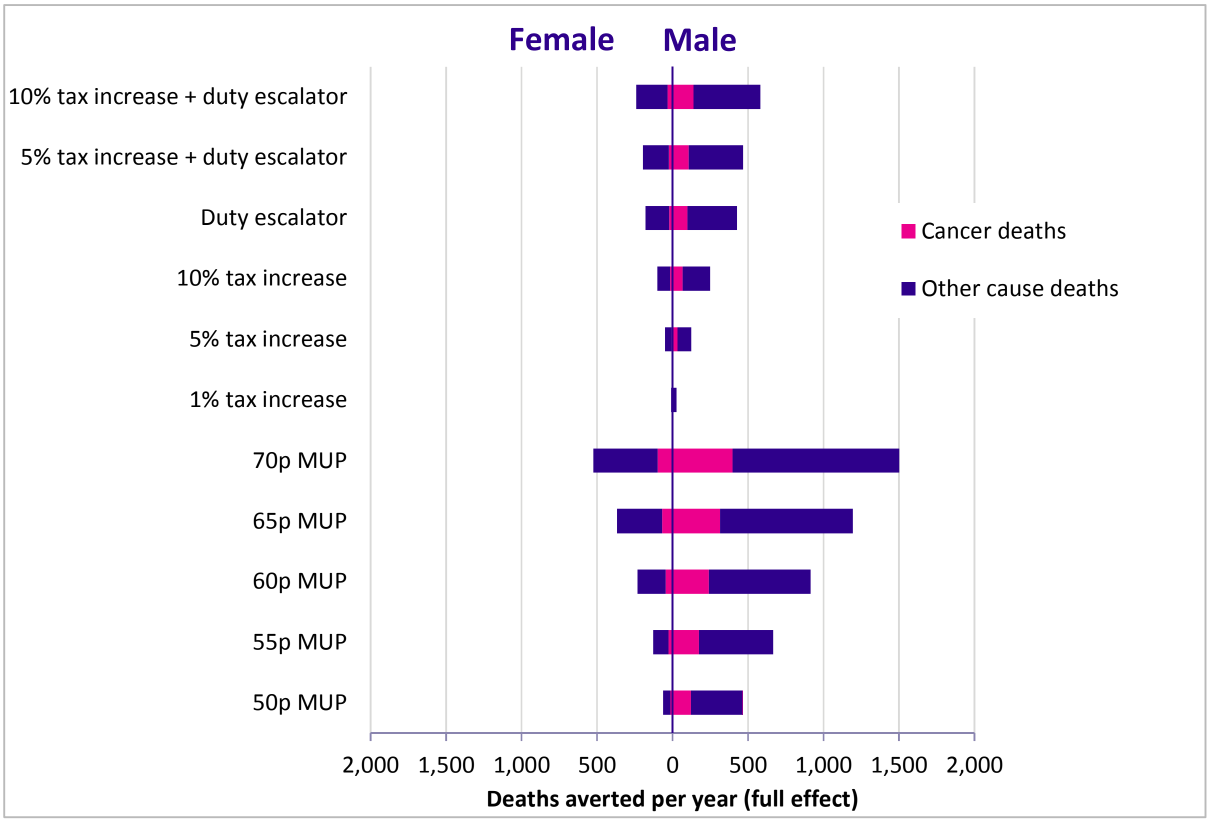


FIGURE 14 ESTIMATED REDUCTION IN ANNUAL ALCOHOL-ATTRIBUTABLE DEATHS IN ENGLAND BY GENDER AND CAUSE UNDER ALTERNATIVE PRICING POLICIES

For a full breakdown of the impact of the alternative pricing policies, see Appendix 2

5.5 COMPARISON OF PRICING POLICY EFFECTS ACROSS UK COUNTRIES

The results presented here relate to estimated future trends and policy impacts among drinkers in England. Previous analyses not commissioned by CRUK using SAPM have also looked at the impact of alcohol policies on drinkers in Scotland, Wales and Northern Ireland.[8,35,36] However, these analyses were carried out using different datasets, use slightly different methodologies for some aspects of the modelling and have different baseline years. Therefore, some of the observed variation discussed below and shown in Table 6 will be attributable to these factors, rather than genuine differences in likely effects of MUP policies.

Table 6 shows the headline results for a 50p MUP policy across all four nations of the UK with figures taken from the most recent Sheffield University reports for countries other than England. There are some notable differences between countries in terms of both baseline drinking characteristics (e.g. the higher abstention rate in Northern Ireland) and modelled policy impacts (e.g. the estimates of effect on consumption range between -1.8% in England to -5.7% in Northern Ireland). These differences in policy effects are likely to be driven by differences between the countries in terms of population subgroups' drinking patterns, prices paid for alcohol and variation in what people drink, and also in the extent and social distribution of alcohol-related harm. For example, off-trade spirits are consumed in significantly higher volumes in Scotland than England and rates of alcohol-related harm are also higher.[37]

TABLE 6 COMPARISON OF ESTIMATES FROM PREVIOUS MODELS ACROSS UK COUNTRIES FOR A 50P MUP

		England	Scotland	Wales	Northern Ireland
Baseline abstention rate		14.7%	14.9%	16.0%	25.9%
Baseline mean consumption of drinkers (units/week)		13.7	14.6	14.6	15.5
Proportion of drinkers who drink at hazardous levels		19.6%	22.5%	18.7%	17.9%
Proportion of drinkers who drink at harmful levels		5.6%	6.4%	6.8%	7.8%
Reduction in consumption under a 50p MUP (units/week)	**Absolute**	-0.24	-0.50	-0.58	-0.90
	Relative	-1.8%	-3.5%	-4.0%	-5.7%
Baseline annual alcohol-attributable deaths		12,166	1,626	785	556
Reduction in annual alcohol-attributable deaths under a 50p MUP	**Absolute**	-525	-121	-53	-63
	Relative	-4.3%	-7.4%	-6.8%	-11.3%

6. DISCUSSION

6.1 SUMMARY OF KEY FINDINGS

Alcohol is projected to continue presenting a major public health challenge over the next 20 years in the UK. The current analysis focuses on England and suggests that there is considerable uncertainty regarding the scale of this challenge with estimates ranging between a 6.1% decrease and a 5.0% increase in annual deaths due to alcohol. However, it is projected that cancer deaths due to alcohol will increase in all scenarios with estimates ranging between increases of 6.5% and 12.7%. This somewhat counter-intuitive finding reflects an increase in the size of the at-risk population for cancer as fewer people die from the effects of alcohol at younger ages due to falling alcohol consumption among younger age groups.

Interventions to reduce alcohol consumption today can substantially reduce the burden of alcohol-related harm in the future. Hypothetical policies reducing alcohol consumption in 2015 by 1%, 5% and 10%, 20% and 50% are estimated to reduce total alcohol-attributable deaths by 2.3%, 10.0%, 21.0%, 34.7% and 79.2% respectively in 2035 and alcohol-attributable cancer deaths by 0.8%, 3.2%, 6.6%, 14.2% and 33.8% respectively in 2035. These reductions in alcohol-related harm are estimated to also lead to substantial reductions in alcohol-related crime and workplace absences as well as in the costs of alcohol to the NHS and other public services.

The World Health Organisation has recommended policies which reduce the affordability, availability and marketing of alcohol as best buys for reducing alcohol-related harm.[12] We focus on pricing policies in this report and our results support these recommendations and particularly suggest that a minimum price of, for example, 50p per unit would lead to an estimated reduction in alcohol consumption of 1.8%, a reduction in alcohol-related-deaths of 4.3% (or 525 fewer deaths per year) at full effect and a reduction in alcohol-attributable cancer deaths of 2.1% (or 135 fewer cancer deaths per year). Under the same policy, alcohol-related crime would fall by an estimated 2.4% and workplace absence by 2.0% while the direct cost of alcohol to the NHS and the criminal justice system would fall by £1.2bn and £2.2bn over a 20 year period respectively. The largest reductions in consumption would be seen among heavier drinkers while moderate drinkers would be much less affected. Taxation policies can also substantially reduce alcohol-related harm; however, these reductions are estimated to be smaller than under MUP as tax increases impact less on the cheaper and higher strength alcohol which is disproportionately purchased by heavier drinkers.

6.2 STRENGTHS AND LIMITATIONS OF THIS STUDY

To our knowledge, this report presents the first estimates of potential future harms from alcohol consumption to be based on an age-period-cohort approach to projecting alcohol consumption trends. It is also the first analysis of alternative alcohol pricing policies to provide estimates of policy effects on alcohol-related cancer outcomes. Both components of the report use the Sheffield Alcohol Policy Model (SAPM), a leading policy appraisal tool which has been used to produce previous policy analyses published in *The Lancet* (on two occasions), *British Medical Journal* and *PLOS Medicine*.[14-17] The full mathematical method of the models has also been published in the peer-reviewed journal *Health Economics*.[21] SAPM has several strengths including operating both within individuals and across cohorts to allow estimates of variation in policy effects across the population and incorporating econometric, epidemiologic and health economic modules which allows for policy effects to be estimated across a broad range of outcomes. The model also uses a series of parameters often not included in comparable models such as estimates of the pass-through of taxation increases to the prices faced by consumers and the differential absolute risk of alcohol-related harm faced by lower socioeconomic groups.[14,32]

Limitations of this study include the assumption that the only response from alcohol producers and retailers to a MUP is to increase the price of products currently sold for less than the MUP threshold to that level. The true market response is likely to be more complex and this means the assumptions presented here are probably conservative as they represent the minimum change in prices which may occur. There are also a number of assumptions and limitations inherent to SAPM, which have been widely discussed in previous publications which are referenced throughout this report. These include the survey data which we use to derive our baseline estimates of alcohol consumption underrepresenting certain subgroups of the population, including dependent drinkers, and underestimation of consumption among those included within the self-report surveys on which the present analyses are based.[38] We also cannot establish who ultimately consumes the alcohol which is recorded as being purchased in the Living Costs and Food Survey which provides the pricing data for the model, although previous sensitivity analyses around this area suggest that making alternative plausible assumptions does not substantially change the model results.[27] Finally, for some health conditions for which there is limited published epidemiological evidence, we assume that the risk of harm increases linearly with consumption above a lower risk threshold and that the slope of this linear increase can be derived by calibration to match it to the observed distribution of drinkers and rates of harm in England.[39]

New sensitivity analyses were not part of this project but extensive exploration of the sensitivity of results and conclusions from SAPM have been undertaken in previous projects.[8,17,27,40-43] This includes examining the effects of using a wide range of alternative alcohol price elasticities which were derived using alternative assumptions (e.g. different groups will have fundamentally different responses to price changes), calculated using alternative methods (e.g. cross-sectional, pseudo-longitudinal or time series methods) from different data (e.g. spending surveys or tax returns) or modified using evidence from published literature (e.g. literature suggesting heavier drinkers are less responsive to price changes). It also includes explorations of the impact of accounting for under-estimation of consumption by self-report surveys, uncertainty regarding the extent of cardioprotective effects arising from moderate alcohol consumption, updating estimates to incorporate the most recently available data and undertaking the modelling exercise in a variety of national contexts and, finally, probabilistic sensitivity analyses. Although these alternative analyses inevitably produce variation in the exact results, the principal conclusions appear robust. These are that minimum unit pricing is an effective approach to reducing alcohol consumption and alcohol-related harm, that greater effects can be achieved by increasing the minimum unit price and that the effects are largest among harmful drinkers and modest among moderate drinkers.

6.3 EFFECTS OF CHANGES IN ALCOHOL CONSUMPTION ON THE WIDER ECONOMY

The projected changes in alcohol consumption may have an effect on the wider economy, such as impacts on employment in the alcohol industry. However, this is complex to model without more detail on where the changes are occurring (i.e. are these changes in consumption in the on-trade or off-trade), and how industry would respond.

Examples of prior attempts to address this question include work by Lehto[44] who first finds that the production and trade of alcohol accounted for 2% of the workforce in the EU in 1990. He notes that changes in alcohol consumption will lead to a reduction in the number of people working in the industry but also notes that these workers should find work elsewhere in a competitive economy and that social problems only arise due to the costs of transferring the workforce. Lehto finds evidence that a fall in alcohol consumption in Italy of 33% was not related to employment rates, and also points out that a large proportion of reduction in the number of workers arises from an increase in productivity, especially through technological progress. Fogarty and Jakeman examine the potential impact on employment of raising tax on wine in Australia.[45] They estimate that, under certain circumstances, direct employment in the wine industry would fall by 6.8%. However, as with other papers, they point out that the employment impact on the wine industry is not the same as the impact on the overall employment rate since other agricultural jobs will become available. However, they do point out that job losses will be concentrated in certain areas.

Overall, it is difficult to get a reliable estimate of the impact of alcohol policies on employment; however, it is likely that, whilst reduced alcohol sales arising from pricing policies will have an impact on employment within the alcohol industry, the effect on overall employment will be negligible. In contrast to this, the analyses above also do not take account of gains in employment through reductions in the harmful consequences of alcohol use which include heavier drinkers being unable to participate in or obtain employment. Previous estimates suggest these employment effects of heavy drinking are of substantial economic importance.[27]

6.4 POLICY IMPLICATIONS

A number of policy implications arise from the results.

First, projections of future levels of alcohol consumption and thus alcohol-related harm are subject to considerable uncertainty. This uncertainty is particularly produced by recent changes in alcohol consumption trends which mean the future cannot straightforwardly be assumed that they will continue to follow a simple linear or curvilinear trend. Consequently, it is unclear whether policy makers in the future will face a decreasing or increasing level of alcohol-related harm.

Second, irrespective of the direction of future trends, intervention today can lead to reductions in alcohol-related harm in the future. However, the conditions people die of may change, leading to rises in harm for some conditions despite overall harm falling. Additional resources may need to be moved from tackling causes of death closely associated with alcohol which occur at younger ages (e.g. alcoholic liver disease) to those less closely associated with alcohol which occur at older ages (e.g. alcohol-related cancers) as the relative sizes of the at-risk populations for these conditions changes.

Third, increases in alcohol prices are an effective approach to reducing alcohol consumption and related harm, including harm due to cancer. However, some pricing policies are more effective than others. In general, minimum unit pricing policies were estimated to be more effective than any of the taxation options modelled in reducing alcohol-related harm, including that arising from cancers. MUP policies also better-targeted harmful drinkers and had proportionately less effect on moderate drinkers when compared to taxation policies. Tax increases implemented incrementally through a duty escalator lead, in time, to larger price increases and thus larger consumption and harm reductions than one-off tax increases and thus represent an effective approach to increasing alcohol taxation.

7. APPENDIX 1: DEVELOPMENT OF THE MODEL TO PROJECT TRENDS IN ALCOHOL HARMS

7.1 ESTIMATING AGE-PERIOD-COHORT MODELS

The age-period-cohort (APC) modelling is conducted separately for abstention and consumption, and male and female models are also estimated separately. This means that, for example, female consumption can increase over time without male consumption necessarily doing so too. Similarly, female abstinence can rise at the same time as female consumption is increasing.

The APC models are regression models where abstinence and consumption are predicted as a function of an individual's survey year, birth cohort and age plus a number of controls which in the next paragraph. However, for each individual in the model, the survey year (i.e. the period) is the exact sum of their birth year (i.e. the cohort to which they belong) and their age. This perfect collinearity means that models based on single years, birth years and ages cannot be identified.[46] For this reason, ages, periods and cohorts are grouped and our previous analyses suggest this allows stable and identifiable estimates to be derived.[13] There are seven age groups (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+), eight time periods (1978-80, 1982-86, 1988-92, 1994-98, 2000-05, 2006-10, 2011-12, 2013) and 18 birth cohorts (1909-11, 1912-16, 1917-21, 1922-26, 1927-31, 1932-36, 1937-41, 1942-46, 1947-51, 1952-56, 1957-61, 1962-66, 1967-71, 1972-76, 1977-81, 1982-86, 1987-91, 1992-95). This grouping technique allows the model to be identified as two individuals in the same time period can be in the same birth cohort but different age bands.

The dependent variables in the abstention and consumption APC models respectively are whether the individual does not drink alcohol and the average number of units of alcohol consumed per week. Alcohol consumption is measured via beverage-specific quantity-frequency questions,[47] and abstainers are any person who has average weekly consumption of zero. Control variables used for both models are the education level of the respondent (of which there are five categories of highest qualification), the ethnicity of the respondent (three categories), which English region the respondent lives in, and three income categories[a]. The abstention modelling uses logistic regression as the dependent variable is binary, whilst the consumption modelling uses negative binomial regression which is commonly used to model alcohol consumption distributions where the variance tends to greatly exceed the mean.

The results of the APC modelling are a set of Odds Ratios (ORs) of likelihood of abstention and Incidence Rate Ratios (IRRs) of mean consumption for each age group, period and birth

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[a] The highest qualification categories are: degree level or higher, higher national diploma or certificate, A Levels, GCSE/O Levels grades A*-C, GCSE/O Levels grades D-G or lower. The ethnicity categories are White European, Asian, Black African or Caribbean. The English region is Government Office Region. The income categories are below 60% of the median (below poverty line), in the top 10%, and inbetween.

cohort. These are shown in Figures A1 and A2. There are several discernible trends visible from the figures. First, abstention in men increases with age from the age of 45, with those aged 75+ almost twice as likely to abstain than the 35-44 reference group. Similarly,

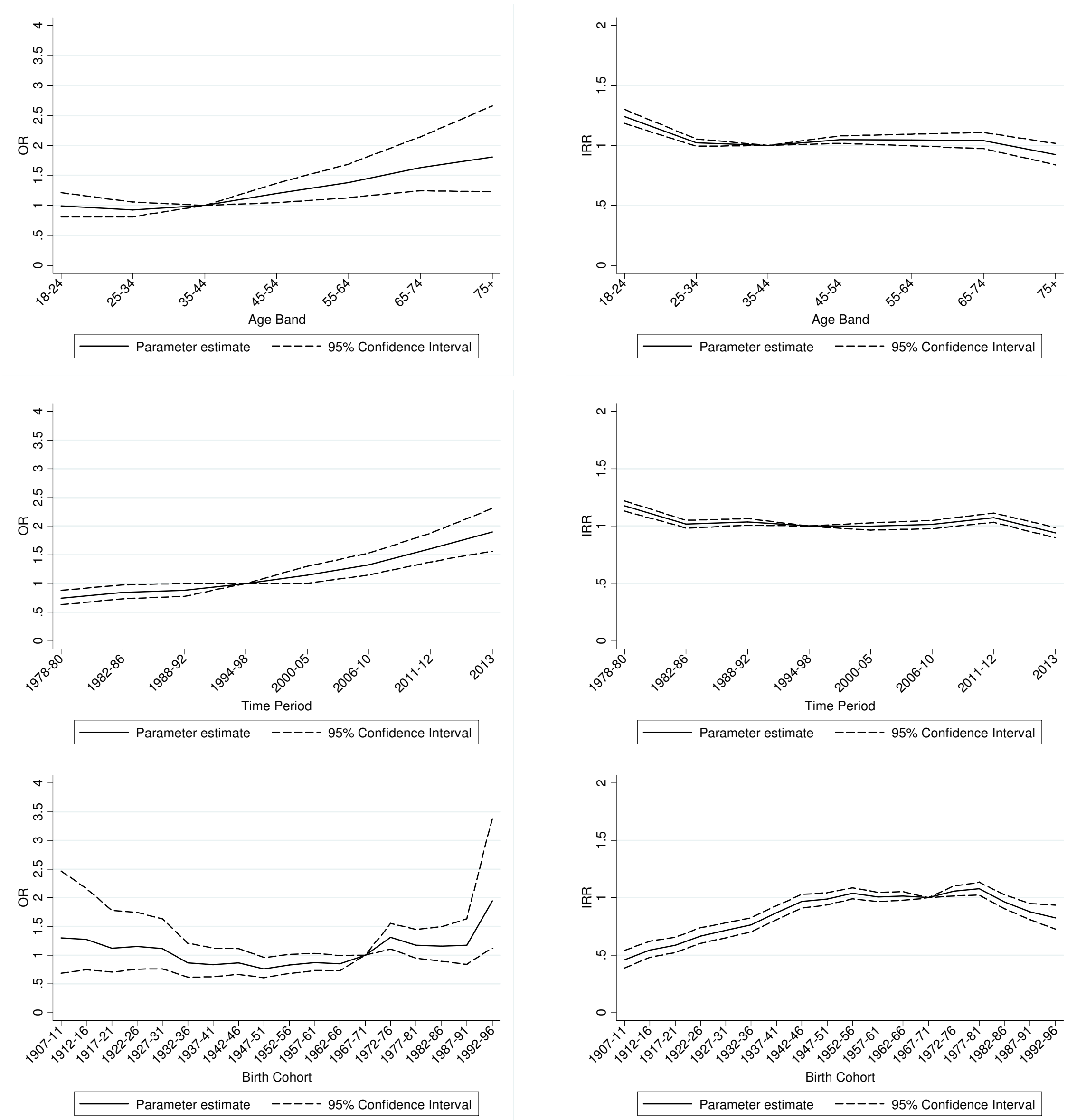


FIGURE A1 AGE, PERIOD AND COHORT EFFECTS ON MALE ABSTENTION (LEFT) AND CONSUMPTION (RIGHT)

abstention amongst men has increased over time, with the most recent period having twice the rate of abstention (once other factors are taken into account) than the 1994-98 reference period. Across birth cohorts, the trend in male abstention is U-shaped with the oldest and youngest birth cohorts having a higher probability of abstaining than the middle birth cohorts. With male consumption (conditional on drinking), we see decreasing consumption as males age. The trend over time is relatively flat, with a slight dip in recent years, holding all else constant. There also appears to be a decrease in consumption amongst the oldest and youngest birth cohorts, in line with abstention rates.

For women, abstention is significantly higher in older age groups once other factors are taken into account. Similarly, there has been an increase in abstention over time, controlling for other factors. However, the youngest birth cohort are less likely to abstain than the very oldest birth cohorts. There appears to have been a slight increase in abstention in the very youngest cohorts compared to the base cohort of those born 1967-71. Consumption is relatively flat across age, save for a marked decrease between 18-24 and 25-34. Female consumption has increased over time and over birth cohort.

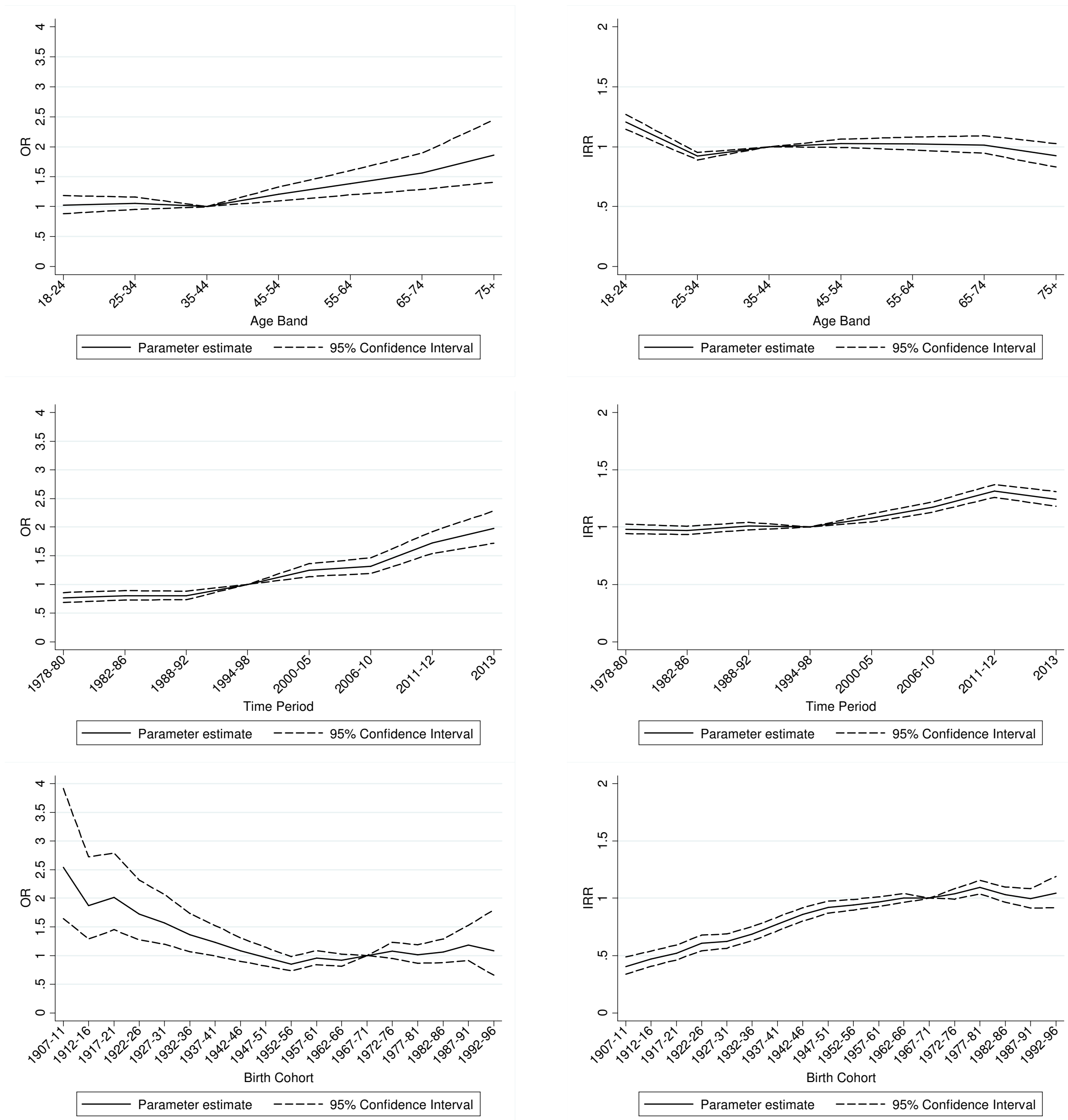


FIGURE A2 AGE, PERIOD AND COHORT EFFECTS ON FEMALE ABSTENTION (LEFT) AND CONSUMPTION (RIGHT)

7.2 PROJECTING FUTURE ABSTINENCE AND CONSUMPTION TRENDS

The period and cohort results are forecasted forwards to 2035 using the four alternative trend scenarios:

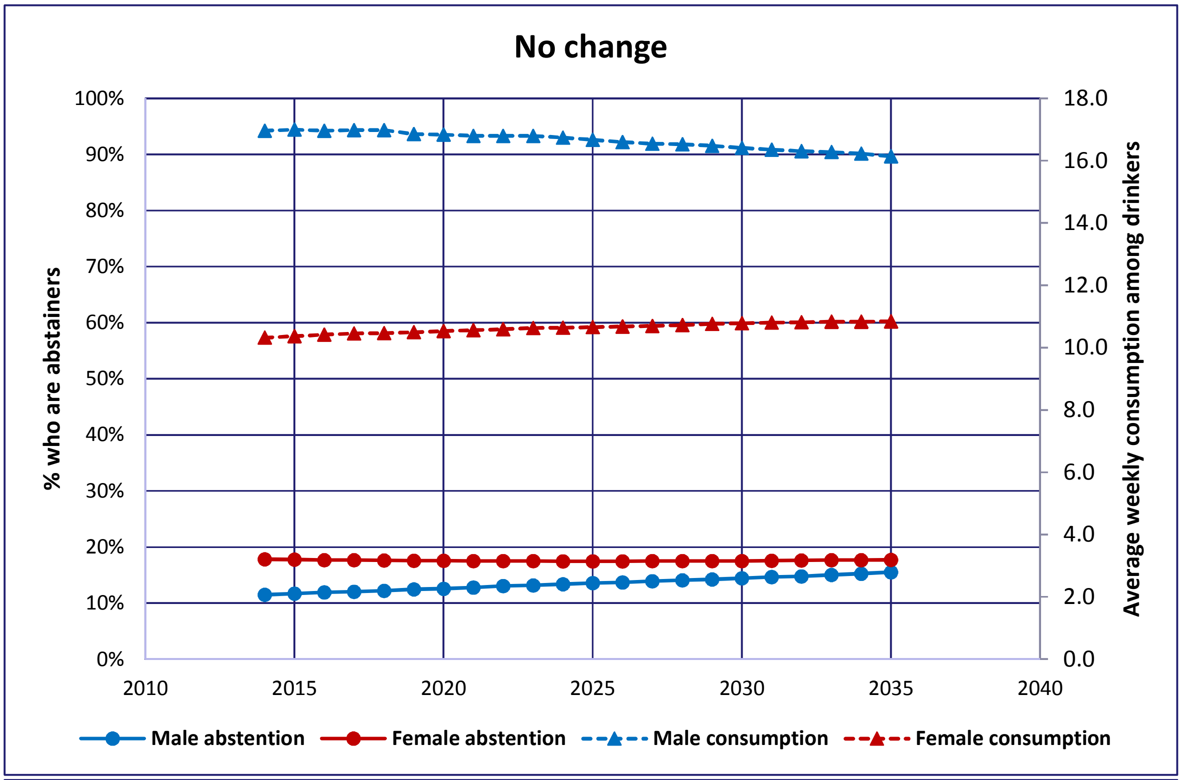
1. **No change:** There is no period effect relative to current abstention and consumption, and new cohorts drink at the same level as the youngest current cohort (i.e. those born between 1992 and 1996)
2. **Overall trend:** We estimate a linear trend in period effects (from 1978-80 to present) and a separate linear trend in cohort effects (from the 1952-56 cohort onwards) and assume that future period and cohort effects follow this trend.
3. **Long-term trend:** We assume that the recent changes are a temporary deviation from a longer-term, underlying linear trend. This long-term trend is estimated based on data, excluding the most recent periods (2006-13) and birth cohorts (1982-1996) and is assumed to re-establish itself from 2015 onwards.
4. **Recent trend:** We assume that the recent changes in trends mark the start of a new long-term trend in period and cohort effects which we estimate as a linear trend from the 2006 period onwards and from the 1982 cohort onwards.

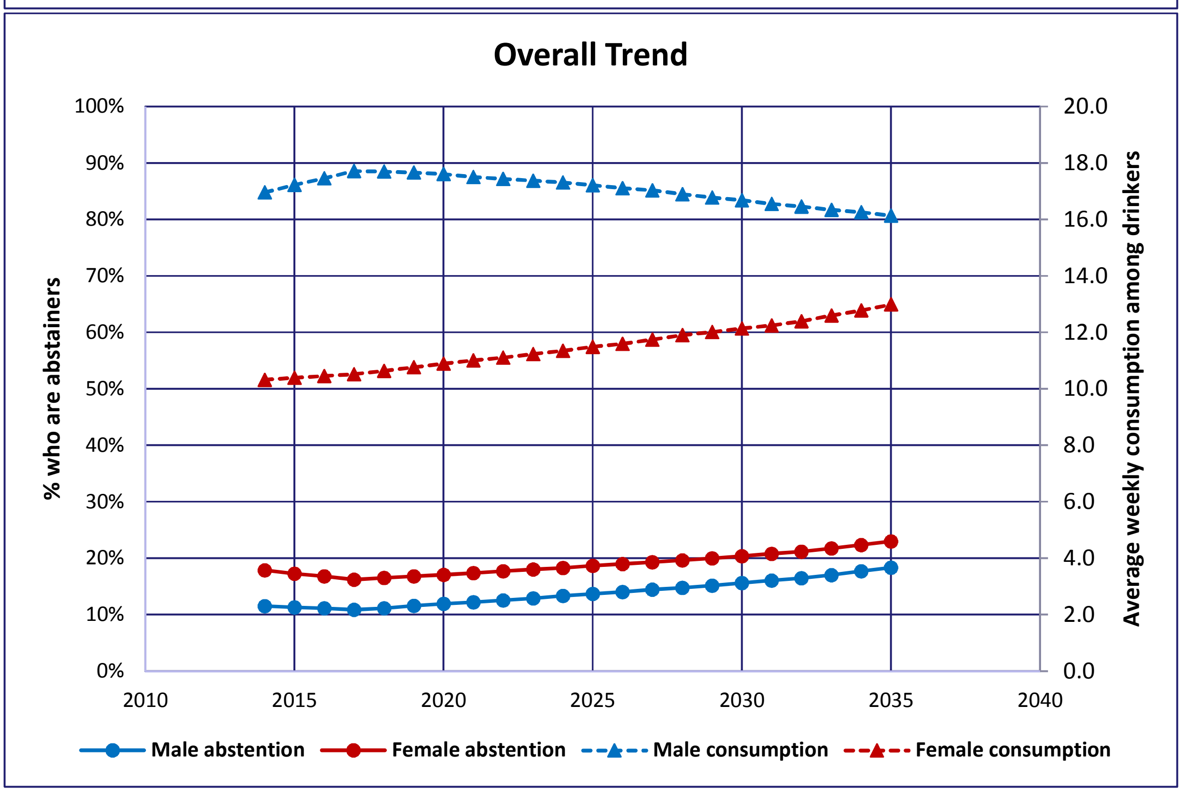
The Sheffield Alcohol Policy Model (SAPM) then uses the age-period-cohort projections to simulate future abstinence rates and consumption levels for the population who are represented by respondents to the most recently available HSE (i.e. 2013). This is done for each of the four APC scenarios above. For each scenario this is achieved as follows:

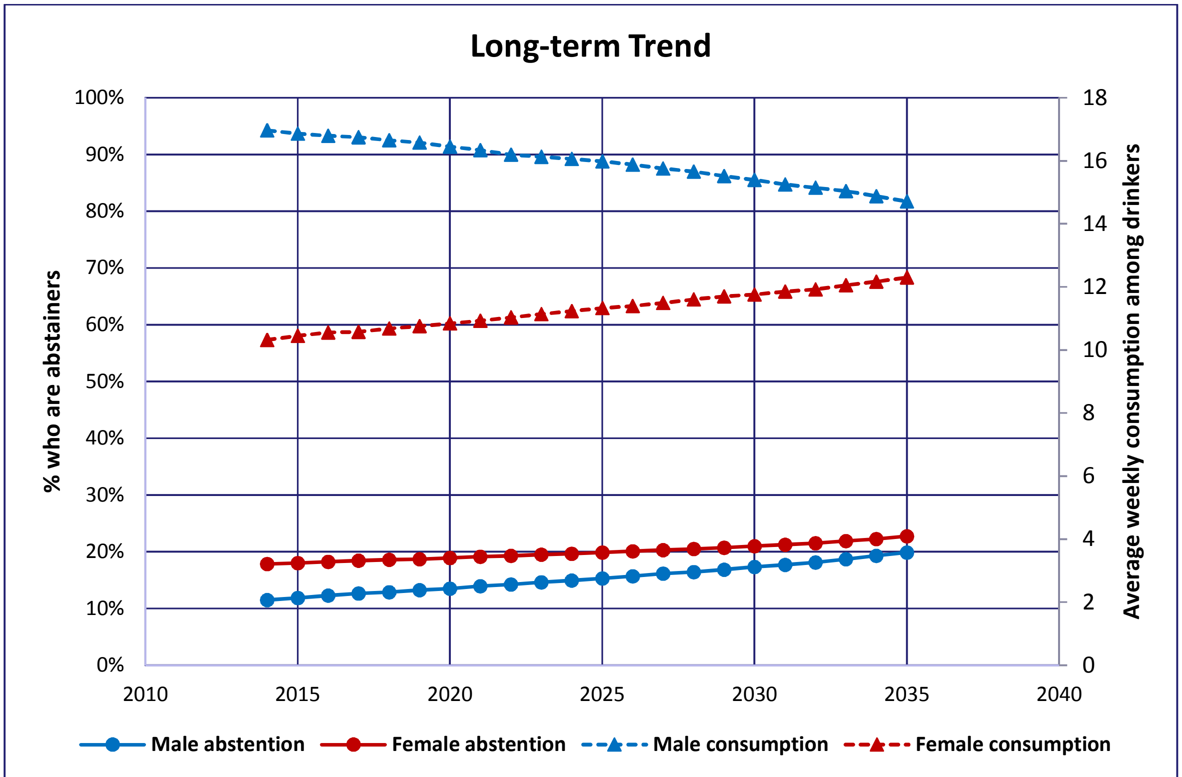
First, for each age-sex subgroup (e.g. male 18-24) of the population we calculate the baseline abstention rate. For each successive year from 2016-2035 we calculate the required abstention rate by applying the appropriate period and cohort effects implied by the scenarios above to this baseline rate. This is compared to the observed abstention rate in each subgroup. Where the observed rate is too high, abstainers in the HSE are selected at random to become drinkers and are assigned the mean consumption of the subgroup. Where the observed rate is too low, drinkers in the HSE are selected at random to become abstainers until the rates match. This process continues until the required and 'observed' abstention rates match. Where the observed rate is too high, drinkers in the HSE are selected at random to become abstainers, until the rates match.

Secondly, the effect of period and cohort trends on the consumption of drinkers is modelled by applying the appropriate period and cohort effects from the above scenarios on mean consumption. Unlike the abstention effects, these are applied at the individual rather than the subgroup level, as not all individuals in each age group will share the same birth cohort and therefore different individuals within the same age group may experience different year-on-year changes in consumption.

The result of this process is an estimate of abstention and consumption levels across the population for every year from 2015-2035 for each of four alternative scenarios. The estimated future abstention and consumption trends are shown in Figure A3.


No change
% who are abstainers
Average weekly consumption among drinkers
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2010
2015
2020
2025
2030
2035
2040
Male abstention
Female abstention
Male consumption
Female consumption


Overall Trend
% who are abstainers
Average weekly consumption among drinkers
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2010
2015
2020
2025
2030
2035
2040
Male abstention
Female abstention
Male consumption
Female consumption



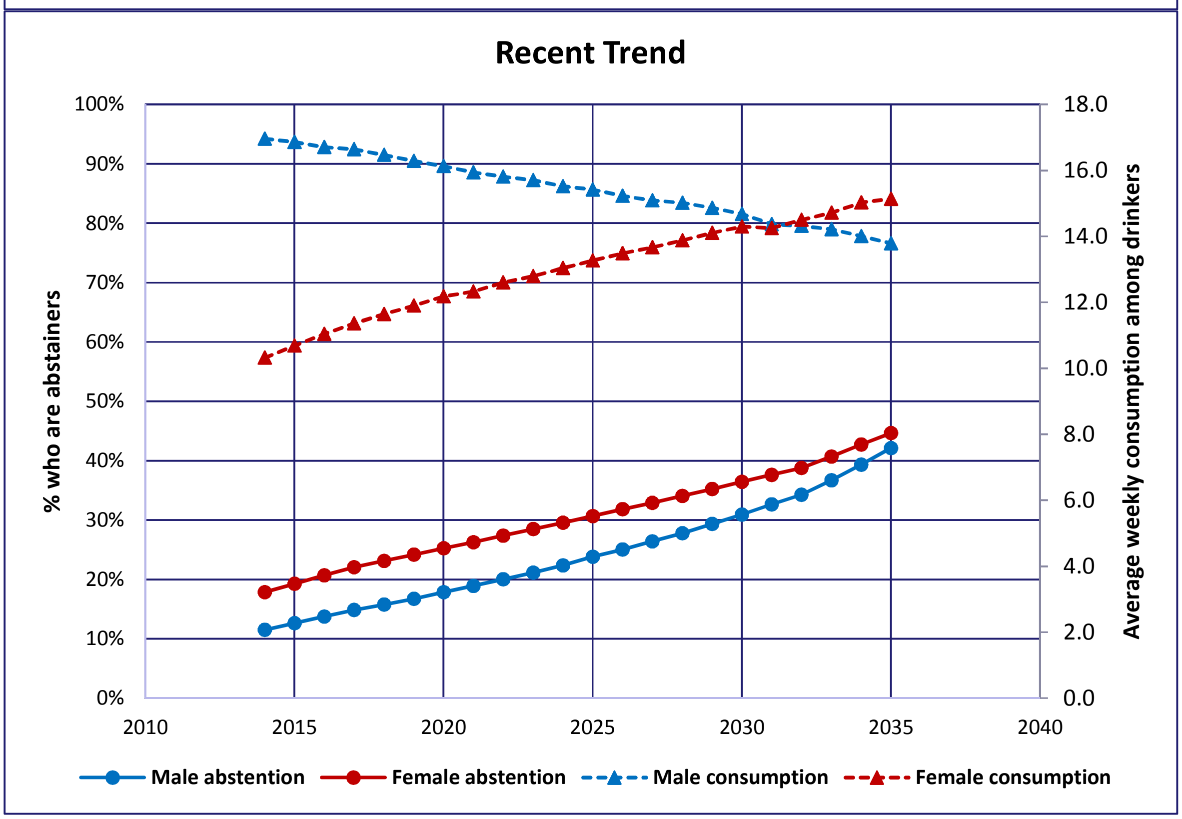


FIGURE A3: PROJECTED ABSTENTION AND CONSUMPTION TRENDS UNDER THE FOUR DO NOTHING SCENARIOS

7.3 ESTIMATING FUTURE LEVELS OF ALCOHOL-RELATED HARM

These trends in alcohol consumption and abstinence are converted into changes in mortality and morbidity for 43 alcohol-related health conditions, 20 types of alcohol-related criminal offences crime and for workplace absence using SAPM under the assumption that all else remains equal. Full details of the methodology of SAPM can be found elsewhere,[17,21] so we provide only an overview here. SAPM includes baseline prevalence for each health conditions for eight age-sex subgroups (18-24, 25-34, 35-54 and 55+ year-old males and females). For every condition, the dose-response relationship between either mean weekly alcohol consumption or peak daily consumption[b] and risk of harm is taken from published epidemiological studies and meta-analyses (in the case of chronic diseases partially-attributable to alcohol) or fitted to the observed levels of consumption and harm (in the case of other health conditions). SAPM operates in annual cycles so that, for every year and for every subgroup, these risk relationships are combined with the individual-level consumption forecast to calculate a cumulative risk. This is compared to the cumulative risk at baseline (i.e. 2015) and combined with the baseline prevalence of the health condition to estimate an updated prevalence. This calculation also accounts for the known lags between changes in consumption and changes in harm[33] as well as changes in the size of the subgroup population due to alcohol-related and all other causes of mortality in previous years. Similar calculations are performed to estimate changes under the modelled scenarios in the alcohol related criminal offences and in alcohol-related workplace absence.

SAPM uses the estimated levels of mortality, morbidity, crime and workplace absence to estimate the costs associated with healthcare usage (i.e. the direct costs to the NHS), crime and workplace absence which are attributable to alcohol. These costs are discounted at 3.5% per year in line with NICE guidance.[48]

Some of the results from this analysis (as outlined in Table A1) may appear counter-intuitive. For example, overall alcohol-related deaths decrease in some scenarios but alcohol-related cancer deaths always increase. Similarly, alcohol-related breast cancer mortality is estimated to increase in all scenarios; however, alcohol-related breast cancer admissions are estimated to decrease in the scenarios labelled Long-term trend, Recent trend and No change. These results arise primarily from shifts in the distribution of alcohol-related risks across age groups. For example, the decline in consumption has been particularly large among younger age groups who, as a result, have lower rates of alcohol-related mortality from a range of conditions which occur at relatively young ages, including alcoholic liver disease, motor vehicle accidents and violence. In contrast, this demographic will still be at an age with a relatively low risk of alcohol-related cancer in 2035 and thus the reduction in their drinking has a relatively small impact on cancer mortality rates. A further example of this kind of process is that, as consumption declines and abstinence increases across the population, fewer people will die from alcohol-related conditions early in their

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[b] Peak daily alcohol consumption refers is collected in HSE and refers to the amount of alcohol consumed on the respondents' highest consuming day during the week preceding the survey. Peak daily consumption is used when modelling relationships between alcohol consumption and acute conditions while mean weekly consumption is used when modelling relationships between alcohol consumption and chronic conditions. See the referenced methodological reports for further details.

lives. This increases the pool of people at potential risk from alcohol-related conditions later in their lives. Even though each individual may have reduced their consumption and be at lower risk, because the risk population for conditions occurring later in life is bigger, the overall number of deaths from those conditions may go up.

7.3.1 ADDITIONAL KEY ASSUMPTIONS OF THE TRENDS AND PRICING ANALYSES

In addition to the assumptions mentioned throughout the main body of the report, the following assumptions should be noted.

The key assumption of age-period-cohort analysis is that the effects can be accurately estimated given we do not observe the oldest birth cohorts at young ages, nor do we observe the youngest birth cohorts at old ages. We also assume that the age, period and cohort effects are independent of each other and that, for example, different cohorts do not have different age effects. Sensitivity analyses in our previously published research suggest that choices about how to group ages, birth cohorts and periods do not substantially affect the model results.[13]

There are also three assumptions in the projection process for the estimated APC trends:

1) The likelihood of any drinker becoming an abstainer is equal for all drinkers within the same age and gender group and is independent of current drinking level. This represents a neutral assumption in the absence of clear quantified evidence of how the probability of becoming an abstainer *as part of a general population trend* varies across the consumption distribution;
2) The likelihood of any abstainer becoming a drinker is equal for all abstainers within the same age and gender group;
3) Abstainers who become drinkers in any given year adopt the mean consumption of their age gender group. Again, this represents a neutral assumption in the absence of evidence pertinent to the context being modelled.

In the process of estimating future rates of partially alcohol-attributable health conditions, including cancers, we also assume that the contribution of other risk factors remains constant. That is to say, we know that some cancers which can be caused by alcohol can also be caused by other factors such as smoking or diet but we do not consider future trends in these other risk factors in our estimates. Therefore, the results presented here represent an 'all else remaining equal' scenario.

For the pricing analysis, we assume that alcohol prices remain constant in real terms over the 20 years the model is run, excluding the modelled pricing interventions. In practice this means that MUP thresholds and future duty rates are adjusted in line with inflation. Failure to do so would result in the impact of these policies eroding over time as their relative effect on price was reduced.

TABLE A1 ESTIMATED CHANGES IN ALCOHOL-RELATED HEALTH OUTCOMES IN ENGLAND IN 2035 UNDER ALTERNATIVE SCENARIOS

Scenario			2015	Change in 2035			
				Overall trend	Long-term trend	Recent trend	No change
Consumption							
Weekly units per drinker			13.7	14.6	13.5	14.5	13.5
Abstention rate			14.7%	20.7%	21.3%	43.4%	16.6%
Health outcomes: mortality							
All alcohol-attributable deaths		**Absolute**	12,166	613	-745	-560	-231
		Relative		5.0%	-6.1%	-4.6%	-1.9%
All alcohol-attributable deaths from cancer		**Absolute**	6,299	799	481	407	556
		Relative		12.7%	7.6%	6.5%	8.8%
of which:	**Oesophageal cancer**	**Absolute**	3,171	503	348	305	383
		Relative		15.9%	11.0%	9.6%	12.1%
	Other mouth and throat cancer	**Absolute**	788	98	62	55	70
		Relative		25.0%	16.4%	14.2%	18.2%
	Colorectal cancer	**Absolute**	1,272	97	42	26	55
		Relative		7.6%	3.3%	2.1%	4.3%
	Liver cancer	**Absolute**	311	22	9	5	13
		Relative		7.1%	3.1%	1.7%	4.0%
	Breast cancer	**Absolute**	757	79	19	16	35
		Relative		10.4%	2.5%	2.1%	4.7%
Health outcomes: hospital admissions							
All alcohol-attributable hospital admissions		**Absolute**	802,118	89,181	10,634	-11,379	44,271
		Relative		11.1%	1.3%	-1.4%	5.5%
All alcohol-attributable hospital admissions from cancer		**Absolute**	59,628	5,377	2,269	1,697	2,998
		Relative		9.0%	3.8%	2.8%	5.0%
of which:	**Oesophageal cancer**	**Absolute**	20,082	2,950	2,007	1,734	2,217
		Relative		14.7%	10.0%	8.6%	11.0%
	Other mouth and throat cancer	**Absolute**	10,535	948	485	398	585
		Relative		19.1%	10.8%	8.8%	12.6%
	Colorectal cancer	**Absolute**	11,793	711	182	55	311
		Relative		6.0%	1.5%	0.5%	2.6%
	Liver cancer	**Absolute**	613	33	6	-1	13
		Relative		5.3%	1.0%	-0.1%	2.1%
	Breast cancer	**Absolute**	16,604	736	-411	-489	-128
		Relative		4.4%	-2.5%	-2.9%	-0.8%

8. APPENDIX 2: ADDITIONAL DATA TABLES

TABLE A2 ESTIMATED CHANGES IN HEALTH OUTCOMES IN 2035 IN ENGLAND UNDER ALTERNATIVE PRICING POLICIES

				Effects of MUP					Effects of tax increases			Effects of duty escalator		
			Baseline	**50p**	**55p**	**60p**	**65p**	**70p**	**1%**	**5%**	**10%**	**-**	**& 5% tax increase**	**& 10% tax increase**
Health outcomes: mortality														
All alcohol-attributable deaths		**Absolute**	12,166	-525	-796	-1147	-1561	-2027	-35	-175	-351	-605	-663	-823
		Relative		-4.3%	-6.5%	-9.4%	-12.8%	-16.7%	-0.3%	-1.4%	-2.9%	-5.0%	-5.4%	-6.8%
All alcohol-attributable deaths from cancer		**Absolute**	6,299	-135	-202	-286	-385	-495	-8	-41	-83	-119	-133	-172
		Relative		-2.1%	-3.2%	-4.5%	-6.1%	-7.9%	-0.1%	-0.7%	-1.3%	-1.9%	-2.1%	-2.7%
of which:	**Oesophageal cancer**	**Absolute**	3,171	-77	-114	-160	-214	-274	-5	-23	-46	-67	-74	-96
		Relative		-2.4%	-3.6%	-5.1%	-6.8%	-8.7%	-0.1%	-0.7%	-1.5%	-2.1%	-2.3%	-3.0%
	Other mouth and throat cancer	**Absolute**	3,959	-100	-149	-208	-277	-354	-6	-29	-59	-85	-96	-123
		Relative		-8.2%	-12.0%	-16.7%	-22.1%	-28.0%	-0.5%	-2.3%	-4.7%	-6.8%	-7.5%	-9.7%
	Colorectal cancer	**Absolute**	1,272	-25	-37	-52	-70	-90	-2	-8	-15	-22	-24	-32
		Relative		-1.9%	-2.9%	-4.1%	-5.5%	-7.0%	-0.1%	-0.6%	-1.2%	-1.7%	-1.9%	-2.5%
	Liver cancer	**Absolute**	311	-5	-8	-12	-16	-20	0	-2	-4	-5	-6	-7
		Relative		-1.8%	-2.6%	-3.7%	-5.1%	-6.6%	-0.1%	-0.6%	-1.1%	-1.6%	-1.8%	-2.3%
	Breast cancer	**Absolute**	757	-4	-8	-14	-22	-31	0	-2	-5	-6	-7	-10
		Relative		-0.6%	-1.1%	-1.9%	-2.9%	-4.1%	-0.1%	-0.3%	-0.6%	-0.9%	-1.0%	-1.3%

				Effects of MUP					Effects of tax increases			Effects of duty escalator		
			Baseline	**50p**	**55p**	**60p**	**65p**	**70p**	**1%**	**5%**	**10%**	**-**	**& 5% tax increase**	**& 10% tax increase**
Health outcomes: hospital admissions														
All alcohol-attributable hospital admissions		**Absolute**	802,118	-22328	-34049	-49418	-67908	-88572	-1624	-8134	-16309	-29507	-32149	-39486
		Relative		-2.8%	-4.2%	-6.2%	-8.5%	-11.0%	-0.2%	-1.0%	-2.0%	-3.7%	-4.0%	-4.9%
All alcohol-attributable hospital admissions from cancer		**Absolute**	59,628	-1259	-1875	-2646	-3556	-4570	-71	-359	-721	-1040	-1162	-1501
		Relative		-2.1%	-3.1%	-4.4%	-6.0%	-7.7%	-0.1%	-0.6%	-1.2%	-1.7%	-1.9%	-2.5%
of which:	**Oesophageal cancer**	**Absolute**	20,082	-508	-752	-1049	-1397	-1782	-29	-147	-296	-429	-479	-619
		Relative		-2.5%	-3.7%	-5.2%	-7.0%	-8.9%	-0.1%	-0.7%	-1.5%	-2.1%	-2.4%	-3.1%
	Other mouth and throat cancer	**Absolute**	10,535	-342	-493	-672	-875	-1098	-17	-87	-174	-252	-282	-363
		Relative		-6.1%	-8.8%	-12.1%	-15.8%	-19.9%	-0.3%	-1.6%	-3.2%	-4.7%	-5.2%	-6.7%
	Colorectal cancer	**Absolute**	11,793	-232	-345	-485	-649	-833	-14	-68	-138	-196	-220	-285
		Relative		-2.0%	-2.9%	-4.1%	-5.5%	-7.1%	-0.1%	-0.6%	-1.2%	-1.7%	-1.9%	-2.4%
	Liver cancer	**Absolute**	613	-11	-16	-23	-31	-40	-1	-3	-7	-9	-10	-14
		Relative		-1.7%	-2.6%	-3.7%	-5.0%	-6.5%	-0.1%	-0.5%	-1.1%	-1.5%	-1.7%	-2.2%
	Breast cancer	**Absolute**	16,604	-166	-269	-417	-604	-817	-10	-53	-107	-152	-170	-221
		Relative		-1.0%	-1.6%	-2.5%	-3.6%	-4.9%	-0.1%	-0.3%	-0.6%	-0.9%	-1.0%	-1.3%

TABLE A3 ESTIMATED CHANGES IN ANNUAL CRIME AND WORKPLACE OUTCOMES AND RELATED COSTS IN ENGLAND UNDER ALTERNATIVE PRICING POLICIES

		Baseline	50p MUP	55p MUP	60p MUP	65p MUP	70p MUP	1% tax increase	5% tax increase	10% tax increase	Duty escalator	5% tax increase + duty escalator	10% tax increase + duty escalator
Crime outcomes													
Total alcohol-related criminal offences (1,000s)	**Absolute**	30,253	-728	-1,065	-1,494	-2,010	-2,579	-44	-221	-442	-734	-808	-1,013
	Relative		-2.4%	-3.5%	-4.9%	-6.6%	-8.5%	-0.1%	-0.7%	-1.5%	-2.4%	-2.7%	-3.3%
Workplace outcomes													
Total alcohol-related days of workplace absence (1,000s)	**Absolute**	161,985	-3,185	-4,769	-6,873	-9,465	-12,362	-220	-1,101	-2,211	-3,662	-4,032	-5,057
	Relative		-2.0%	-2.9%	-4.2%	-5.8%	-7.6%	-0.1%	-0.7%	-1.4%	-2.3%	-2.5%	-3.1%
Alcohol-attributable costs													
Healthcare costs (billions)	**Absolute**	50.7	-1.3	-1.9	-2.8	-3.8	-4.9	-0.1	-0.4	-0.9	-1.4	-1.5	-2.0
	Relative		-2.5%	-3.8%	-5.4%	-7.5%	-9.7%	-0.2%	-0.9%	-1.8%	-2.8%	-3.1%	-3.9%
Crime costs (billions)	**Absolute**	90.6	-2.2	-3.3	-4.6	-6.2	-8.0	-0.1	-0.7	-1.4	-2.3	-2.5	-3.1
	Relative		-2.5%	-3.6%	-5.1%	-6.9%	-8.8%	-0.2%	-0.8%	-1.6%	-2.5%	-2.8%	-3.5%
Workplace costs (billions)	**Absolute**	10.4	-0.2	-0.3	-0.4	-0.6	-0.8	0.0	-0.1	-0.1	-0.2	-0.3	-0.3
	Relative		-1.9%	-2.9%	-4.2%	-5.8%	-7.6%	-0.1%	-0.7%	-1.4%	-2.3%	-2.5%	-3.1%

TABLE A4 ESTIMATED CHANGES IN ALCOHOL CONSUMPTION BY GENDER AND DRINKER GROUP UNDER ALTERNATIVE PRICING POLICIES

Mean consumption per drinkers (units/week)		Population	Male			Female		
			Moderate	Hazardous	Harmful	Moderate	Hazardous	Harmful
Baseline		13.7	7.3	30.5	85.8	3.9	22.0	66.4
50p MUP	Absolute	-0.24	-0.09	-0.53	-4.00	0.00	0.00	-1.05
	Relative	-1.8%	-1.3%	-1.7%	-4.7%	0.0%	0.0%	-1.6%
55p MUP	Absolute	-0.36	-0.14	-0.80	-5.49	-0.01	-0.08	-1.77
	Relative	-2.6%	-2.0%	-2.6%	-6.4%	-0.2%	-0.4%	-2.7%
60p MUP	Absolute	-0.52	-0.21	-1.18	-7.06	-0.02	-0.23	-2.74
	Relative	-3.8%	-2.9%	-3.9%	-8.2%	-0.6%	-1.1%	-4.1%
65p MUP	Absolute	-0.71	-0.30	-1.63	-8.77	-0.05	-0.46	-3.85
	Relative	-5.2%	-4.1%	-5.4%	-10.2%	-1.3%	-2.1%	-5.8%
70p MUP	Absolute	-0.93	-0.40	-2.14	-10.62	-0.08	-0.73	-5.08
	Relative	-6.8%	-5.5%	-7.0%	-12.4%	-2.1%	-3.3%	-7.7%
1% tax increase	Absolute	-0.02	-0.01	-0.04	-0.13	0.00	-0.02	-0.06
	Relative	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%
5% tax increase	Absolute	-0.08	-0.05	-0.21	-0.67	-0.01	-0.08	-0.31
	Relative	-0.6%	-0.6%	-0.7%	-0.8%	-0.3%	-0.4%	-0.5%
10% tax increase	Absolute	-0.16	-0.09	-0.42	-1.34	-0.02	-0.16	-0.64
	Relative	-1.2%	-1.3%	-1.4%	-1.6%	-0.5%	-0.7%	-1.0%
Duty escalator	Absolute	-0.29	-0.17	-0.78	-2.47	-0.04	-0.29	-1.16
	Relative	-2.1%	-2.4%	-2.5%	-2.9%	-1.0%	-1.3%	-1.7%
5% tax increase + duty escalator	Absolute	-0.32	-0.19	-0.85	-2.69	-0.04	-0.32	-1.26
	Relative	-2.3%	-2.6%	-2.8%	-3.1%	-1.1%	-1.4%	-1.9%
10% tax increase + duty escalator	Absolute	-0.39	-0.23	-1.04	-3.30	-0.05	-0.39	-1.55
	Relative	-2.9%	-3.2%	-3.4%	-3.8%	-1.3%	-1.8%	-2.3%

TABLE A5 ESTIMATED CHANGES IN ALCOHOL-ATTRIBUTABLE DEATHS BY GENDER AND DRINKER GROUP UNDER ALTERNATIVE PRICING POLICIES

Annual alcohol-attributable deaths		Population	Male			Female		
			Moderate	Hazardous	Harmful	Moderate	Hazardous	Harmful
Baseline		12,166	-679*	3,254	5,686	-2,287*	1,772	4,419
50p MUP	Absolute	-525	-22	-139	-302	3	3	-68
	Relative	-4.3%	3.2%	-4.3%	-5.3%	-0.2%	0.1%	-1.5%
55p MUP	Absolute	-796	-34	-211	-422	4	-18	-115
	Relative	-6.5%	5.0%	-6.5%	-7.4%	-0.2%	-1.0%	-2.6%
60p MUP	Absolute	-1,147	-51	-308	-555	4	-56	-180
	Relative	-9.4%	7.5%	-9.5%	-9.8%	-0.2%	-3.2%	-4.1%
65p MUP	Absolute	-1,561	-72	-424	-696	2	-112	-258
	Relative	-12.8%	10.7%	-13.0%	-12.2%	-0.1%	-6.3%	-5.8%
70p MUP	Absolute	-2,027	-97	-550	-855	0	-178	-346
	Relative	-16.7%	14.3%	-16.9%	-15.0%	0.0%	-10.1%	-7.8%
1% tax increase	Absolute	-35	-2	-12	-10	0	-4	-6
	Relative	-0.3%	0.3%	-0.4%	-0.2%	0.0%	-0.2%	-0.1%
5% tax increase	Absolute	-175	-12	-61	-51	-1	-21	-28
	Relative	-1.4%	1.7%	-1.9%	-0.9%	0.1%	-1.2%	-0.6%
10% tax increase	Absolute	-351	-24	-122	-102	-3	-43	-57
	Relative	-2.9%	3.5%	-3.8%	-1.8%	0.1%	-2.4%	-1.3%
Duty escalator	Absolute	-605	-36	-211	-180	-3	-76	-100
	Relative	-5.0%	5.3%	-6.5%	-3.2%	0.1%	-4.3%	-2.3%
5% tax increase + duty escalator	Absolute	-663	-40	-231	-197	-3	-83	-109
	Relative	-5.4%	5.9%	-7.1%	-3.5%	0.1%	-4.7%	-2.5%
10% tax increase + duty escalator	Absolute	-823	-51	-285	-245	-4	-102	-135
	Relative	-6.8%	7.5%	-8.8%	-4.3%	0.2%	-5.8%	-3.0%

* Due to the (disputed) cardioprotective effects on alcohol, we estimate that alcohol has a net protective effect on moderate drinkers. The negative figures in these columns therefore represent a negative change in deaths from a negative baseline and are therefore positive even though they represent a reduction in overall deaths due to alcohol

TABLE A6 ESTIMATED CHANGES IN ALCOHOL-ATTRIBUTABLE CANCER DEATHS BY GENDER AND DRINKER GROUP UNDER ALTERNATIVE PRICING POLICIES

Annual alcohol-attributable cancer deaths		Population	Male			Female		
			Moderate	Hazardous	Harmful	Moderate	Hazardous	Harmful
Baseline		6,299	1,137	1,620	1,436	599	836	671
50p MUP	Absolute	-135	-14	-32	-74	0	0	-14
	Relative	-2.1%	-1.3%	-2.0%	-5.2%	0.0%	0.0%	-2.1%
55p MUP	Absolute	-202	-22	-49	-104	-2	-4	-22
	Relative	-3.2%	-2.0%	-3.0%	-7.2%	-0.3%	-0.4%	-3.2%
60p MUP	Absolute	-286	-33	-73	-134	-4	-10	-32
	Relative	-4.5%	-2.9%	-4.5%	-9.3%	-0.7%	-1.2%	-4.7%
65p MUP	Absolute	-385	-47	-102	-165	-9	-19	-42
	Relative	-6.1%	-4.2%	-6.3%	-11.5%	-1.5%	-2.3%	-6.3%
70p MUP	Absolute	-495	-64	-134	-198	-15	-31	-53
	Relative	-7.9%	-5.6%	-8.3%	-13.8%	-2.5%	-3.7%	-7.9%
1% tax increase	Absolute	-8	-2	-3	-2	0	-1	-1
	Relative	-0.1%	-0.1%	-0.2%	-0.2%	-0.1%	-0.1%	-0.1%
5% tax increase	Absolute	-41	-8	-14	-12	-2	-3	-3
	Relative	-0.7%	-0.7%	-0.9%	-0.8%	-0.3%	-0.4%	-0.4%
10% tax increase	Absolute	-83	-16	-28	-23	-4	-7	-6
	Relative	-1.3%	-1.4%	-1.7%	-1.6%	-0.6%	-0.8%	-0.8%
Duty escalator	Absolute	-119	-23	-40	-34	-5	-9	-8
	Relative	-1.9%	-2.0%	-2.5%	-2.3%	-0.9%	-1.1%	-1.1%
5% tax increase + duty escalator	Absolute	-133	-25	-45	-38	-6	-10	-9
	Relative	-2.1%	-2.2%	-2.8%	-2.6%	-1.0%	-1.3%	-1.3%
10% tax increase + duty escalator	Absolute	-172	-33	-58	-49	-8	-14	-11
	Relative	-2.7%	-2.9%	-3.6%	-3.4%	-1.3%	-1.6%	-1.7%

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10. LIST OF ACRONYMS

APC	Age Period Cohort
HSE	Health Survey England
IRR	Incidence Rate Ratio
MUP	Minimum Unit Pricing
NHS	National Health Service
OR	Odds Ratio
SAPM	Sheffield Alcohol Policy Model
WHO	World Health Organisation