Estimating the long-term health impacts of changes in alcohol consumption in England during the COVID-19 pandemic

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Lay summary

Drinking patterns in England have changed during the COVID-19 pandemic.

Some people are drinking more alcohol than before the pandemic, whilst others are drinking less. Heavier drinkers have increased their consumption the most, bringing a risk of more alcohol-related health problems. These changes have continued beyond the national lockdowns of 2020 and 2021. Deaths as a direct consequence of alcohol have risen.

Using computer modelling, we utilised a range of survey and healthcare data to predict the impact of increased alcohol consumption on future alcohol-related harm. It is not certain how long pandemic-related changes in drinking patterns will continue. To account for this uncertainty, three different scenarios for future alcohol consumption were created.

Alcohol influences the development of over 200 medical conditions and has wide-reaching social consequences. In this modelling study we project the impact of alcohol use on rates of nine of the main diseases linked to alcohol (high blood pressure, stroke, liver disease, and six forms of cancer) up to 2035.

The results from the model show an increase in new cases of diseases linked to alcohol. Depending on the scenario, this is between 11,661 and 147,892 cases of disease in total by 2035. This is projected to lead to between 2,431 and 9,914 extra premature deaths. This may be worse for the less well-off in society. Finally, the extra costs to the National Health Service are estimated to be between £369 million and £1.2 billion, depending on the duration of the changes in alcohol consumption during the COVID-19 pandemic.

These changes in alcohol harm and costs to society can be prevented as part of COVID-19 recovery planning. More funding is needed for alcohol treatment and support, along with other policies to prevent alcohol harm targeting the price of alcohol, where it is sold, and how it is promoted.

Executive summary

Study aims

To quantify future health, healthcare and economic impacts of changes in alcohol consumption observed during the COVID-19 pandemic.

Background

Alcohol consumption patterns in England changed during the COVID-19 pandemic. Between one-fifth and one-third of adults increased their alcohol consumption, with a similar proportion drinking less. There is evidence that heavier drinkers before the pandemic have increased their alcohol consumption the most. There was a 20% increase in alcohol-specific deaths in England in 2020 compared with 2019, and this trend persisted through 2021.

Alcohol harm includes disease morbidity and mortality, healthcare costs, and wider social consequences. There have also been changes in healthcare utilisation during the pandemic, which could mean other aspects of alcohol harm worsen but become less visible. Future trends in alcohol consumption are uncertain, and the long-term indirect effect of the pandemic on alcohol harm is unknown.

Methods

This study used the well-validated HealthLumen microsimulation model. Alcohol consumption data was obtained from the Alcohol Toolkit Study survey, and epidemiological, relative risk, and cost data from published literature. Three alcohol consumption scenarios were investigated: 1) short-term, where alcohol consumption patterns in 2020 and 2021 revert to 2019 levels at the start of 2023; 2) medium-term, where alcohol consumption patterns in 2020 and 2021 revert to 2019 levels at the start of 2025; 3) long-term, where alcohol consumption patterns in 2020 and 2021 remain permanently until the end of the microsimulation. Disease incidence, mortality and healthcare costs were modelled for selected alcohol-related health outcomes, including cancers, hypertension, stroke and liver cirrhosis. The microsimulation model was run from 2020 to 2035 for the population of England as a whole, and for different occupational social grade groups (A-C1 and C2-E).

Key results and findings

In all three alcohol consumption scenarios, the model projected a significant increase in the incident cases of disease, mortality, and healthcare costs.

In the short-term scenario, we project by 2035 there will be 1,284 additional incident cases of alcohol-related cancer, 8,520 cases of hypertension, 1,201 cases of stroke and 655 cases of liver cirrhosis. In the medium-term scenario, we project by 2035 there will be 4,119 additional incident cases of alcohol-related cancer, 25,153 cases of hypertension, 4,014 cases of stroke

and 1,832 cases of liver cirrhosis. In the long-term scenario, we project by 2035 there will be 18,785 additional incident cases of alcohol-related cancer, 99,593 cases of hypertension, 20,046 cases of stroke and 9,498 cases of liver cirrhosis.

The C2-E population is projected to face worse outcomes than the A-C1 population per 100,000 people. Under the projected short-term scenario, there will be 2.1% more incident disease cases per 100,000 in the C2-E population than in the A-C1 population in 2022, and by 2035 the cumulative premature deaths in the C2-E population will be three-fold greater than in the A-C1 population. Under the projected long-term scenario, there will be 4.3% more cumulative additional incident cases of disease by 2035, and 36% more additional cumulative premature deaths in the C2-E population than the A-C1 population per 100,000.

Total healthcare costs for the selected diseases modelled by 2035 were £369 million in the short-term scenario, £568 million in the medium-term scenario, and £1.2 billion in the long-term scenario.

Conclusions and recommendations

Changes in alcohol consumption during the COVID-19 pandemic will result in a significantly increased health and economic burden in England from the alcohol-related diseases studied. If drinking patterns do not revert to pre-COVID patterns, the disease burden is far higher. These findings are consistent with the real-world increases in alcoholic liver disease emergency hospital admissions and alcohol-specific deaths.

Indirect effects of the pandemic, such as changes in alcohol harm, cannot be ignored in COVID-19 recovery planning. A comprehensive alcohol strategy is needed to harmonise policies across the UK, with a coherent set of evidence-based policies: increased resources for alcohol treatment and support; price interventions through the new alcohol duty system; the introduction of minimum unit pricing in England; adding public health as an objective of the licensing system for alcohol outlets; and improving alcohol marketing regulation, to reduce the reach and appeal of marketing to those vulnerable.

This will prevent avoidable ill-health, reduce the impact on the healthcare system, and save money. These policies to reduce alcohol harm also complement other ongoing policy agendas, including around narrowing socio-economic and regional inequalities. They either offer return on investment, are low cost, or can generate revenue, contributing to the health, social and economic recovery from the pandemic.

Dissemination plans and expected influence

These findings will be included in an Institute of Alcohol Studies report and a linked policy briefing, which will be launched at an event for researchers and policymakers. The research team is in contact with broadcast and non-broadcast journalists about the report release, to maximise the influence of the findings with a policy audience and engage with the public. Further opportunities to engage with parliamentarians and policy officials are planned in

collaboration with the Alcohol Health Alliance UK, to influence public policy decisions on alcohol and recovery from the COVID-19 pandemic.

Patient and public involvement in this study

Through the People In Research website, members of the public were identified ahead of Stage 2 application to NIHR's Policy Research Programme, and virtual introductory meetings were held with the joint Principal Investigator. Six members of the public provided feedback on the plain English summary, planned patient and public involvement (PPI), and the dissemination plan. Two members of this group were included as co-applicants on the proposal. Both were experienced contributors to applied health research projects, which was desirable given the short timeframe for this research (6 months).

There has been ongoing dialogue between the two PPI co-applicants and joint Principal Investigator throughout the project, concerning project updates, developments with the pandemic and national response, and other developments relevant to the research. Formal PPI activities have been recorded in a PPI log and in meeting minutes.

In June 2021 a concept and design PPI workshop was held virtually with the project team, to develop the alcohol consumption scenarios and shape the design of the study. This resulted in agreement on having short-, medium- and long-term alcohol consumption scenarios, with a recommendation to undertake an additional literature review to finalise the durations for these, which was completed following the workshop. The PPI contributors also made suggestions for other potential health outcomes to model (for example: foetal alcohol spectrum disorders and mental health conditions such as depression and suicidal ideation). Following investigation, it was not possible to include these outcomes with available data sources, so the PPI input has identified areas where improved disease surveillance and routine data are needed, as reflected in the report. Finally, for dissemination, the PPI contributors recommended that non-alcohol audiences are reached, for example by inviting other alliances to the report launch (e.g. health inequalities, public health, liver health alliances).

In January 2022, a two-part results and recommendations PPI workshop was held virtually with key members of the project team. In the first meeting, preliminary results were shared along with draft tables and charts for feedback on the content and design. Feedback on the results and presentation of data and charts was actioned before part two of the meeting, so that improvements could be discussed. The take-home messages for the report were discussed, and changes plus the addition of new policy issues (e.g. the cost of living crisis expected Spring 2022) were agreed. The draft policy recommendations were discussed, and the top 5 were prioritised in order and agreed upon. Additional recommendations were also considered by the whole project team, but deprioritised.

The PPI co-applicants have reviewed the executive summary and lay summary of this report. The final contribution from the PPI co-applicants will be a plain English review of a policy briefing, which is to be published by the Institute of Alcohol Studies, and is one of the project outputs to accompany the main technical report.

How this study addresses equality and diversity

The data available for this project enabled consideration of future outcome trends by sex and occupational category, the latter being related to socioeconomic status. Understanding how outcomes may vary across these groups indicates that some groups are more at risk of harm than others and supports efforts to target interventions with a view to reducing health inequalities. We used data from Government statistics (e.g. Office for National Statistics, National Health Service) and established survey samples (e.g. Alcohol Toolkit Study) which are designed to be representative of the population and are inclusive in their design, undertaking and reporting.

Socio-economic health inequalities have widened due to the COVID-19 pandemic, with some evidence that this also applies to inequalities in harm from alcohol. The results from this study concern the entire population of England and are also presented separately for different occupational social grade groups, to indicate the impact on health inequalities resulting from alcohol across incident cases of disease, premature mortality, and healthcare costs. The aim is that this will inform policy responses to recovery from the COVID-19 pandemic, including prevention, low-cost and revenue-generating policies, and those that offer a return on investment, especially for disadvantaged groups. We acknowledge there would be value in further studies additionally reporting health, healthcare and economic projections by other aspects of identity, such as ethnicity, however this was beyond the scope of this particular project.

Policy relevance

Key findings of the research for the attention of policy makers include:

- There is uncertainty around the indirect effect of the COVID-19 pandemic on alcohol harm. However even if the changes to alcohol consumption are short term, there are knock-on effects on alcohol harm over the longer term.
- This modelling study projects between 11,661 and 147,892 cases of selected alcohol-related diseases in England in total by 2035.
- This is projected to lead to between 2,431 and 9,914 extra premature deaths, and to impact the less well-off in society the most.
- The costs to the National Health Service are estimated to be between £363 million and £1.2 billion.
- The findings of this modelling study are consistent with the real-world increases in alcoholic liver disease emergency hospital admissions and alcohol-specific deaths.

Relevance to policy context:

- Indirect effects of the pandemic, such as changes in alcohol-related harm, cannot be ignored in COVID-19 recovery planning.
- There are no national targets to reduce alcohol harm or an alcohol strategy in place, with the last national alcohol strategy published 10 years ago. Policies are increasingly divergent across the UK (for example minimum unit pricing).
- Evidence already exists on the effectiveness and cost-effectiveness of various alcohol control policies.
- A comprehensive alcohol strategy is needed to harmonise policies across the UK, with a coherent set of evidence-based policies: increased resources for alcohol treatment and support; price interventions through the new alcohol duty system; the introduction of minimum unit pricing in England; adding public health as an objective of the licensing system for alcohol outlets; and improving alcohol marketing regulation, to reduce the reach and appeal of marketing to those vulnerable.
- Such policies can prevent avoidable ill-health, reduce the impact on the healthcare system, and save money. These policies to reduce alcohol harm also complement other ongoing policy agendas around narrowing socio-economic and regional inequalities. They either offer return on investment, are low cost, or can generate revenue, contributing to the health, social and economic recovery from the pandemic.

Key policy questions that could be addressed through extension to this research:

- Modelling synergies with other non-communicable disease risk factors, for example obesity and tobacco smoking, and how these have changed as an indirect result of the COVID-19 pandemic.
- Anticipated longer term impacts on resources needed in both National Health Service healthcare and drug and alcohol treatment services.
- Modelling the impact of alcohol control policies (such as minimum unit pricing, changes to the licensing system, marketing regulation) and policies to increase availability of support and treatment, to avert the changes in alcohol-related harm projected in this study and to narrow inequalities.

Abbreviations

Terms	Meaning
ATS	Alcohol Toolkit Study, conducted by University College London
A-C1	Occupational social grade grouping covering junior, intermediate and higher managerial and professional roles, which can be an indicator of a socio-economic status (see Table 1)
Baseline scenario	Where 2019 levels of alcohol intake continue, assuming no change in alcohol intake within age and sex group from 2019.
CHD	Coronary heart disease
Chemotherapy	Treatment of disease (in this report, cancers) by the use of cytotoxic medication and other chemical substances. Chemotherapy is typically used to treat metastatic cancers.
COVID-19	Infectious disease caused by the SARS-CoV-2 virus
Cumulative incidence	Successive additions of annual cases of a disease. For example, the cumulative incidence between 2021 and 2025 would be the sum of the all-new disease cases in each of those years.
C-2E	Occupational social grade grouping covering skilled, semi-skill, unskilled and casual roles, along with pensioners and unemployed people, which can be an indicator of socioeconomic status (see Table 1)
CRUK	Cancer Research UK
Direct cost	The expenditure that is directly attributable to the utilisation of healthcare resources.
GBP	Great British Pounds
Health inequalities	Systemic differences in the health status of different populations. Health inequalities includes differences in health state and the distribution and availability of health resources
Incidence	The occurrence of new cases of a disease over a given time period
IAS	Institute of Alcohol Studies
ICD	International Classification of Diseases
Lockdown	The periods of time where the population faced legal restrictions and further guidance to combat the spread of COVID-19. All lockdowns were different, but shared common features, such as venue closures, stay at home requirements, and limits on social contact.
Microsimulation	A computer model that replicates real life as closely as possible using national population and disease statistics. It can test the long-term impact of a range of different scenarios on future outcomes. This model is referred to as 'the microsimulation'.
NCD	Non-communicable disease
NHS	National Health Service
NPI	Non-pharmaceutical interventions
Off-trade	The sale of alcohol in supermarkets, off-licenses and shops who do not have permission for their customers to consume alcohol on site

ONS	Office for National Statistics
OHID	Office for Health Improvement and Disparities, formerly part of PHE
On-trade	The sale of alcohol in pubs, restaurants and venues where their customers can consume alcohol on site
Pandemic	Epidemic of an infectious disease that is widespread and affects a significant number of people
PHE	Public Health England (until 2021)
Prevalence	This is the total number of cases (both pre-existing and newly occurring) of a disease in a particular population over a given time period.
Radiotherapy	Treatment of disease (in this report, cancer) by the use of ionising radiation. Radiotherapy is typically used for earlier stage cancers.
Regression	A statistical technique for estimating the relationships between variables.
Restrictions	Measures which forced or encouraged behavioural changes to inhibit the spread of COVID-19. These include, for example, the limit on the number of households who can gather together.
Static	This refers to the 'steady state' of the risk factor assuming no change from current exposure levels. However, changes in the population (e.g., ageing) occur. The steady-state runs from 2018.
SES	Socioeconomic status
Tumourectomy	Surgery to remove a cancerous tumour from the body
UCL	University College London
WHO	World Health Organisation

Introduction

Alcohol consumption as an indirect effect of the COVID-19 pandemic

In addition to the direct effects of the virus, the pandemic has also had numerous indirect effects on health and wellbeing. One of these indirect effects in England has been changes in alcohol consumption.

Measures necessary to control the spread of COVID-19, described as non-pharmaceutical interventions (NPIs), are one factor behind the indirect effect of the pandemic on alcohol consumption and harm. For example in England there have been seven and a half months of on-trade closures during national lockdowns in total, with the dates summarised in a 2021 report from Public Health England (PHE) [1]. The dates of on-trade closures and details of alcohol policy-relevant changes are detailed for the whole of the UK in this interactive timeline.

Alcohol consumption during the COVID-19 pandemic

Early data on drinking during the pandemic were of variable quality and from a range of sources. A report synthesising the emerging evidence base in June 2020 identified that different surveys repeatedly found between a fifth and a third of people reported drinking more during lockdown [2]. Where the proportion of people drinking less during lockdown had also been reported, this was often similar to or exceeded the proportion drinking more during lockdown [2]. One survey which has been conducted continuously throughout the pandemic is the Alcohol Toolkit Study (ATS) [3]. These data are collected monthly and show an increase in the proportion of people who are drinking at increasing or higher risk levels which has been sustained over the course of the pandemic.

The increase in the prevalence of drinking at increasing and higher risk levels is not spread evenly across different groups in society. Increases in higher risk drinking have been more pronounced in those belonging to more disadvantaged groups [1, 4] and heavier drinkers [1, 5]. This has potential health consequences, as well as an impact on health inequalities.

It has been reported that the impact on total alcohol sales, based on duty receipts from HM Revenue and Customs, is relatively small [1, 6, 7]. However, aggregate data on the amount of alcohol sold masks the changes in individuals' consumption that are evident in the individual-level self-reported data.

Alcohol harm during the COVID-19 pandemic

During the pandemic, healthcare has not been accessed as it normally would have been. This was particularly the case at the start of the pandemic and in the first lockdown (from 23rd March 2020), when overall healthcare utilisation reduced sharply [8, 9], including for substance use disorders [10]. Recent data show emergency department attendances and emergency admissions towards the end of 2021 are closer to pre-pandemic levels [11], but NHS outpatient referrals are at lower levels than those prior to the pandemic, particularly for GP referrals [12]. NHS waiting lists were also at record levels of six million people at the end of 2021 [13] and ambulance call response times are the longest since this indicator was introduced in 2017 [14]. Taken together with the increases in higher risk drinking, this poses a continued risk that alcohol harm persists or worsens but becomes less visible.

There have been increases in some measures of alcohol harm in England. Overall, rates of unplanned admissions to hospital for alcohol specific causes decreased by 3.2% in 2020 compared to 2019 [1]. Public Health England (PHE) state this is related to reduced admissions for mental and behavioural disorders due to alcohol use, which may in turn linked to the pattern of reduced healthcare utilisation across the board. However there was a significant increase of 13.5% in unplanned admissions for alcoholic liver disease in 2020 [1]. This increase persisted through 2021 [15].

There has also been an increase in the number of alcohol specific deaths. These were first reported by the Office for National Statistics (ONS) and are also included in the PHE report. In 2020, there was a 20% increase in alcohol specific deaths in England compared to 2019 [1]. Again, this increase has persisted through 2021 [15].

Future trends in alcohol consumption and harm

The pandemic is not over, and the economic and social consequences of the pandemic will be experienced for some time to come. Medium-to-longer term impacts of the pandemic on alcohol consumption and harm, in health, healthcare and economic terms, are unclear.

Should the increased prevalence of higher risk drinking identified in survey data continue, most of the health consequences of these new trends are yet to be realised, as many of the health consequences of alcohol are chronic conditions that develop over a long period of time. Because of this uncertainty, there is a need to model scenarios of future trends to identify scale of the future disease burden, and the kinds of policy responses and resources needed.

Aims and objectives

This study aims to quantify the impact of changes in alcohol consumption during COVID-19 on epidemiological, economic and healthcare utilisation outcomes using a peer-reviewed and well-validated microsimulation model [16-20]. There are over 200 health conditions linked to alcohol [21] as well as harms to others and wider social consequences. It is not possible or

feasible to model all of these, and the aim of this study is to illustrate the scale of the future problem but not its full extent.

Because of the uncertainty around future consumption trends, this study models what will happen to alcohol harm if alcohol consumption goes back to pre-pandemic levels imminently, after a delay, or if these new drinking patterns are permanent.

Objectives

- Simulate the future impact of recent changes in alcohol consumption on alcohol harm for four alcohol consumption scenarios (2020 to 2035), using a validated microsimulation model
- Estimate the impact on alcohol-related morbidity and mortality, hospitalisations, harm and costs by age- group, sex and socio-economic status (SES), to gauge indirect effects of COVID-19 on alcohol-related inequalities
- Develop and disseminate recommendations to influence policy and minimise future alcohol harm

Methods

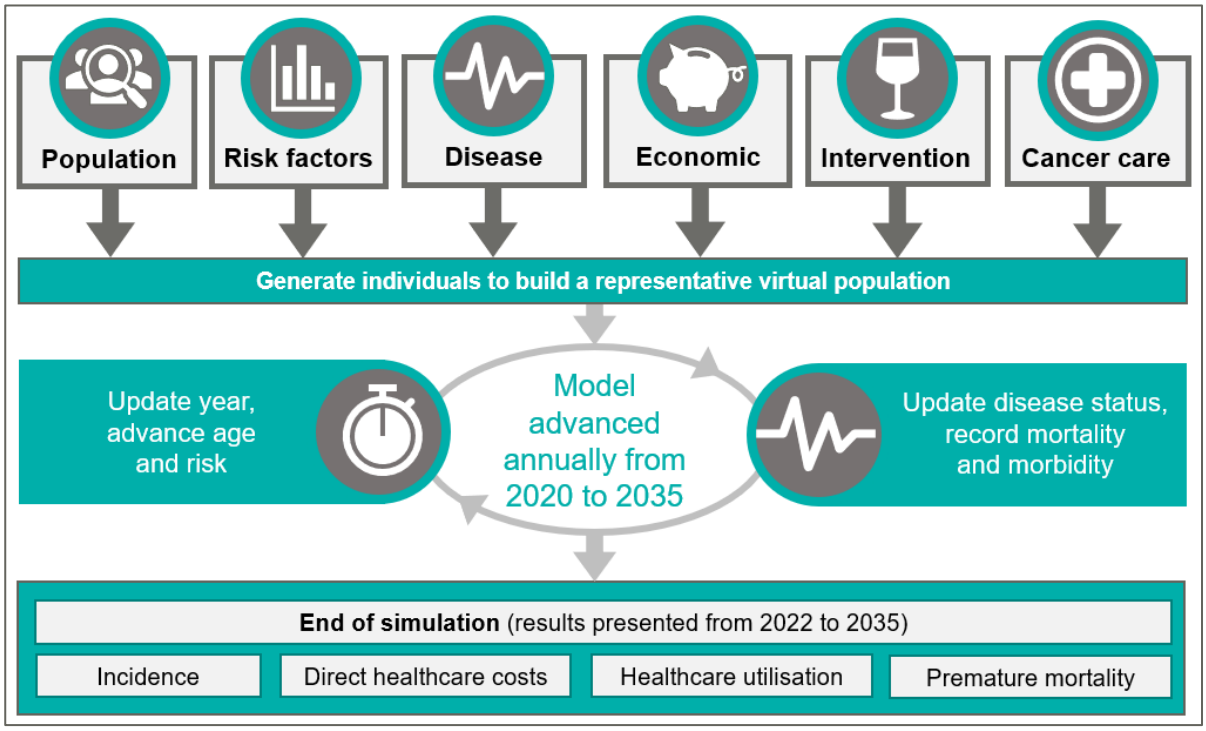
Overview of the Microsimulation Model

This study used the well-validated HealthLumen microsimulation model to project the future impact of increased alcohol consumption during the COVID-19 pandemic on the burden of alcohol-related disease in England. Microsimulation is an advanced method for modelling non-communicable diseases (NCDs) due to its capacity to simulate entire populations at an individual level over time.

The inputs of the microsimulation comprise six modules: 1) population, 2) risk factor, 3) disease epidemiology, 4) economic, 5) intervention, and 6) cancer care. The model inputs can be viewed in more detail in Appendix 1. Details of the microsimulation model engine are available in Appendix 3. An overview of the microsimulation model structure is available in Figure 1.

Each individual in the model is assigned an age, sex, and alcohol intake (units per week), which is associated with a relative risk of developing several alcohol-related diseases (Appendix 1). The microsimulation was run between 2020 and 2035, and outputs are presented from 2022 to 2035. The year 2035 was chosen because this provides a long enough time horizon by which to explore impacts on a range of chronic diseases especially where there is a longer lag-effect between alcohol consumption and disease onset (e.g. some cancers).

Figure 1. Schematic of the microsimulation model structure



Microsimulation Model Data Inputs

Module 1: Population

The microsimulation model has been utilised to simulate three populations, each of 100 million individuals: one that is representative of the total population of England, and two that are representative of the two standard groupings of Approximated Social Grades (ASGs), A-C1 and C2-E, based on occupation as defined by The National Readership Survey (NRS) [22] (Table 1). The size of the population of the microsimulation was chosen to be 100 million in order to accurately project the incidence of the rarer cancers included in the model. All results are then scaled to the size of the population in England.

Table 1. Descriptions of standard approximated occupational social grade groupings used in population modelling

ASG	Description
Population A-C1: ASGs A, B, and C1	
A	Higher managerial roles, administrative or professional.
B	Intermediate managerial roles, administrative or professional.
C1	Supervisory or clerical and junior managerial roles, administrative or professional.
Population C2-E: ASGs C2, D, and E	
C2	Skilled manual workers.
D	Semi-skilled and unskilled manual workers.
E	State pensioners, casual and lowest grade workers, unemployed with state benefits only.

Single-year age and sex-disaggregated population projections for 2020-2035, birth rates by mother's age, and death rates by age and sex for England were sourced from ONS [23]. 2011 census data [24] was used to estimate the percentage of individuals in each SES group by sex and age group, since the 2021 census was not available at the time of analysis. Birth and death rates were assumed to be the same across A-C1 and C2-E SES groups.

As the 2011 census did not capture SES data below age 16 and above age 65, we assumed that 50% of individuals below the age of 16 belong to the A-C1 and C2-E SES categories, and that that the distribution of SES in the age 60-64 population was representative of the population aged between 65 and 110. As the population aged below 16 progressed and aged through the microsimulation, their alcohol consumption value changed depending on which age and SES group they belonged to. We assumed no change in the probability of a person belonging to a specific SES group between 2020 and 2035.

Module 2: Risk Factor

The microsimulation model utilised age and sex-disaggregated alcohol consumption data from the ATS [3] collected between January 2019 and November 2021. The ATS measured alcohol consumption through monthly household interviews with representative samples of approximately 1,800 English participants aged 16+. There was a switch in modality of the ATS, from face-to-face to telephone delivery from April 2020 onwards, necessitated by the pandemic.

In line with alcohol risk categories used by the UK Health Security Agency (formerly PHE), alcohol consumption was considered at three levels of risk: high-risk alcohol consumption (>50 units/week in males, >35 in females), increasing-risk alcohol consumption (14-50 units/week in males, 14-35 units/week in females), and low-risk alcohol consumption (<14 units/week in males and females) [25]. Alcohol consumption estimates were derived for males and females in three age groups (15-39, 40-59, and 60+) and two SES groups (A-C1, and C2-E). These groups were chosen to allow the highest level of stratification while maintaining a large enough sample size by which to model robust effects. The annual mean of 2019 monthly alcohol consumption values from the ATS was considered as a pre-lockdown 'baseline' for each age, sex and SES group. A static model was used to predict future alcohol consumption under the baseline model, whereby alcohol consumption within specific age, sex and SES groups is assumed to remain stable between 2020 and 2035. This was preferred over a dynamic model, as future levels of alcohol consumption are highly dependent on policy and pricing trends, among other factors. The baseline model can therefore be considered a 'no change' scenario.

Module 3: Disease

Nine diseases for which alcohol consumption is known to be a risk factor were modelled as part of this study. These included six cancers: breast cancer, colorectal cancer, liver cancer, mouth cancer, oesophageal cancer, and throat cancer; in addition to hypertension, liver cirrhosis, and stroke.

For all modelled cancers, the data on incidence, mortality, and survival were extracted by age and sex from the Cancer Research UK (CRUK) online data and statistics portal [26]. The relative risks of alcohol consumption on the incidence of modelled cancers were extracted from a meta-analysis conducted by Bagnardi et al. [27] (Appendix 1).

For hypertension, liver cirrhosis, and stroke, extensive literature reviews were conducted to source incidence, prevalence, mortality, survival, and relative risk data by sex and age group (Appendix 1). Where possible, International Classification of Diseases (ICD) codes were used to establish diagnostic consistency across input data for diseases. For example, ICD code C15 'Malignant neoplasm of the oesophagus' was used to source incidence, mortality, and survival data for oesophageal cancer. Where epidemiological data were not available, values were estimated based on formulae detailed in Appendix 2.

Module 4: Health economics

Annual direct costs for each modelled disease were calculated by multiplying the annual direct cost per patient by the number of prevalent cases output in the model in a particular year. The definitions of the costs used can be found in Appendix 1.

Table 2. Direct costs per patient used in the microsimulation

Disease	Cost (GBP)	Year of cost	2021 cost (GBP)[a]	Reference
Breast cancer	3006.56	2010	3644.80	Laudicella et al. [28]
Colorectal cancer	4319.56	2010	5236.52	Laudicella et al. [28]
Liver cancer	10,451.58	2013	12,016.24	McEwan et al. [29]
Mouth cancer	4914.00	2002	7011.17	Speight et al. [30]
Oesophageal cancer	7847.00	2005	10,654.29	Agus et al. [31]
Throat cancer	7847.00	2005	10,654.29	Agus et al. [31] (oesophageal cancer proxy)
Hypertension	132.2	2018	153.12	Constanti et al. [32]; Lovibond et al. [33]
Liver cirrhosis	1218.65	2014	1377.52	Tanajewski et al. [34]
Stroke	2815.00	2007	3520.99	Ward et al. [35]

a) All costs inflated to 2021 using the CCEMG-EPPI online cost conversion tool to adjust estimates of cost expressed in one price year.

Module 5: Scenarios

Three distinct risk factor scenarios were modelled that correspond to hypothesised differences in the number of years taken for alcohol consumption to return to pre-pandemic levels:

- 'Long-term' refers to a scenario in which the alcohol consumption patterns of 2020 and 2021 remain indefinitely (from 2022 until the end of the microsimulation in 2035)
- 'Medium-term' refers to a scenario in which the alcohol consumption patterns of 2020 and 2021 remain between 2022 and the end of 2024, before returning to pre-pandemic levels at the beginning of 2025
- 'Short-term' refers to a scenario in which the alcohol consumption patterns of 2020 and 2021 remain for 2022 only, before returning to pre-pandemic levels at the start of 2023

In the microsimulation, at the start of 2020, an individual is assigned a certain probability of moving between alcohol consumption groups. To calculate the bidirectional movement between the low risk, increasing risk and high-risk consumption groups (by age, sex, and SES), the size of the groups in 2019 was compared against the size of the consumption

groups in 2020 (January to December) and 2021 (January to November). The net change in the size of each group was estimated. The ATS dataset is a repeated cross-sectional study, so no longitudinal data were available to determine alcohol consumption at the individual level. Further detail is available in appendix 1.

Module 6: Cancer care

The probability of an individual receiving chemotherapy, radiotherapy, or a tumourectomy, was extracted from CRUK [36] and the National Cancer Registration and Analysis Service (NCRAS) [37]. To calculate the utilisation of these services between 2022 and 2035, the excess incidence of cancers under the three scenarios compared to baseline was multiplied by the respective probabilities of chemotherapy, radiotherapy, and tumourectomy, and reflects the treatments in the first year from an incident case. The average length of stay for breast cancer and colorectal cancer in the first 12 months from diagnosis (6.50 and 18.91 days, respectively), and the number of outpatient visits for breast cancer and colorectal cancer in the first 12 months from diagnosis (11.18, and 7.26, respectively), was extracted from Laudicella et al 2016 [38]. In the microsimulation, each incident case of colorectal and breast cancer is assigned the average length of stay in hospital, and the average number of outpatient visits, over the first 12 months. The results of this module are provided in appendix 2.

Baseline scenarios

The baseline scenario refers to a situation whereby individuals within the microsimulation continue consuming alcohol at 2019 levels, by age and sex group, from 2020 to 2035. Further details are provided in Module 2: Risk Factor. The baseline scenarios are modelled separately for the whole population of England, and for the A-C1 and C-2E socioeconomic groups.

Short, Medium and Long-term scenarios

The modelled scenarios are theoretical situations whereby individuals change their alcohol consumption at the beginning of 2020 and continue to drink at the new level until the end of the 2022 (the ‘short-term’ scenario), until the end of 2024 (the ‘medium-term’ scenario), or until the end of 2035 (the ‘long-term’ scenario). Each of these scenarios are modelled separately for the whole population of England, and for the A-C1 and C-2E socioeconomic groups.

Microsimulation model outputs

The microsimulation was run between 2020 and 2035, and results are presented for 2022 to 2035. For example, the additional incidence of disease is captured from 2022 onwards, and excludes the additional incidence of disease in 2020 and 2021.

Additional Cumulative Incidence

Additional cumulative incidence cases of all modelled diseases in the total population, as well as A-C1 and C-2E populations, between 2022 and 2035, under the short-term, medium-term, and long-term scenarios compared to the baseline scenario.

Cancer Care

Additional cumulative number of individuals who have had a tumourectomy, radiotherapy, or chemotherapy (and the number of additional bed days and outpatient visits for breast and colorectal cancer) in the total population, as well as A-C1 and C-2E populations, between 2022 and 2035, under the short-term, medium-term, and long-term scenarios compared to the baseline scenario.

Premature Mortality

Additional cumulative premature mortality in the total population, as well as A-C1 and C-2E populations, between 2022 and 2035, under the short-term, medium-term, and long-term scenarios compared to the baseline scenario.

Economic Projections

Additional cumulative direct healthcare costs in the total population, as well as A-C1 and C2-E populations, between 2022 and 2035, under the short-term, medium-term, and long-term scenarios compared to the baseline scenario.

Results

Summary

Epidemiological projections

Incidence of disease

Under the short-term scenario, in 2022, we project that there will be 1.9% more incident cases of disease compared to the baseline scenario: 1.6% more in the A-C1 population, and 2.2% more in the C2-E population. Between 2022 and 2035, 2,860 additional cases of disease were projected under the short-term scenario. Declining incidence of disease (particularly hypertension) relative to baseline post-2022 led the number of additional cases of disease to be higher by 2022 than by 2035 under the short-term scenario, although results became non-significant in later years.

Under the medium-term scenario, between 2022 and 2024, we project that there will be 35,095 additional cumulative incident cases of disease, compared to the baseline scenario: 1.8% more in the A-C1 population, and 2.0% more in the C2-E population. Between 2022 and 2035, 24,706 additional cases of disease were projected under the medium-term scenario. Again, declining incidence of disease relative to baseline post-2024 led the number of additional cases of disease to be higher by 2024 than by 2035 under the medium-term scenario, although results became non-significant in later years.

Under the long-term scenario, between 2022 and 2035, we project that there will be 147,892 excess cumulative incidence cases of disease, compared to the baseline scenario: 1.6% more in the A-C1 population, and 1.7% more in the C2-E population.

Cancer care

Under the short-term scenario, compared to the baseline scenario, we project that there will be 550 individuals who will need a tumourectomy; 637 who will need chemotherapy; and 532 who will need radiotherapy in 2022. Between 2022 and 2035, we project that there will be individuals 1,137 individuals who will need a tumourectomy; 799 who will need chemotherapy; and 649 who will need radiotherapy.

Under the medium-term scenario, compared to the baseline scenario we project that there will be 1,832 individuals who will need a tumourectomy; 1,933 who will need chemotherapy; and 1,554 who will need radiotherapy between 2022 and 2024. Between 2022 and 2034, we project that there will be 2,343 individuals who will need a tumourectomy; 1961 who will need chemotherapy; and 1590 who will need radiotherapy.

Under the long-term scenario, compared to the baseline scenario we project that there will be 8,605 individuals who will need a tumourectomy; 8,400 who will need chemotherapy; and 6,707 who will need radiotherapy between 2022 and 2035.

Mortality

Under the short-term scenario, compared to the baseline scenario, we project that there will be 2,431 additional cumulative premature deaths in England, between 2022 and 2035. This rises to 3,725 under the medium-term scenario, and 9,914 under the long-term scenario. The projected number of additional premature deaths is higher in the C2-E population than the A-C1 population under all scenarios, compared to baseline.

Economic projections

Under the short-term scenario, between 2022 and 2035, we project that the increase in alcohol-related diseases will result in £369 million additional direct healthcare costs. Under the medium-term scenario, between 2022 and 2035, we project that the increase in alcohol-related diseases will result in £568 million additional direct healthcare costs. Under the long-term scenario, between 2022 and 2035, we project that the increase in alcohol-related diseases will result in £1,239 million additional direct healthcare costs.

Epidemiological projections

Short-term scenario

Results for the total population

Under the short-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2022, the changes in alcohol consumption during the COVID-19 pandemic is projected to result in 11,661 additional incident cases of diseases in 2022. We project that, in 2022, there will be 8,520 additional incident cases of hypertension, 1,201 additional incident cases of stroke, 1,285 additional incident cases of cancers, and 655 additional incident cases of liver cirrhosis.

Between 2022 and 2035, under the short-term scenario, we project that there will be 2,860 additional incident cases of disease, compared to the baseline scenario. The only statistically significant single disease result over this time period is for stroke, for which we project 2,994 additional incident cases (confidence limit: ±2,062). Results for other individual diseases were not statistically significant. In this instance, the additional incidence of stroke is higher than that of the total for all diseases due to the number of additional hypertension and throat cancer cases under baseline exceeding those under the intervention scenario. Table 1 and 2 of the results appendix presents the excess cases by age group and sex by 2035.

Figure 1. Additional cumulative incidence cases of disease in the total population, between 2022 and 2035, under the short-term scenario compared to the baseline scenario

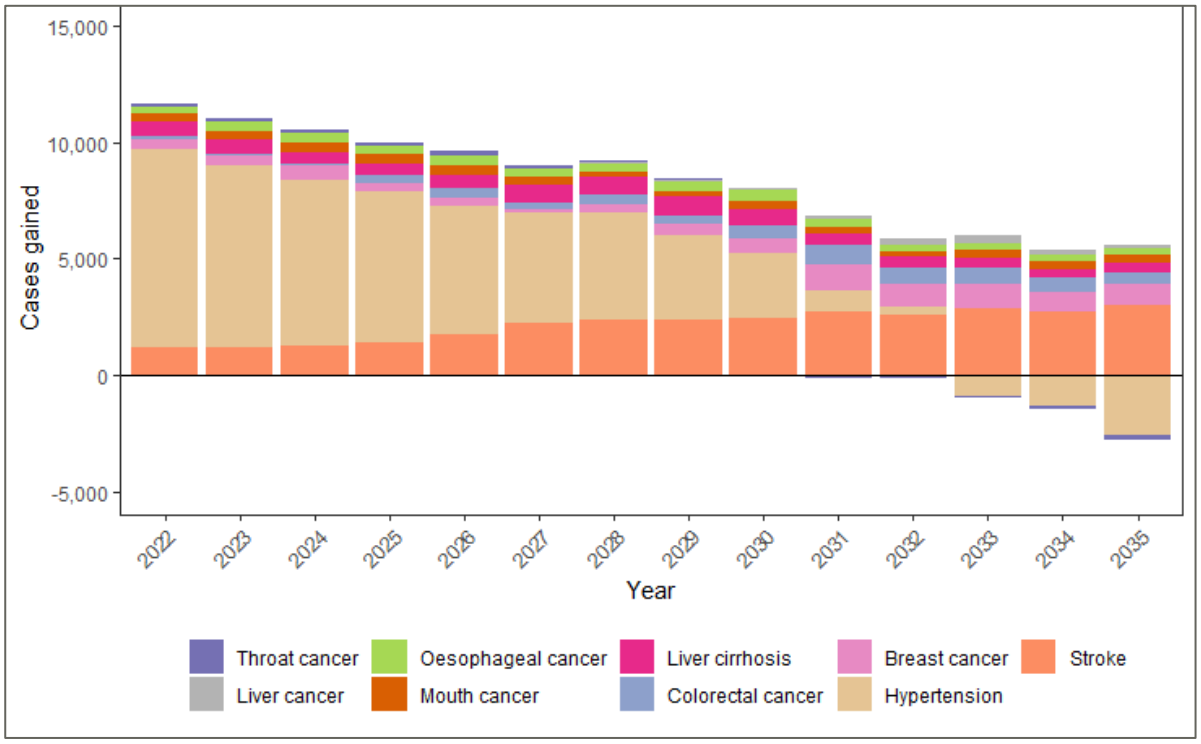


Table 3. Additional incident cases of disease in 2022, under the short-term scenario, compared to the baseline scenario, for the population of England

Disease	Excess incident cases (confidence limit)
Hypertension	**8,520 (±934)**
Stroke	**1,201 (±519)**
Liver cirrhosis	**655 (±168)**
Breast cancer	**403 (±320)**
Mouth cancer	**346 (±109)**
Oesophageal cancer	**306 (±131)**
Throat cancer	**121 (±85)**
Colorectal cancer	96 (±292)
Liver cancer	13 (±109)

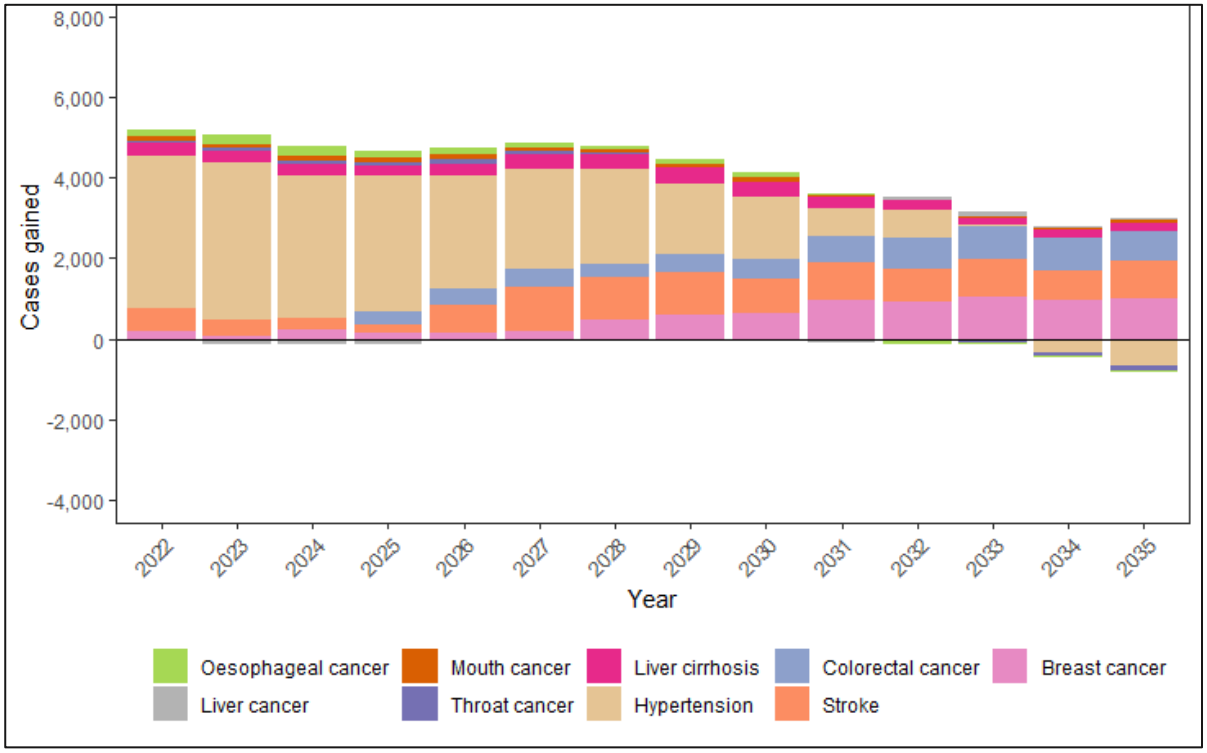
Numbers in bold signify where the confidence limit of a result does not span zero.

Results by socioeconomic status

Under the short-term scenario, the increase in alcohol consumption during the COVID-19 pandemic is projected to result in 5,135 additional incident cases of disease in the A-C1 population, and 6,526 additional incident cases of disease in the C2-E population in 2022 (Table 4).

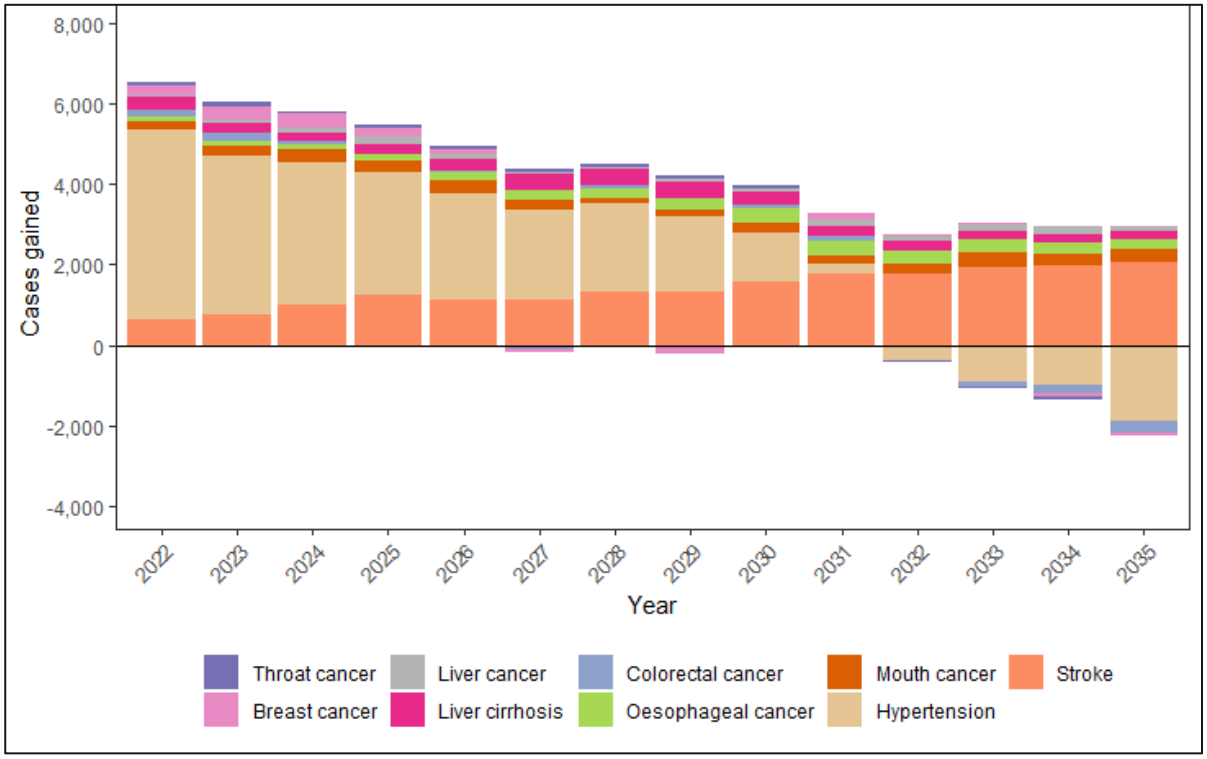
In the A-C1 population, under the short-term scenario, we project that there will be 3,790 additional incident cases of hypertension, 586 additional incident cases of stroke, 451 additional incident cases of cancers, and 308 additional incident cases of liver cirrhosis in 2022 compared to the baseline scenario. Between 2022 and 2035, we project a statistically significant additional cumulative incidence only for breast cancer (1,011 (confidence limit: ±927)).

Figure 2. Additional cumulative incidence cases of disease in the A-C1 population, between 2022 and 2035, under the short-term scenario compared to baseline



In the C2-E population, under the short-term scenario, we project that there will be 4,730 additional incident cases of hypertension, 615 additional incident cases of stroke, 833 additional incident cases of cancers, and 348 additional incident cases of liver cirrhosis in 2022 compared to the baseline scenario (Figure 3). Between 2022 and 2035, we project a statistically significant additional cumulative incidence of stroke (2,062 (confidence limit: ±1,420)) and mouth cancer (319 (confidence limit: ±289)).

Figure 3. Additional cumulative incidence cases of disease in the C2-E population, between 2022 and 2035, under the short-term scenario compared to baseline



In 2022, we project a statistically significant excess of hypertension, stroke, liver cirrhosis, oesophageal cancer, and mouth cancer in the A-C1 and C2-E populations, while the additional incidence of breast and throat cancer is significant only in the C2E population (Table 4).

Table 4. Additional incident cases of disease in 2022, under the short-term scenario, compared to the baseline scenario, by socioeconomic status

Disease	A-C1 (confidence limit)	% Difference*	C2-E (confidence limit)	% Difference*
Hypertension	**3,790 (±697)**	**+1.9**	**4,730 (±621)**	**+2.6**
Stroke	**586 (±380)**	**+1.0**	**615 (±354)**	**+1.0**
Liver cirrhosis	**308 (±123)**	**+5.1**	**348 (±114)**	**+5.8**
Breast cancer	170 (±240)	+0.7	**233 (±211)**	**+1.1**
Mouth cancer	**111 (±80)**	**+4.4**	**235 (±74)**	**+9.5**
Oesophageal cancer	**195 (±96)**	**+5.3**	**111 (±89)**	**+3.0**
Throat cancer	53 (±62)	+3.5	**68 (±58)**	**+4.4**
Colorectal cancer	-56 (±215)	-0.3	151 (±198)	+0.8
Liver cancer	-22 (±80)	-0.9	35 (±74)	+1.4

Numbers in bold signify where the confidence limit of a result does not span zero. Negative numbers indicate a disease where there is projected to be a reduction in the number of future cases.

*Percentage difference in cumulative incidence of disease, intervention compared to baseline, by end of 2022 under the short-term scenario.

Per 100,000 population, the additional cumulative incidence of disease in 2022 is 28% greater in the C2-E population than the A-C1 population. This analysis was not conducted for the projections of additional cumulative incidence from 2022 to 2035 due to limited statistical significance.

Due to the small sample size when disaggregating by age, sex, and SES these projections could not be interpreted with any amount of certainty so are not presented here.

Medium-term scenario

Results for the total population

Under the medium-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2024, the increase in alcohol consumption, during the COVID-19 pandemic, is projected to result in 35,095 additional incident cases of diseases between 2022 and 2024 (Figure 4). We project that there will be 25,153 additional incident cases of hypertension, 4,014 additional incident cases of stroke, 4,119 additional incident cases of cancers, and 1,832 additional incident cases of liver cirrhosis (Table 5)

Figure 4.

Between 2022 and 2035, under the medium-term scenario, we project that there will be 24,706 additional incident cases of disease, compared to the baseline scenario. Table 1 and 2 of the results appendix presents the excess cases by age group and sex by 2035.

Figure 4. Additional cumulative incidence cases of disease in the total population, between 2022 and 2035, under the medium-term scenario compared to the baseline scenario

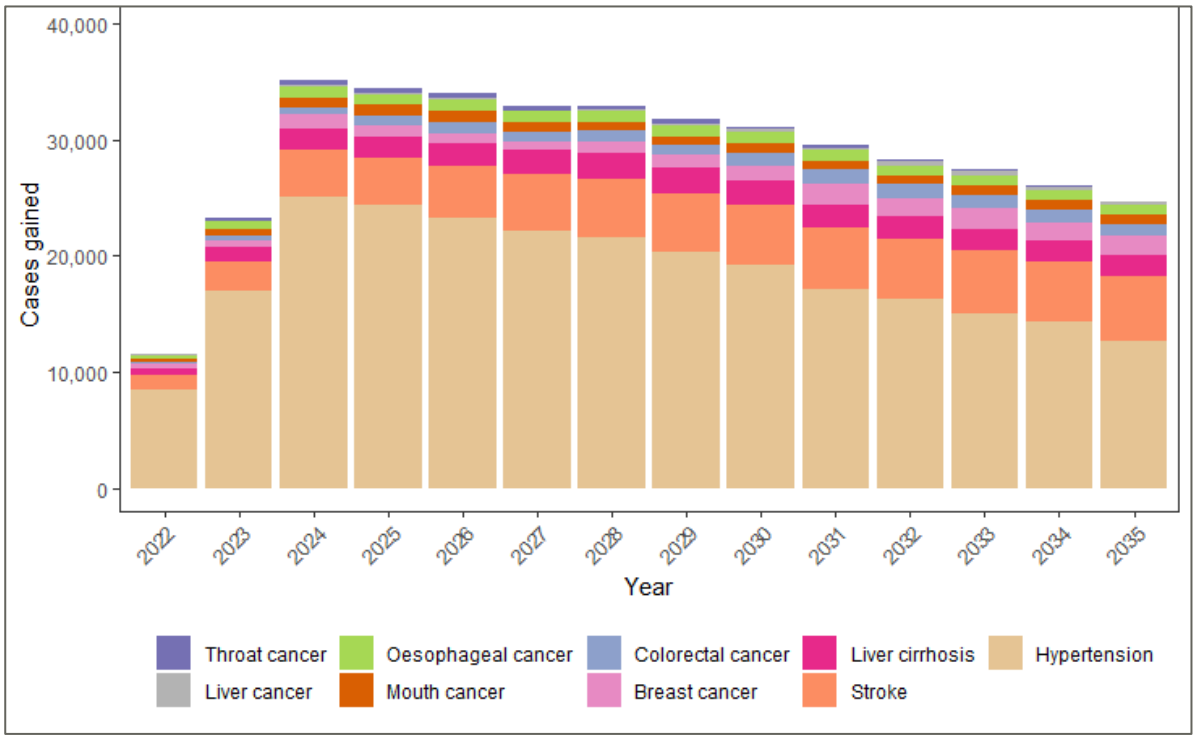


Table 5. Additional incident cases of disease between 2022 and 2024 and up to 2035, under the medium-term scenario, compared to the baseline scenario, for the population of England

Disease	2022-2024 only	2022-2035
Hypertension	**25,130 (±1,628)**	**12,690 (±3,608)**
Stroke	**4,014 (±909)**	**5,514 (±2,062)**
Liver cirrhosis	**1,832 (±293)**	**1,902 (±645)**
Breast cancer	**1,146 (±558)**	**1,667 (±1,248)**
Mouth cancer	**879 (±190)**	**840 (±423)**
Oesophageal cancer	**958 (±230)**	**800 (±520)**
Throat cancer	**400 (±148)**	77 (±328)
Colorectal cancer	**636 (±511)**	965 (±1,163)
Liver cancer	100 (±191)	251 (±434)

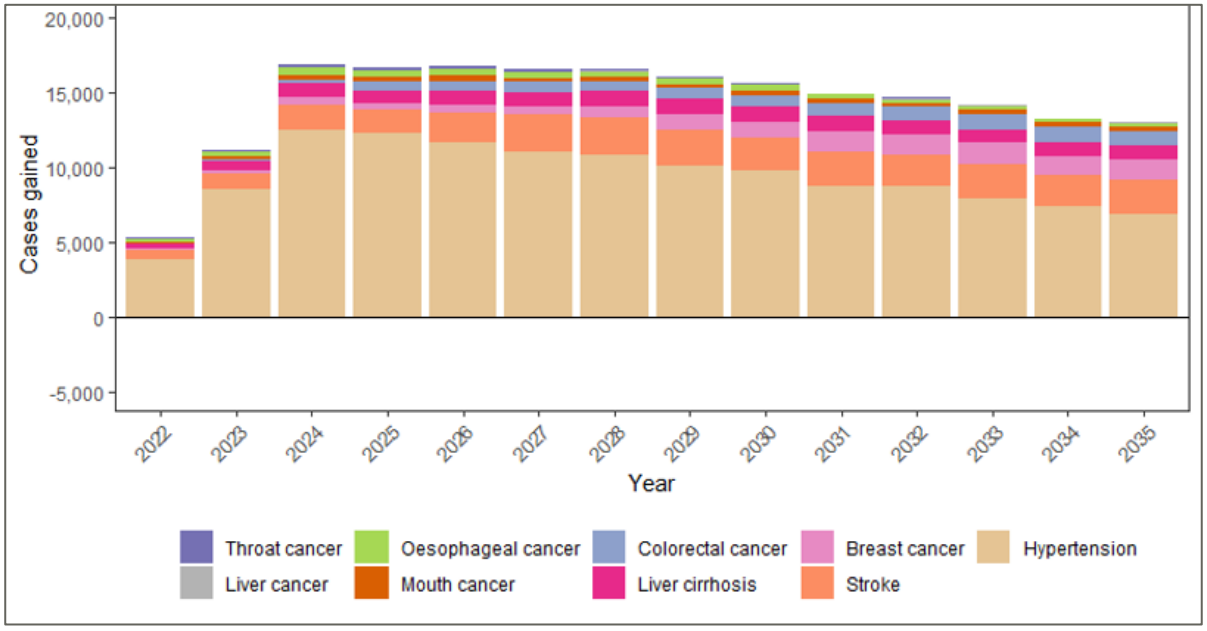
Numbers in bold signify where the confidence limit of a result does not span zero.

Results by socioeconomic status

Under the medium-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2024, the increase in alcohol consumption, during the COVID-19 pandemic, is projected to result in 16,796 additional cumulative incidence cases of disease in the A-C1 population, and 18,300 additional cumulative incidence cases of disease in the C2-E population.

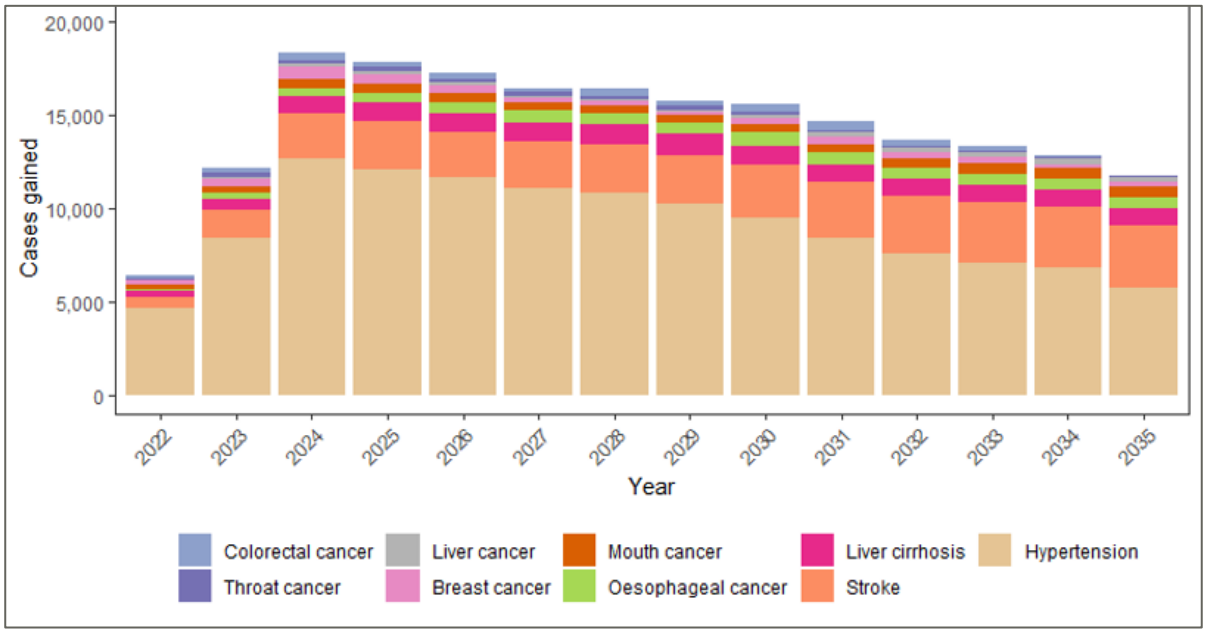
In the A-C1 population, under the medium-term scenario, we project that there will be 12,498 additional incident cases of hypertension, 1,620 new additional incident cases of stroke, 1,759 new additional incident cancers, and 919 new additional incident cases of liver cirrhosis between 2022 and 2024 (Figure 5).

Figure 5. Additional cumulative incidence cases of disease in the A-C1 population, between 2022 and 2035, under the medium-term scenario compared to baseline



In the C2-E population, under the medium-term scenario, we project that there will be 12,632 new additional incident cases of hypertension, 2,394 new additional incident cases of stroke, 2,361 new additional incident cases of cancers, and 913 new additional incident cases of liver cirrhosis between 2022 and 2024 (Figure 6).

Figure 6. Additional cumulative incidence cases of disease in the C2-E population, between 2022 and 2035, under the medium-term scenario compared to baseline



The projected additional cumulative incidence of breast cancer, colorectal cancer, hypertension, liver cancer, mouth cancer and stroke are projected to be higher in the C2-E population than the A-C1 population between 2022 and 2024. Fewer results are statistically significant in the projections for additional cumulative incidence between 2022 and 2035 (Table 6).

Table 6. Additional cumulative incident cases of disease between 2022 and 2024, and between 2022 and 2035, under the medium-term scenario, compared to the baseline scenario

Disease	A-C1 (confidence limit)				C2-E (confidence limit)			
	2022-2024	% Difference*	2022-2035	% Difference**	2022-2024	% Difference*	2022-2035	% Difference**
Breast cancer	**518 (±417)**	+0.7	**1,391 (±927)**	+0.4	**628 (±370)**	+1.0	275 (±836)	+0.1
Colorectal cancer	231 (±375)	+0.4	**911 (±846)**	+0.3	**405 (±347)**	+0.7	55 (±798)	+0.0
Hypertension	**12,498 (±1,213)**	+2.1	**6,904 (±2,669)**	+0.2	**12,632 (±1,085)**	+2.3	**5,786 (±2,428)**	+0.2
Liver cancer	-57 (±139)	-0.7	60 (±314)	+0.2	**157 (±130)**	+2.0	191 (±299)	+0.5
Liver cirrhosis	**919 (±215)**	+5.0	**945 (±471)**	+1.1	**913 (±198)**	+5.1	**957 (±440)**	+1.1
Mouth cancer	**364 (±140)**	+4.7	292 (±308)	+0.8	**515 (±129)**	+6.7	**549 (±289)**	+1.5
Oesophageal cancer	**496 (±168)**	+4.4	215 (±378)	+0.4	**463 (±157)**	+4.1	**585 (±358)**	+1.0
Stroke	**1,620 (±664)**	+0.9	**2,241 (±1,496)**	+0.2	**2,394 (±620)**	+1.3	**3,273 (±1,420)**	+0.4
Throat cancer	207 (±108)	+4.4	-33 (±238)	-0.1	**193 (±100)**	+4.1	110 (±225)	+0.5

Numbers in bold signify where the confidence limit of a result does not span zero. Negative numbers indicate a disease where there is projected to be a reduction in the number of future cases

* Percentage difference in cumulative incidence of disease, intervention compared to baseline, by end of 2024 under the medium-term scenario

** Percentage difference in cumulative incidence of disease, intervention compared to baseline, by end of 2035 under the medium-term scenario

Per 100,000 population, the additional cumulative incidence of disease between 2022 and 2024 is 18% greater in the C2-E population than the A-C1 population. The additional cumulative incidence of cancers per 100,000 is projected to be 29% greater in the C2-E population than the A-C1 population. This analysis was not conducted for the projections of additional cumulative incidence from 2022 to 2035 due to limited statistical significance.

Due to the small sample size when disaggregating by age, sex, and SES these projections could not be interpreted with any amount of certainty so are not presented here.

Long-term scenario

Results for the total population

Under the long-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2035, the increase in alcohol consumption, during the COVID-19 pandemic, is projected to result in 147,892 additional incident cases of diseases between 2022 and 2035 (Figure 7). We project that there will be 99,593 excess incident cases of hypertension, 20,046 excess incident cases of stroke, 18,785 additional incident cases of the cancers, and 9,498 additional incident cases of liver cirrhosis (Table 7). Table 1 and 2 of the results appendix presents the excess cases by age group and sex by 2035.

Table 7

Figure 7. Additional cumulative incidence cases of disease in the total population, between 2022 and 2035, under the long-term scenario compared to the baseline scenario

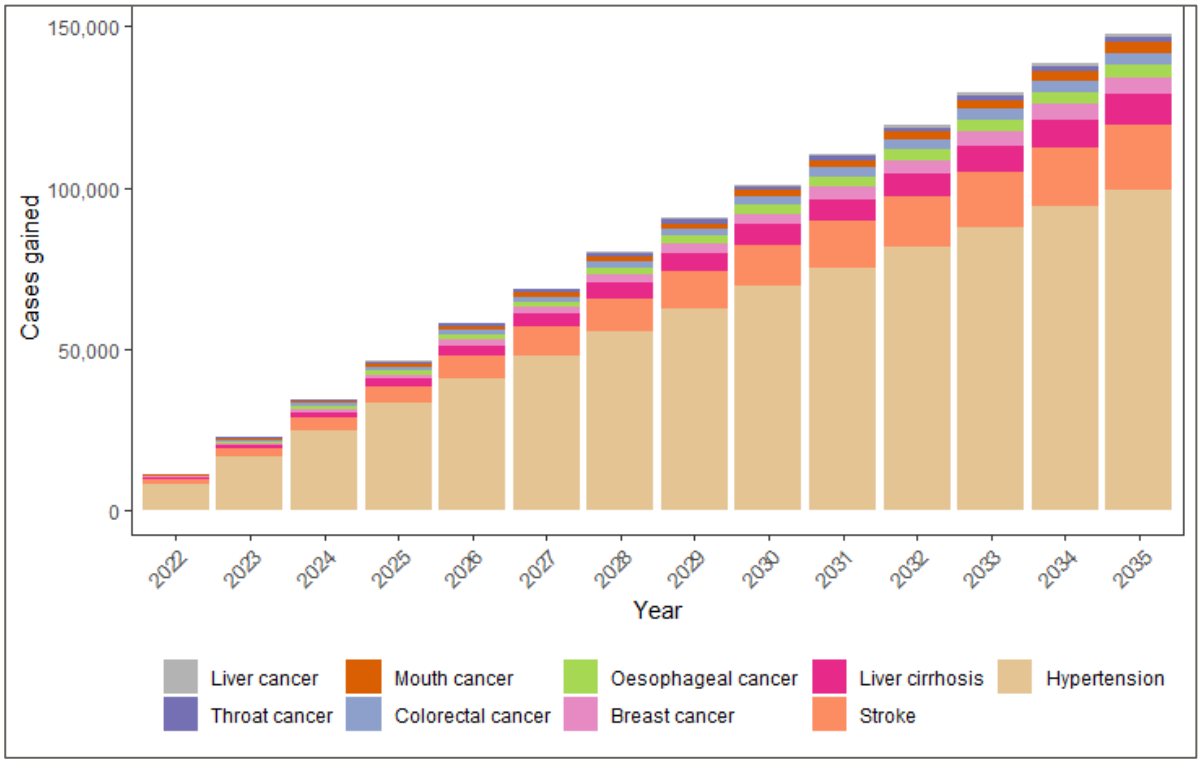


Table 7. Additional cumulative incident cases of disease between 2022 and 2035, under the long-term scenario, compared to the baseline scenario, for the population of England

Disease	Additional cumulative incidence (confidence limit)
Breast cancer	**5,163 (±1,250)**
Colorectal cancer	**3,511 (±1,164)**
Hypertension	**99,563 (±3,622)**
Liver cancer	**1,074 (±435)**
Liver cirrhosis	**9,498 (±652)**
Mouth cancer	**3,359 (±426)**
Oesophageal cancer	**3,955 (±524)**
Stroke	**20,046 (±2,066)**
Throat cancer	**1,723 (±331)**

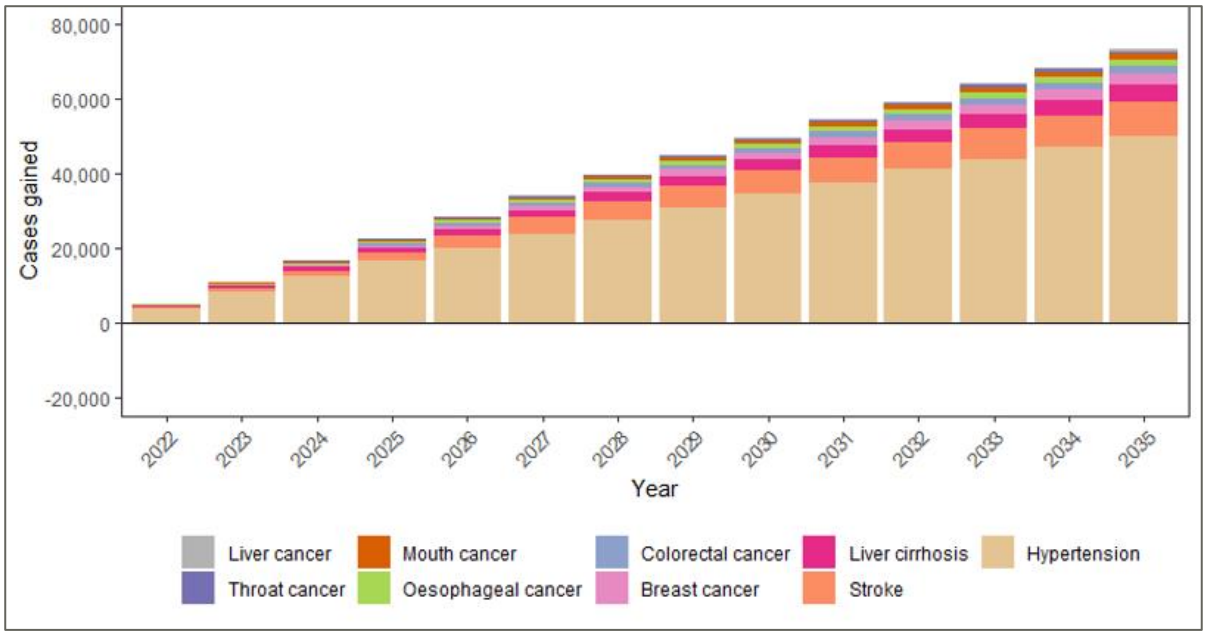
Numbers in bold signify where the confidence limit of a result does not span zero.

Results by socioeconomic status

Under the long-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2035, the increase in alcohol consumption, during the COVID-19 pandemic, is projected to result in 73,019 additional incidence cases of disease in the A-C1 population, and 74,870 in the C2-E population.

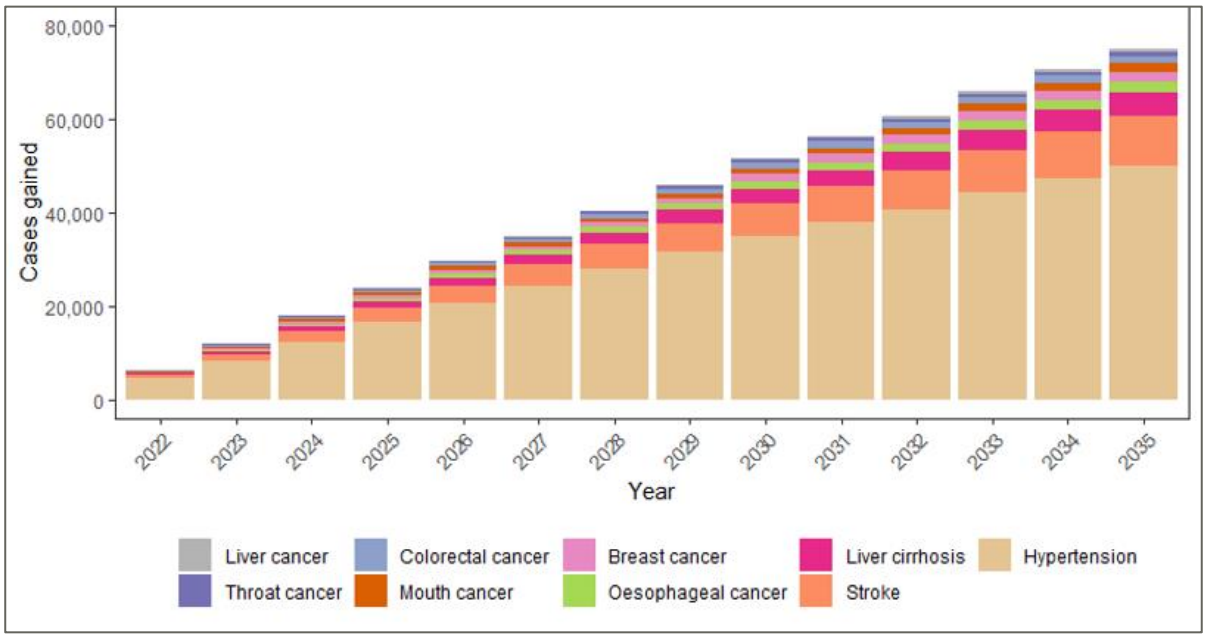
In the A-C1 population, under the long-term scenario, compared to the baseline scenario, we project that there will be 49,747 additional incident cases of hypertension, 9,328 additional incident cases of stroke, 9,432 additional incident cases of modelled cancers, and 4,512 additional incident cases of liver cirrhosis between 2022 and 2035 (Figure 8).

Figure 8. Additional cumulative incidence cases of disease in the A-C1 population, between 2022 and 2035, under the long-term scenario compared to baseline



In the C2-E population, under the long-term scenario, compared to the baseline scenario, we project that there will be 49,816 additional incident cases of hypertension, 10,718 additional incident cases of stroke, 9,351 additional incident cases of modelled cancers, and 4,985 additional incident cases of liver cirrhosis, between 2022 and 2035 (Figure 9).

Figure 9. Additional cumulative incidence cases of disease in the C2-E population, between 2022 and 2035, under the long-term scenario compared to baseline



The projected cumulative incidence of all diseases is significant under the long-term scenario, between 2022 and 2035, although there is no significant difference between the projected additional cumulative incidence of disease in the A-C1 and C2-E populations (Table 8).

Table 8. Additional incident cases of disease between 2022 and 2035, under the long-term scenario, compared to the baseline scenario

Disease	A-C1 (confidence limit)	% Difference*	C2-E (confidence limit)	% Difference*
Breast cancer	**2,951 (±928)**	+0.9	**2,212 (±837)**	+0.7
Colorectal cancer	**2,025 (±847)**	+0.7	**1,486 (±799)**	+0.5
Hypertension	**49,747 (±2,678)**	+1.7	**49,816 (±2,438)**	+1.8
Liver cancer	**523 (±315)**	+1.3	**551 (±300)**	+1.4
Liver cirrhosis	**4,512 (±476)**	+5.1	**4,985 (±445)**	+5.7
Mouth cancer	**1,491 (±311)**	+3.9	**1,867 (±292)**	+5.0
Oesophageal cancer	**1,682 (±380)**	+2.9	**2,272 (±361)**	+3.9
Stroke	**9,328 (±1,498)**	+1.0	**10,718 (±1,423)**	+1.2
Throat cancer	**760 (±240)**	+3.3	**963 (±227)**	+4.2

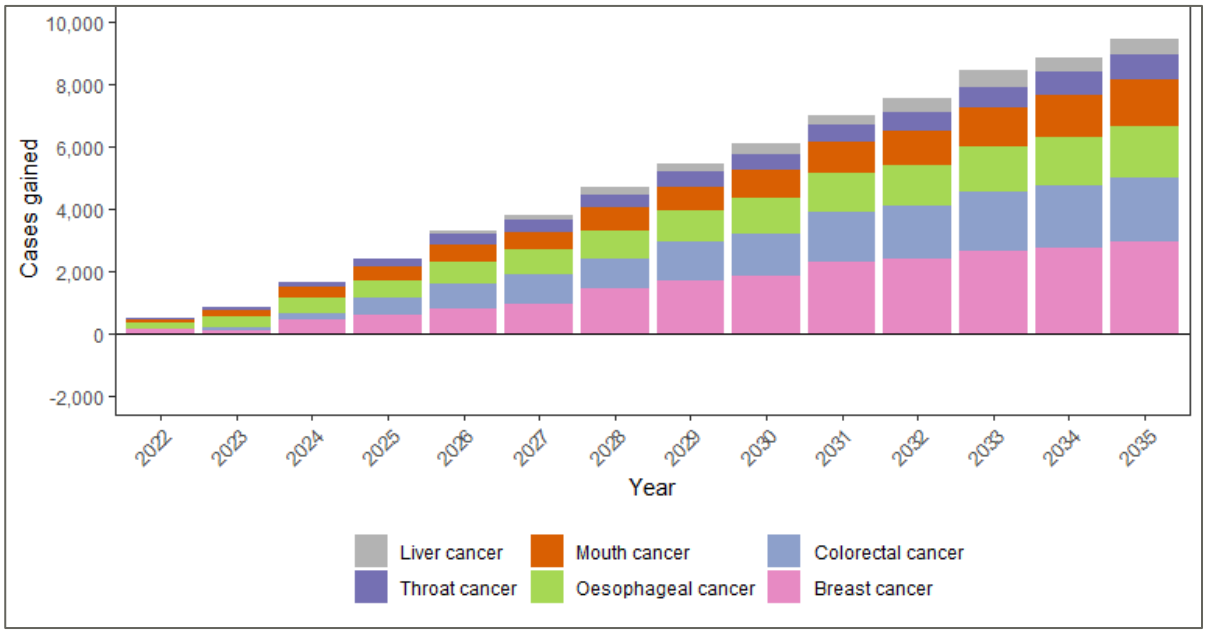
Numbers in bold signify where the confidence limit of a result does not span zero.

* Percentage difference in cumulative incidence of disease, intervention compared to baseline, by end of 2035 under the long-term scenario

Per 100,000 population, the additional cumulative incidence of disease between 2022 and 2035 is 10% greater in the C2-E population than the A-C1 population. The additional cumulative incidence of cancers per 100,000 is projected to be 3% greater in the C2-E population than the A-C1 population.

In the A-C1 population, under the long-term scenario, we project that there will be 7,432 new additional cases of cancer between 2022 and 2035. This includes 2,952 new additional cases of breast cancer, 2,025 new additional cases of colorectal cancer, 523 new additional cases of liver cancer, 1,491 new additional cases of mouth cancer, 1,682 new additional cases of oesophageal cancer, and 760 new additional cases of throat cancer (Appendix 3).

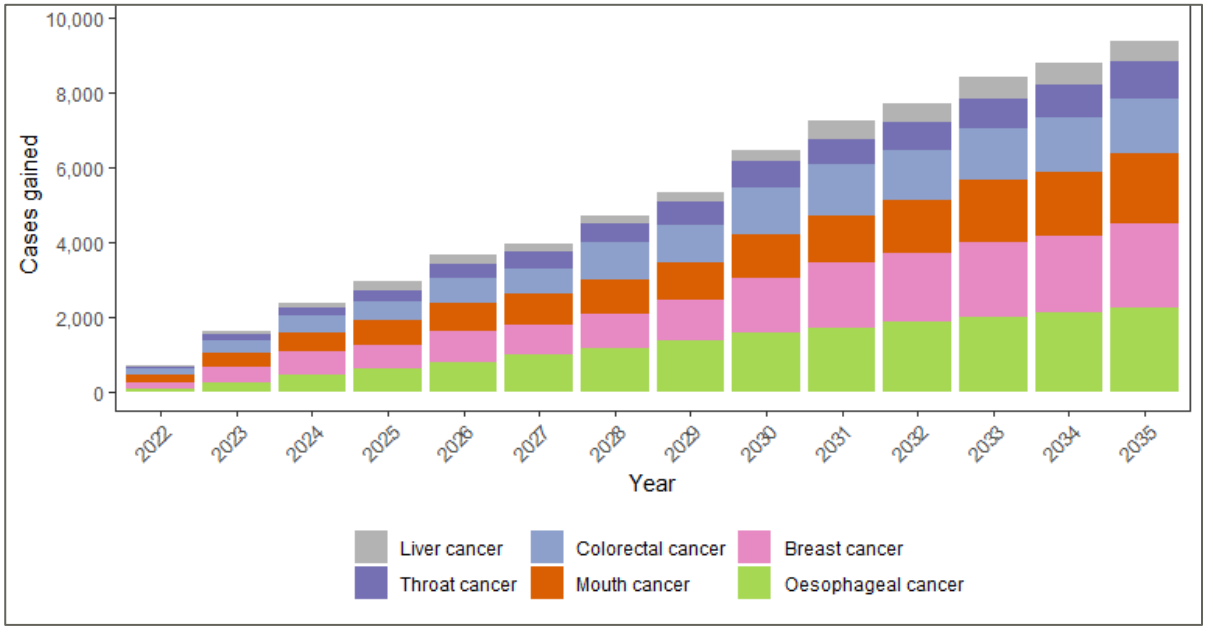
Figure 10. Additional cumulative incidence of cancers in the A-C1 population, between 2022 and 2035, under the long-term scenario compared to baseline



In the C2-E population, under the long-term scenario, we project that there will be 9,351 new additional cases of cancer between 2022 and 2035. This includes 2,212 new additional cases of breast cancer, 1,486 new additional cases of colorectal cancer, 551 new additional cases of liver cancer, 1,867 new additional cases of mouth cancer, 2,272 new additional cases of oesophageal cancer, and 963 new additional cases of throat cancer (Figure 11).

Due to the small sample size when disaggregating by age, sex, and SES these projections could not be interpreted with any amount of certainty so are not presented here.

Figure 11. Additional cumulative incidence of cancers in the C2-E population, between 2022 and 2035, under the long-term scenario compared to baseline



Cancer care

Tumourectomy, radiotherapy and chemotherapy

Under the short-term scenario, compared to the baseline scenario, we project that there will be 550 individuals who will need a tumourectomy; 637 who will need chemotherapy; and 532 who will need radiotherapy. Under the medium-term scenario, compared to the baseline scenario we project that there will be 1,832 individuals who will need a tumourectomy; 1,933 who will need chemotherapy; and 1,554 who will need radiotherapy.

Table 9. Additional number of people projected to require a tumourectomy, chemotherapy, and radiotherapy in the total population of England, under the short and medium-term scenarios, compared to baseline

Cancer type	Tumourectomy			Chemotherapy			Radiotherapy		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
Breast	**326**	**928**	**4182**	**137**	**390**	**1755**	**254**	**722**	**3253**
Colorectal	62	**413**	**2282**	30	**197**	**1088**	3	**19**	**105**
Liver	3	20	**215**	3	24	**258**	1	4	**43**
Mouth	**55**	**141**	**537**	**260**	**659**	**2519**	**118**	**299**	**1142**
Oesophageal	**58**	**182**	**751**	**138**	**431**	**1780**	**58**	**182**	**751**
Throat	**45**	**148**	**638**	**70**	**232**	**999**	**99**	**328**	**1413**

Numbers in bold signify where the confidence limit of a result does not span zero. Results for the short-term scenario are for the year 2022 only. Results for the medium-term scenario are for the years 2022 to 2024. Results for the long-term scenario are for the years 2022 to 2035.

Under the short-term scenario, the majority of people who will need to undergo a tumourectomy or chemotherapy, under the short-term scenario, belong to the C2-E SES group (69% and 63%, respectively), while 62% of the population who are projected to require radiotherapy belong to the A-C1 SES group.

Under the long-term scenario, compared to the baseline scenario, we project that there will be an additional 8,605 people who will need a tumourectomy in their first year of treatment, between 2022 and 2035. The majority of individuals who undergo tumourectomy are those who have breast cancer and colorectal cancer (4,182 and 2,282, respectively). Due to the statistics on the provision of cancer treatments by cancer site, the chance of an individual undergoing a tumour removal surgery for liver, mouth and oesophageal cancers are relatively low (20%, 16%, and 19%, respectively), which is reflected in the projection.

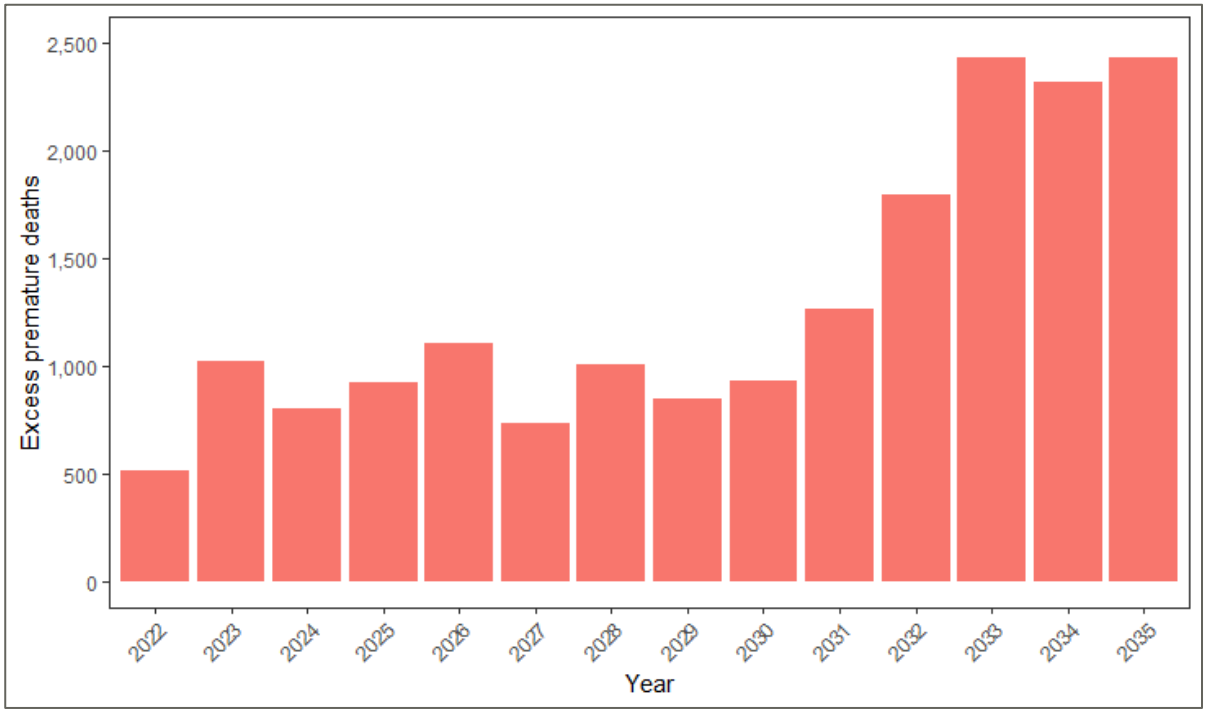
Premature mortality projections

Premature deaths are defined as those that occur before the age of 75.

Short-term scenario

Under the short-term scenario, between 2022 and 2035, we project that there will be 2,431 cumulative premature deaths in England (Figure 12): 621 in the A-C1 population, and 1,810 in the C2-E population. Per 100,000 population, we project that there will be approximately 200% more deaths in the C-2E population than the A-C1 population, between 2022 and 2035, under the short-term scenario.

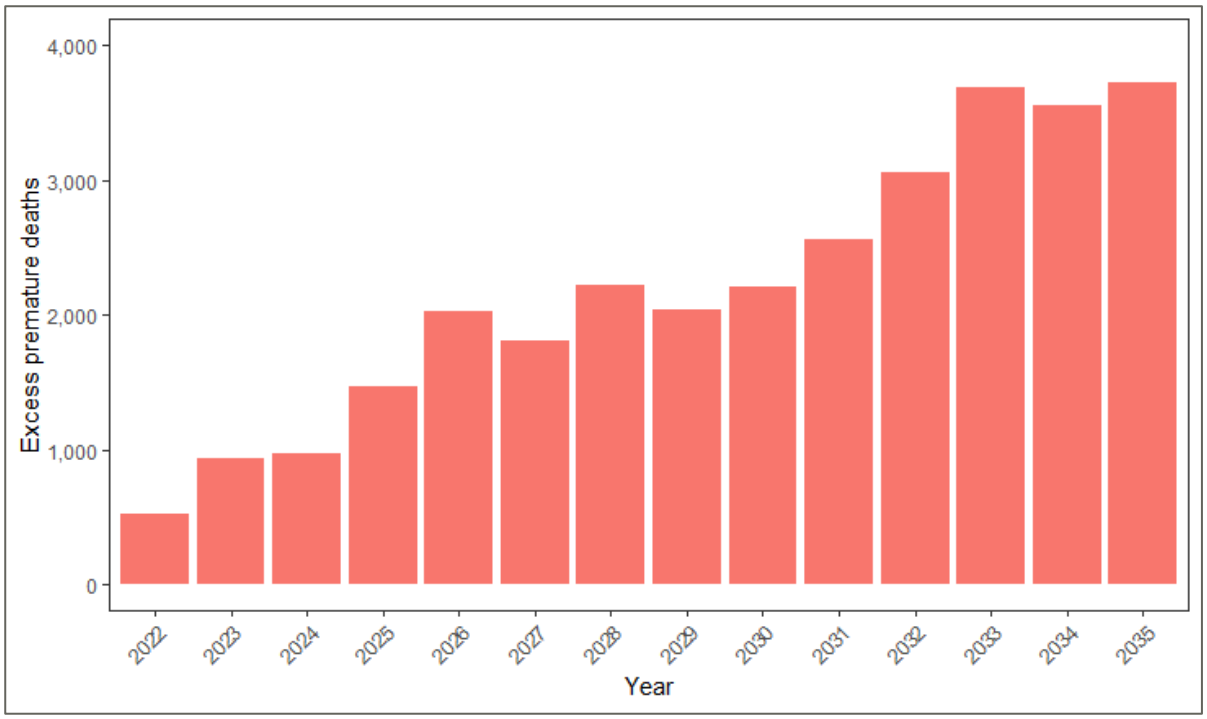
Figure 12. Additional cumulative premature mortality in the population of England, between 2022 and 2035, under the short-term scenario compared to baseline



Medium-term scenario

Under the medium-term scenario, between 2022 and 2035, we project that there will be 3,725 premature deaths in England (Figure 13): 1,118 in the A-C1 population, and 2,606 in the C2-E population. Per 100,000 population, we project that there will be approximately 125% more deaths in the C-2E population than the A-C1 population, between 2022 and 2035, under the medium-term scenario.

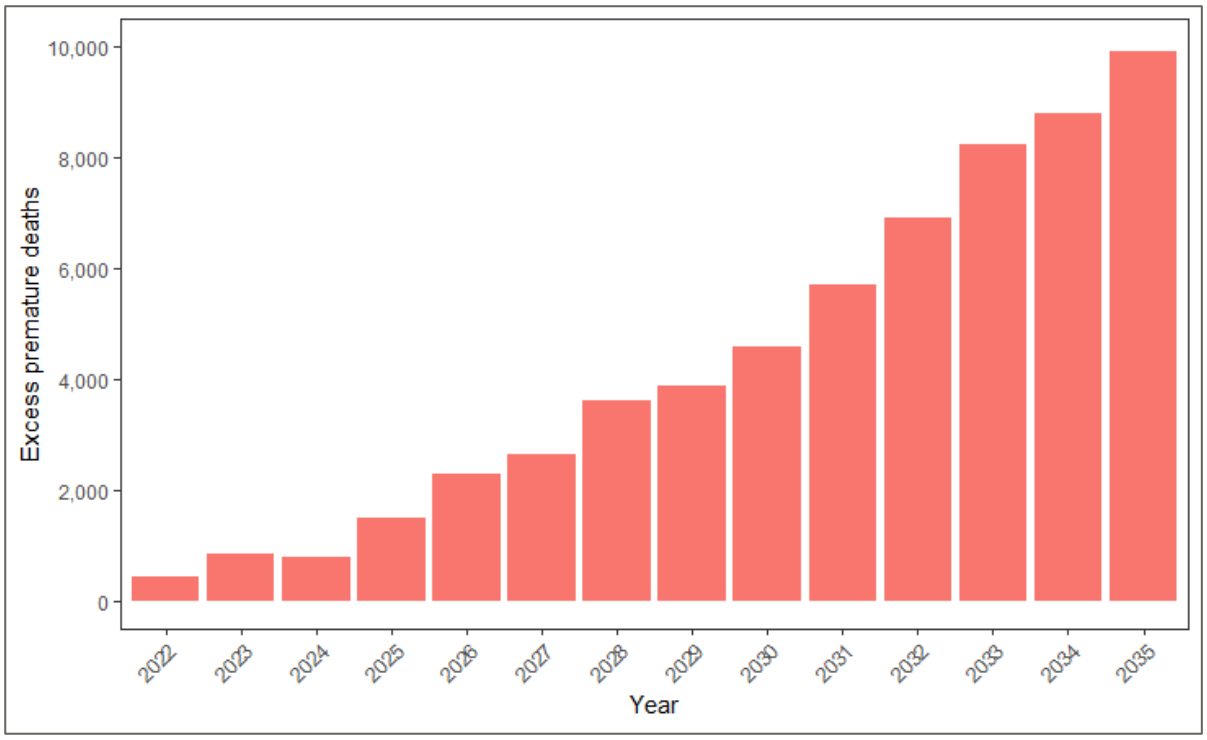
Figure 13. Additional cumulative premature mortality in the population of England, between 2022 and 2035, under the medium-term scenario compared to baseline



Long-term scenario

Under the long-term scenario, between 2022 and 2035, we project that there will be 9,914 premature deaths in England (Figure 14): 4,453 in the A-C1 population, and 5,461 in the C2-E population. Per 100,000 population, we project that there will be approximately 23% more deaths in the C-2E population than the A-C1 population, between 2022 and 2035, under the long-term scenario.

Figure 14. Additional cumulative premature mortality in the population of England, between 2022 and 2035, under the long-term scenario compared to baseline



Economic projections

All results are presented in 2021 GBP (£). The costs incurred in the A-C1 and C2-E populations may not sum to the costs projected in the total population due to rounding. Additional costs are reflective of the additional prevalence of disease in any given year.

Short-term scenario

Under the short-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2022, the increase in alcohol consumption during the COVID-19 pandemic is projected to result in £369 million additional direct healthcare costs between 2022 and 2035 (Figure 15). We project that there will be £144 and £219 million additional direct healthcare costs between 2022 and 2035 in the A-C1 and C2-E populations, respectively (Table 10).

Figure 15. Additional cumulative direct healthcare costs in the population of England, under the short-term scenario, between 2022 and 2035, compared to the baseline scenario

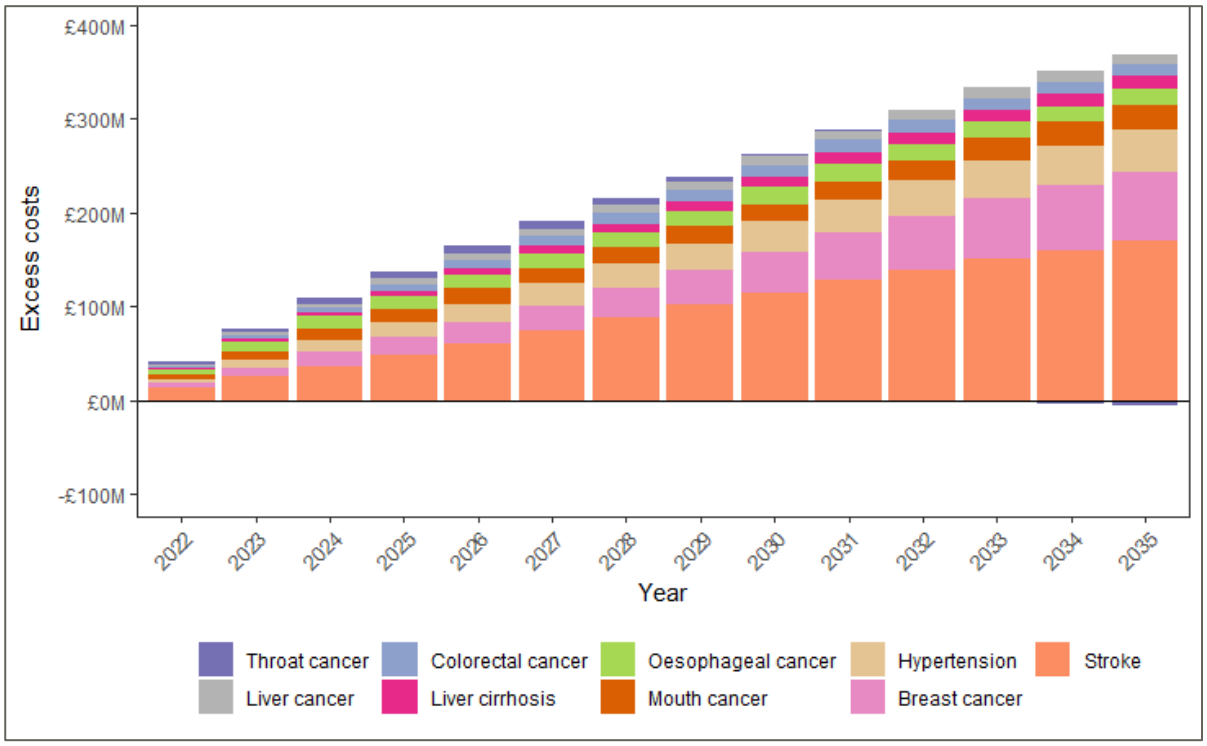


Table 10. Additional cumulative direct healthcare costs in the A-C1 and C2-E population, under the short-term scenario, by 2035, compared to the baseline scenario

Disease	A-C1 excess cost (confidence limit)	C-2E additional cost (confidence limit)	Total additional cost (confidence limit)
Breast cancer	**£31.44M (±£13.26M)**	**£42.30M (±£12.09M)**	**£73.73M (±£17.95M)**
Colorectal cancer	£6.13M (±£12.63M)	£5.74M (±£11.89M)	£11.87M (±£17.34M)
Hypertension	**£16.16M (±£1.79M)**	**£27.96M (±£1.64M)**	**£44.12M (±£2.42M)**
Liver cancer	£1.19M (±£7.91M)	**£10.32M (±£7.53M)**	**£11.51M (±£10.92M)**
Liver cirrhosis	**£6.21M (±£2.45M)**	**£7.49M (±£2.28M)**	**£13.70M (±£3.35M)**
Mouth cancer	**£9.39M (±£6.62M)**	**£17.27M (±£6.20M)**	**£26.66M (±£9.07M)**
Oesophageal cancer	**£4.22M (±£8.85M)**	**£12.89M (±£8.35M)**	**£17.11M (±£12.17M)**
Stroke	**£71.54M (±£17.64M)**	**£98.61M (±£16.75M)**	**£170.15M (±£24.32M)**
Throat cancer	-£2.31M (±£6.20M)	-£3.73M (±£5.82M)	-£6.05M (±£8.51M)

Results in bold indicate where the confidence limit of a projection does not span zero.

Medium-term scenario

Under the medium-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2024, the increase in alcohol consumption during the COVID-19 pandemic is projected to result in £568 million additional direct healthcare costs between 2022 and 2035 (Figure 16). We project that there will be £248 and £320 million additional direct healthcare costs between 2022 and 2035 in the A-C1 and C2-E populations, respectively (Table 11).

Figure 16. Additional cumulative direct healthcare costs in the population of England, under the medium-term scenario, between 2022 and 2035, compared to the baseline scenario

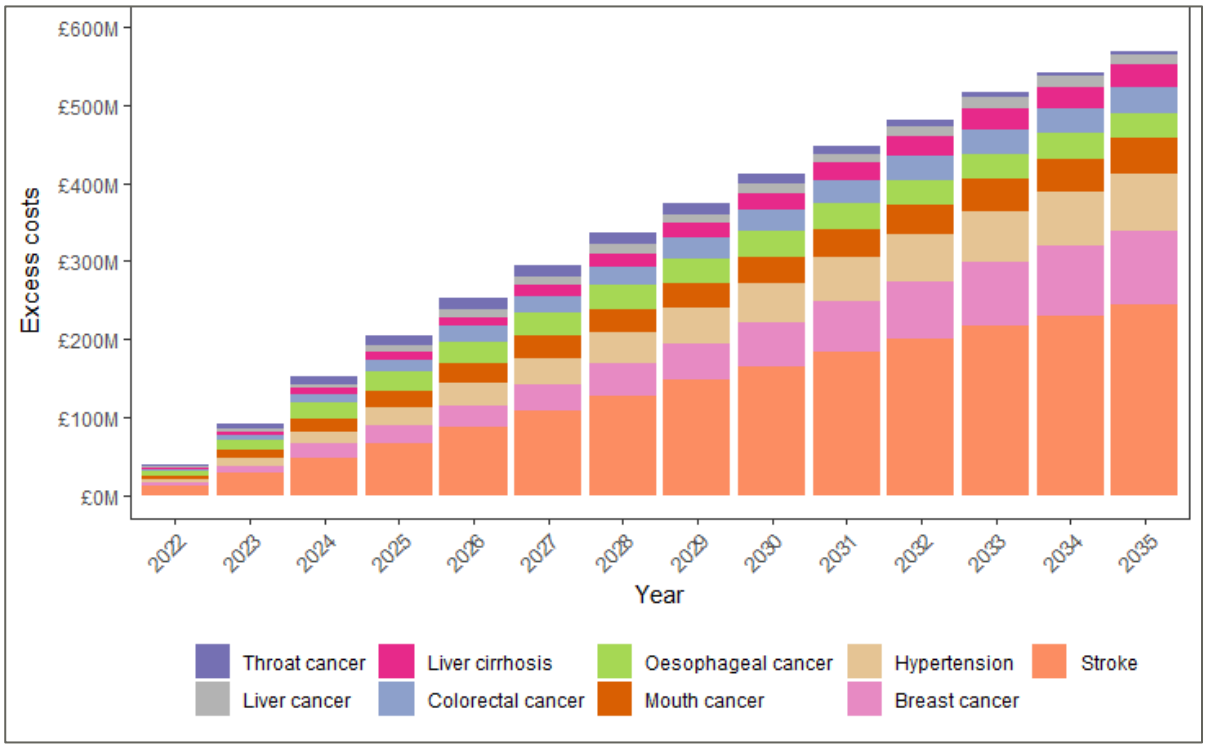


Table 11. Additional cumulative direct healthcare costs in the A-C1 and C2-E population, under the medium-term scenario, by 2035, compared to the baseline scenario

Disease	A-C1 additional cost (confidence limit)	C-2E additional cost (confidence limit)	Total additional cost (confidence limit)
Breast cancer	**£42.92M (±£13.27M)**	**£52.26M (±£12.09M)**	**£95.17M (±£17.95M)**
Colorectal cancer	**£14.83M (±£12.63M)**	**£17.28M (±£11.89M)**	**£32.11M (±£17.35M)**
Hypertension	**£30.37M (±£1.79M)**	**£42.74M (±£1.64M)**	**£73.11M (±£2.42M)**
Liver cancer	£1.22M (±£7.91M)	**£12.35M (±£7.53M)**	**£13.57M (±£10.92M)**
Liver cirrhosis	**£12.86M (±£2.45M)**	**£16.15M (±£2.29M)**	**£29.02M (±£3.35M)**
Mouth cancer	**£19.56M (±£6.63M)**	**£26.06M (±£6.21M)**	**£45.63M (±£9.08M)**
Oesophageal cancer	**£11.84M (±£8.86M)**	**£20.49M (±£8.36M)**	**£32.33M (±£12.18M)**
Stroke	**£111.71M (±£17.64M)**	**£131.79M (±£16.75M)**	**£243.50M (±£24.33M)**
Throat cancer	£2.46M (±£6.21M)	£0.68M (±£5.83M)	£3.15M (±£8.52M)

Results in bold indicate where the confidence limit of a projection does not span zero

Long-term scenario

Under the long-term scenario, which assumes that alcohol consumption patterns in 2020 and 2021 continue to 2035, the increase in alcohol consumption during the COVID-19 pandemic is projected to result in £1.239 billion additional direct healthcare costs between 2022 and 2035 (Figure 17). We project that there will be £576 and £663 million additional direct healthcare costs between 2022 and 2035 in the A-C1 and C2-E populations, respectively (Table 12).

Figure 17. Additional cumulative direct healthcare costs in the population of England, under the long-term scenario, between 2022 and 2035, compared to the baseline scenario

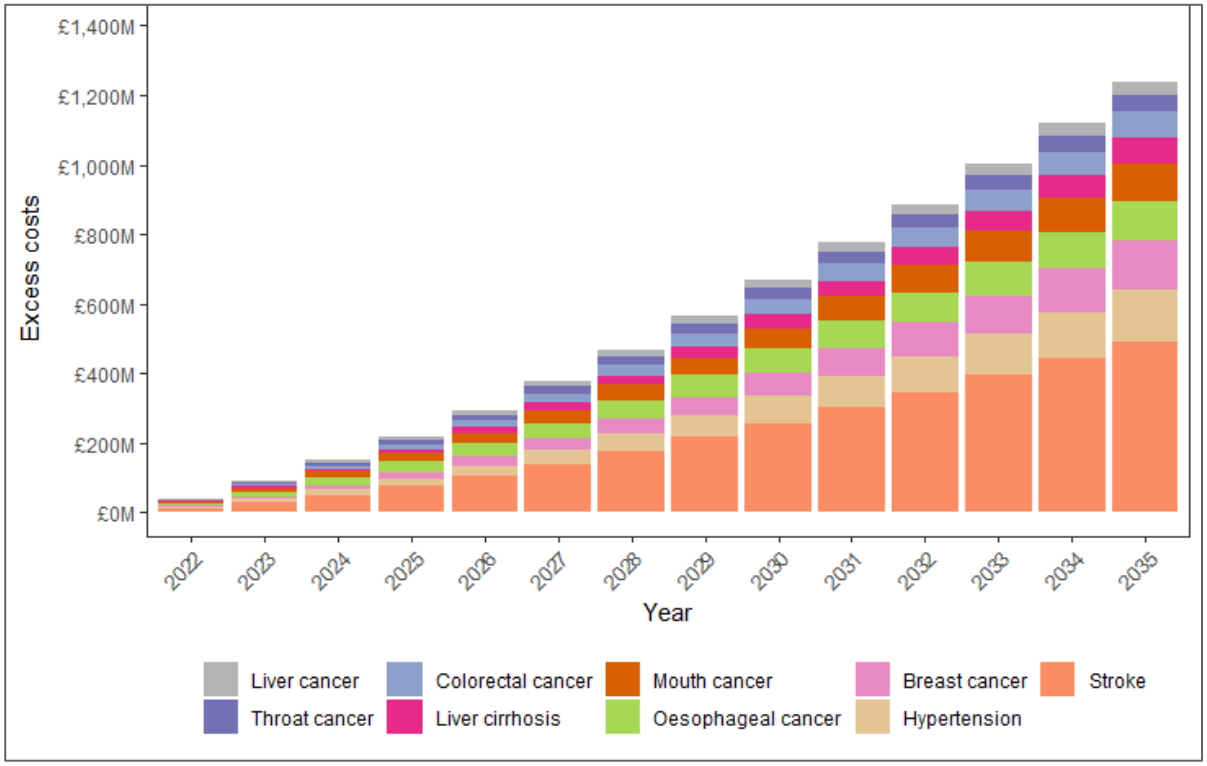


Table 12. Additional cumulative direct healthcare costs in the A-C1 and C2-E population, under the long-term scenario, by 2035, compared to the baseline scenario

Disease	A-C1 additional cost (confidence limit)	C2-E additional cost (confidence limit)	Total additional cost (confidence limit)
Breast cancer	**£56.70M (±£13.27M)**	**£81.79M (±£12.10M)**	**£138.49M (±£17.96M)**
Colorectal cancer	**£32.38M (±£12.64M)**	**£39.91M (±£11.90M)**	**£72.29M (±£17.36M)**
Hypertension	**£68.33M (±£1.79M)**	**£81.93M (±£1.64M)**	**£150.26M (±£2.43M)**
Liver cancer	**£13.48M (±£7.94M)**	**£23.08M (±£7.55M)**	**£36.56M (±£10.95M)**
Liver cirrhosis	**£36.10M (±£2.46M)**	**£40.17M (±£2.30M)**	**£76.28M (±£3.37M)**
Mouth cancer	**£50.98M (±£6.66M)**	**£58.78M (±£6.25M)**	**£109.76M (±£9.13M)**
Oesophageal cancer	**£50.88M (±£8.91M)**	**£61.44M (±£8.41M)**	**£112.32M (±£12.25M)**
Stroke	**£243.47M (±£17.66M)**	**£249.32M (±£16.77M)**	**£492.79M (±£24.36M)**
Throat cancer	**£23.74M (±£6.25M)**	**£26.23M (±£5.87M)**	**£49.97M (±£8.58M)**

Results in bold indicate where the confidence limit of a projection does not span zero.

Discussion

Summary of findings

This microsimulation modelling study quantified potential future health and economic impacts of changes in alcohol consumption patterns throughout the COVID-19 pandemic on nine non-communicable diseases (hypertension, stroke, liver cirrhosis, breast cancer, colorectal cancer, liver cancer, mouth cancer, oesophageal cancer, and throat cancer) depending on how long changes in alcohol consumption persist (until 2022, 2024, and 2035 in the modelled scenarios).

We projected that the changes in alcohol consumption patterns in 2020 and 2021 will result in a significantly increased health and economic burden of alcohol-related diseases, which grew in magnitude as the length of the modelled scenarios increased. We projected that there will be 11,661 additional incident cases of disease under the short-term scenario; 35,095 additional cumulative incidence cases of disease under the medium-term scenario; and 147,892 additional cumulative incidence cases of disease under the long-term scenario, compared to the baseline scenario. The increase in premature mortality is projected to be greater among the more disadvantaged occupational group. In addition, under the short-term scenario, we projected significant increases in cancer treatments in 2022 alone, with 2,338 individuals needing chemotherapy or radiotherapy, and 550 requiring a tumour removal surgery.

Within England, these findings are consistent with the real-world increases already observed in alcoholic liver disease emergency hospital admissions [1] and alcohol-specific deaths [1]. The increase in alcohol-specific deaths has been observed in all four home nations of the UK, to different extents [39]. Latest figures supplied by the Office for Health Disparities (OHID) suggest that the upward trends in recent years for deaths associated with alcoholic liver disease and mental and behavioural disorders due to alcohol have continued since the beginning of the COVID-19 pandemic (see results appendix) [40].

Implications of this study

All of the health outcomes modelled to 2035 are chronic non-communicable diseases which develop over many years, meaning the changes in alcohol harm are not inevitable and can be prevented.

Alcohol-related mortality rates in the most deprived group are 70% higher than those in the least deprived group, and alcohol-specific mortality rates in the most deprived group are 2.4 times those in the least [41]. The north of England has higher rates of alcohol-related and alcohol-specific mortality than the south [41]. The increase in alcohol specific deaths that has occurred since May 2020 onwards has also been concentrated in more deprived groups [15]. Preventing alcohol harm will contribute to narrowing inequalities. There is growing recognition that inequalities and their upstream causes must be addressed. For example, the House of Commons Health and Social Care, and Science and Technology Committees' 'lessons learned' report in October 2021 stated "existing social, economic and health inequalities were

exacerbated by the pandemic" [42]. This is now compounded by the imminent cost of living crisis arising due to rising energy costs alongside inflation measured at 6.2%, the highest levels for 30 years [43]. Averting alcohol harm will also reduce the alcohol-related workload for the NHS, meaning money can be saved and resources can be used elsewhere to benefit patients.

PHE's 2016 evidence review concluded several policies would be effective and cost-effective in reducing harm from alcohol. Firstly, combining an increase in taxation alongside the introducing minimum unit pricing was estimated to lead to substantial reductions in harm as well as increased government revenue. Secondly, reducing alcohol availability through reducing the hours it is available for sale can substantially reduce alcohol-related harm in the night-time economy, and this is cost-effective when it is enforced and targeted at the most densely populated areas. Thirdly, enforcing legislative measures to prevent drink-driving are effective and cost-effective. Finally, in terms of treatment and support, identification and intervention for drinkers at risk of harm and specialist treatment for harmful or dependent drinkers reduce consumption and harm in these groups [25]. PHE later estimated that every £1 invested in treatment has a return on investment of £3 [44].

Similarly, increased taxation, advertising restrictions, and reducing availability through reducing hours of sale are the World Health Organisation's (WHO) 'best buy' policies for reducing the harmful use of alcohol and also form part of their 'SAFER' alcohol control initiative [45]. A recent Organisation for Economic Co-operation and Development report concluded that policies to tackle harmful alcohol consumption are cost-effective and provide an excellent return on investment [46].

Evidence-based policies to reduce harm from alcohol such as those identified by PHE and WHO can also contribute to broader current Government priorities, such as improving productivity, 'levelling up' and reducing inequalities, NHS improvement and economic recovery through offering a return on investment or being low cost and having the potential to generate revenue. Whole population policies can disproportionately impact heavier drinkers in disadvantaged groups, for example minimum pricing impacts alcohol consumption among harmful drinkers on low incomes the most, leading to the greatest health gains for this group [47]. These policies also do not have to be detrimental to the hospitality sector in its recovery from the pandemic. Cuts and freezes to alcohol duty are of little benefit for pubs and hospitality [48] and minimum unit pricing is unlikely to have an impact on the on-trade either [46].

Strengths of this study

First, this study makes a valuable contribution to our understanding of the potential impacts of the COVID-19 pandemic on alcohol consumption and alcohol-related harm. Few studies have previously investigated differences in alcohol-related harm between socioeconomic groups in terms of health, mortality, and direct costs. This report therefore represents an important step in highlighting the need to address post-pandemic alcohol-related health inequalities in England by providing an overview of the impact changes in alcohol consumption will have into the future.

Second, this study utilised a well-validated microsimulation modelling approach which enables the projection of increased alcohol consumption in millions of individuals over time (rather than groups/cohorts using weighted averages, as in many studies). This allows for differences in disease incidence, prevalence, mortality, and costs to be identified between sexes and age groups.

Third, we leveraged the flexibility of the microsimulation model to account for uncertainty surrounding the future course of changes in alcohol consumption by modelling three short-, medium-, and long-term scenarios for a return to pre-pandemic drinking levels. It was also possible to examine the consequence of changes for a subset of the population.

Fourth, by undertaking extensive literature reviews, we have utilised the best available, nationally representative data for the epidemiological, healthcare and cost outputs. One distinctive advantage of our modelling approach is the potential to account the risks associated with multiple conditions in the same individual.

Fifth, the use of the ATS in this study is a strength because the data have been collected consistently and frequently before and throughout the pandemic, which is a distinct advantage over other alcohol consumption surveys in the UK.

Limitations of this study

First, this study represents only some aspects of alcohol-related harm in England. Nine alcohol-related conditions were modelled, but almost 200 diseases are linked to alcohol consumption. However, given that an attempt to model all diseases influenced by alcohol consumption would not be feasible, this study presents projections for a range of diseases that have been strongly connected with alcohol consumption, and which contribute significantly to alcohol-related harm in England, such as liver disease [1]. In addition, a strong link exists between high alcohol consumption and risk for some mental health conditions [49-51], quality of life [52, 53], and a wider negative social outcomes, such as suicide [54] and domestic violence [55]. We conducted a literature review to identify evidence and data to include a wider range of outcomes in the microsimulation model, including mental health, however, there was a lack of data in this area, preventing the modelling of these outcomes. Nevertheless, the model is flexible enough to include these outcomes when more data become available. This work highlights the impact of changes in alcohol consumption on some alcohol-related health outcomes, but not all, so our results our results are likely an underestimate of the full extent of alcohol harm as high levels of alcohol consumption may contribute to other health outcomes in ways that are difficult to capture in the data.

Secondly, as a result of the pandemic, the mode of the ATS was changed from April 2020 onwards from face-to-face interviews to a telephone questionnaire. There is evidence that survey mode can influence measurement of alcohol consumption [56]. However, prior research using the ATS investigated the comparability of the telephone and face-to-face survey modes in a sensitivity analysis, and concluded that it would be reasonable to compare

data from before and after the lockdown in England [4]. In addition, the assumption that high risk alcohol consumption has increased since the onset of the pandemic is corroborated by changes in alcohol-related harm from 2020 onwards. As with most surveys, it is possible that very heavy and dependent drinkers are under-represented in the ATS. The impact of this is unclear but projections from the model would likely be worse if this were possible to fully account for. The policy recommendations, particularly increased resources for alcohol treatment and support, still hold relevance for people experiencing multiple disadvantage such that they aren't represented in survey data.

Thirdly, while the microsimulation model accounted for changes in the demographic composition of the population between 2022 and 2035, we did not explore the impact of continuing secular trends in alcohol consumption. For example, a decline in alcohol consumption amongst young people in the UK has been documented over the past two decades [57]. Nevertheless, this decline is known to have plateaued amongst certain groups in recent years [58]. In addition, the alcohol-related diseases modelled as part of this study are chronic and largely occur from middle-age onwards. The impact on our findings of ongoing trends in alcohol consumption among young people would therefore be mitigated to some extent by these factors.

Conclusion

This study quantified potential future health and economic impacts of changes in alcohol consumption patterns throughout the COVID-19 pandemic. We projected that the changes in alcohol consumption patterns in 2020 and 2021 will result in a significantly increased health and economic burden of alcohol-related diseases. This burden was greater in the medium-term and long-term alcohol consumption scenarios, compared with the short-term scenario.

The indirect effects of the pandemic, such as changes in alcohol-related harm, cannot be ignored in COVID-19 recovery planning. Action is needed through a comprehensive alcohol strategy, to harmonise policies across the UK, with a coherent set of policies to prevent avoidable ill health and reduce the impact on the healthcare system and save money.

Based on current evidence, this can be achieved through: increased resources for alcohol treatment and support; price interventions through the new alcohol duty system, which will be introduced in 2023 [59]; the introduction of minimum unit pricing in England; adding public health as an objective of the licensing system for alcohol outlets, and; improving the approach to regulating alcohol marketing, to reduce the reach and appeal of marketing to those vulnerable.

These policies to reduce alcohol harm can complement other ongoing policy agendas around narrowing socio-economic and regional inequalities. They offer return on investment, or are low cost or can generate revenue, contributing to the health, social and economic recovery from the pandemic.

References

1. Public Health England. *Monitoring alcohol consumption and harm during the COVID-19 pandemic: report*. GOV.UK 2021.
2. Institute of Alcohol Studies, *Alcohol consumption during the COVID-19 lockdown: summary of emerging evidence from the UK*. 2020.
3. University College London, *Alcohol Toolkit Study (ATS)*, Ipsos Mori, Editor. 2022.
4. Jackson, S.E., et al., *Moderators of changes in smoking, drinking and quitting behaviour associated with the first COVID-19 lockdown in England.* Addiction (Abingdon, England), 2021.
5. Anderson, P., et al., *The COVID-19 alcohol paradox: British household purchases during 2020 compared with 2015-2019.* PLoS ONE, 2022. **17**(1): p. e0261609.
6. *Twitter @VictimOfMaths* https://twitter.com/victimofmaths/status/1468158537658511361?s=21. 2021 07/12/2021.
7. HM Revenue & Customs. *Alcohol Bulletin*. GOV.UK 2021 30/11/2021.
8. NHS England. *Statistics » A&E Attendances and Emergency Admissions 2020-21*. 2020 2020-07.
9. NHS England, *Statistical Press Notice. Statistics » Monthly Hospital Activity*. 2020.
10. National Drug Treatment Monitoring System. *NDTMS monthly report summary - June 2020*. 2020 2020-07.
11. NHS England. *Statistical commentary A&E October 2021. Statistics » A&E Attendances and Emergency Admissions 2021-22*. 2021
12. NHS England. *Statistical Press Notice NHS Outpatient Referrals, November 2021. Statistics » Consultant-led Outpatient Referrals*. 2022 2022-01-13.
13. NHS England. *Statistical Press Notice - NHS referral to treatment (RTT) waiting times data November 2021. Statistics » Consultant-led Referral to Treatment Waiting Times*. 2022 2022-01-13.
14. NHS England. *Statistical Note: Ambulance Quality Indicators (AQI). Statistics » Ambulance Quality Indicators Data 2021-22*. 2022 2022-01-13.
15. Office for Health Improvement and Disparities. *Wider Impacts of COVID-19*.
16. Webber, L., et al., *The future burden of obesity-related diseases in the 53 WHO European-Region countries and the impact of effective interventions: A modelling study.* BMJ Open, 2014. **4**(7): p. e004787-e004787.
17. Pimpin, L., et al., *Estimating the costs of air pollution to the National Health Service and social care: An assessment and forecast up to 2035.* PLOS Medicine, 2018. **15**(7): p. e1002602.
18. Pérez-Ferrer, C., et al., *Inequalities in smoking and obesity in Europe predicted to 2050: Findings from the EConDA project.* Scandinavian Journal of Public Health, 2018. **46**(5): p. 530-540.
19. Retat, L., et al., *Screening and brief intervention for obesity in primary care: Cost-effectiveness analysis in the BWeL trial.* International Journal of Obesity, 2019. **43**(10): p. 2066-2075.
20. Courbould, E., et al., *Making conversations count. The health and economic benefits of improving smoking cessation support in UK general practice*. 2020, Cancer Research UK.
21. Office for Health Improvement and Disparities, O. *Alcohol: applying All Our Health*. Guidance 2022 [cited 2022 19/05/2022]; Available from: https://www.gov.uk/government/publications/alcohol-applying-all-our-health/alcohol-applying-all-our-health.

22. National Readership Survey. *Social Grade*. 2022 [cited 2022 21/01]; Available from: https://www.nrs.co.uk/nrs-print/lifestyle-and-classification-data/social-grade/.
23. Office For National Statistics, *Population projections - England*. 2018.
24. Office for National Statistics, *2011 Census Statistics*. 2011, NOMIS.
25. Public Health England. *The public health burden of alcohol and the effectiveness and cost-effectiveness of alcohol control policies: evidence review*. GOV.UK 2016 2016.
26. Cancer Research UK. *Cancer statistics for the UK*. 2022 [cited 2022 January 27th]; Available from: https://www.cancerresearchuk.org/health-professional/cancer-statistics-for-the-uk.
27. Bagnardi, V.R., M; Botteri, E; Tramacere, I; Islami, F; Fedirko, V; Scotti, L; Jenab, M; Turati, F; Pasquali, E; Pelucchi, C; Galeone, C; Bellocco, R; Negri, E; Corrao, G; Boffetta, P; La Vecchia, C, *Alcohol consumption and site-specific cancer risk: A comprehensive dose–response meta-analysis.* British Journal of Cancer, 2015. **112**(3): p. 580-593.
28. Laudicella, M., et al., *Cost of care for cancer patients in England: evidence from population-based patient-level data.* British Journal of Cancer, 2016. **114**(11): p. 1286-1292.
29. McEwan, P.W., S; Ward, T; Brenner, M; Kalsekar, A; Yuan, Y, *Estimating the cost-effectiveness of daclatasvir + sofosbuvir versus sofosbuvir + ribavirin for patients with genotype 3 hepatitis C virus.* Cost Effectiveness and Resource Allocation, 2017. **15**(15).
30. Speight, P.P., S; Moles, D; Downer, M; Smith, D; Henriksson, M; Augustovski, F, *The cost-effectiveness of screening for oral cancer in primary care.* Health Technology Assessment, 2006. **10**(14): p. 1-144.
31. Agus, A.M., et al., *Description and predictors of hospital costs of oesophageal cancer during the first year following diagnosis in Northern Ireland.* Eur J Cancer Care (Engl), 2013. **22**(4): p. 450-458.
32. Constanti, M.F., C; Glover, M; Boffa, R; Wierzbicki, A; McManus, R, *Cost-effectiveness of initiating pharmacological treatment in stage one hypertension based on 10-year cardiovascular disease risk.* Hypertension, 2020. **77**(2).
33. Lovibond, K.J., S; Barton, P; Caulfield, M; Heneghan, C; Hobbs, R; Hodgkinson, J; Mant, J; Martin, U; Williams, B; Wonderling, D; McManus, R, *Cost-effectiveness of options for the diagnosis of high blood pressure in primary care: A modelling study.* The Lancet, 2011. **378**(9798): p. 1219-1230.
34. Tanajewski, L.H., R; Harman, D; Aithai, G; Card, T; Gkountouras, G; Berdunov, V; Guha, I; Elliott, R, *Economic evaluation of a community-based diagnostic pathway to stratify adults for non-alcoholic fatty liver disease: A Markov model informed by a feasibility study.* BMJ Open, 2017. **7**(6).
35. Ward, S., et al., *A systematic review and economic evaluation of statins for the prevention of coronary events.* Health Technology Assessment, 2007. **11**(14).
36. UK, C.R. *Cancer statistics for the UK*. 2022 [cited 2022 January 27th]; Available from: https://www.cancerresearchuk.org/health-professional/cancer-statistics-for-the-uk.
37. *Statistics by cancer type*, C.R. UK, Editor. 2019.
38. Laudicella, M., et al., *Cost of care for cancer patients in England: evidence from population-based patient-level data*, in *British Journal of Cancer*. 2016. p. 1286-1292.
39. Office for National Statistics. *Alcohol-specific deaths in the UK*. 2021 07/12/2021.
40. Office for Health Improvement and Disparities, *Personal communication, Professor Nick Sheron*, HealthLumen, Editor. 11th March 2022.

41. Public Health England. *Alcohol-related mortality: New method & Alcohol specific mortality. Local Alcohol Profiles for England*. 2021 2021.
42. House of Commons Health and Social Care and Science and Technology Committees. *Coronavirus: lessons learned to date report published - Committees - UK Parliament*. 2021 12/10/2021.
43. Office for National Statistics. *Inflation and price indices*. 2022 2022-01-19.
44. Public Health England. *Alcohol and drug prevention, treatment and recovery: why invest?* GOV.UK 2018 2018.
45. World Health Organization. *The SAFER Initiative: A world free from alcohol harm*. 2018 2018.
46. Organisation for Economic Co-operation and Development, *Preventing Harmful Alcohol Use: OECD Health Policy Studies*. 2021.
47. Holmes, J., et al., *Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study.* The Lancet, 2014. **383**(9929): p. 1655-1664.
48. Institute of Alcohol Studies, *October 2021 Budget Analysis*. 2021.
49. Gémes, K., et al., *Moderate alcohol consumption and depression – a longitudinal population-based study in Sweden.* Acta Pyschiatrica Scandinavia, 2019. **139**(6): p. 526-535.
50. Britton, A., L.N. Fat, and A. Neligan, *The association between alcohol consumption and sleep disorders among older people in the general population.* Scientific Reports, 2020. **10**(1).
51. Jordaan, G.P. and R. Emsley, *Alcohol-induced psychotic disorder: a review.* Metabolic Brain Disease, 2014. **29**(2): p. 231-243.
52. Srivastava, S. and M. Bhatia, *Quality of life as an outcome measure in the treatment of alcohol dependence.* Ind Psychiatry J, 2013. **22**(1): p. 41-46.
53. Kim, K. and J.-S. Kim, *The Association between Alcohol Consumption Patterns and Health-Related Quality of Life in a Nationally Representative Sample of South Korean Adults.* PLOS ONE, 2015. **10**(3): p. e0119245.
54. Darvishi, N., et al., *Alcohol-Related Risk of Suicidal Ideation, Suicide Attempt, and Completed Suicide: A Meta-Analysis.* PLOS ONE, 2015. **10**(5): p. e0126870.
55. Wilson, I.M., K. Graham, and A. Taft, *Alcohol interventions, alcohol policy and intimate partner violence: a systematic review.* BMC Public Health, 2014. **14**(1): p. 881.
56. Link, M. and A. Mokdad, *Effects of survey mode on self-reports of adult alcohol consumption: a comparison of mail, web and telephone approaches.* J Stud Alcohol, 2005. **66**(2): p. 239-245.
57. Oldham, M., et al., *The decline in youth drinking in England—is everyone drinking less? A quantile regression analysis.* Addiction, 2020. **115**(2): p. 230-238.
58. Shipton, D., B. Whyte, and D. Walsh, *Alcohol-related mortality in deprived UK cities: worrying trends in young women challenge recent national downward trends.* Journal of Epidemiology and Community Health, 2013. **67**(10): p. 805-812.
59. HM Revenue & Customs and HM Treasury, *The new alcohol duty system*. 2021.