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Updating England-Specific Alcohol-Attributable Fractions

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Table of Contents

Table of Figures

Table of Tables

Abbreviations

AAF Alcohol-Attributable Fraction

GLF General Lifestyle Survey

ICD10 International Classification of Diseases 10th Revision

LAPE Local Alcohol Profiles for England

PYLL Potential years of life lost

RR Relative risk

Glossary

Alcohol-Attributable Fraction Indicates the proportion of a disease or injury that could be prevented if exposure to alcohol was eliminated.

Binge drinking Drinking more than eight units for men and more than six units for women on a single drinking occasion.

Current drinker A person who has drunk alcohol within the last 12 months.

Former drinker A person who is not a current drinker but who has drunk alcohol in the past.

Gamma distribution A two parameter family of continuous probability distributions, with a shape (α) parameter and rate (β) parameter.

Lifetime abstainer A person who has never drank alcohol.

Meta-analysis A statistical procedure for pooling the findings from individual research studies.

Partially attributable condition A condition where alcohol is a component cause in its development e.g. hypertensive diseases.

Probability density function Characterises the distribution of a continuous random variable.

Relative risk Relative measure of risk estimating the size of the association between an exposure and an outcome. Indicates the relative likelihood of the outcome occurring in the exposed relative to the unexposed.

Variance-covariance matrix A square matrix representing the variables measured and showing the variances within each variable and the co-variances between pairs of variables.

Wholly attributable condition A condition which by definition is 100% attributable to alcohol consumption e.g. alcoholic cardiomyopathy.

Executive summary

AAFs were calculated for 52 conditions, including 20 conditions, which were wholly attributable to alcohol consumption (*wholly attributable conditions* are conditions where alcohol is 100% contributory e.g. alcoholic liver disease), and 32 conditions that were partially attributable to alcohol (*partially attributable conditions* are conditions where only a proportion of cases are attributable to alcohol consumption e.g. oesophageal cancer).

Considering only the harmful consequences of alcohol consumption:

- 21,162 deaths were attributable to alcohol consumption in 2010.
  - 5,221 deaths were from wholly attributable conditions.
  - 15,941 deaths were from partially attributable conditions; 12,783 from chronic conditions and 3,158 from injuries.
  - The biggest contributors to alcohol-attributable deaths were cancers, digestive diseases and injuries.
  - 296,421 potential years of life were lost due to deaths attributable to alcohol consumption in 2010; equivalent to an average of 15.4 and 11.3 years of life lost per alcohol-related death in men and women, respectively.
- 914,929 hospital admission episodes were attributable to alcohol consumption in 2010/11 based on analyses of admission episodes containing an alcohol-attributable condition in the primary or secondary diagnosis fields.
  - 288,753 hospital admission episodes were for wholly attributable conditions.
  - 626,176 hospital admission episodes were for partially attributable conditions; 545,567 for chronic conditions and 80,609 for injuries.
  - Based on conditions in primary or secondary diagnosis fields, the largest contributors to alcohol-attributable hospital admissions were hypertensive diseases, mental and behavioural disorders due to use of alcohol and other unintentional injuries.
- An additional analysis of hospital admission episodes was undertaken to inform a consultation on reliable proxy measures for alcohol-related hospital admissions. Based on analyses of admission episodes containing an alcohol-attributable condition in the primary diagnosis field only or an external cause in any field:
  - 202,871 primary hospital admission episodes were attributable to alcohol consumption in 2010/11.
  - 54,097 primary hospital admission episodes were for wholly attributable conditions.
  - 148,774 primary hospital admission episodes were for partially attributable conditions; 68,682 were related to chronic conditions and 80,092 were related to injuries.
  - Based on conditions in the primary diagnosis field or an external cause in any field, types of unintentional injury and mental and behavioural disorders due to the use of alcohol were the largest contributors for males and females.

The calculation of Alcohol-Attributable Fractions (AAFs) has been used to estimate the impact that alcohol has on population health and health service use. In England, AAFs are routinely applied to provide an indication of the health impacts of alcohol and have been used to develop the Local Alcohol Profiles for England (LAPE) online tool and in the development of the Sheffield Alcohol Policy Model. There have been a number of methodological developments in the calculation of AAFs since the calculation of the original AAFs that underpin national estimates of the health impact of alcohol. The aim of this report was to review these methodological developments and to apply these in the calculation of new, updated AAFs for England. Since the calculation of the previous AAFs, further evidence on the association between alcohol consumption and the development of a number of chronic conditions and acute consequences has accumulated. Consequently here, AAFs were calculated for 52 conditions, including 20 conditions, which by definition were wholly attributable to alcohol consumption, and 32 conditions that were partially attributable to alcohol. Five new wholly attributable conditions and three new partially attributable chronic conditions were included in the update calculations.

Overall, considering only the harmful consequences, 21,162 deaths were estimated to be attributable to alcohol consumption based on the new AAFs; these deaths represented 4.6% of all recorded deaths in England in 2010. Men experienced greater harm from their alcohol consumption than women with this difference most likely arising because of higher levels of alcohol consumption among men. Younger men were disproportionately affected by their alcohol use compared to older men. As a proportion of all deaths recorded in England in 2010, alcohol-attributable deaths were highest among 25-34 year olds men and 35-44 year old women. By disease areas, the biggest contributors to alcohol-attributable deaths were cancers, digestive diseases and injuries. Potential years of life lost (PYLL) were calculated as an estimate of premature or untimely death attributable to alcohol use. Considering only deaths attributable to alcohol consumption, 296,421 potential years of life were lost in 2010. For men and women, respectively, this is equivalent to an average of 15.4 and 11.3 years of life lost per alcohol-related death.

Two sets of analyses were undertaken to examine alcohol-attributable hospital admissions. Based on the main analyses (of admission episodes containing an alcohol-attributable condition in the primary or secondary diagnosis fields) there were an estimated 914,929 primary and secondary admission episodes in 2010/11. The largest contributors to hospital admissions in this analysis were hypertensive diseases, mental and behavioural disorders due to use of alcohol and other unintentional injuries. For an additional set of analyses (of episodes containing an alcohol-attributable condition in the primary diagnosis field or an external cause in any field) there were an estimated 202,871 primary admissions. In this analysis, types of injury were the largest contributor to admissions across all ages for both men and women.

In summary, based on developing methodologies and a growing evidence base for the association between alcohol consumption and the development of acute and chronic conditions, we have calculated updated AAFs for England. There were limitations to the methods used to calculate the updated AAFs; as with calculation of the previous AAFs it has not been possible to develop methodologies for calculating uncertainty around the AAF estimates. This major limitation aside, we have addressed several shortcomings of the methods used previously to calculate England-specific AAFs. While the figures presented here provide a more accurate estimate of the harm attributable to alcohol consumption, they are still likely to be a conservative estimate given the continuing limitations and uncertainties in the current research evidence.

1. Introduction

Alcohol-Attributable Fractions (AAFs) specific to England were calculated in 2008[1] based on population estimates of alcohol consumption available at the time (the 2005 General Household Survey). In this 2008 study,[1] AAFs for chronic disease were calculated using pooled estimates of the effect of alcohol consumption extracted from the published literature.[2-5] Risk estimates were primarily extracted from the work undertaken by Corrao and colleagues[2,6,7] as these estimates were based on a comprehensive and systematic review of the epidemiological literature. For external causes of morbidity and mortality, primarily injury, relative risk estimates were not available and AAFs were directly extracted from the literature.[5,8,9]

Since undertaking the 2008 study, further work has sought to address the direction, form and strength of the relationship between alcohol consumption and a range of acute and chronic conditions. It was therefore timely to review this work and update the methodology for calculating new England-specific AAFs.

2. Review of conditions and sources of relative risk estimates

2.1 Identification of new sources of risk estimates

For the update, an electronic search was undertaken in Medline to identify new systematic reviews and meta-analyses that have examined the relationship between alcohol consumption and the risk of acute and chronic outcomes. These searches were supplemented by checking the references identified in recent work by Rehm and colleagues.[10] In total, 20 new meta-analyses covering a range of chronic conditions and risk of injury were identified.

2.2 Wholly attributable conditions

Table 1 summarises the wholly attributable conditions (i.e. 100% AAF by definition) included in the 2008 calculation of AAFs.[1] Changes to the International Classification of Diseases 10th Revision (ICD10) coding in April 2012 introduced a category for alcohol-induced acute pancreatitis (K85.2). Other codes not included in 2008 calculations[1] were: fetal alcohol syndrome (dysmorphic) (Q86.0); excess blood alcohol levels (R78.0); evidence of alcohol involvement determined by blood alcohol level (Y90); and evidence of alcohol involvement determined by level of intoxication (Y91).

Table 1. Wholly attributable conditions

CONDITION	ICD10 CODE(S)
Alcohol-induced pseudo-Cushing's syndrome	E24.4
Mental and behavioural disorders due to use of alcohol	F10
Degeneration of nervous system due to alcohol	G31.2
Alcoholic polyneuropathy	G62.1
Alcoholic myopathy	G72.1
Alcoholic cardiomyopathy	I42.6
Alcoholic gastritis	K29.2
Alcoholic liver disease	K70
Alcohol-induced chronic pancreatitis	K86.0
Ethanol poisoning	T51.0
Methanol poisoning	T51.1
Toxic effect of alcohol, unspecified	T51.9
Accidental poisoning by and exposure to alcohol	X45
Intentional self-poisoning by and exposure to alcohol[a]	X65
Poisoning by and exposure to alcohol, undetermined intent[a]	Y15
Alcohol-induced acute pancreatitis[b]	K85.2
Fetal alcohol syndrome (dysmorphic)[b]	Q86.0
Excess alcohol blood levels[b]	R78.0
Evidence of alcohol involvement determined by blood alcohol level[b]	Y90
Evidence of alcohol involvement determined by level of intoxication[b]	Y91

[a]Included in the 2008 calculation of AAFs as 'Partially attributable conditions'. [b]Not included in 2008 calculation of AAFs.

2.3 Chronic conditions associated with alcohol consumption

Chronic conditions included in the 2008 study[1] are shown in Table 2 below. A series of new systematic reviews and meta-analyses have been produced by Rehm and colleagues and other research groups since then and new estimates of the relationship between alcohol consumption and a range of chronic conditions have been identified for:

- oral and pharyngeal cancers[11]
- oesophageal cancers[12]
- colorectal cancers[13]
- laryngeal cancers[14]
- type 2 diabetes[15]
- types of stroke[16]
- pancreatitis[17]
- liver cirrhosis[18]
- ischaemic heart disease[19-21]
- hypertension[22]
- epilepsy[23]
- cardiac arrhythmias[24,25]

As part of a larger study to estimate the global burden of disease and injury attributable to alcohol, Rehm and colleagues[10] evaluated the evidence for the impact of alcohol on diseases and injury. Since the 2008 calculation of England-specific AAFs,[1] meta-analyses have quantified the association between alcohol consumption and the risk of three conditions not included in the 2008 study; tuberculosis,[26] pneumonia,[27] and low birth weight.[28]

The evidence for the relationship between alcohol consumption and some conditions that were included in the calculation of England-specific AAFs in 2008 has also been re-evaluated. While AAFs for psoriasis, gastro-oesophageal laceration-haemorrhage syndrome and heart failure were previously included, these conditions have not been included in this update. For gastro-oesophageal laceration-haemorrhage syndrome and heart failure, previous relative risk estimates were not based on meta-analyses but estimated from clinical cases. As no meta-analyses have been conducted that can be used to inform this update these conditions have been excluded. In relation to psoriasis, Rehm and colleagues[10] have questioned the overall sufficiency of the evidence for establishing a causal relationship between alcohol consumption and psoriasis. While studies show that there is a consistent association between alcohol consumption and psoriasis, evidence is currently lacking as to whether alcohol is a true attributable cause of the condition.[10,29]

Table 2. Sources of data for chronic conditions

CONDITION	ICD10 CODE(S)	SOURCE(S) FOR 2008 STUDY	NEW SOURCE(S)
INFECTIOUS AND PARASITIC DISEASES			
Tuberculosis	A15-A19	Not included	Lönnroth et al., 2008[26]
MALIGNANT NEOPLASM OF:			
Lip, oral cavity and pharynx	C00-C14	Corrao et al., 2004[2]	Tramacere et al., 2010[11]
Oesophagus	C15	Corrao et al., 2004[2]	Islami et al., 2011[12]
Colon	C18	Corrao et al., 2004[2]	Ferdiko et al., 2011[13]
Rectum	C20	Corrao et al., 2004[2]	Ferdiko et al., 2011[13]
Liver and intrahepatic bile ducts	C22	Corrao et al., 2004[2]	Not available; used Corrao et al., 2004[2]
Larynx	C32	Corrao et al., 2004[2]	Islami et al., 2010[14]
Breast	C50	Collaborative Group on Hormonal Factors in Breast Cancer, 2002[30]	Available[31]; but used Collaborative Group on Hormonal Factors in Breast Cancer, 2002[30] as based on individual patient data.
DIABETES MELLITUS			
Diabetes mellitus (type II)	E11	Gutjahr et al., 2001[3]	Baliunas et al., 2009[15]
DISEASES OF THE NERVOUS SYSTEM			
Epilepsy and Status epilepticus	G40-G41	Rehm et al., 2004[4]	Samokhvalov et al., 2010[23]
CARDIOVASCULAR DISEASE			
Hypertensive diseases	I10-I15	Corrao et al., 2004[2]	Taylor et al., 2009[22]
Ischaemic heart disease	I20-I25	Corrao et al., 2004[2]	Roerecke et al., 2010;[19] Roerecke et al., 2012[20] Ronksley et al., 2011[21]
Cardiac arrhythmias	I47-I48	Gutjahr et al., 2001[3]	Samokhvalov et al., 2010[24] Kodama et al., 2011[25]
Heart failure	I50-I51	Single et al., 1996[8]	Not included; risk estimates not available from meta-analyses
Haemorrhagic stroke	I60-I62, I69.0-I69.2	Corrao et al., 2004[2]	Patra et al., 2010[16]
Ischaemic stroke	I63-I66, I69.3-I69.4	Corrao et al., 2004[2]	Patra et al., 2010[16]
Oesophageal varices	I85	Corrao et al., 2004[2]	Applied new estimate for unspecified liver disease[18]
RESPIRATORY INFECTIONS			
Pneumonia	J10.0, J11.0, J12-J15, J18	Not included	Samokhvalov et al., 2010[27]
DIGESTIVE DISEASE			
Gastro-oesophageal laceration-haemorrhage syndrome	K22.6	English et al., 1995[9]	Not included; risk estimates not available from meta-analyses
Unspecified liver disease	K73, K74	Corrao et al., 2004[2]	Rehm et al., 2010[18]
Cholelithiasis (gall stones)	K80	Gutjahr et al., 2001[3]	Not available; used Gutjahr et al., 2001[3]
Acute and chronic pancreatitis	K85, K86.1	Corrao et al., 2004[2]	Irving et al., 2012[17]
SKIN DISEASE			
Psoriasis	L40 excluding L40.5	Gutjahr et al., 2001[3]	Not included; insufficient evidence for causal relationship
PREGNANCY AND CHILDBIRTH			
Spontaneous abortion	O03	Gutjahr et al., 2001[3]	Not available; used Gutjahr et al., 2001[3]
Low birth weight	P05-P07	Not included	Patra et al., 2011[28]

2.4 Acute consequences of alcohol consumption

Since the 2008 calculation of England-specific AAFs, research[32,33] has been undertaken to examine alcohol consumption and risk of injury, and new methods have been developed for calculating AAFs related to injury.[33,34] These methods take into account average consumption, occasions of binge drinking, and the length of time at risk after consumption. The acute conditions included in the 2008 study are shown in Table 3. In addition to these, additional ICD10 codes for other types of unintentional injury and poisoning were included in the update.

Table 3. Sources of data for acute consequences

CONDITION	ICD10 CODE(S)	SOURCE(S) FOR 2008 STUDY	NEW SOURCE(S)
UNINTENTIONAL INJURIES			
Road/pedestrian traffic accidents	§	Ridolfo, 2001[5]	Taylor et al., 2010[32]
Poisoning	X40–X49 (excl. X45)	Not included	Taylor et al., 2010[32]
Fall injuries	W00-W19	Ridolfo, 2001[5]	Taylor et al., 2010[32]
Fire injuries	X00-X09	Single, 1996[8]	Taylor et al., 2010[32]
Drowning	W65-W74	English, 1995[9]	Taylor et al., 2010[32]
Other unintentional injuries	§§		
Water transport accidents	V90-V94	Single, 1996[8]	Included under 'Other unintentional injuries'
Air/space transport accidents	V95-V97	Single, 1996[8]	
Work/machine injuries	W24-W31	English, 1995[9]	
Firearm injuries	W32-W34	Single, 1996[8]	
Inhalation of gastric contents/Inhalation and ingestion of food causing obstruction of the respiratory tract	W78, W79	Single, 1996[8]	
Accidental excessive cold	X31	Single, 1996[8]	
INTENTIONAL INJURIES			
Intentional self-harm	X60-X84, X87.0 (excl. X65)	English, 1995[9]	Taylor et al., 2010[32]
Event of undetermined intent	Y10-Y34, Y87.2 (excl. Y15)	English, 1995[9]	Taylor et al., 2010[32]
Assault	X85-Y09, Y87.1	Single, 1996[8]	Taylor et al., 2010[32]

§ V021-V029, V031-V039, V041-V049, V092, V093, V123-V129, V133-V139, V143-V149, V194-V196, V203-V209, V213-V219, V223-V229, V233-V239, V243-V249, V253-V259, V263-V269, V273-V279, V283-V289, V294-V299, V304-V309, V314-V319, V324-V329, V334-V339, V344-V349, V354-V359, V364-V369, V374-V379, V384-V389, V394-V399, V404-V409, V414-V419, V424-V429, V434-V439, V444-V449, V454-V459, V464-V469, V474-V479, V484-V489, V494-V499, V504-V509, V514-V519, V524-V529, V534-V539, V544-V549, V554-V559, V564-V569, V574-V579, V584-V589, V594-V599, V604-V609, V614-V619, V624-V629, V634-V639, V644-V649, V654-V659, V664-V669, V674-V679, V684-V689, V694-V699, V704-V709, V714-V719, V724-V729, V734-V739, V744-V749, V754-V759, V764-V769, V774-V779, V784-V789, V794-V799, V803-V805, V811, V821, V830-V833, V840-V843, V850-V853, V860-V863, V870-V878, V892

§§ V01, V090, V091, V099, V100-V109, V110-V119, V120-122, V130-132, V140-V142, V150-V159, V160-V169, V170-V179, V180-V189, V191-V193, V20-V28: 0.1–0.2; V290-V293, V30-V38: 0.1–0.2; V390-V393, V40-V48: 0.1–0.2; V490-V493, V50-V58: 0.1–0.2; V590-V593, V60-V68: 0.1–0.2; V690-V693, V70-V78: 0.1–0.2; V790-V793, V800, V801, V806–V809, V810, V812–V819, V820, V822–V829, V834–V839, V844–V849, V854–V859, V864–V869, V879, V88, V890, V891, V893–V899, V90-V94, V95-V97, V98-V99, W20-W52, W75-W84, W85–W99, X10-X19, X20-X29, X30-X33, X50-X57, X58, X59, Y40-Y84 Y85, Y86, Y88, Y89

3. Calculation of new AAFs

3.1 Chronic conditions

Methodological developments in the calculation of AAFs were incorporated into the update. Recent studies have used a continuous approach to calculate the AAFs based on the following formula:

$$AAF = \frac{P_{abs} + P_{form}RR_{form} + \int_0^\infty P(x)RR(x)dx - 1}{P_{abs} + P_{form}RR_{form} + \int_0^\infty P(x)RR(x)dx}$$

where:

P_{abs} = proportion of lifetime abstainers

P_{form} = proportion of former drinkers

$P(x)$ = probability distribution function of drinkers

RR_{form} = relative risk (RR) for former drinkers

$RR(x)$ = relative risk function for a given alcohol consumption in grams per day

Using adapted methodology,[35] we initially developed a preliminary model in Microsoft Excel using an equivalent, discrete, form of the equation:

$$AAF = \frac{\sum P_i RR_i - 1}{\sum P_i RR_i}$$

By summing the products of the proportions in each exposure stratum i and RRi for each stratum of interest the AAF was calculated. Alcohol consumption was capped at an exposure of 250g of alcohol per day in the Excel model. Following testing of the Excel model, simulations were developed in R (version 2.15.1) with alcohol consumption capped at an exposure of 150g of alcohol per day to provide a more conservative estimate in line with the international literature.[36]

For conditions which demonstrated a linear dose-response relationship (see Appendix 1) the increase in the relative risk (RR) per gram of alcohol intake was extracted from the article, or where only categorical estimates were presented, was estimated by assuming a log–linear relationship between exposure and risk.

For conditions with a non-linear relationship, the RR function was extracted from the article where available (see Appendix 1). However, for a number of conditions the RR function that described the dose-response relationship was not reported in full and we therefore contacted the authors for the full RR function. This data was not forthcoming for one condition (malignant neoplasm of lip, oral cavity and pharynx) and we therefore extracted RR values based on a categorical approach and modelled the dose response curve using quadratic approximation. Although new estimates were identified for ischaemic heart disease,[19-21] it was not possible to develop a model based on the new risk estimates for this update that incorporated patterns of drinking and therefore the RR function reported by Corrao and colleagues[2] was used.

The risks of the incidence of a condition may be differentially affected by alcohol consumption compared to mortality, and for a select number of conditions, separate risk estimates were available for mortality and morbidity. Therefore, separate AAFs for mortality and morbidity have been calculated for types of stroke and liver cirrhosis.

3.2 Acute conditions

As noted in Section 2.4, Taylor and colleagues[37] have devised a method of incorporating average daily consumption, occasions of binge drinking, and the length of time at risk after consumption into the calculation of AAFs for alcohol-related injury, resulting in the following formula:

$$AAF_{injury} = \frac{P_{abs+former} + P_{current\,(non-binge)} + P_{current\,(binge)} RR_{binge}(x) - 1}{P_{abs+former} + P_{current\,(non-binge)} + P_{current\,(binge)} RR_{binge}(x)}$$

where:

$RR_{binge}(x) = \mathrm{P}_{dayatrisk} * P_{daysatrisk} * (RR_{crude}(x) - 1) + 1$

$P_{abs+former}$ = proportion of lifetime abstainers and former drinkers

$P_{current(non\text{-}binge)}$ = prevalence of current drinkers who do not engage in binge drinking

$P_{current(binge)}$ = prevalence of current drinkers who engage in binge drinking

$RR_{binge(x)}$ = risk ratio for binge drinkers given a binge amount of alcohol consumed, corrected for both time at risk and number of drinking occasions

$P_{dayatrisk}$ (calculated based on the average binge consumption x) = proportion of a given day during which a person binge drinks and is at risk

$P_{daysatrisk}$ = percentage of days the person undertakes binge drinking

$RR_{crude(x)}$ = relative risk at drinking level x, not adjusted for the time at risk per occasion

In addition we used the following formula (Taylor et al., 2011[37]) to calculate an AAF for average consumption:

$$AAF_{injury} = \frac{P_{abs+former} + \int_0^{\alpha} P(x)RR(x)dx - 1}{P_{abs+former} + \int_0^{\alpha} P(x)RR(x)dx}$$

where:

$RR(x) = P_{dayatrisk} * (RR_{crude}(x) - 1) + 1$

$P(x)$ = prevalence of drinking level x

$RR(x)$ = relative risk of drinking level x compared to lifetime abstainers and former drinkers, corrected for time at risk

$P_{dayatrisk}$ (calculated based on drinking level x) = proportion of a day at risk per drinking occasion

$RR_{crude}(x)$ = relative risk at drinking level x, not adjusted for the time at risk per occasion.

Using these methods, separate AAFs were calculated for morbidity and mortality, with the AAFs for mortality obtained from the AAFs for morbidity (personal communication, Rehm and colleagues). We used estimates of the proportion of the population in England that are current binge drinkers as described in Section 3.3. The proportion of the day at risk per drinking occasion was calculated for each quantity of alcohol using drinking hours approximated from Taylor and colleagues[33] (1 drink [~10 grams of alcohol] = 30 minutes; 3 drinks = 2 hours; 5 drinks = 3 hours; 7 drinks = 4.8 hours) to determine the proportion of the day in which risk was significantly higher. Data on the frequency of 'binge drinking' and occasions of 'binge drinking' were not recorded in the General Lifestyle Survey (GLF) and so we used a subset of data from the 2011 Health Survey for England.[38] The subset included participants who had completed weekly drinking diaries and who based on their diary units had drank greater than 8 units (men; n=839) and greater than 6 units (women; n=528) on any one day of the diary week. Among those drinking greater than 8/6 units but less than 12/9 units, men (n=459) reported 'binge drinking' on a mean 1.58 (SD 1.10) days and women (n=377) on a mean 1.51 (SD 1.02) days. For men and women drinking greater than 12/9 units, men (n=328) drank at this level on a mean 1.41 days (SD 0.88) and women on a mean 1.54 (SD 1.48) days.

3.3 Determination of the age- and gender-specific distribution of alcohol consumption

The age-specific distribution of alcohol consumption for adults aged 16 years and older in England was determined based on the 2010 GLF. The dataset included 12,651 participants aged over 16 years from England. Respondents were first categorised into current drinkers, former drinkers and lifetime abstainers. Former drinkers (n=854; 8%) were respondents who reported either: (i) 'very occasionally' drinking but did not provide estimates of weekly drinking; (ii) that they 'used to drink'; or (iii) reported that they have not drank in the last year. Lifetime abstainers (n=893; 8%) were respondents who reported that they had 'always been a nondrinker'. After discounting non-eligible and non-applicable cases (n=1,420), 9,484 current drinkers (84%) were identified with a valid estimate of weekly alcohol consumption. For current drinkers we used the estimate of respondent's weekly alcohol consumption in units of alcohol converted to grams a day to model consumption (where 1 unit was equal to 8 grams).

For estimates of binge drinking among current drinkers we used the estimate of total units on the day that the respondent reported that they had drank most. We categorised current drinkers into three groups ('non-binge drinkers', 'binge drinkers I' and 'binge drinkers II') depending on whether on their heaviest drinking day they: (1) drank 8 units or less for men (n=3,384; 66%) and 6 units or less for women (n=3,937; 64%) ('non-binge drinkers'); (2) drank more than 8 units for men (n=559; 12%) and more than 6 units for women (n=569; 11%) ('binge drinkers I'); or (3) drank more than 12 units for men (n=563; 12%) and more than 9 units for women (n=472; 9%) on their heaviest drinking day.

Although other recent studies of population alcohol consumption in England have assumed that alcohol consumption is approximately log-normally distributed,[39] based on recent work on the statistical modelling of alcohol exposure data by Rehm and colleagues[36] we used a gamma distribution to model alcohol consumption. Consumption was modelled among drinkers in subgroups defined by age and sex using data from the 2010 GLF. We determined the mean (μ) and standard distribution (σ) for the sex-specific distribution of alcohol consumption for adults aged over 16 years across seven age categories: 16–24; 25–34; 35–44; 45–54; 55–64; 65–74; and 75+. The means and standard distributions were used to calculate the shape (α) and rate (β) parameters of the gamma distribution using the following formulas:

$$\alpha = \frac{\mu^2}{\sigma^2} \qquad \beta = \frac{\mu}{\sigma^2}$$

We normalised the gamma function by adding a coefficient in front of the probability density function to take account of the proportion of drinkers compared to the total number of individuals in the population and to ensure that the area under the function integrated correctly between 0 and 150g.[40]

3.4 Upshifting consumption

It is widely acknowledged that national surveys underestimate population levels of alcohol consumption, as shown in the discrepancies between estimates drawn from survey data and those from taxation figures on alcohol sales. Based on the 2010 GLF, weekly consumption was estimated to be 11.5 units per adult aged over 16 in Great Britain; approximating to the consumption of around 6 litres of pure alcohol per adult. In comparison, taxation (i.e. clearance) data for 2010/11 showed that per adult (aged 16 years and over), the equivalent of 10.6 litres of pure alcohol were taxed; equating to *per capita* consumption estimates of around 20 units per adult per week. The difference between the GLF and taxation data amounts to around 430 million units per week, meaning that around one bottle of wine per adult drinker per week is unaccounted for in the national survey data. Comparison of taxation figures on alcohol sales, the General Lifestyle Survey (formerly the General Household Survey) and Scottish Health Survey over time suggest that differences in *per capita* consumption and survey estimates of alcohol intake have increased since 2000;[41] this is despite revisions to the methodology used to produce consumption estimates in 2006.

Rehm and colleagues[36] have developed methods to account for this underestimation based on the triangulation of *per capita* consumption estimates with population estimates from national surveys to produce upshifted estimates. This approach has been applied in the Global Burden of Disease 2010 comparative risk assessment. There are however, limitations to this method. It has been argued that because risk estimates are themselves based on self-reported alcohol consumption estimates, it is most appropriate to use unshifted population estimates.[42] While it may reasonably be assumed that epidemiological studies provide more accurate data on alcohol exposure than do national alcohol surveys,[36] any purported difference has yet to be quantified.[36] Methodologies for measuring consumption vary between epidemiological studies[43] and all reported alcohol consumption may be subject to bias arising from systematic and random measurement error. A further limitation of the method is that by defining the upshift using *per capita* consumption estimates any upshift is underpinned by an assumption that undercoverage is distributed evenly across age and sex groups, and different levels of consumption.[44]

Using the data outlined above, we determined the coverage rate of the 2010 GLF compared to the *per capita* consumption estimates to be 56.5%. In consideration of this difference and taking into consideration the limitations of the upshift method, it was felt that some form of upshift in consumption was warranted. As a conservative estimate and following recommendations in the international literature,[36] we used the inverse of 90% of this coverage rate (62.8%), to account for alcohol not consumed, due to loss or wastage, to model upshifted consumption. The upshift applied did not however take account of unrecorded consumption (e.g. untaxed cross border purchases, illicit alcohol, homemade consumption); one measure of the scale of unrecorded consumption, the tax gap for alcohol duty, estimated that illicit alcohol accounted for up to 14% of the UK beer market in 2009-2010.[45] Using the methods devised by Rehm and colleagues,[36] we adjusted the mean alcohol consumption and standard deviation (SD) of the alcohol distribution as follows[36]:

$$\mu_{shifted} = \frac{\mu_{survey}}{0.628} \qquad \sigma_{shifted} = 1.174 * \mu_{shifted} + 1.003 * sex$$

Where sex was coded 0 for men and 1 for women

Mean (SD) alcohol consumption, before and after the data was upshifted, for men and women across age groups is shown in Table 4. For men the highest mean consumption appeared among 45-54 year olds, reaching a peak of 22.8 g/day based on unshifted consumption estimates and 36.3 g/day based on the upshifted estimates. For women, daily consumption was highest in the 45-54 year old age group, reaching a maximum 12.7 g/day and 20.3 g/day, based on unshifted and upshifted consumption estimates, respectively.

Table 4. Mean (SD) alcohol consumption in grams per day (average and upshifted)

SEX	AGE GROUP						
	16-24	25-34	35-44	45-54	55-64	65-74	75+
MEAN (SD) ALCOHOL CONSUMPTION IN GRAMS PER DAY[a]							
Men	20.0 (32.5)	21.1 (25.6)	21.8 (25.5)	22.8 (26.0)	22.8 (27.0)	18.6 (22.2)	12.9 (15.1)
Women	12.0 (20.3)	10.1 (13.0)	12.4 (15.7)	12.7 (16.9)	11.6 (18.1)	8.8 (13.5)	6.5 (10.5)
UPSHIFTED MEAN (SD) ALCOHOL CONSUMPTION IN GRAMS PER DAY							
Men	31.9 (37.5)	33.6 (39.5)	34.8 (40.8)	36.3 (42.7)	36.3 (42.6)	29.7 (34.8)	20.6 (24.1)
Women	19.1 (23.4)	16.0 (19.8)	19.7 (24.1)	20.3 (24.8)	18.4 (22.6)	14.0 (17.4)	10.3 (13.1)

[a]n=9,484 current drinkers; General Lifestyle Survey, 2010

3.5 Alcohol consumption during pregnancy

Based on the 2010 Infant Feeding Survey,[46] 49% of women reported stopping drinking during pregnancy and 46% reported drinking less. To account for changes in consumption during pregnancy, for the calculation of the AAF for low birth weight and spontaneous abortion we reclassified 49% of current drinkers as former drinkers. In lieu of accurate information about levels of consumption during pregnancy, we used the unshifted distribution of alcohol consumption to model a lower level of alcohol consumption during pregnancy.

3.6 Impact of alcohol consumption in those aged 15 years and under

In the previous AAFs report,[1] AAFs were calculated for adults aged 16 years and older and estimates of alcohol attributable mortality and morbidity presented for these age groups only. Whilst we did not extend the AAF methodology to incorporate younger age groups in the update, the mortality and morbidity arising from wholly attributable conditions, and related to low birth weight, was included in the update to provide a broader picture of the harms of alcohol consumption. While the calculation of the AAF for low birth weight was related to levels of alcohol consumption in adults aged 16 years and over, mortality and morbidity arising from low birth weight was coded in cases falling within the 0 to 15 years age category. An AAF for low birth weight was therefore derived by taking an average of the AAFs calculated in the 16 to 45 years age categories, which was then applied in the 0 to 15 years age category.

3.7 Estimating uncertainty of alcohol-attributable fractions

Reporting of AAFs should incorporate a measure of uncertainty around the estimates. Simulation methods are being increasingly used for constructing confidence intervals over more conventional methods.[47] We explored using stimulation techniques to develop measures of uncertainty around the estimates presented here, but this was not found to be feasible for this update report due to a lack of information in the published papers on the RR estimates and their variance. While, at this time we are not able to progress with calculations of the uncertainty of the AAF estimates reported here any future updates of AAF should reconsider the methods available to incorporate measures of the uncertainty.

4. Updated alcohol attributable fractions

The updated AAFs are shown in full in Appendix 2 and in Table 5, summarised compared to the old AAFs for chronic conditions and updated AAFs without the 90% upshift in consumption applied.

Based on the updated AAFs, for all age groups, among men and women, the highest AAF for a partially attributable condition was associated with deaths from unspecified liver disease (for AAFs based on the upshifted model, ranging from 55% to 76% among men and from 57% to 69% among women). Overall, for partially attributable chronic conditions among men, the AAF increased up to 55-64 years and decreased thereafter. For acute conditions, the AAFs decreased with age. For women, across both partially acute and chronic conditions, the AAFs increased with age up to 45 to 54 years and then decreased.

Among both men and women, negative AAFs (indicating a beneficial effect of alcohol consumption) were calculated for four conditions, diabetes mellitus (type II), cholelithiasis (gall stones), ischaemic stroke (mortality and morbidity) and ischaemic heart disease. However, as the impact of irregular heavy drinking occasions on the apparent cardioprotective effects of alcohol consumption[19] was not taken into account in the calculation of the AAFs they likely overestimate the protective effects of alcohol. Among women, alcohol use also showed an overall protective effect for morbidity related to haemorrhagic stroke. The AAFs for these selected conditions are shown across age categories in Figures 1 and 2.

Figure 1. Alcohol-attributable fractions by age for selected conditions – Men

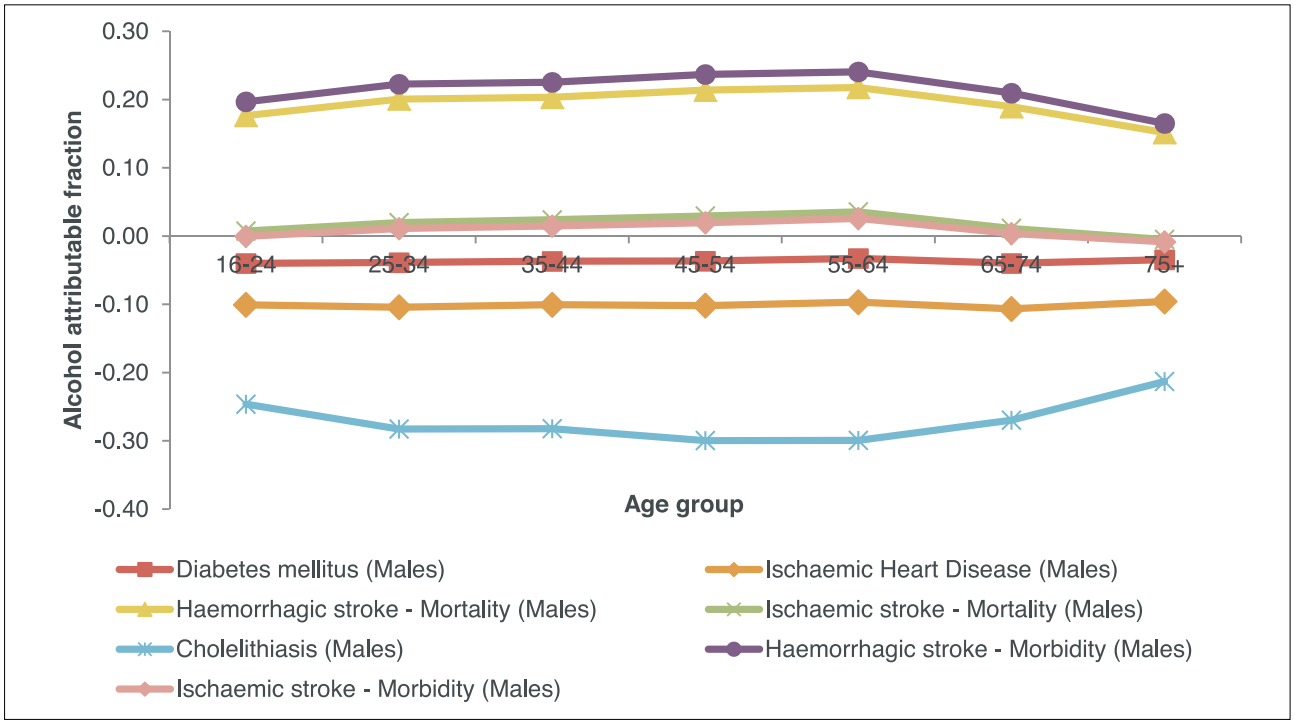
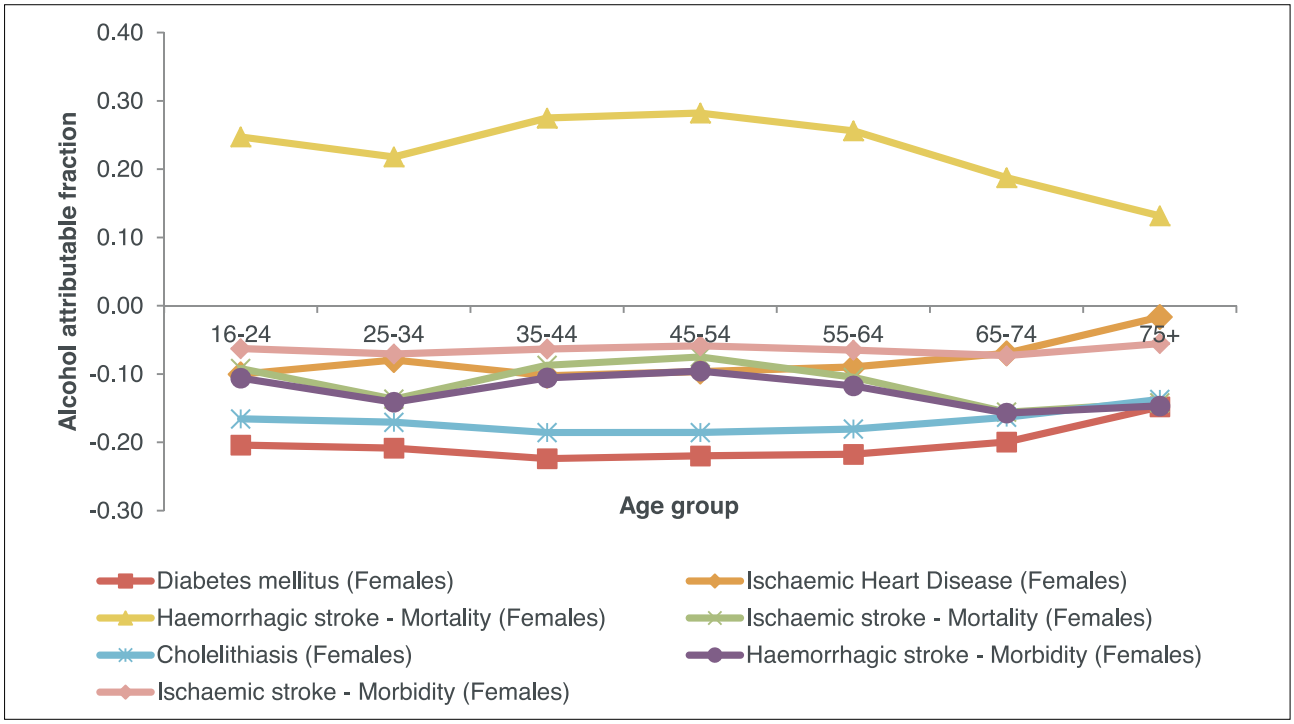


Figure 2. Alcohol-attributable fractions by age for selected conditions – Women



4.1 Comparison with old AAFs

As shown in Table 5, the calculation of the updated AAFs reflected changes in the known risk relationships between alcohol and the various alcohol-attributable chronic conditions. For conditions for which new estimates were not available (e.g. breast cancer and ischaemic heart disease), the differences between the old and new AAFs were small, whereas for others for which new estimates were available (e.g. selected cancers, epilepsy, diabetes and ischaemic stroke), the changes resulted in both higher and lower AAFs. For example, the use of new risk estimates for the relationship between alcohol and oesophageal cancer resulted in an almost doubling of the AAF estimated for this condition.

4.2 Comparison with AAFs based on unshifted consumption estimates

As shown in Table 5, the application of the upshift to the consumption estimates resulted in higher AAFs across the chronic conditions included. The size of the impact was related to the nature of the risk relationship with alcohol. For conditions with a linear dose-response relationship with alcohol (Appendix 1), the impact of the upshift tended to be relatively small; for example, the AAF for oesophageal cancer for men ranged from 44% to 56% without the upshift compared to 52% to 63% with the upshift. For conditions with a non-linear relationship, such as unspecified liver disease and pancreatitis, the impact on the resulting AAF was greater. Among women, for example, hypertensive diseases show a shallow J-shaped risk relationship with alcohol, without the upshift applied, AAFs ranged from -27% to 4% and from -6% to 31% with it applied.

Table 5. Comparison of AAFs across old and new methodologies

CONDITION	ICD10 CODE(S)	OLD AAFS		NEW AAFS			
				UNSHIFTED CONSUMPTION		UPSHIFTED CONSUMPTION	
		M	F	M	F	M	F
INFECTIOUS AND PARASITIC DISEASES							
Tuberculosis	A15-A19	–	–	0.11–0.25	0.09–0.13	0.22–0.35	0.11–0.22
MALIGNANT NEOPLASM OF:							
Lip, oral cavity and pharynx	C00-C14	0.44–0.57	0.20–0.35	0.29–0.47	0.18–0.31	0.29–0.53	0.24–0.43
Oesophagus	C15	0.26–0.38	0.10–0.20	0.44–0.56	0.33–0.45	0.52–0.63	0.38–0.53
Colon	C18	0.06–0.09	0.02–0.04	0.10–0.14	0.08–0.10	0.13–0.19	0.11–0.14
Rectum	C20	0.04–0.06	0.01–0.03				
Liver and intrahepatic bile ducts	C22	0.07–0.11	0.03–0.05	0.09–0.13	0.07–0.09	0.12–0.18	0.10–0.13
Larynx	C32	0.14–0.2	0.05–0.10	0.19–0.31	0.13–0.20	0.28–0.41	0.17–0.29
Breast	C50	–	0.11–0.21	–	0.09–0.11	–	0.11–0.15
DIABETES MELLITUS							
Diabetes mellitus (type II)	E11	-0.10– -0.04	-0.06– -0.04	-0.06– -0.04	-0.24– -0.11	-0.04– -0.03	-0.22– -0.15
DISEASES OF THE NERVOUS SYSTEM							
Epilepsy and Status epilepticus	G40-G41	0.42–0.61	0.35–0.64	0.16–0.27	0.12–0.17	0.24–0.37	0.15–0.25
CARDIOVASCULAR DISEASE							
Hypertensive diseases	I10-I15	0.28–0.41	0.09–0.19	0.09–0.19	-0.27–0.04	0.15–0.27	-0.06–0.31
Ischaemic heart disease	I20-I25	-0.11– -0.07	-0.09– -0.06	-0.13– -0.09	-0.10–0	-0.11– -0.10	-0.10– -0.02
Cardiac arrhythmias	I47-I48	0.30–0.38	0.22–0.36	0.09–0.13	0.07–0.09	0.12–0.18	0.10–0.13
Heart failure	I50-I51	–	–	–	–	–	–
Haemorrhagic stroke	I60-I62, I69.0-I69.2	0.19–0.36	0.06–0.13	0.11–0.16[a] 0.12–0.18[b]	0.09–0.19[a] -0.21– -0.12[b]	0.15–0.22[a] 0.17–0.24[b]	0.13–0.28[a] -0.16– -0.10[b]
Ischaemic stroke	I63-I66, I69.3-I69.4	0–0.20	-0.03– -0.02	-0.04– -0.02[a] -0.04–0.02[b]	-0.21– -0.10[a] -0.10–0.04[a]	0–0.04[a] -0.01–0.03[b]	-0.16– -0.08[a] -0.07–0.06[b]
Oesophageal varices	I85	0.67–0.81	0.37–0.57	0.36–0.62[a] 0.22-0.37[b]	0.50–0.56[a] 0.27-0.50[b]	0.55–0.76 0.33-0.50[b]	0.57–0.69 0.31-0.51[b]
RESPIRATORY INFECTIONS							
Pneumonia	J10.0, J11.0, J12-J15, J18	–	–	0.08–0.11	0.02–0.05	0.10–0.15	0.03–0.08
DIGESTIVE DISEASE							
Gastro-oesophageal laceration-haemorrhage syndrome	K22.6	0.47	0.47	–	–	–	–
Unspecified liver disease	K73, K74	0.67–0.81	0.37–0.57	0.36–0.62[a] 0.22-0.37[b]	0.50–0.56[a] 0.27-0.50[b]	0.55–0.76[a] 0.33-0.50[b]	0.57–0.69[a] 0.31-0.51[b]
Cholelithiasis (gall stones)	K80	-0.26– -0.17	-0.23– -0.11	-0.25– -0.19	-0.19– -0.14	-0.30– -0.21	-0.19– -0.14
Acute and chronic pancreatitis	K85, K86.1	0.23–0.34	0.07–0.16	0.09–0.25	0.08–0.12	0.20–0.43	0.10–0.21
SKIN DISEASE							
Psoriasis	L40 exclu. L40.5	0.30–0.36	0.22–0.33	–	–	–	–
PREGNANCY AND CHILDBIRTH							
Spontaneous abortion	O03	–	0.12–0.23	–	0.08–0.11	–	0.08–0.11
Low birth weight	P05-P07	–	–	0.05	0.05	0.05	0.05

[a] AAFs for mortality. [b] AAFs for morbidity. – = AAF not calculated.

5 Alcohol-attributable mortality

5.1 Number of deaths

Appendix 3 shows the full breakdown of alcohol-attributable deaths caused and prevented in 2010 by age, sex and condition. Overall, an estimated net 14,277 deaths were attributable to alcohol consumption; of these 21,162 deaths were caused and 6,885 were prevented by alcohol consumption (Table 6). However, it was not possible to take into account the impact of irregular heavy drinking occasions on the apparent cardioprotective effects of alcohol consumption[19] and the figures presented for deaths prevented are therefore likely to be an overestimate. The net deaths accounted for 3.1% of all recorded deaths in England in 2010 (rising to 4.6% when only the harmful consequences of alcohol consumption were considered). Broken down by wholly and partially attributable conditions, 5,221 deaths were from wholly attributable conditions (e.g. alcoholic liver disease) and of the net 9,056 partially alcohol-attributable deaths, 5,898 were related to chronic conditions and 3,158 were related to acute conditions (see Figures 3 and 4).

Table 6. Number and proportion of deaths attributable to alcohol consumption by age and sex

SEX	ALCOHOL ATTRIBUTABLE DEATHS (% OF DEATHS IN 2010)								
	0-15	16-24	25-34	35-44	45-54	55-64	65-74	75+	TOTAL
NET DEATHS									
Men	0 (0.0%)	323 (21.5%)	644 (24.8%)	1,298 (23.2%)	2,037 (18.2%)	2,482 (10.1%)	1,785 (4.1%)	1,369 (1.0%)	9,938 (4.5%)
Women	0 (0.0%)	58 (9.1%)	157 (12.6%)	548 (16.0%)	970 (12.8%)	1,185 (7.3%)	816 (2.7%)	604 (0.3%)	4,338 (1.8%)
Total	**0 (0.0%)**	**381 (17.9%)**	**801 (21.2%)**	**1,846 (21.2%)**	**3,007 (17.4%)**	**3,667 (10.4%)**	**2,601 (5.2%)**	**1,973 (2.2%)**	**14,277 (3.1%)**
HARMFUL									
Men	0 (0.0%)	325 (21.5%)	651 (25.1%)	1,353 (24.2%)	2,244 (20.0%)	2,946 (12.0%)	2,650 (6.1%)	3,630 (2.8%)	13,638 (6.2%)
Women	0 (0.0%)	58 (9.2%)	159 (12.9%)	563 (16.4%)	1,022 (13.5%)	1,321 (8.1%)	1,209 (4.0%)	3,029 (1.7%)	7,306 (3.1%)
Total	**0 (0.0%)**	**383 (15.8%)**	**811 (19.6%)**	**1,916 (19.9%)**	**3,266 (15.8%)**	**4,268 (8.9%)**	**3,860 (3.5%)**	**6,659 (0.6%)**	**21,162 (4.6%)**
PROTECTIVE									
Men	0 (0.0%)	-1 (-0.1%)	-8 (-0.3%)	-55 (-1.0%)	-207 (-1.8%)	-464 (-1.9%)	-865 (-2.0%)	-2,261 (-1.7%)	-3,862 (-1.7%)
Women	0 (0.0%)	-1 (-0.1%)	-3 (-0.2%)	-15 (-0.4%)	-51 (-0.7%)	-136 (-0.8%)	-393 (-1.3%)	-2,424 (-1.4%)	-3,024 (-1.3%)
Total	**0 (0.0%)**	**-2 (-0.1%)**	**-10 (-0.3%)**	**-70 (-0.8%)**	**-258 (-1.4%)**	**-601 (-1.5%)**	**-1,258 (-1.7%)**	**-4,685 (-1.5%)**	**-6,885 (-1.5%)**

As shown in Table 6, net alcohol-attributable deaths among men (4.5%) accounted for a higher proportion of all deaths in 2010 than among women (1.8%). The number and proportion of net alcohol-attributable deaths also varied by age due to patterns in the distribution of alcohol consumption. Among men, as a proportion of net alcohol-attributable deaths, younger age groups were disproportionately affected by their alcohol use compared to older age groups and among women; those aged 35-44 years old were the most affected.

Figure 3. Alcohol-attributable deaths by type of condition – Men

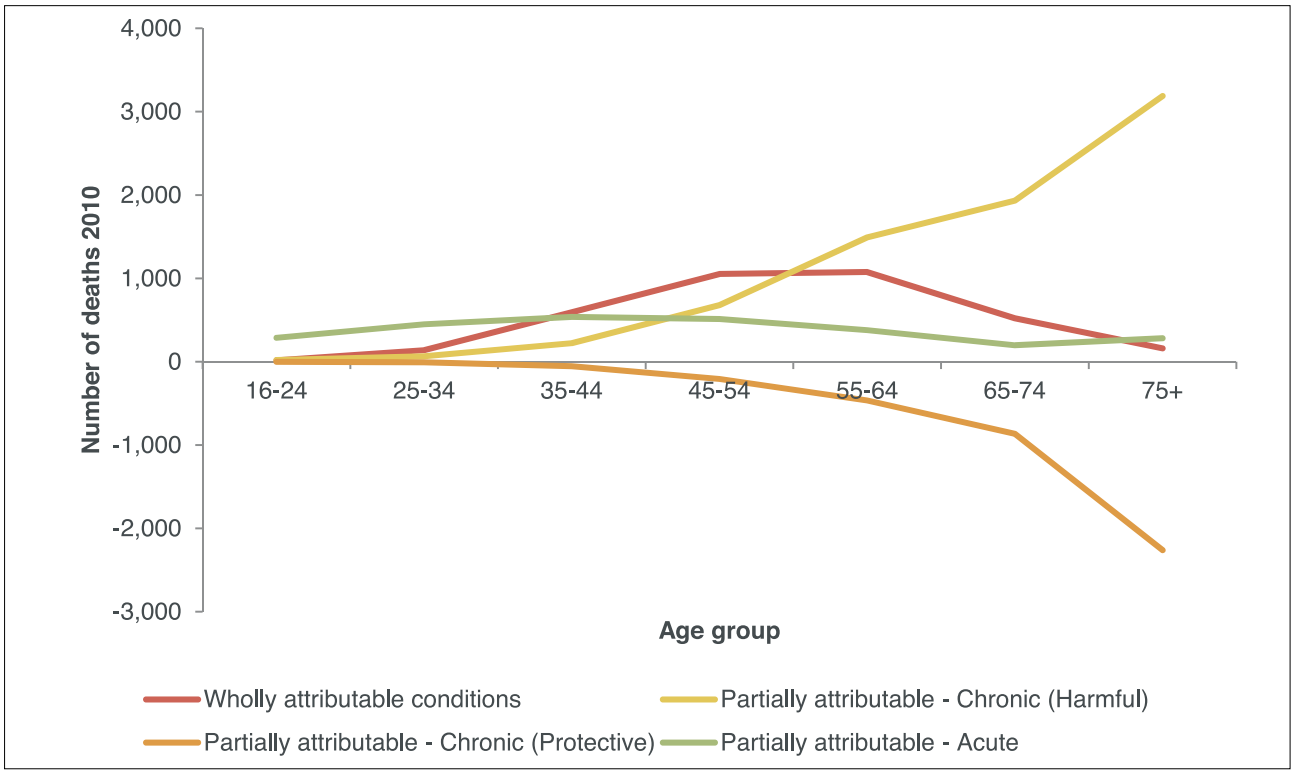
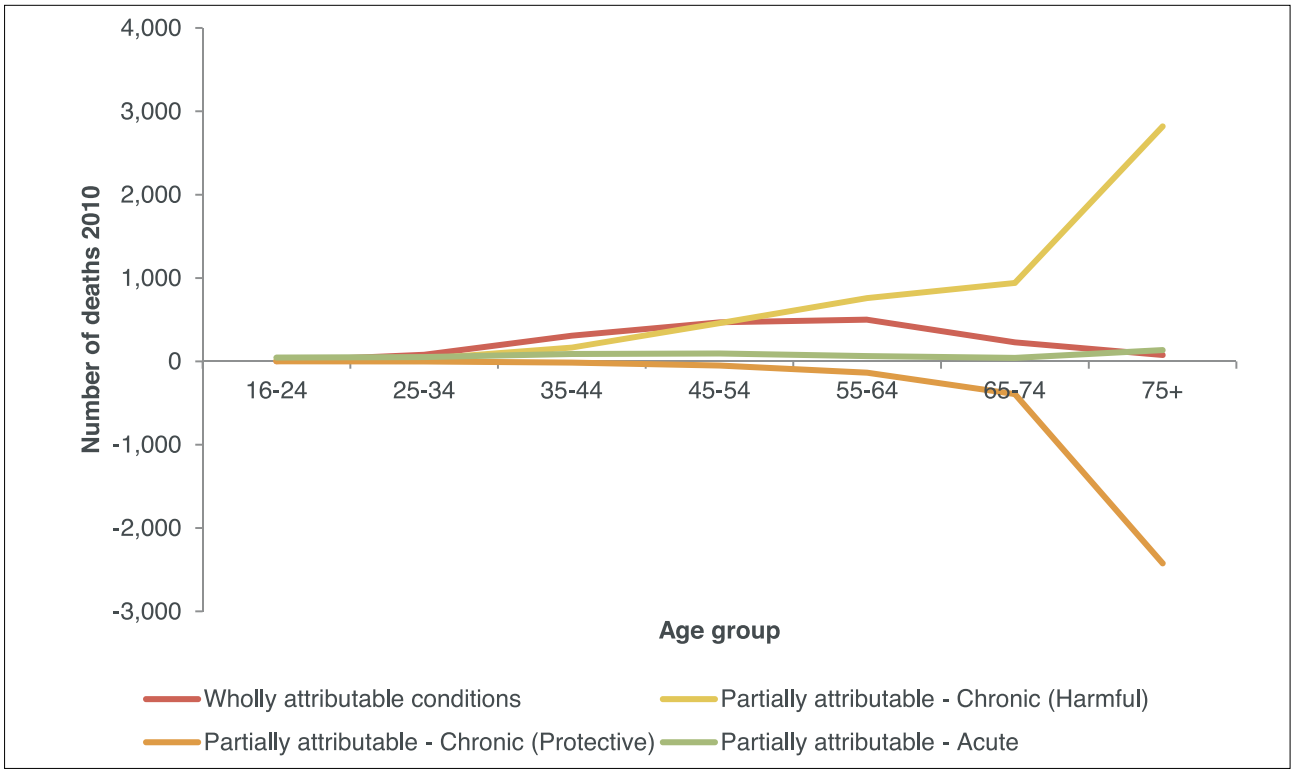


Figure 4. Alcohol-attributable deaths by type of condition – Women



5.2 Causes of death

By disease areas, the biggest contributors to alcohol-attributable deaths across all age groups were cancers (n=7,531), digestive diseases (n=5,454) and injuries (n=3,340). Among younger age groups (16 to 44 year olds), injuries, neuropsychiatric illnesses and digestive diseases were the most frequent causes of alcohol-attributable deaths compared to cancers, digestive diseases and injuries in older age groups (45 to 75+ year olds).

Examining specific conditions, the largest causes of death were alcoholic (and unspecified) liver disease (n=5,320), cancer of the oesophagus (n=3,233) and colorectal cancer (n=1,808). An estimated 4,494 deaths from ischaemic heart disease were prevented. As shown in Table 7, road and pedestrian traffic accidents and intentional injuries were the top causes of alcohol-attributable deaths among 16-24 year old men and women, respectively. For those aged between 35 and 64 years, alcoholic liver disease was the primary cause of alcohol-attributable death. Among older age groups (>55 years for men and >65 years for women), prevented deaths from ischaemic heart disease began to outweigh deaths caused by alcohol consumption (not shown).

Table 7. Top three causes of alcohol-attributable deaths

AGE	MEN		WOMEN	
	CONDITION	N	CONDITION	N
16-24	Road/pedestrian traffic accidents	121	Road/pedestrian traffic accidents	19
	Intentional self-harm	72	Intentional self-harm	12
	Poisoning	27	Epilepsy	7
25-34	Intentional self-harm	136	Alcoholic liver disease[a]	71
	Road/pedestrian traffic accidents	101	Intentional self-harm	15
	Poisoning	95	Poisoning	12
35-44	Alcoholic liver disease[a]	498	Alcoholic liver disease[a]	268
	Intentional self-harm	206	Breast cancer	68
	Poisoning	99	Mental and behavioural disorders	44
45-54	Alcoholic liver disease[a]	978	Alcoholic liver disease[a]	457
	Intentional self-harm	209	Breast cancer	157
	Cancer of the oesophagus	191	Haemorrhagic stroke	75
55-64	Alcoholic liver disease[a]	1,068	Alcoholic liver disease[a]	515
	Cancer of the oesophagus	514	Breast cancer	242
	Colorectal cancer	213	Cancer of the oesophagus	108
65-74	Cancer of the oesophagus	731	Alcoholic liver disease[a]	301
	Alcoholic liver disease[a]	606	Breast cancer	219
	Colorectal cancer	330	Cancer of the oesophagus	195
75+	Cancer of the oesophagus	921	Breast cancer	512
	Pneumonia	826	Cancer of the oesophagus	481
	Colorectal cancer	482	Pneumonia	423
16-75+	Alcoholic liver disease[a]	3,501	Alcoholic liver disease[a]	1,820
	Cancer of the oesophagus	2,397	Breast cancer	1,205
	Colorectal cancer	1,117	Cancer of the oesophagus	836

[a]Combines alcoholic liver disease (K70) and unspecified liver disease (K73, K74).

5.3 Potential years of life lost

Potential years of life lost (PYLL) were calculated as an estimate of premature or untimely death attributable to alcohol use. In our analyses, dying before the age of 75 years was considered premature; for example, a person dying in the 16-24 years age group would have lost 55 years of potential life (based on the mid-point of 20 years). In PYLL analyses, conditions that affect younger age groups are likely to be the most significant contributors to PYLL values, and consequently chronic diseases that impact on older groups may have little impact. A net total of 270,624 potential years of life were lost due to alcohol-attributable deaths among people aged 16 to 74 years old in 2010 (an estimated 8,523 PYLL per 1,000 persons); 296,421 PYLLs were caused by alcohol and 25,797 PYLLs were prevented. Table 8 provides a further breakdown of PYLL caused and prevented across age and sex groups.

Table 8. Net alcohol-attributable PYLL by age and sex

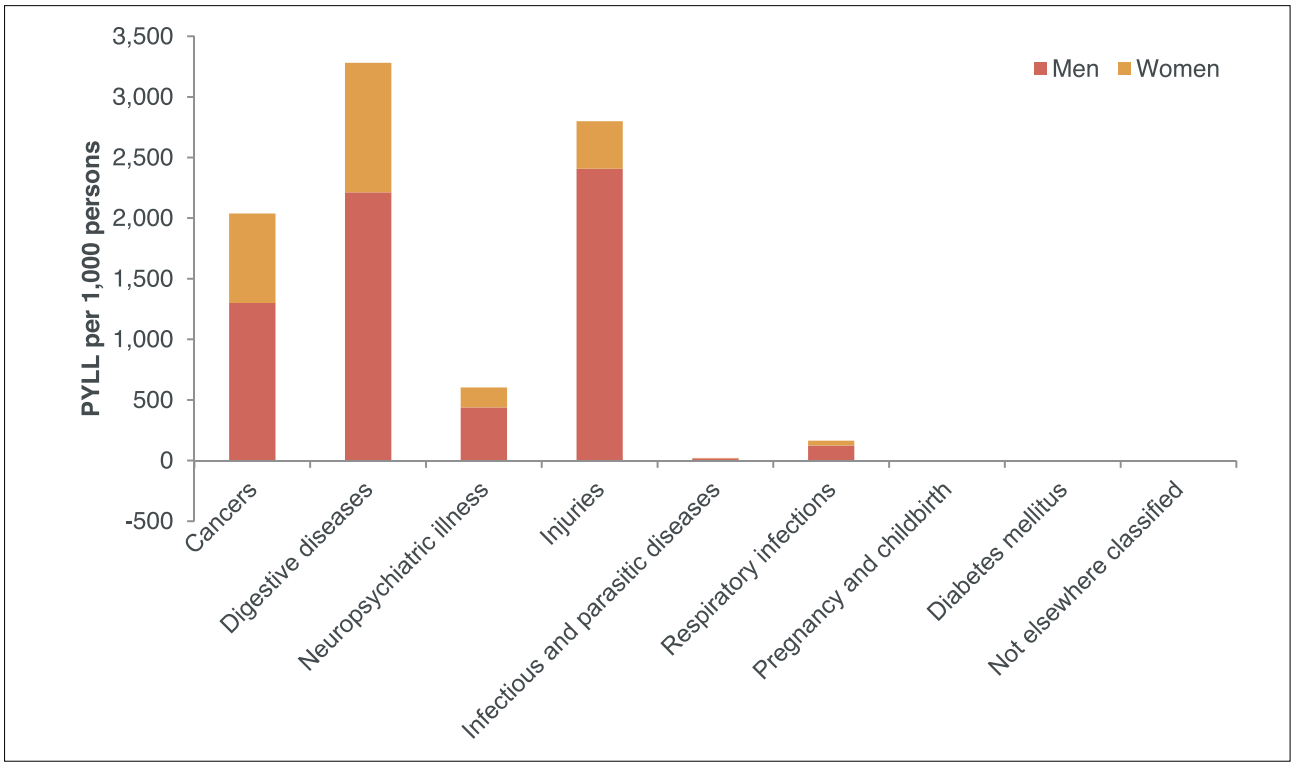
	AGE GROUP						
	16-24	25-34	35-44	45-54	55-64	65-74	TOTAL
NET PYLL							
Men	17,779	29,290	46,080	51,950	38,464	9,817	193,380
Women	3,076	7,108	19,483	24,728	18,361	4,488	77,244
Total	**20,855**	**36,398**	**65,564**	**76,677**	**56,825**	**14,305**	**270,624**
HARMFUL PYLL							
Men	17,840	29,631	48,044	57,224	45,664	14,576	212,980
Women	3,076	7,210	19,991	26,040	20,475	6,649	83,441
Total	**20,916**	**36,841**	**68,036**	**83,264**	**66,139**	**21,225**	**296,421**
PROTECTIVE PYLL							
Men	-61	-342	-1,964	-5,275	-7,199	-4,759	-19,600
Women	0	-101	-508	-1,313	-2,114	-2,162	-6,197
Total	**-103**	**-476**	**-2,497**	**-6,587**	**-9,313**	**-6,920**	**-25,797**
NET PYLL PER 1,000							
Men	589	875	1,192	1,634	1,338	493	6,121
Women	106	212	499	764	617	204	2,402
Total	**696**	**1,087**	**1,691**	**2,398**	**1,954**	**697**	**8,523**
HARMFUL PYLL PER 1,000							
Men	591	886	1,243	1,800	1,588	732	6,839
Women	106	215	512	805	688	302	2,628
Total	**698**	**1,101**	**1,755**	**2,604**	**2,276**	**1,034**	**9,467**
PROTECTIVE PYLL PER 1,000							
Men	-2	-10	-51	-166	-250	-239	-718
Women	0	-3	-13	-41	-71	-98	-226
Total	**-2**	**-13**	**-64**	**-207**	**-321**	**-337**	**-944**

Injuries, digestive diseases, and cancers contributed the largest number of PYLLs by disease area (see Table 9). Figure 5 shows the age-specific PYLL per 100,000 persons by disease area and sex. Within these disease areas, years of life were lost primarily due to deaths related to liver disease (101,269 years), cancer of the oesophagus (22,435 years) and road traffic accidents (17,872 years). For cardiovascular diseases, men showed a net gain in PYLL compared to a loss among women (Table 9). Among women, PYLL saved in this disease area due to deaths prevented from ischaemic heart disease were offset by deaths caused by haemorrhagic stroke (-4,513 PYLL vs. 5,187 PYLL); a finding that was not apparent among men (-19,278 PYLL vs. 5,067 PYLL).

Table 9. Net alcohol-attributable PYLL by disease area and sex

DISEASE AREA	MEN	WOMEN	TOTAL
NUMBER OF PYLL			
Cardiovascular disease	-9,575	670	-8,905
Cancers	35,749	22,202	57,951
Digestive diseases	70,031	34,856	104,887
Neuropsychiatric illness	14,233	5,509	19,742
Injuries	79,005	12,893	91,898
Infectious and parasitic diseases	557	113	670
Respiratory infections	3,441	1,211	4,652
Pregnancy and childbirth	0	0	0
Diabetes mellitus	-60	-211	-271
PYLL PER 100,000 PERSONS			
Cardiovascular disease	-374	1	-373
Cancers	1,300	741	2,041
Digestive diseases	2,213	1,068	3,281
Neuropsychiatric illness	438	165	603
Injuries	2,407	392	2,799
Infectious and parasitic diseases	18	4	22
Respiratory infections	123	41	165
Pregnancy and childbirth	0	0	0
Diabetes mellitus	-3	-9	-12

Figure 5. Age-specific net PYLL per 100,000 persons by disease area and sex



5.4 Comparison with old AAFs

Aggregated data for alcohol-attributable deaths based on the old attributable fractions were available for 2008 to 2010[i] (Table 10). Based on the old AAFs, between 2008 and 2010, a total of 62,084 deaths were attributable to alcohol consumption with 41,642 deaths among men and 20,442 among women. As a percentage of all deaths, alcohol-attributable deaths accounted for 4.4% of all deaths.

The introduction of the new methodology and calculation of new AAFs shows some adjustments to the aggregated number of alcohol-attributable deaths. Based on the new AAFs, there were a total of 62,836 alcohol-attributable deaths[ii] between 2008 and 2010, representing a 2.3% increase (from 62,084 to 63,553) in the number of alcohol-attributable deaths between the old and new fractions.

A breakdown of the number deaths by conditions was not available based on the old AAFs so it was not possible to further investigate the impact of the new AAFs by disease areas.

Table 10. Alcohol-attributable deaths based on old and new AAFs: 2008 to 2010

NUMBER OF DEATHS 2008-2010 (% OF ALL DEATHS 2008-2010)		
	OLD AAFS	NEW AAFS
Men	41,642 (6.2%)	41,565 (6.2%)
Women	20,442 (2.8%)	21,987 (3.0%)
Total	**62,084 (4.4%)**	**63,553 (4.6%)**

[i] This data was calculated as part of the Local Alcohol Profiles for England dataset. The calculation of alcohol-attributable deaths in this dataset was based only on alcohol-attributable conditions for which alcohol consumption has a harmful impact (AAFs>0).

ii This data excludes those deaths prevented by alcohol consumption.

6. Alcohol-attributable morbidity

Hospital admission episodes were calculated as a proxy measure for the burden of alcohol-attributable morbidity. Hospital admission episodes can provide a meaningful measure of hospital activity and the health service burden arising from alcohol consumption in the population. However, as alcohol-related morbidity that does not result in an admission to hospital is not captured by the measure it does not provide a true epidemiological analysis of disease. It is therefore likely that the level of alcohol-attributable morbidity reported in this Section is an underestimate.

6.1 Primary and secondary diagnoses

The new AAFs were applied to hospital admission episodes where the primary diagnosis field or any of the secondary diagnosis fields contained an alcohol-attributable condition.

6.1.1 Number of hospital admissions

Appendix 4 shows the full breakdown of alcohol-attributable hospital admissions caused and prevented in 2010 by age, sex and condition. A net total of 813,485 hospital admissions were recorded; of these, 914,929 admissions were caused by alcohol consumption and 101,444 were prevented. There were an estimated 288,753 admissions for wholly attributable conditions and 524,732 for partially attributable conditions, of which 444,123 were related to chronic conditions and 80,609 to acute conditions. The number of alcohol-attributable hospital admissions by age and sex is shown in Table 11 and by type of condition in Figures 6 and 7.

Table 11. Number of alcohol-attributable hospital admissions (primary or secondary diagnoses) by age and sex

SEX	NUMBER OF HOSPITAL ADMISSIONS								
	0-15	16-24	25-34	35-44	45-54	55-64	65-74	75+	TOTAL
NET ADMISSIONS									
Men	2,903	26,251	38,887	64,764	92,725	121,782	118,930	94,209	560,451
Women	3,490	15,683	19,417	39,236	62,407	71,727	41,481	-406	253,034
Total	**6,393**	**41,934**	**58,304**	**104,000**	**155,131**	**193,508**	**160,411**	**93,804**	**813,485**
HARMFUL									
Men	2,903	26,406	39,471	66,662	97,247	129,003	129,358	105,844	596,893
Women	3,490	16,840	22,041	43,770	69,474	80,269	50,510	31,640	318,035
Total	**6,393**	**43,246**	**61,512**	**110,432**	**166,721**	**209,272**	**179,868**	**137,484**	**914,929**
PROTECTIVE									
Men	0	-154	-584	-1,897	-4,522	-7,221	-10,428	-11,635	-36,442
Women	0	-1,157	-2,625	-4,535	-7,068	-8,543	-9,029	-32,045	-65,002
Total	**0**	**-1,312**	**-3,209**	**-6,432**	**-11,590**	**-15,764**	**-19,457**	**-43,680**	**-101,444**

Figure 6. Number of alcohol-attributable hospital admissions by type of condition – Men

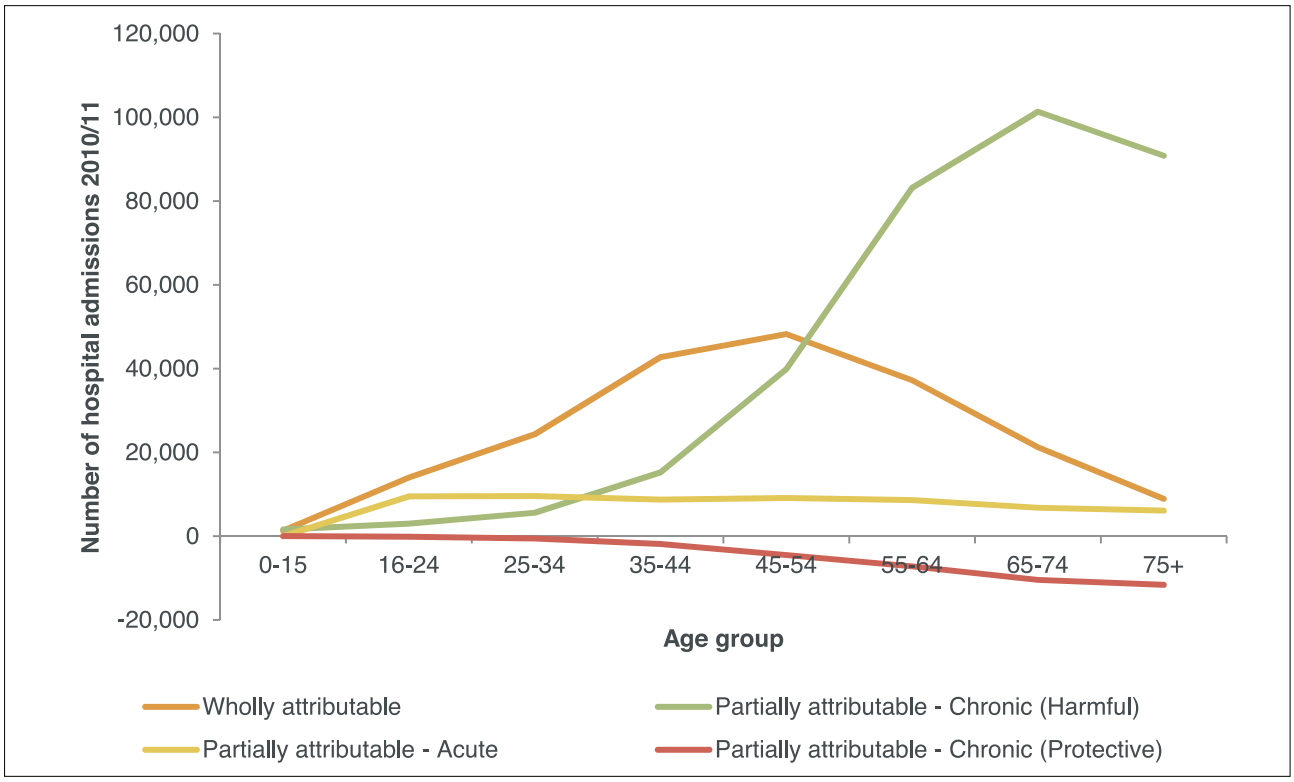
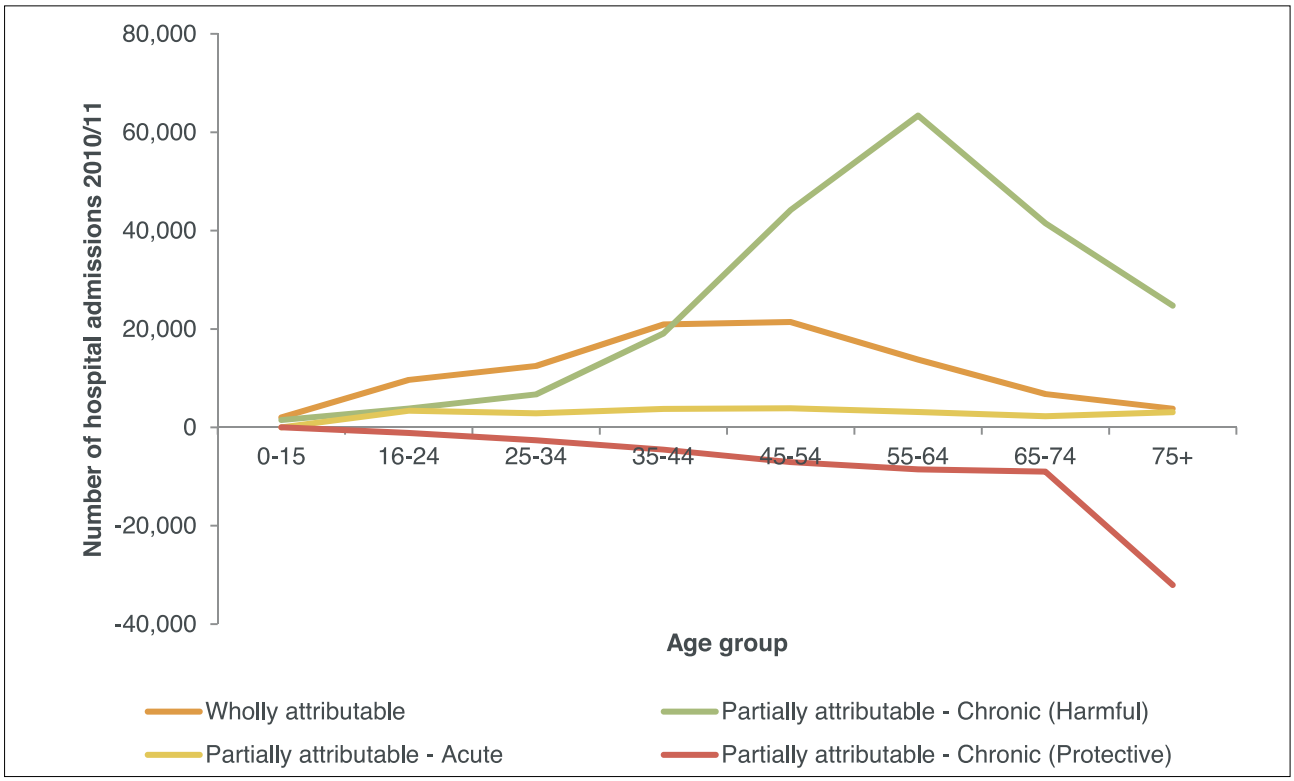


Figure 7. Number of alcohol-attributable hospital admissions by type of condition – Women



6.1.2 Causes of hospital admissions

Among those aged 15 years and under, there were 6,393 alcohol-attributable admissions; 3,318 admissions were for wholly attributable conditions (mostly for mental and behavioural disorders related to alcohol use, n=2,461) and 3,075 were related to admissions for low birth weight arising from maternal alcohol use. For men in the 16-24 and 25-34 year age groups, the largest contributors by disease area to hospital admissions were neuropsychiatric illnesses, followed by injuries (Figures 8 and 9). Among the older age groups, the largest contributors were cardiovascular disease and neuropsychiatric illness. Women followed a similar pattern, but with breast cancer being another major contributor among women aged 35 to 74 years of age. According to specific conditions, the largest contributors to hospital admissions were hypertensive diseases (n=307,326), mental and behavioural disorders due to use of alcohol (n=191,742) and cardiac arrhythmias (n=60,438). Table 12 shows the top three contributors to hospital admissions across each age group for men and women.

Table 12. Top three causes of alcohol-attributable hospital admissions (primary or secondary diagnoses)

AGE	MEN		WOMEN	
	CONDITION	N	CONDITION	N
16-24	Mental and behavioural disorders	10,037	Mental and behavioural disorders	4,695
	Other unintentional injuries	4,108	Ethanol poisoning	4,211
	Assault	1,523	Epilepsy	2,042
25-34	Mental and behavioural disorders	17,639	Mental and behavioural disorders	7,098
	Other unintentional injuries	4,690	Ethanol poisoning	3,705
	Ethanol poisoning	3,566	Epilepsy	2,423
35-44	Mental and behavioural disorders	30,443	Mental and behavioural disorders	11,904
	Hypertensive diseases	7,895	Hypertensive diseases	9,177
	Alcoholic liver disease[a]	5,426	Breast cancer	3,761
45-54	Mental and behavioural disorders	33,188	Hypertensive diseases	28,366
	Hypertensive diseases	25,018	Mental and behavioural disorders	12,331
	Alcoholic liver disease[a]	10,377	Breast cancer	8,109
55-64	Hypertensive diseases	55,472	Hypertensive diseases	45,815
	Mental and behavioural disorders	24,584	Mental and behavioural disorders	8,309
	Alcoholic liver disease	11,419	Breast cancer	6,348
65-74	Hypertensive diseases	70,371	Hypertensive diseases	23,450
	Mental and behavioural disorders	14,557	Cardiac arrhythmias	4,630
	Cardiac arrhythmias	11,499	Breast cancer	4,251
75+	Hypertensive diseases	59,123	Cardiac arrhythmias	12,015
	Cardiac arrhythmias	18,392	Epilepsy	3,174
	Mental and behavioural disorders	6,904	Mental and behavioural disorders	3,110
16-75+	Hypertensive diseases	219,925	Hypertensive diseases	87,401
	Mental and behavioural disorders	138,374	Mental and behavioural disorders	53,368
	Cardiac arrhythmias	40,094	Breast cancer	25,884

[a]Combines alcoholic liver disease (K70) and unspecified liver disease (K73, K74).

Figure 8. Net hospital admissions (primary or secondary diagnoses) by disease area – Men

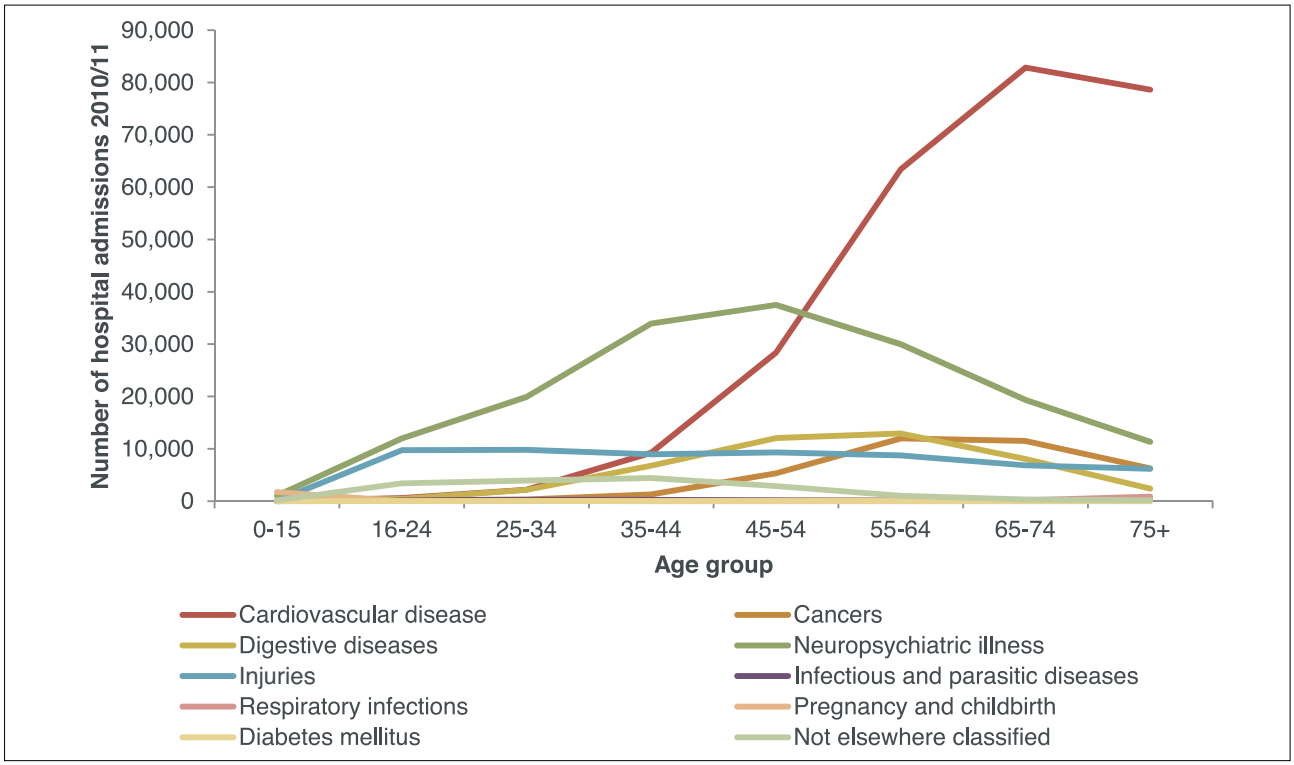
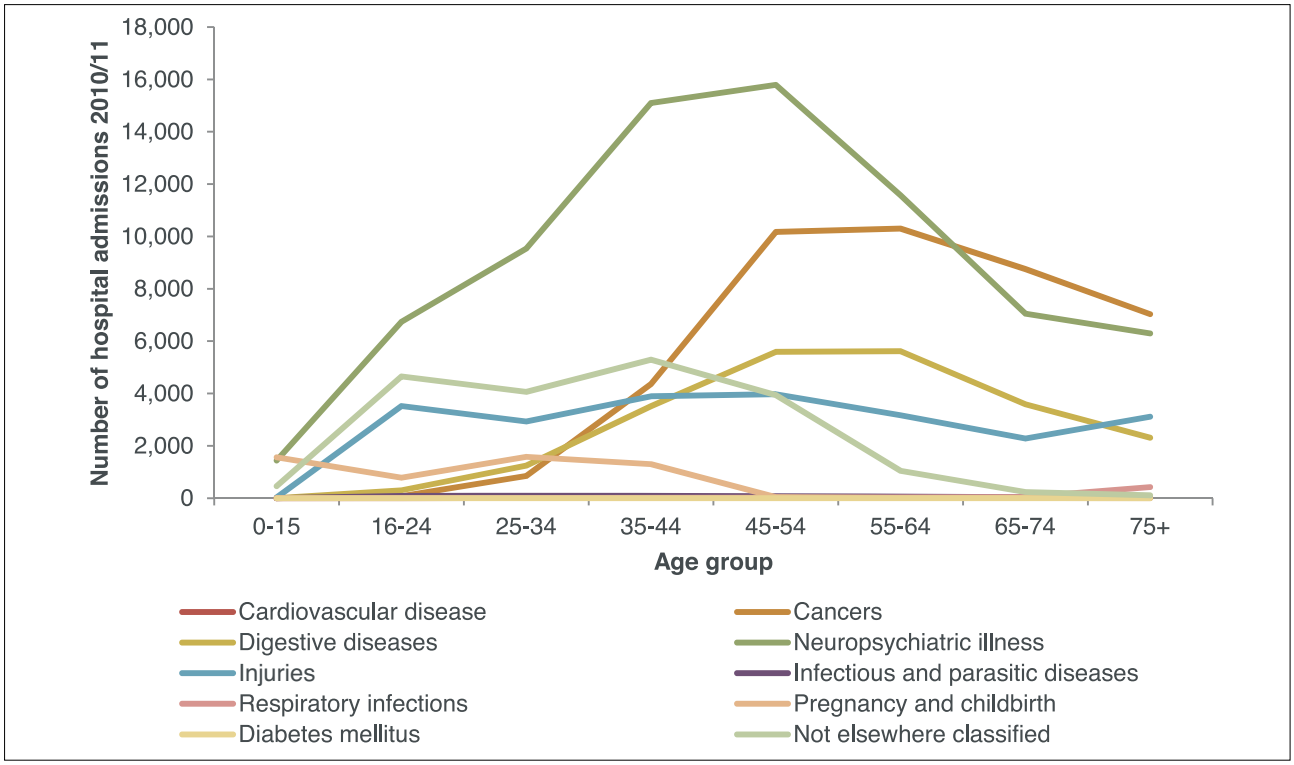


Figure 9. Net hospital admissions (primary or secondary diagnoses) by disease area – Women



6.2 Comparison with old AAFs

Based on the old AAFs, an estimated 1,168,266 admission episodes were attributable to alcohol consumption in 2010/11[iii]. A total of 279,768 admissions were for wholly attributable conditions and 888,498 admissions were for partially attributable conditions, of which, 819,746 were related to chronic conditions and 68,751 were related to acute conditions (Table 13). In comparison, based on the introduction of the new methodology, the new AAFs estimated that 914,929 admission episodes were attributable to alcohol consumption in 2010/11.

Table 13. Number of alcohol-attributable hospital admissions by type of condition (primary or secondary diagnoses) for old and new AAFs

TYPE OF CONDITION	NUMBER OF HOSPITAL ADMISSIONS	
	OLD AAFS	NEW AAFS[a]
Wholly attributable	279,768	288,753
Partially attributable	888,498	626,176
Chronic	*819,746*	*545,567*
Acute	*68,751*	*80,609*
Total	**1,168,266**	**914,929**

[a]Calculations based on alcohol-attributable conditions with AAF>0 for comparison.

It was possible to compare the old and new AAFs by disease area, and this comparison showed that there were fewer admissions attributable across the disease areas based on the new calculations (Table 14), but an increase in admissions associated with cancers, pregnancy and childbirth, and conditions not classified elsewhere.

Table 14. Number of alcohol-attributable hospital admissions by disease area (primary or secondary diagnoses) for old and new AAFs

DISEASE AREA	NUMBER OF HOSPITAL ADMISSIONS	
	OLD AAFS	NEW AAFS[a]
Cardiovascular disease	651,461	395,592
Cancers	37,600	78,216
Digestive diseases	76,251	74,265
Neuropsychiatric illness	290,298	238,494
Injuries	96,066	82,325
Infectious and parasitic diseases	Not included	1,472
Respiratory infections	Not included	1,597
Pregnancy and childbirth	8,771	6,973
Diabetes mellitus	0[b]	0[b]
Not elsewhere classified	7,818[c]	35,995[d]

[a]Calculations based on alcohol-attributable conditions with AAF>0 for comparison. [b]Calculated AAF<0 for diabetes mellitus. [c]Including psoriasis and alcohol-induced pseudo-Cushing's syndrome. [d]Including alcohol-induced pseudo-Cushing's syndrome, fetal alcohol syndrome (dysmorphic), ethanol/methanol poisoning, toxic effect of alcohol (unspecified) and excess alcohol blood levels.

iii This data was calculated as part of the 'Admission episodes for alcohol-attributable conditions' indicator dataset (previously NI39). The calculation of alcohol-attributable hospital admissions in this dataset is based only on alcohol-attributable conditions for which alcohol consumption has harmful consequences (AAF>0).

A big decrease in the number of admission for cardiovascular disease was related to changes to the AAF for cardiac arrhythmias. The changes resulted in a large decrease in the number of hospital admissions attributed to this condition (from 204,482 to 60,438). Changes to the methodology also resulted in fewer admissions attributed to hypertensive disease (from 436,681 to 328,449), oesophageal varices (from 5,572 to 3,689), haemorrhagic stroke (from 2,339 to 1,784) and ischaemic stroke (from 1,282 to 126). Further examining specific conditions, the top three causes of alcohol-attributable hospital admissions for the old AAFs were hypertensive diseases, cardiac arrhythmias and mental and behavioural disorders. Hypertensive diseases were also the largest contributor to alcohol-attributable admissions based on the new AAFs, followed by mental and behavioural disorders and cardiac arrhythmias.

6.3 Primary diagnosis and external causes of injury

An additional analysis of hospital admission episodes was undertaken. In 2011, the former North West Public Health Observatory (NWPHO; now Public Health England), in partnership with the Health and Social Care Information Centre and the Department of Health, undertook a consultation[iv] to determine, in part, whether hospital admissions based on primary diagnoses only should be provided alongside those based on primary and secondary diagnoses.[v] At a national level, largely as a result of improvements in diagnosis and recording, there has been an increase in the coding of secondary conditions. This means that estimates of alcohol-attributable admissions based on both primary and secondary diagnoses for different time periods are not directly comparable, as some of the increase over time is the result of those improvements. Consequently here, the new AAFs were applied to admissions where the primary diagnosis field contained an alcohol-attributable condition or where an external cause was recorded in any of the secondary diagnosis fields. The outcomes of the consultation concluded that the current method of alcohol-related admission figures using primary and secondary diagnosis fields would continue to be published (see Section 6.2), supplemented by the new measure examined in the additional analyses presented here.[48]

6.3.1 Number of hospital admissions

A net total of 168,173 hospital admissions with an alcohol-attributable primary diagnosis or external cause were recorded in 2010/11. Of these, 202,871 admissions were caused by alcohol consumption and 34,698 were prevented. A net total of 54,097 admissions were for wholly attributable conditions and 114,076 admissions were for partially attributable conditions, of which, 33,984 were related to chronic conditions and 80,092 were related to acute conditions. The number of alcohol-attributable hospital admissions by age and sex is shown in Table 15 and by type of condition in Figures 10 and 11.

iv See www.lape.org.uk/downloads/Alcohol%20Related%20Hospital%20Admissions%20Consultation.pdf

v Up to 20 diagnoses can be recorded for a patient for a hospital episode. The primary diagnosis field is used to record the main condition treated or investigated during the relevant episode of care and there are up to 19 secondary diagnosis fields that are used to describe other conditions related to the episode.

Table 15. Number of alcohol-attributable hospital admissions (primary diagnosis or external causes) by age and sex

SEX	NUMBER OF HOSPITAL ADMISSIONS								
	0-15	16-24	25-34	35-44	45-54	55-64	65-74	75+	TOTAL
NET ADMISSION EPISODES									
Men	2,045	13,138	15,977	19,866	21,359	19,441	13,780	11,633	117,239
Women	2,366	5,813	5,919	9,001	9,113	7,331	4,715	6,675	50,934
Total	**4,412**	**18,951**	**21,896**	**28,866**	**30,472**	**26,773**	**18,495**	**18,309**	**168,173**
HARMFUL									
Men	2,045	13,217	16,314	21,020	24,176	23,697	18,591	15,839	134,900
Women	2,366	6,402	7,256	11,019	11,928	10,580	8,019	10,400	67,971
Total	**4,412**	**19,619**	**23,571**	**32,039**	**36,104**	**34,277**	**26,611**	**26,239**	**202,871**
PROTECTIVE									
Men	0	-79	-337	-1,154	-2,817	-4,256	-4,811	-4,206	-17,660
Women	0	-589	-1,338	-2,018	-2,815	-3,248	-3,304	-3,725	-17,038
Total	**0**	**-668**	**-1,675**	**-3,173**	**-5,632**	**-7,504**	**-8,115**	**-7,931**	**-34,698**

Figure 10. Net alcohol-attributable hospital admissions (primary diagnosis or external causes) by type of condition – Men

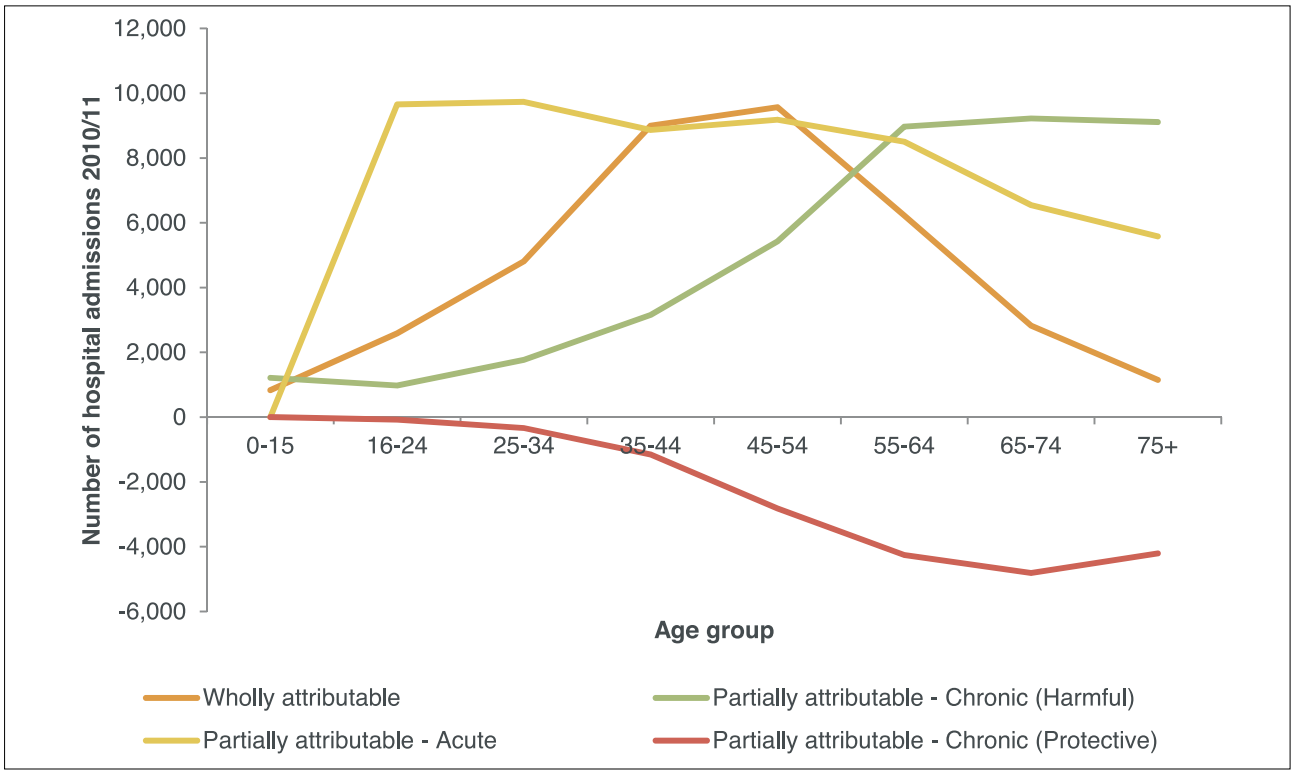
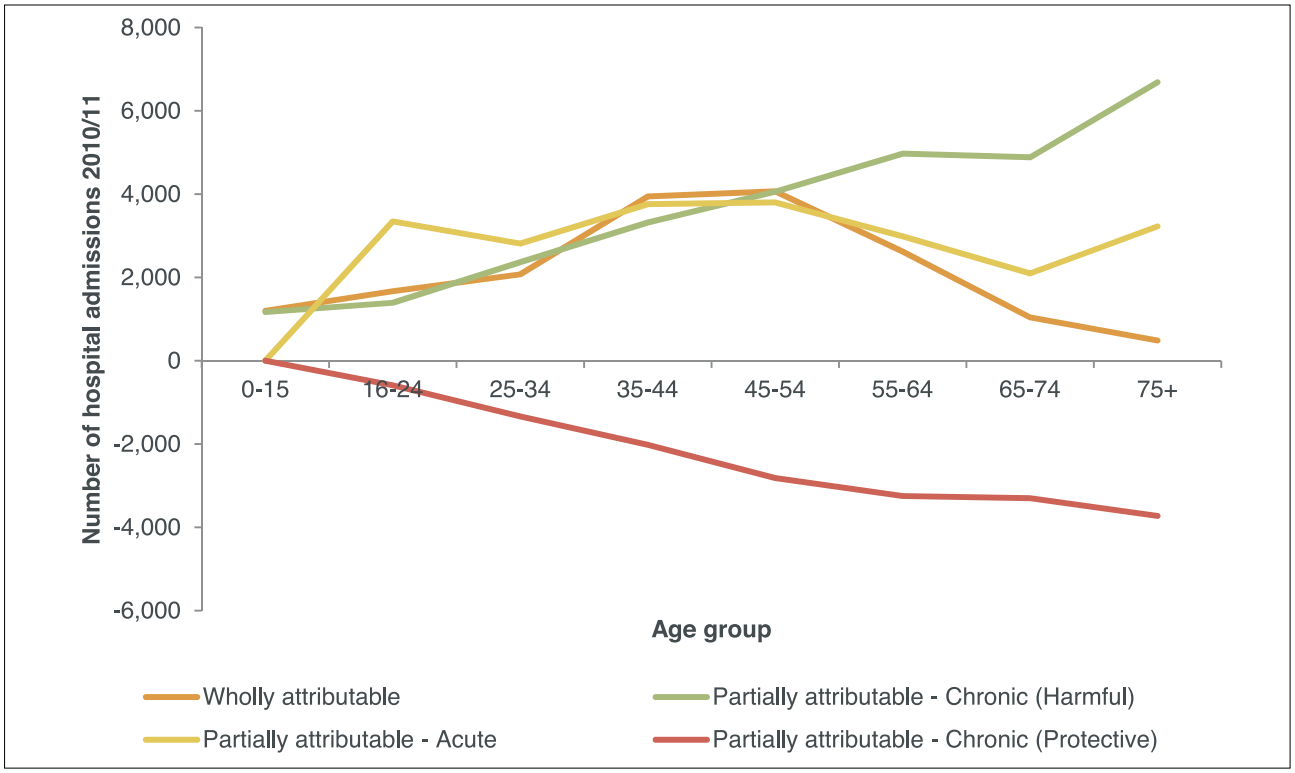


Figure 11. Net alcohol-attributable hospital admissions (primary diagnosis or external causes) by type of condition – Women



6.3.2 Causes of hospital admissions

A total of 4,412 admission episodes were recorded among the 15 years and under age group. Of these, 2,032 were related to wholly attributable admissions and 2,380 were related to admissions for low birth weight arising from maternal alcohol consumption. The admissions for alcohol-specific conditions were dominated by admissions for mental and behavioural disorders due to use of alcohol (n=1,836).

Across all age groups 16 years and older, the largest contributor to hospital admissions by disease area was injuries (n=81,014) (Figures 12 and 13). Among younger age groups (16 to 54 years), injuries and neuropsychiatric illnesses were the largest contributors to alcohol-attributable hospital admissions, compared to injuries, neuropsychiatric illnesses and cancers in older age groups (55 to 75+ years). According to specific conditions, the largest contributors to hospital admissions were mental and behavioural disorders due to use of alcohol (n=36,358), other unintentional injuries (n=38,460), and fall injuries (n=21,175). As shown in Table 16, types of injury were the largest contributor to admissions across all ages and for both men and women.

Table 16. Top three causes of alcohol-attributable net hospital admissions (primary diagnosis or external causes)

AGE	MEN		WOMEN	
	CONDITION	N	CONDITION	N
16-24	Other unintentional injuries Mental and behavioural disorders Assault	3,801 2,182 1,612	Mental and behavioural disorders Intentional self-harm Spontaneous abortion	1,420 1,196 1,005
25-34	Other unintentional injuries Mental and behavioural disorders Fall injuries	4,285 3,723 1,525	Spontaneous abortion Mental and behavioural disorders Other unintentional injuries	1,996 1,531 1,256
35-44	Mental and behavioural disorders Other unintentional injuries Fall injuries	6,393 4,255 1,610	Mental and behavioural disorders Other unintentional injuries Spontaneous abortion	2,612 1,920 1,555
45-54	Mental and behavioural disorders Other unintentional injuries Alcoholic liver disease[a]	6,179 4,823 2,503	Mental and behavioural disorders Other unintentional injuries Alcoholic liver disease[a]	2,493 2,071 1,344
55-64	Other unintentional injuries Mental and behavioural disorders Alcoholic liver disease[a]	5,278 3,417 2,438	Breast cancer Other unintentional injuries Alcoholic liver disease[a]	1,620 1,626 1,281
65-74	Other unintentional injuries Fall injuries Cardiac arrhythmias	4,128 2,104 1,988	Breast cancer Other unintentional injuries Fall injuries	1,201 1,007 978
75+	Fall injuries Pneumonia Other unintentional injuries	3,231 3,040 2,202	Fall injuries Pneumonia Other unintentional injuries	2,402 1,080 745
Total	**Other unintentional injuries** **Mental and behavioural disorders** **Fall injuries**	**28,773** **24,962** **14,264**	**Mental and behavioural disorders** **Other unintentional injuries** **Fall injuries**	**11,396** **9,688** **6,911**

[a]Includes alcoholic liver disease (K70) and unspecified liver disease (K73, K74).

Figure 12. Net hospital admissions (primary diagnosis or external causes) by disease area – Men

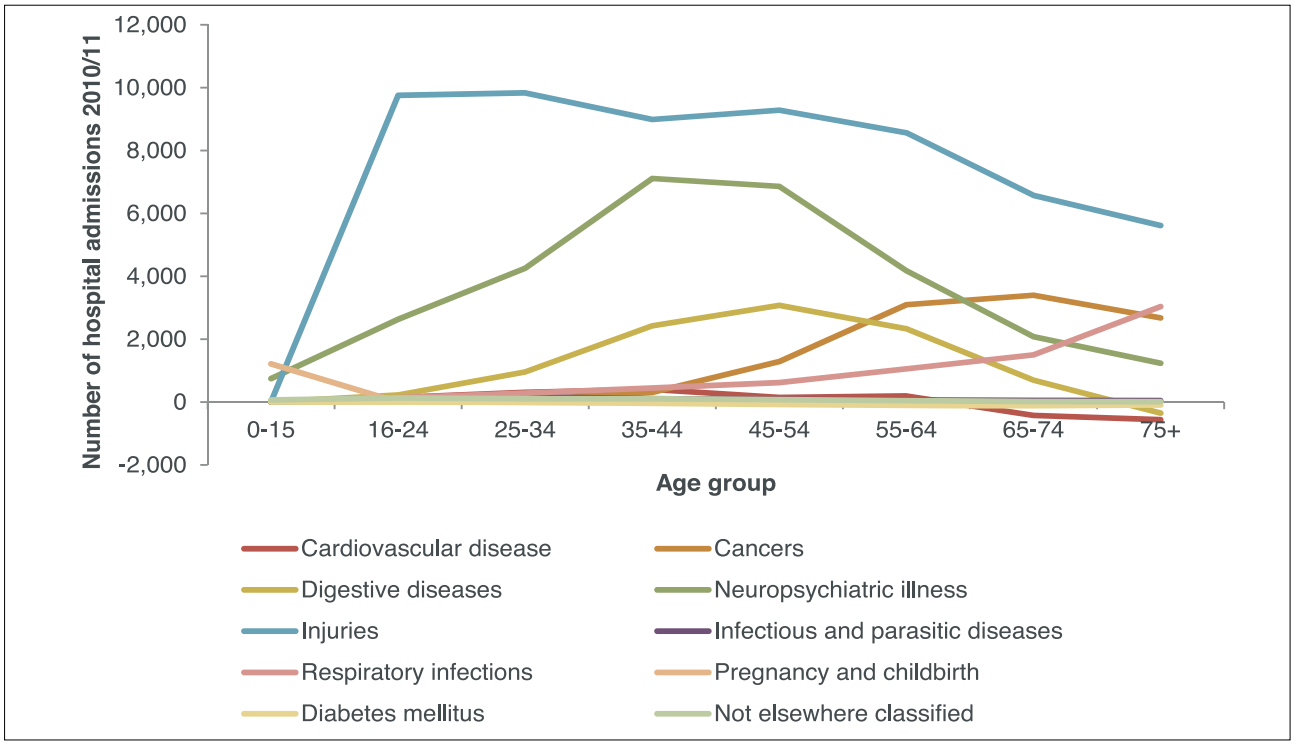
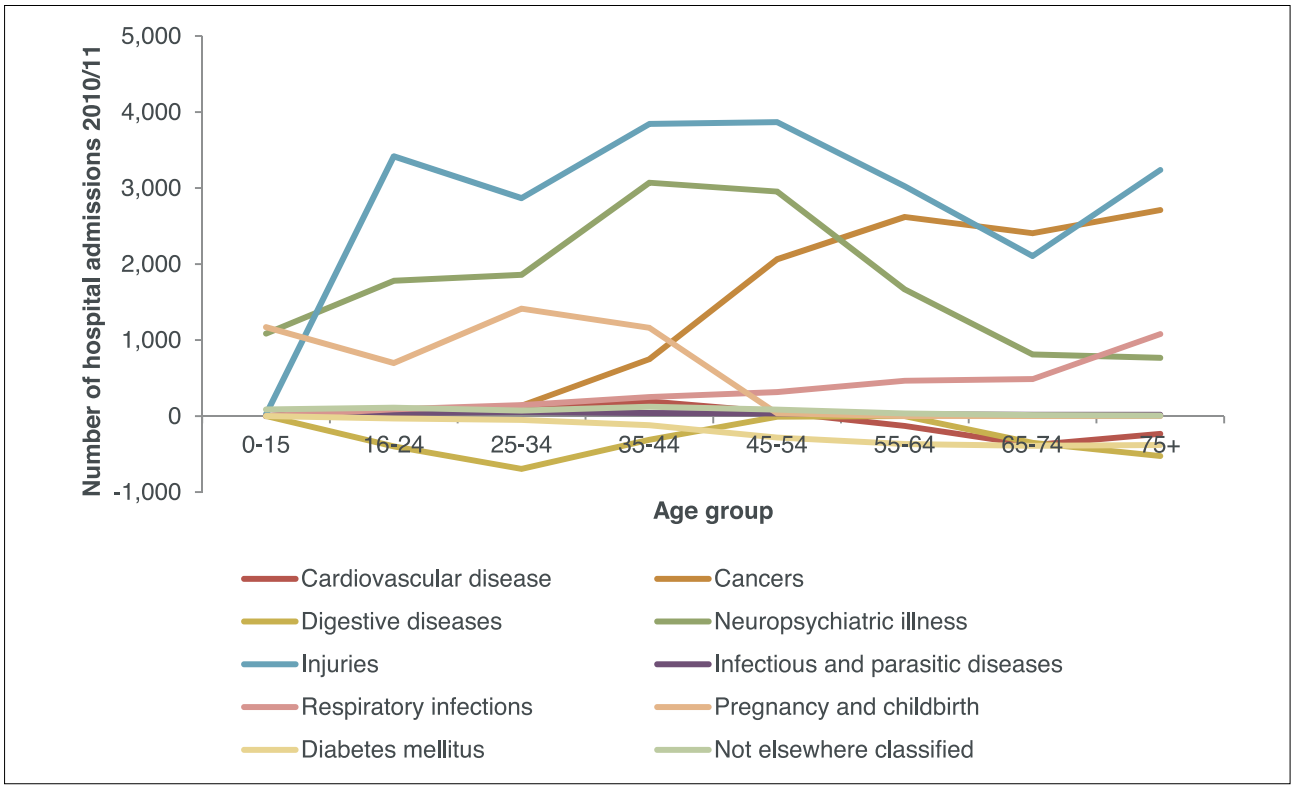


Figure 13. Net hospital admissions (primary diagnosis or external causes) by disease area – Women



7. Discussion

There is clear and consistent evidence that alcohol consumption is associated with the development of a number of chronic conditions and acute consequences. Methodological developments have further enabled the relationship between alcohol consumption and disease to be characterised with evidence of a causal impact of average volume of alcohol consumption found for a number of major diseases.[10] Alcohol consumption has also been shown to be causal for a range of acute consequences, most notably traffic accidents.[49] The calculation of AAFs has been used to estimate the impact that alcohol has on population health. In England, AAFs are routinely applied to provide an indication of the public health effects of alcohol and used to develop the Local Alcohol Profiles for England (LAPE) online tool. There have been a number of methodological developments in the calculation of AAFs since the calculation of the old AAFs that underpin the LAPE estimates. The aim of this report was to review these methodological developments and to apply these to the calculation of new, updated AAFs for England.

AAFs were calculated for 52 conditions, including 20 conditions, which by definition were wholly attributable to alcohol consumption, and 32 conditions that were partially attributable to alcohol. Five new wholly attributable conditions and three new partially attributable chronic conditions were included in the updated calculations. The evidence for the relationship between some conditions and alcohol consumption have been re-evaluated since the 2008 study[1] and subsequently, psoriasis, gastro-oesophageal laceration-haemorrhage syndrome and heart failure were not included in the updated calculations. Where identified, new estimates of the relationship between alcohol consumption and each chronic condition were included. New methods that took into account average consumption, occasions of binge drinking, and the length of time at risk after consumption were used to calculate AAFs related to injury.[33,34] Additional ICD10 codes for other types of unintentional injuries and poisoning were included in the update.

Considering only the harmful consequences, based on the new AAFs, 21,162 deaths were estimated to be attributable to alcohol consumption in 2010; representing 4.6% of all recorded deaths in England in 2010. While an estimated 6,885 deaths were prevented by alcohol consumption in 2010 based on the new AAFs, this figure is likely to be an overestimate due the impact of irregular heavy drinking occasions not having been accounted for in the analyses.[19] Men were at greater risk of harm from their alcohol consumption than women; considering only harmful consequences, 6.2% of deaths among men were alcohol-attributable in 2010 compared to 3.1% of deaths among women. Although gender-specific risk estimates were incorporated for some conditions for this update, this difference more likely arose because of the higher levels of alcohol consumption among men. Among men and women, the proportion of deaths that were alcohol-attributable in 2010 was highest among 25-34 year olds and 35-44 year olds (25.1% and 16.4% respectively). By disease areas, the biggest contributors to alcohol-attributable deaths were cancers, digestive diseases and injuries. For those under 45 years of age, injuries, neuropsychiatric illnesses and digestive diseases were the most frequent causes of alcohol-attributable death. In those aged over 45 years, cancers, digestive diseases and injuries dominated. Potential years of life lost (PYLL) were calculated as an estimate of premature or untimely death attributable to alcohol use. In 2010, considering only harmful consequences, 296,421 potential years of life were lost due to deaths from alcohol-attributable conditions (in comparison, 25,797 potential years of life were saved). For men and women, respectively, this is equivalent to an average of 15.4 and 11.3 years of life lost per alcohol-related death. Potential years of life were lost primarily due to deaths from digestive diseases including liver disease (105,254 years), injuries including road traffic accidents (91,898 years) and cancers (57,951 years).

Two sets of analyses were undertaken to examine alcohol-attributable hospital admissions. For our main analyses we examined admission episodes containing an alcohol-attributable condition in the primary or secondary diagnosis fields. Based on the harmful consequences only, there were an estimated 914,929 admission episodes in 2010/11 (in comparison, an estimated 101,444 admission episodes were prevented). Among men and women, the largest contributors to hospital admissions were hypertensive diseases, mental and behavioural disorders due to use of

alcohol and cardiac arrhythmias. For an additional set of analyses, to inform a consultation on a reliable proxy measure for alcohol-related hospital admissions, we examined admission episodes containing an alcohol-attributable condition in the primary diagnosis field or an external cause in any field. Based on the harmful consequences only, there were an estimated 202,871 primary admission episodes in 2010/11 (in comparison, an estimated 34,698 admission episodes were prevented). In this analysis, types of unintentional injury and mental and behavioural disorders due to the use of alcohol were the largest contributors to admissions for both men and women.

There were limitations to the methods used to calculate the updated AAFs. As with calculation of the previous AAFs it has not been possible to develop methodologies for calculating uncertainty around the AAF estimates. Although methodologies[47] have developed in this area it has not been possible to incorporate them into the update due to a lack of information in the published papers on the RR estimates and their variance. This major limitation aside, we have addressed several limitations in the methods used to previously calculate the AAFs. Methodological developments in the calculation of AAFs were incorporated into the update, which used a continuous, rather than a categorical, approach where possible to calculate the AAFs. We have also used updated methodologies[37] to incorporate average consumption, occasions of binge drinking, and the length of time at risk after consumption into the calculation of AAFs for alcohol-related injury. Butt and colleagues[50] have noted that the estimates pooled in the meta-analysis by Taylor and colleagues[37,49] may overestimate the risk of injury associated with alcohol use. Many studies of injury risk and alcohol consumption fail to account for drinking context in their analyses and therefore there is the potential in these studies that injury risk may actually be attributable to involvement in other high-risk activities (e.g. illicit substance use) other than alcohol use.[50] However, the meta-analysis by Taylor and colleagues[32,37] provides the best estimates of injury risk currently available and the AAFs presented here are an improvement on the AAFs previously calculated. Another limitation in the previous calculation of AAFs estimates was the likely underestimation of consumption in the general population. For the update, the age-specific distribution of alcohol consumption in England was determined based on the 2010 General Lifestyle Survey and we used a gamma distribution to model alcohol consumption.[36] Following recommendations in the international literature we used the methods proposed by Rehm and colleagues[36] to model upshifted consumption. The model was also capped at an exposure of 150g of alcohol per day in line with recommendations in the international literature on the basis that few individuals continue to consume alcohol on a daily basis above this level for a period of time. This is likely a conservative measure and its application may warrant further consideration in future calculation of AAFs. While it is still not possible to apply age-specific RR estimates across the conditions examined, for a number of conditions it was possible to apply sex-specific estimates.

Whether there is evidence for a protective effect of alcohol consumption continues to be debated. We identified three meta-analyses[19-21] that had been published since the calculation of the previous AAFs. Two meta-analyses[20,21] confirmed that light to moderate levels of alcohol consumption appear to be associated with a cardioprotective effect; however Roerecke and Rehm[20] noted that there was a large amount of uncertainty around the estimates calculated. A further meta-analysis by Roerecke and Rehm[19] concluded that the cardioprotective effect of moderate alcohol consumption was not apparent when heavy drinking occasions were mixed with, on average, light to moderate levels of consumption. It was not possible to take the relationship between heavy drinking occasions and ischaemic heart disease into account in our analyses and therefore it is likely that the protective effects attributed to alcohol consumption here are an overestimate.

In summary, based on developing methodologies and a growing evidence base for the causal role that alcohol plays in the development of a number of acute and chronic conditions, we have calculated updated AAFs for England. The figures presented here provide a more accurate estimate of the harm attributable to alcohol consumption, yet they are still likely to be a conservative estimate given the continuing limitations and uncertainties of the current evidence.

8. References

1. Jones L., Bellis M. A., Dedman D., Sumnall H., Tocque K.
   Alcohol-attributable fractions for England. Alcohol-attributable mortality and hospital admissions.
   Liverpool: North West Public Health Observatory; 2008.

2. Corrao G., Bagnardi V., Zambon A., La Vecchia C.
   A meta-analysis of alcohol consumption and the risk of 15 diseases.
   Preventive Medicine 2004; 38: 613–9.

3. Gutjahr E., Gmel G., Rehm J.
   Relation between average alcohol consumption and disease. An overview.
   European Addiction Research 2001; 7: 117–27.

4. Rehm J., Room R., Monteiro M., Gmel G., Graham K., Rehn N. et al.
   Alcohol use. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, editors. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors.
   Geneva: World Health Organization; 2004. p. 959–1108.

5. Ridolfo B., Stevenson C.
   The quantification of drug-caused mortality and morbidity in Australia 1998.
   Canberra: Australian Institute of Health and Welfare; 2001.

6. Corrao G., Bagnardi V., Zambon A., Aricò S.
   Exploring the dose-response relationship between alcohol consumption and the risk of several alcohol-related conditions: a meta-analysis.
   Addiction 1999; 94: 1551–73.

7. Corrao G., Rubbiati L., Zambon A., Aricò S.
   Alcohol-attributable and alcohol-preventable mortality in Italy. A balance in 1983 and 1996.
   European Journal of Public Health 2002; 12: 214–23.

8. Single E., Robson L., Xie X., Rehm J.
   The cost of substance use in Canada.
   Ottawa: Canadian Centre on Substance Abuse; 1996.

9. English D. R., Holman C. D. J., Milne E., Winter M. J., Hulse G. K., Codde J. P. et al.
   The quantification of drug caused morbidity and mortality in Australia. 1995 edition.
   Canberra: Commonwealth Department of Human Services and Health; 1995.

10. Rehm J., Baliunas D., Borges G. L. G., Graham K., Irving H., Kehoe T. et al.
    The relation between different dimensions of alcohol consumption and burden of disease: an overview.
    Addiction 2010; 105: 817–43.

11. Tramacere I., Negri E., Bagnardi V., Garavello W., Rota M., Scotti L. et al.
    A meta-analysis of alcohol drinking and oral and pharyngeal cancers. Part 1: overall results and dose-risk relation.
    Oral Oncology 2010; 46: 497-503.

12. Islami F., Fedirko V., Tramacere I., Bagnardi V., Jenab M., Scotti L. et al.
    Alcohol drinking and esophageal squamous cell carcinoma with focus on light-drinkers and never-smokers: a systematic review and meta-analysis.
    International Journal Of Cancer Journal International Du Cancer 2011; 129: 2473-84.

13. Fedirko V., Tramacere I., Bagnardi V., Rota M., Scotti L., Islami F. et al.
    Alcohol drinking and colorectal cancer risk: an overall and dose-response meta-analysis of published studies.
    Annals Of Oncology 2011; 22: 1958-72.

14. Islami F., Tramacere I., Rota M., Bagnardi V., Fedirko V., Scotti L. et al.
    Alcohol drinking and laryngeal cancer: overall and dose-risk relation--a systematic review and meta-analysis.
    Oral Oncology 2010; 46: 802-10.

15. Baliunas D. O., Taylor B. J., Irving H., Roerecke M., Patra J., Mohapatra S. et al.
    Alcohol as a risk factor for Type 2 Diabetes: a systematic review and meta-analysis.
    Diabetes Care 2009; 32: 2123–32.

16. Patra J., Taylor B., Irving H., Roerecke M., Baliunas D., Mohapatra S. et al.
    Alcohol consumption and the risk of morbidity and mortality for different stroke types - a systematic review and meta-analysis.
    BMC Public Health 2010; 10: 258.

17. Irving H. M., Samokhvalov A. V., Rehm J.
    Alcohol as a risk factor for pancreatitis. a systematic review and meta-analysis.
    JOP 2012; 10: 387–92.

18. Rehm J., Taylor B., Mohapatra S., Irving H., Baliunas D., Patra J. et al.
Alcohol as a risk factor for liver cirrhosis: a systematic review and meta-analysis.
Drug and Alcohol Review 2010; 29: 437–45.

19. Roerecke M., Rehm J.
Irregular heavy drinking occasions and risk of ischemic heart disease: a systematic review and meta-analysis.
American Journal of Epidemiology 2010; 171: 633–44.

20. Roerecke M., Rehm J.
The cardioprotective association of average alcohol consumption and ischaemic heart disease: a systematic review and meta-analysis.
Addiction 2012; doi:10.1111/j.1360-0443.2012.03780.x.

21. Ronksley P. E., Brien S. E., Turner B. J., Mukamal K. J., Ghali W. A.
Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis.
BMJ 2011; 342: d671.

22. Taylor B., Irving H. M., Baliunas D., Roerecke M., Patra J., Mohapatra S. et al.
Alcohol and hypertension: gender differences in dose–response relationships determined through systematic review and meta-analysis.
Addiction 2009; 104: 1981–90.

23. Samokhvalov A. V., Irving H., Mohapatra S., Rehm J.
Alcohol consumption, unprovoked seizures, and epilepsy: a systematic review and meta-analysis.
Epilepsia 2010; 51: 1177–84.

24. Samokhvalov A. V., Irving H. M., Rehm J.
Alcohol consumption as a risk factor for atrial fibrillation: a systematic review and meta-analysis.
European Journal of Cardiovascular Prevention & Rehabilitation 2010; 17: 706–12.

25. Kodama S., Saito K., Tanaka S., Horikawa C., Saito A., Heianza Y. et al.
Alcohol consumption and risk of atrial fibrillation: a meta-analysis.
Journal Of The American College Of Cardiology 2011; 57: 427-36.

26. Lönnroth K., Williams B. G., Stadlin S., Jaramillo E., Dye C.
Alcohol use as a risk factor for tuberculosis – a systematic review.
BMC Public Health 2008; 8: 289.

27. Samokhvalov A. V., Irving H. M., Rehm J.
Alcohol consumption as a risk factor for pneumonia: a systematic review and meta-analysis.
Epidemiology and Infection 2010; 138: 1789-95.

28. Patra J., Bakker R., Irving H., Jaddoe V. W. V., Malini S., Rehm J.
Dose–response relationship between alcohol consumption before and during pregnancy and the risks of low birthweight, preterm birth and small for gestational age (SGA)—a systematic review and meta-analyses.
BJOG 2011; 118: 1411–21.

29. Cassano N., Vestita M., Apruzzi D., Vena G. A.
Alcohol, psoriasis, liver disease and anti-psoriasis drugs.
International Journal of Dermatology 2011; 50: 1323-31.

30. Collaborative Group on Hormonal Factors in Breast Cancer.
Alcohol, tobacco and breast cancer--collaborative reanalysis of individual data from 53 epidemiological studies, including 58,515 women with breast cancer and 95,067 women without the disease.
British Journal of Cancer 2002; 87: 1234–45.

31. Key J., Hodgson S., Omar R. Z., Jensen T. K., Thompson S. G., Boobis A. R. et al.
Meta-analysis of studies of alcohol and breast cancer with consideration of the methological issue.
Cancer Causes & Control 2006; 17: 759-70.

32. Taylor B., Irving H. M., Kanteres F., Room R., Borges G., Cherpitel C. et al.
The more you drink, the harder you fall: a systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together.
Drug and Alcohol Dependence 2010; 110: 108–16.

33. Taylor B., Rehm J., Room R., Patra J., Bondy S.
Determination of lifetime injury mortality risk in Canada in 2002 by drinking amount per occasion and number of occasions.
American Journal of Epidemiology 2008; 168: 1119–25.

34. Rehm J., Room R., Taylor B.
Method for moderation: measuring lifetime risk of alcohol-attributable mortality as a basis for drinking guidelines.
International Journal of Methods in Psychiatric Research 2008; 17: 141-51.

35. Kelly C., Pashayan N., Munisamy S., Powles J. W.
Mortality attributable to excess adiposity in England and Wales in 2003 and 2015: explorations with a spreadsheet implementation of the Comparative Risk Assessment methodology.
Population Health Metrics 2009; 7: 11.

36. Rehm J., Kehoe T., Gmel G., Stinson F., Grant B., Gmel G.
Statistical modeling of volume of alcohol exposure for epidemiological studies of population health: the US example.
Population Health Metrics 2010; 8: 3.

37. Taylor B. J., Shield K. D., Rehm J.
Combining best evidence: a novel method to calculate the alcohol-attributable fraction and its variance for injury mortality.
BMC Public Health 2011; 11: 265.

38. The Health and Social Care Information Centre.
Health Survey for England 2011. Health, social care and lifestyles. Craig R, Mindell J, editors.
Leeds: The Health and Social Care Information Centre.; 2012.

39. Nichols M., Scarborough P., Allender S., Rayner M.
What is the optimal level of population alcohol consumption for chronic disease prevention in England? Modelling the impact of changes in average consumption levels.
BMJ Open 2010; 2: e000957.doi:10.1136/bmjopen-2012-.

40. Gmel G., Shield K. D., Frick H., Kehoe T., Gmel G., Rehm J.
Estimating uncertainty of alcohol-attributable fractions for infectious and chronic diseases.
BMC Medical Research Methodology 2011; 11: 48.

41. Catto S.
How much are people in Scotland really drinking? A review of data from Scotland's routine national surveys.
Edinburgh: NHS Health Scotland; 2008.

42. Parkin D.
Cancers attributable to consumption of alcohol in the UK in 2010.
British Journal of Cancer 2011; 105: S14-S8.

43. Corrao G., Bagnardi V., Zambon A., Aricò S.
Exploring the dose-response relationship between alcohol consumption and the risk of several alcohol-related conditions: a meta-analysis.
Addiction 1999; 94: 1551-73.

44. Meier P. S., Meng Y., Holmes J., Baumberg B., Purhouse R., Hill-McManus D. et al.
Adjusting for unrecorded consumption in survey and per capita sales data: quantification of impact on gender- and age-specific alcohol-attributable fractions for oral and pharyngeal cancers in Great Britain.
Alcohol and Alcoholism 2013; 48: 241-9.

45. National Audit Office.
Renewed Alcohol Strategy: a progress report.
London: National Audit Office; 2012.

46. McAndrew F., Thompson J., Fellows L., Large A., Speed M., Renfrew M. J.
Infant Feeding Survey 2010.
Leeds: Health and Social Care Information Centre; 2012.

47. Greenland S.
Interval estimation by simulation as an alternative to and extension of confidence intervals.
International Journal of Epidemiology 2004; 33: 1389-97.

48. Public Health England.
Alcohol-related admissions: summary of responses to the consultation and future plans.
London: Public Health England; 2013.

49. Taylor B., Rehm J.
The relationship between alcohol consumption and fatal motor vehicle injury: high risk at low alcohol levels.
Alcoholism: clinical and experimental research 2012; 36: 1827-34.

50. Butt P., Bierness D., Gliksman L., Paradis C., Stockwell T.
Alcohol and health in Canada: a summary of evidence and guidelines for low-risk drinking.
Ottawa: Canadian Centre on Substance Abuse; 2011.

Appendix 1. Summary of exposure categories and dose-response relationship for conditions included in update

CONDITION	SOURCE	SEX	EXPOSURE CATEGORIES	DOSE-RESPONSE RELATIONSHIP	RR FOR FORMER DRINKERS VS. LIFE-TIME ABSTAINERS
Tuberculosis	Lönnroth et al., 2008[26]	–	≥40 g/d: 2.94 (1.89–4.59)	Relationship between risk and consumption not described	M: 1.21 (1.10–1.32) F: 1.44 (1.28–1.61)
Malignant neoplasm of lip, oral cavity and pharynx	Tramacere et al., 2010[11]	–	10 g/d 1.29 (1.25-1.32) 25 g/d: 1.85 (1.74–1.96) 50 g/d: 3.24 (2.89–3.64) 75 g/d: 5.42 (4.58–6.40) 100 g/d: 8.61 (6.91–10.73) 125 g/d: 13.02 (9.87–17.18)	Non-linear. RR function not reported. (Quadratic approximation = 1.32 + -0.001*alc + 0.0008*alc^2)	All-cause mortality
Malignant neoplasm of oesophagus	Islami et al., 2011[12]	–	<12.5 g/d 1.38 (1.14–1.67) >12.5–<50 g/d 2.62 (2.07–3.31) >50 g/d 5.54 (3.92–7.28)	Not reported. Relationship with moderate and high alcohol intakes	All-cause mortality
Malignant neoplasm of colon and rectum	Ferdiko et al., 2011[13]	–	–	lnRR = 0.006992*alc – 0.00001*alc^2	All-cause mortality
Malignant neoplasm of liver and intrahepatic bile ducts	Corrao et al., 2004[2]	–	25 g/d: 1.19 (1.12 –1.27) 50 g/d: 1.4 (1.25–1.56) 100 g/d: 1.81 (1.50–2.19)	Linear	All-cause mortality
Malignant neoplasm of larynx	Islami et al., 2010[14]	–	<12.5 g/d 0.88 (0.70–1.12) <50 g/d 1.50 (1.23–1.83) >50 g/d 2.46 (1.88–3.22)	lnRR = 0.01625*alc – 0.00003*alc^2	All-cause mortality
Malignant neoplasm of breast	Collaborative Group on Hormonal Factors in Breast Cancer, 2002[30]	F	<25 g/d: 1.07 25–34 g/d: 1.21 35–44 g/d: 1.32 >45 g/d: 1.46 (1.33–1.61)	Linear	All-cause mortality
Diabetes mellitus (type II)	Baliunas et al., 2009[15]	M	nadir 22 g/d: 0.87 (0.76–1.00) deleterious >60 g/d: 1.01 (0.71–1.44)	U-shaped. lnRR = β1*alc + β2*alc*ln(alc)	1.18 (0.89–1.52)
		F	nadir 24 g/d: 0.60 (0.52–0.69) deleterious >50 g/d: 1.02 (0.83–1.26)	U-shaped. lnRR = β1*alc0.5 + β2*alc^3	1.14 (0.99–1.31)
Epilepsy and Status epilepticus	Samokhvalov et al., 2010[23]	–	25 g/d: 1.37 (1.28–1.47) 50 g/d: 1.86 (1.62–2.13) 100 g/d: 3.44 (2.61–4.52)	Non-linear	All-cause mortality
Hypertensive diseases	Taylor et al., 2009[22]	M	25 g/d: 1.25 (1.19–1.32) 50 g/d: 1.62 (1.46–1.81) 100 g/d: 2.64 (2.14–3.26)	Linear	0.94 (0.49–1.39)
		F	<5 g/d: 0.82 (0.73–0.93) 25 g/d: 1.24 (0.87–1.77) 50 g/d: 1.81 (1.13–2.90) 100 g/d: 2.81 (1.56–5.05)	J-shaped (shallow)	0.94 (0.49–1.39)
Ischaemic heart disease	Corrao et al., 2000[2]	–	nadir 20 g/d: 0.80 (0.78–0.83) deleterious >89 g/d: 1.05 (1.00–1.11)	J-shaped. lnRR = 0.01110*alc - 0.09867*alc$^{0.5}$	
Ischaemic heart disease	Roerecke & Rehm, 2012 (Mortality)	M	<2.5 g/d: 0.94 (0.74–1.21) 2.5-12 g/d: 0.89 (0.79–1.00) 12-24 g/d: 0.86 (0.73–1.02) 24 – 36 g/d: 0.78 (0.63–0.97)	J-shaped. lnRR = β1*alc$^{0.5}$ + β2*alc^3	1.21 (1.12–1.30)
		F	<2.5 g/d: 0.98 (0.74–1.30) 2.5-12 g/d: 0.84 (0.74–0.96) 12-24 g/d: 1.03 (0.84–1.27) 24 – 36 g/d: 0.89 (0.57–1.40)	J-shaped. lnRR = β1*alc + β2*alc*ln(alc)	1.39 (1.17–1.66)

CONDITION	SOURCE	SEX	EXPOSURE CATEGORIES	DOSE-RESPONSE RELATIONSHIP	RR FOR FORMER DRINKERS VS. LIFE-TIME ABSTAINERS
Ischaemic heart disease	Roerecke & Rehm, 2012 (Morbidity)	M	<2.5 g/d: 0.82 (0.65–1.02) 2.5-12 g/d: 0.77 (0.65–0.92) 12-24 g/d: 0.75 (0.64–0.88) 24 – 36 g/d: 0.74 (0.53–1.02)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*ln(alc)*alc^{0.5}$	0.99 (0.90–1.08)
		F	<2.5 g/d: 0.91 (0.78–1.07) 2.5-12 g/d: 0.54 (0.45–0.65) 12-24 g/d: 0.61 (0.38–0.99) 24 – 36 g/d: 0.40 (0.14–1.13)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc$	1.11 (0.94–1.32)
Cardiac arrhythmias	Kodama et al., 2011[25]	–	–	Linear. lnRR = 0.0074*alc	Not enough data
Haemorrhagic stroke	Patra et al., 2010[16] (Mortality)	M	12 g: 1.09 (1.06-1.12) 36 g: 1.28 (1.18-1.39) 60 g: 1.51 (1.32-1.73) 84 g: 1.79 (1.48-2.15)	Linear	1.33 (0.91–1.96)
		F	12 g: 0.89 (0.52-1.52) 36 g: 1.52 (1.08-2.14) 60 g: 2.39 (1.61-3.55) 84 g: 3.66 (2.16-6.19)	J-shaped. lnRR = $\beta1*log(alc) + \beta2*alc$	1.15 (0.71–1.92)
Haemorrhagic stroke	Patra et al., 2010[16] (Morbidity)	M	12 g: 1.10 (1.06-1.14) 36 g: 1.32 (1.18-1.47) 60 g: 1.59 (1.32-1.91) 84 g: 1.91 (1.47-2.47)	Linear	1.33 (0.91–1.96)
		F	12 g: 0.69 (0.54-0.89) 36 g: 0.99 (0.73-1.33) 60 g: 1.43 (0.99-2.05) 84 g: 2.03 (1.30-3.18)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc^{0.5}*log(alc)$	1.15 (0.71–1.92)
Ischaemic stroke	Patra et al., 2010[16] (Morbidity)	M	12 g: 0.86 (0.81-0.93) 36 g: 1.00 (0.94-1.07) 60 g: 1.17 (1.09-1.27) 84 g : 1.36 (1.23-1.50)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc^{0.5}*log(alc)$	1.33 (0.91–1.96)
		F	12 g: 0.66 (0.55-0.79) 36 g: 0.85 (0.73-1.00) 60 g: 1.35 (1.14-1.60) 84 g: 2.31 (1.70-3.13)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc$	1.15 (0.71–1.92)
Ischaemic stroke	Patra et al., 2010[16] (Morbidity)	M	12 g: 0.87 (0.81-0.93) 36 g: 0.99 (0.92-1.07) 60 g: 1.15 (1.05-1.25) 84 g: 1.32 (1.18-1.47)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc^{0.5}*log(alc)$	1.33 (0.91–1.96)
		F	12 g: 0.82 (0.74-0.92) 36 g: 0.92 (0.81-1.05) 60 g: 1.13 (0.98-1.31) 84 g: 1.44 (1.19-1.74)	J-shaped. lnRR = $\beta1*alc^{0.5} + \beta2*alc$	1.15 (0.71–1.92)
Pneumonia*	Samokhvalov et al., 2010[27]	–	24 g: 1.12 (1.02–1.23) 60 g: 1.33 (1.06–1.67) 120 g: 1.76 (1.13–2.77)	Linear	Not enough data
Unspecified liver disease	Rehm et al., 2010[18] (Mortality)	M	0–12 g/d: 1.0 (0.6–1.6) 12–24 g/d: 1.6 (1.4–2.0) 24–36 g/d: 2.8 (2.3–3.4) 36–48 g/d: 5.6 (4.5–7.0) 48–60 g/d: 7.0 (5.8–8.5) >60 g/d: 14.0 (11.7–16.7)	Non-linear	1.31 (0.67–2.57)
		F	0–12 g/d: 1.9 (1.1–3.1) 12–24 g/d: 5.6 (4.5–6.9) 24–36 g/d: 7.7 (6.3–9.5) 36–48 g/d: 10.1 (7.5–13.5) 48–60 g/d: 14.7 (11.0–19.6) >60 g/d: 22.7 (17.2–30.1)	Non-linear	6.50 (2.21–19.08)

CONDITION	SOURCE	SEX	EXPOSURE CATEGORIES	DOSE-RESPONSE RELATIONSHIP	RR FOR FORMER DRINKERS VS. LIFE-TIME ABSTAINERS
Unspecified liver disease	Rehm et al., 2010[18] (Morbidity)	M	0–12 g/d: 0.3 (0.1–0.9) 12–24 g/d: 0.3 (0.2–0.4) 24–36 g/d: 0.7 (0.5–1.0) 36–48 g/d: 2.0 (1.5–2.7) 48–60 g/d: 2.3 (1.7–3.2) >60 g/d: 5.0 (3.9–6.4)	Non-linear. As Butt et al.[50] note, there is no known biological reason for a reduced risk of liver cirrhosis morbidity at some levels of consumption. The relative risk has been artificially put at zero for these levels of consumption	1.31 (0.67–2.57)
		F	0–12 g/d: 0.4 (0.1–1.2) 12–24 g/d: 1.0 (0.5–1.9) 24–36 g/d: 2.4 (1.8–3.2) 36–48 g: 1.9 (1.4–2.6) 48–60 g: 5.9 (3.7–9.3) >60 g: 6.1 (4.6–8.0)	Non-linear. As Butt et al.[50] note, there is no known biological reason for a reduced risk of liver cirrhosis morbidity at some levels of consumption. The relative risk has been artificially put at zero for these levels of consumption	6.50 (2.21–19.08)
Acute and chronic pancreatitis	Irving et al., 2009[17]	–	<24 g/d: 1.0 (0.8–1.2) 25 g/d: 1.10 (1.08–1.12) 36–48 g/d: 1.2 (1.0–1.5) >48 g/d: 2.5 (2.0–3.1) 50 g/d: 1.46 (1.34–1.59) 100 g/d: 4.50 (3.22–6.31)	Non-linear	All-cause mortality
Low birth weight	Patra et al., 2011[28]	F	12 g: 1.03 (0.96-1.11) 24 g: 1.23 (1.10–1.36) 36 g: 1.50 (1.30–1.73) 48 g: 1.86 (1.54–2.24) 60 g: 2.32 (1.83–2.93) 72 g: 2.91 (2.18-3.88) 84 g: 3.67 (2.60-5.17)	Non-linear. $\ln RR = \beta 1 * alc^{0.5} + \beta 2 * alc$	NA
Motor vehicle accidents	Taylor et al., 2011[32]	–	Categorical estimates not reported	Non-linear	NA
Non-motor vehicle accidents	Taylor et al., 2011[32]	–	Categorical estimates not reported	Non-linear	NA

Appendix 2. Updated alcohol-attributable fractions

CONDITION	ICD10 CODE(S)	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
WHOLLY ATTRIBUTABLE CONDITIONS																	
Alcohol-induced pseudo-Cushing's syndrome	E24.4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mental and behavioural disorders due to use of alcohol	F10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Degeneration of nervous system due to alcohol	G31.2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcoholic polyneuropathy	G62.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcoholic myopathy	G72.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcoholic cardiomyopathy	I42.6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcoholic gastritis	K29.2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcoholic liver disease	K70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcohol-induced acute pancreatitis**	K85.2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Alcohol-induced chronic pancreatitis	K86.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fetal alcohol syndrome (dysmorphic)	Q86.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Excess alcohol blood levels	R78.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ethanol poisoning	T51.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Methanol poisoning	T51.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Toxic effect of alcohol, unspecified	T51.9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Accidental poisoning by and exposure to alcohol	X45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Intentional self-poisoning by and exposure to alcohol*	X65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Poisoning by and exposure to alcohol, undetermined intent	Y15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Evidence of alcohol involvement determined by blood alcohol level	Y90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Evidence of alcohol involvement determined by level of intoxication	Y91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

CONDITION	ICD10 CODE(S)	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
PARTIALLY ATTRIBUTABLE CONDITIONS - CHRONIC CONDITIONS																	
Infectious and parasitic diseases																	
Tuberculosis	A15-A19	0.00	0.00	0.30	0.19	0.33	0.17	0.34	0.21	0.35	0.22	0.35	0.20	0.31	0.14	0.22	0.11
Malignant neoplasm of:																	
Lip, oral cavity and pharynx	C00-C14	0.00	0.00	0.53	0.38	0.44	0.35	0.44	0.42	0.46	0.43	0.47	0.40	0.40	0.31	0.29	0.24
Oesophagus	C15	0.00	0.00	0.58	0.49	0.61	0.48	0.61	0.53	0.63	0.53	0.63	0.51	0.60	0.45	0.52	0.38
Colorectal	C18-C20, C21	0.00	0.00	0.16	0.11	0.18	0.12	0.18	0.13	0.19	0.14	0.19	0.13	0.17	0.11	0.13	0.11
Liver and intrahepatic bile ducts	C22	0.00	0.00	0.15	0.11	0.17	0.11	0.17	0.12	0.18	0.13	0.18	0.12	0.16	0.10	0.12	0.11
Larynx	C32	0.00	0.00	0.35	0.25	0.39	0.23	0.39	0.28	0.41	0.29	0.41	0.27	0.36	0.21	0.28	0.17
Breast	C50	0.00	0.00	0.00	0.12	0.00	0.13	0.00	0.14	0.00	0.15	0.00	0.14	0.00	0.12	0.00	0.11
Diabetes mellitus																	
Diabetes mellitus (type II)	E11	0.00	0.00	-0.04	-0.20	-0.04	-0.21	-0.04	-0.22	-0.04	-0.22	-0.03	-0.22	-0.04	-0.20	-0.03	-0.15
Diseases of the nervous system																	
Epilepsy and Status epilepticus	G40-G41	0.00	0.00	0.32	0.22	0.35	0.20	0.35	0.24	0.37	0.25	0.37	0.23	0.33	0.18	0.24	0.15
Cardiovascular disease																	
Hypertensive diseases	I10-I15	0.00	0.00	0.22	0.26	0.25	0.17	0.25	0.30	0.27	0.31	0.27	0.25	0.23	0.09	0.15	-0.06
Ischaemic heart disease	I20-I25	0.00	0.00	-0.10	-0.10	-0.10	-0.08	-0.10	-0.10	-0.10	-0.10	-0.10	-0.09	-0.11	-0.07	-0.10	-0.02
Cardiac arrhythmias	I47-I48	0.00	0.00	0.15	0.10	0.17	0.11	0.17	0.12	0.18	0.13	0.18	0.12	0.16	0.10	0.12	0.11
Haemorrhagic stroke - Mortality	I60-I62, I69.0-I69.2	0.00	0.00	0.18	0.25	0.20	0.22	0.20	0.27	0.21	0.28	0.22	0.26	0.19	0.19	0.15	0.13
Haemorrhagic stroke - Morbidity		0.00	0.00	0.20	-0.11	0.22	-0.14	0.23	-0.11	0.24	-0.10	0.24	-0.12	0.21	-0.16	0.17	-0.15
Ischaemic stroke - Mortality	I63-I66, I69.3-I69.4	0.00	0.00	0.01	-0.09	0.02	-0.14	0.02	-0.09	0.03	-0.08	0.04	-0.10	0.01	-0.16	0.00	-0.14
Ischaemic stroke - Morbidity		0.00	0.00	0.00	-0.06	0.01	-0.07	0.01	-0.06	0.02	-0.06	0.03	-0.07	0.00	-0.07	-0.01	-0.06
Oesophageal varices - Mortality	I85	0.00	0.00	0.70	0.64	0.73	0.62	0.74	0.68	0.76	0.69	0.76	0.66	0.70	0.58	0.55	0.57
Oesophageal varices - Morbidity		0.00	0.00	0.44	0.31	0.47	0.41	0.48	0.38	0.50	0.40	0.50	0.41	0.44	0.42	0.33	0.51
Respiratory infections																	
Pneumonia	J10.0, J11.0, J12-J15, J18	0.00	0.00	0.12	0.07	0.14	0.06	0.14	0.08	0.15	0.08	0.15	0.08	0.13	0.05	0.10	0.03
Digestive disease																	
Unspecified liver disease - Mortality	K73, K74	0.00	0.00	0.70	0.64	0.73	0.62	0.74	0.68	0.76	0.69	0.76	0.66	0.70	0.58	0.55	0.57
Unspecified liver disease - Morbidity		0.00	0.00	0.44	0.31	0.47	0.41	0.48	0.38	0.50	0.40	0.50	0.41	0.44	0.42	0.33	0.51

CONDITION	ICD10 CODE(S)	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Cholelithiasis (gall stones)	K80	0.00	0.00	-0.25	-0.17	-0.28	-0.17	-0.28	-0.19	-0.30	-0.19	-0.30	-0.18	-0.27	-0.16	-0.21	-0.14
Acute and chronic pancreatitis	K85, K86.1	0.00	0.00	0.35	0.17	0.39	0.14	0.40	0.20	0.43	0.21	0.43	0.18	0.35	0.12	0.20	0.10
Pregnancy and childbirth																	
Spontaneous abortion	O03	0.00	0.00	0.00	0.08	0.00	0.08	0.00	0.11	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Low birth weight	P05-P07	0.05	0.05	0.00	0.05	0.00	0.03	0.00	0.05	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
PARTIALLY ATTRIBUTABLE CONDITIONS - ACUTE CONDITIONS																	
Unintentional injuries																	
Road/pedestrian traffic accidents - Mortality	§	0.00	0.00	0.42	0.25	0.46	0.22	0.39	0.22	0.41	0.23	0.28	0.14	0.16	0.07	0.06	0.03
Road/pedestrian traffic accidents - Morbidity		0.00	0.00	0.28	0.17	0.31	0.15	0.26	0.15	0.27	0.15	0.19	0.09	0.11	0.05	0.04	0.02
Poisoning - Mortality	X40–X49	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Poisoning - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Fall injuries - Mortality	W00-W19	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Fall injuries - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Fire injuries - Mortality	X00-X09	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Fire injuries - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Drowning - Mortality	W65-W74	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Drowning - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Other unintentional injuries - Mortality	Rest of 'V' series §§	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Other unintentional injuries - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Intentional injuries																	
Intentional self-harm - Mortality	X60-X84, Y87.0	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Intentional self-harm - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Event of undetermined intent - Mortality	Y10-Y34, Y87.2	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Event of undetermined intent - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02
Assault - Mortality	X85-Y09, Y87.1	0.00	0.00	0.32	0.18	0.37	0.17	0.37	0.20	0.40	0.19	0.38	0.14	0.26	0.08	0.12	0.04
Assault - Morbidity		0.00	0.00	0.14	0.08	0.17	0.08	0.16	0.09	0.18	0.08	0.17	0.06	0.12	0.04	0.05	0.02

§ = V021-V029, V031-V039, V041-V049, V092, V093, V123-V129, V133-V139, V143-V149, V194-V196, V203-V209, V213-V219, V223-V229, V233-V239, V243-V249, V253-V259, V263-V269, V273-V279, V283-V289, V294-V299, V304-V309, V314-V319, V324-V329, V334-V339, V344-V349, V354-V359, V364-V369, V374-V379, V384-V389, V394-V399, V404-V409, V414-V419, V424-V429, V434-V439, V444-V449, V454-V459, V464-V469, V474-V479, V484-V489, V494-V499, V504-V509, V514-V519, V524-V529, V534-V539, V544-V549, V554-V559, V564-V569, V574-V579, V584-V589, V594-V599, V604-V609, V614-V619, V624-V629, V634-V639, V644-V649, V654-V659, V664-V669, V674-V679, V684-V689, V694-V699, V704-V709, V714-V719, V724-V729, V734-V739, V744-V749, V754-V759, V764-V769, V774-V779, V784-V789, V794-V799, V803-V805, V811, V821, V830-V833, V840-V843, V850-V853, V860-V863, V870-V878, V892. §§ = V01, V090, V091, V099, V100-V109, V110-V119, V120-122, V130-132, V140-V142, V150-V159, V160-V169, V170-V179, V180-V189, V191-V193, V20-V28: 0.1–0.2; V290-V293, V30-V38: 0.1–0.2; V390-V393, V40-V48: 0.1–0.2; V490-V493, V50-V58: 0.1–0.2; V590-V593, V60-V68: 0.1–0.2; V690-V693, V70-V78: 0.1–0.2; V790-V793, V800, V801, V806–V809, V810, V812–V819, V820, V822–V829, V834–V839, V844–V849, V854–V859, V864–V869, V879, V88, V890, V891, V893–V899, V90-V94, V95-V97, V98-V99, W20-W52, W75-W84, W85–W99, X10-X19, X20-X29, X30-X33, X50-X57, X58, X59, Y40-Y84 Y85, Y86, Y88, Y89

Appendix 3. Alcohol-attributable mortality in England 2010

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
WHOLLY ATTRIBUTABLE CONDITIONS																
Alcohol-induced pseudo-Cushing's syndrome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mental and behavioural disorders	0	0	10	0	24	7	88	44	119	40	133	50	54	25	17	15
Degeneration of nervous system	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0
Alcoholic polyneuropathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcoholic myopathy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcoholic cardiomyopathy	0	0	0	0	4	0	9	1	17	5	18	2	12	2	4	0
Alcoholic gastritis	0	0	0	0	0	0	1	0	1	0	0	1	3	0	0	0
Alcoholic liver disease	0	0	3	1	88	67	448	246	861	396	896	433	445	196	136	59
Alcohol-induced acute pancreatitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcohol-induced chronic pancreatitis	0	0	0	0	5	1	11	5	11	6	6	3	3	1	1	1
Fetal alcohol syndrome	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess alcohol blood levels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethanol poisoning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methanol poisoning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Toxic effect of alcohol, unspecified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accidental poisoning by and exposure to alcohol	0	0	3	1	15	4	33	12	39	20	23	11	4	4	3	1
Intentional self-poisoning by and exposure to alcohol	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0
Poisoning by and exposure to alcohol, undetermined intent	0	0	1	0	2	0	0	1	2	0	0	0	0	0	0	0
Evidence of alcohol involvement determined by blood alcohol level	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evidence of alcohol involvement determined by level of intoxication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
PARTIALLY ATTRIBUTABLE CONDITIONS																
Infectious and parasitic diseases																
Tuberculosis	0	0	1	0	2	1	5	1	6	1	4	2	10	3	15	10
Malignant neoplasms																
Lip, oral cavity and pharynx	0	0	2	0	1	1	11	7	80	24	166	51	129	38	95	68
Oesophagus	0	0	1	0	4	0	35	6	191	45	514	108	731	195	921	481
Colorectal	0	0	1	0	5	3	14	10	72	40	213	81	330	129	482	427
Liver and intrahepatic bile ducts	0	0	0	0	3	1	7	3	23	8	62	22	88	32	97	76
Larynx	0	0	0	0	0	0	2	1	11	2	45	6	60	7	47	9
Breast	0	0	0	0	0	6	0	68	0	157	0	242	0	219	0	512
Diabetes mellitus																
Diabetes mellitus (type II)	0	0	0	0	0	0	0	0	-1	-2	-1	-5	-5	-18	-20	-132
Diseases of the nervous system																
Epilepsy and Status epilepticus	0	0	11	7	20	6	34	14	31	13	26	11	18	6	23	25
Cardiovascular disease																
Hypertensive diseases	0	0	0	0	2	0	9	4	28	13	58	27	77	21	174	-131
Ischaemic heart disease	0	0	-1	0	-8	-2	-55	-13	-205	-44	-455	-105	-846	-220	-2168	-372
Cardiac arrhythmias	0	0	0	0	0	0	1	0	1	1	4	3	20	8	107	247
Haemorrhagic stroke	0	0	2	2	6	6	27	22	58	75	101	92	126	125	247	361
Ischaemic stroke	0	0	0	0	0	0	1	-1	4	-5	13	-24	15	-148	-32	-1741
Oesophageal varices	0	0	0	0	1	0	1	0	6	1	4	1	2	2	3	2
Respiratory infections																
Pneumonia	0	0	2	0	4	1	14	6	28	12	75	26	138	41	826	423

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Digestive disease																
Unspecified liver disease	0	0	0	1	10	4	50	22	117	61	172	82	161	105	113	148
Cholelithiasis (gall stones)	0	0	0	0	0	0	-1	0	-1	-1	-8	-2	-14	-8	-41	-47
Acute and chronic pancreatitis	0	0	1	0	5	0	15	3	22	7	35	5	29	8	39	29
Pregnancy and childbirth																
Spontaneous abortion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Low birth weight	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unintentional injuries																
Road/pedestrian traffic accidents	0	0	121	19	101	10	71	7	62	9	26	6	8	3	7	3
Poisoning	0	0	27	6	95	12	99	18	63	12	21	7	7	1	2	1
Fall injuries	0	0	8	1	12	1	31	6	44	12	55	12	62	13	123	52
Fire injuries	0	0	2	0	3	1	4	2	4	2	8	3	5	1	4	2
Drowning	0	0	9	0	8	1	7	2	10	1	6	1	4	1	2	0
Other unintentional injuries	0	0	25	3	39	4	47	10	60	14	73	10	52	14	115	72
Intentional injuries																
Intentional self-harm	0	0	72	12	136	15	206	31	209	29	147	16	46	6	22	3
Event of undetermined intent	0	0	22	5	52	7	70	13	56	14	41	7	12	3	5	1
Assault	0	0	3	0	4	0	2	1	3	0	0	0	1	0	0	0
Total deaths (net)	**0**	**0**	**323**	**58**	**644**	**157**	**1,298**	**548**	**2,037**	**970**	**2,482**	**1,185**	**1,785**	**816**	**1,369**	**604**
Caused	**0**	**0**	**325**	**58**	**651**	**159**	**1,353**	**563**	**2,244**	**1,022**	**2,946**	**1,321**	**2,650**	**1,209**	**3,630**	**3,029**
Prevented	**0**	**0**	**-1**	**-1**	**-8**	**-3**	**-55**	**-15**	**-207**	**-51**	**-464**	**-136**	**-865**	**-393**	**-2,261**	**-2,424**

Appendix 4. Alcohol-attributable morbidity in England 2010/11 (based on primary or secondary diagnoses)

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
WHOLLY ATTRIBUTABLE CONDITIONS																
Alcohol-induced pseudo-Cushing's syndrome	0	0	0	1	0	0	0	1	0	1	0	2	0	1	0	0
Mental and behavioural disorders	1,022	1,439	10,037	4,695	17,639	7,098	30,443	11,904	33,188	12,331	24,584	8,309	14,557	4,482	6,904	3,110
Degeneration of nervous system	0	0	1	1	9	9	68	21	115	50	179	46	100	24	50	10
Alcoholic polyneuropathy	0	0	0	2	9	7	46	38	59	19	91	19	64	8	38	2
Alcoholic myopathy	0	0	0	0	1	0	2	1	7	3	21	7	17	1	2	0
Alcoholic cardiomyopathy	0	0	0	0	28	2	124	17	248	27	329	20	208	10	83	10
Alcoholic gastritis	1	1	120	43	330	97	428	153	350	94	203	65	67	20	25	11
Alcoholic liver disease	0	0	55	58	1,217	837	5,070	2,768	9,483	4,406	9,879	4,031	5,614	1,915	1,548	522
Alcohol-induced acute pancreatitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcohol-induced chronic pancreatitis	0	0	123	27	968	277	1,927	572	1,717	431	816	175	253	54	70	17
Fetal alcohol syndrome	108	83	6	6	1	4	0	0	0	1	0	0	0	0	0	0
Excess alcohol blood levels	0	0	9	4	10	3	9	8	18	3	14	7	17	11	14	9
Ethanol poisoning	123	381	3,093	4,211	3,566	3,705	4,009	4,868	2,633	3,607	898	942	249	197	97	83
Methanol poisoning	8	6	3	2	6	0	4	0	5	0	3	1	2	0	2	2
Toxic effect of alcohol, unspecified	31	72	299	437	335	353	382	416	224	327	104	94	21	26	11	15
Accidental poisoning by and exposure to alcohol	5	8	14	10	16	7	22	15	17	10	6	1	2	3	9	1
Intentional self-poisoning by and exposure to alcohol	2	13	37	67	46	47	82	66	48	50	14	16	5	3	2	1
Poisoning by and exposure to alcohol, undetermined intent	1	1	2	0	1	1	1	3	0	5	2	2	3	0	1	1
Evidence of alcohol involvement determined by blood alcohol level	2	0	8	3	2	1	3	2	5	2	2	1	3	2	4	1
Evidence of alcohol involvement determined by level of intoxication	3	8	174	68	147	44	119	60	116	44	73	32	47	18	31	22

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
PARTIALLY ATTRIBUTABLE CONDITIONS																
Infectious and parasitic diseases																
Tuberculosis	0	0	118	80	282	93	175	77	123	84	121	52	117	35	88	26
Malignant neoplasms																
Lip, oral cavity and pharynx	0	0	69	30	106	58	448	176	1,847	579	2,997	904	1,526	499	530	315
Oesophagus	0	0	1	1	35	12	393	88	1,750	432	4,736	1,177	5,644	1,560	3,681	1,576
Colorectal	0	0	25	14	145	118	354	310	1,396	945	3,438	1,705	3,580	2,280	1,645	2,232
Liver and intrahepatic bile ducts	0	0	5	6	5	8	22	16	76	57	184	76	148	80	86	121
Larynx	0	0	2	0	4	4	57	8	251	50	618	88	584	80	297	42
Breast	0	0	0	27	0	647	0	3,761	0	8,109	0	6,348	0	4,251	0	2,741
Diabetes mellitus																
Diabetes mellitus (type II)	0	0	-20	-199	-74	-620	-267	-1,808	-612	-3,598	-880	-4,657	-1,323	-5,142	-1,221	-4,783
Diseases of the nervous system																
Epilepsy and Status epilepticus	0	0	1,923	2,042	2,264	2,423	3,369	3,135	4,114	3,385	5,112	3,188	4,597	2,536	4,344	3,174
Cardiovascular disease																
Hypertensive diseases	0	0	345	504	1,702	1,214	7,895	9,177	25,018	28,366	55,472	45,815	70,371	23,450	59,123	-21,124
Ischaemic heart disease	0	0	-19	-14	-105	-48	-786	-339	-2,741	-1,138	-5,118	-1,991	-8,089	-2,514	-9,561	-4,671
Cardiac arrhythmias	0	0	146	123	302	201	842	378	2,360	856	6,552	2,142	11,499	4,630	18,392	12,015
Haemorrhagic stroke	0	0	33	-13	54	-34	125	-55	201	-91	250	-115	233	-145	889	-241
Ischaemic stroke	0	0	0	-10	3	-24	10	-44	33	-67	66	-97	14	-176	-54	-438
Oesophageal varices	0	0	47	27	86	56	226	86	523	207	730	343	536	393	139	291
Respiratory infections																
Pneumonia	0	0	2	0	4	1	14	6	28	12	75	26	138	41	826	423

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Digestive disease																
Unspecified liver disease	0	0	73	45	127	104	356	221	894	648	1,540	1,117	1,334	1,380	279	1,452
Cholelithiasis (gall stones)	0	0	-115	-922	-405	-1,899	-845	-2,289	-1,169	-2,173	-1,223	-1,682	-1,016	-1,052	-798	-788
Acute and chronic pancreatitis	0	0	162	156	460	205	926	373	1,293	439	1,291	402	1,024	272	528	326
Pregnancy and childbirth																
Spontaneous abortion	0	0	0	774	0	1,574	0	1,301	0	37	0	0	0	0	0	0
Low birth weight	1,597	1,478	0	2	0	1	0	0	0	0	0	0	0	0	0	0
Unintentional injuries																
Road/pedestrian traffic accidents	0	0	1,304	336	1,000	238	800	170	742	164	330	92	104	48	51	31
Poisoning	0	0	200	149	219	86	193	95	144	73	98	37	62	22	41	21
Fall injuries	0	0	1,320	398	1,414	466	1,400	617	1,727	809	1,870	1,020	1,936	999	3,561	2,352
Fire injuries	0	0	36	5	32	6	33	6	30	6	20	4	11	2	7	3
Drowning	0	0	3	1	2	0	3	1	3	0	1	0	1	0	1	0
Other unintentional injuries	0	0	4,108	1,179	4,690	1,393	4,731	2,155	5,418	2,349	5,893	1,827	4,552	1,138	2,394	662
Intentional injuries																
Intentional self-harm	0	0	938	1,137	917	520	778	602	584	401	249	118	77	33	35	15
Event of undetermined intent	0	0	43	16	54	11	45	11	26	8	16	4	6	2	4	1
Assault	0	0	1,523	154	1,235	109	727	91	435	47	126	14	36	5	13	4
Total admissions (net)	**2,903**	**3,490**	**26,251**	**15,683**	**38,887**	**19,417**	**64,764**	**39,236**	**92,725**	**62,407**	**121,782**	**71,727**	**118,930**	**41,481**	**94,209**	**-406**
Caused	**2,903**	**3,490**	**26,406**	**16,840**	**39,471**	**22,041**	**66,662**	**43,770**	**97,247**	**69,474**	**129,003**	**80,269**	**129,358**	**50,510**	**105,844**	**31,640**
Prevented	**0**	**0**	**-154**	**-1,157**	**-584**	**-2,625**	**-1,897**	**-4,535**	**-4,522**	**-7,068**	**-7,221**	**-8,543**	**-10,428**	**-9,029**	**-11,635**	**-32,045**

Appendix 5. Alcohol-attributable morbidity in England 2010/11 (based on primary diagnosis or external causes)

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
WHOLLY ATTRIBUTABLE CONDITIONS																
Alcohol-induced pseudo-Cushing's syndrome	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mental and behavioural disorders	750	1,086	2,182	1,420	3,723	1,531	6,393	2,612	6,179	2,493	3,417	1,331	1,552	562	766	361
Degeneration of nervous system	0	0	1	0	1	4	25	8	36	25	61	21	37	9	13	1
Alcoholic polyneuropathy	0	0	0	1	7	4	15	17	20	9	31	5	14	3	3	1
Alcoholic myopathy	0	0	0	0	0	0	2	0	2	0	13	4	5	0	1	0
Alcoholic cardiomyopathy	0	0	0	0	8	0	23	4	63	6	45	5	20	0	2	2
Alcoholic gastritis	0	1	100	34	225	80	299	114	241	71	145	44	42	16	17	7
Alcoholic liver disease	0	0	19	20	328	240	1,400	807	2,311	1,201	2,186	1,084	1,051	419	271	94
Alcohol-induced acute pancreatitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcohol-induced chronic pancreatitis	0	0	53	10	315	90	611	175	537	114	215	59	57	10	27	4
Fetal alcohol syndrome	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess alcohol blood levels	0	0	0	0	3	0	0	1	2	0	1	0	0	0	0	1
Ethanol poisoning	38	63	107	91	89	58	80	101	56	69	37	27	13	10	10	2
Methanol poisoning	7	5	3	0	5	0	2	0	1	0	2	1	1	0	1	2
Toxic effect of alcohol, unspecified	21	19	21	19	10	14	24	19	16	15	7	5	2	2	2	1
Accidental poisoning by and exposure to alcohol	4	9	19	12	13	8	19	9	12	11	7	2	2	4	10	1
Intentional self-poisoning by and exposure to alcohol	2	10	34	45	40	34	52	50	32	38	9	20	5	2	3	0
Poisoning by and exposure to alcohol, undetermined intent	0	1	2	1	1	1	2	4	1	4	2	2	2	0	2	1
Evidence of alcohol involvement determined by blood alcohol level	2	0	12	3	6	4	14	9	14	4	12	5	6	2	5	3
Evidence of alcohol involvement determined by level of intoxication	2	3	35	12	39	7	38	11	44	8	34	7	14	1	16	6

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
PARTIALLY ATTRIBUTABLE CONDITIONS																
Infectious and parasitic diseases																
Tuberculosis	0	0	96	40	169	53	103	41	82	34	64	23	50	17	44	16
Malignant neoplasms																
Lip, oral cavity and pharynx	0	0	14	10	32	25	125	70	483	186	805	284	482	192	222	161
Oesophagus	0	0	1	2	10	3	89	20	421	108	1,156	283	1,470	396	1,340	665
Colorectal	0	0	4	2	24	17	64	50	268	169	831	380	1,129	558	908	890
Liver and intrahepatic bile ducts	0	0	0	1	3	2	10	4	31	13	80	26	101	34	81	65
Larynx	0	0	1	0	1	0	21	3	86	13	227	27	217	24	127	18
Breast	0	0	0	5	0	89	0	602	0	1,574	0	1,620	0	1,201	0	911
Diabetes mellitus																
Diabetes mellitus (type II)	0	0	-5	-32	-13	-52	-37	-120	-81	-281	-101	-369	-118	-392	-91	-382
Diseases of the nervous system																
Epilepsy and Status epilepticus	0	0	450	360	528	318	680	434	624	428	657	305	474	236	454	402
Cardiovascular disease																
Hypertensive diseases	0	0	33	32	107	53	246	210	426	356	459	344	466	188	401	-206
Ischaemic heart disease	0	0	-7	-4	-54	-14	-494	-155	-1,773	-582	-2,975	-1,013	-3,519	-1,184	-2,990	-597
Cardiac arrhythmias	0	0	80	61	160	86	397	156	917	319	1,878	632	1,988	991	1,572	1,942
Haemorrhagic stroke	0	0	18	-6	37	-21	101	-42	199	-83	283	-113	337	-210	484	-501
Ischaemic stroke	0	0	0	-4	2	-10	10	-32	41	-76	119	-152	27	-356	-108	-1,035
Oesophageal varices	0	0	20	9	46	26	121	53	278	112	387	168	259	189	80	161
Respiratory infections																
Pneumonia*	0	0	141	90	282	143	447	251	617	315	1,059	466	1,501	487	3,040	1,080
Digestive disease																
Unspecified liver disease	0	0	19	8	33	28	73	54	192	143	252	197	203	219	70	179
Cholelithiasis (gall stones)	0	0	-67	-542	-271	-1,241	-623	-1,669	-963	-1,794	-1,180	-1,602	-1,174	-1,163	-1,017	-1,005
Acute and chronic pancreatitis	0	0	99	72	332	108	667	208	761	255	715	217	519	148	286	195

CONDITION	0-15		16-24		25-34		35-44		45-54		55-64		65-74		75+	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Pregnancy and childbirth																
Spontaneous abortion	0	0	0	699	0	1,413	0	1,162	0	35	0	0	0	0	0	0
Low birth weight	1,212	1,167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unintentional injuries																
Road/pedestrian traffic accidents	0	0	1,355	338	1,052	239	818	173	758	167	337	92	108	48	51	34
Poisoning	0	0	230	157	263	94	219	94	159	77	104	34	62	21	37	23
Fall injuries	0	0	1,439	419	1,525	482	1,610	674	2,086	886	2,268	1,071	2,104	978	3,231	2,402
Fire injuries	0	0	34	5	32	7	33	6	33	6	21	5	12	2	6	2
Drowning	0	0	4	1	3	0	3	1	3	1	3	1	1	0	1	0
Other unintentional injuries	0	0	3,801	1,062	4,285	1,256	4,255	1,920	4,823	2,071	5,278	1,626	4,128	1,007	2,202	745
Intentional injuries																
Intentional self-harm	0	0	1,134	1,196	1,182	612	1,072	783	790	532	323	138	86	34	35	15
Event of undetermined intent	0	0	45	14	56	11	43	11	27	8	16	4	7	2	4	1
Assault	0	0	1,612	153	1,335	113	814	97	503	53	151	15	37	5	14	4
Total admissions (net)	**2,045**	**2,366**	**13,138**	**5,813**	**15,977**	**5,919**	**19,866**	**9,001**	**21,359**	**9,113**	**19,441**	**7,331**	**13,780**	**4,715**	**11,633**	**6,675**
Caused	**2,045**	**2,366**	**13,217**	**6,402**	**16,314**	**7,256**	**21,020**	**11,019**	**24,176**	**11,928**	**23,697**	**10,580**	**18,591**	**8,019**	**15,839**	**10,400**
Prevented	**0**	**0**	**-79**	**-589**	**-337**	**-1,338**	**-1,154**	**-2,018**	**-2,817**	**-2,815**	**-4,256**	**-3,248**	**-4,811**	**-3,304**	**-4,206**	**-3,725**

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