Potential Years of Life Lost (PYLL) due to alcohol consumption in the UK

An addendum to: Mortality and morbidity risks from alcohol consumption in the UK: Analyses using the Sheffield Alcohol Policy Model (v2.7) to inform the UK Chief Medical Officers' review of the UK lower risk drinking guidelines

Final report

22nd August 2016

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1. Executive summary

This report is an addendum to a previous report produced by University of Sheffield which presented mortality and morbidity risks of alcohol consumption in the UK to inform the UK Chief Medical Officers' review of the country's lower risk drinking guidelines.

In this report, new analyses are presented which estimate the potential years of life lost (PYLL) by UK adults as a result of different levels and patterns of alcohol consumption. PYLLs are a measure of the number of years of life lost due to premature death. The main findings are:

- If consuming at around the proposed new guideline levels of 14 units per week spread across five days, there is no substantial difference in the average number of potential years of life lost or gained for drinkers relative to abstainers;
- If consuming at double the proposed new guidelines (i.e. 28 units per week spread across five days), drinkers lose on average 1.1 years of life if male and 1.8 years of life if female compared to non-drinkers.
- These averages include the large majority of drinkers who do not die due to alcohol and the small minority who do die prematurely. If drinkers consume across their life course 28 units per week spread evenly across five days, an estimated 6.9% of them will die as a result of their drinking and these individuals will lose an average of 24.2 years of life.

2. Background

In January 2016, the UK Chief Medical Officers published proposed new lower risk drinking guidelines for the country. These guidelines were developed between 2013 and 2015 by expert committees who examined existing evidence and, through Public Health England (PHE), commissioned new research to inform their decision-making. As part of this process, in September 2014, PHE commissioned the University of Sheffield's Alcohol Research Group to provide modelled estimates of the mortality and morbidity risks to UK adults associated with different levels and patterns of alcohol consumption.[1] The resulting report played an important role in informing the guideline development process.[2]

Following discussions across 2015 between the University of Sheffield, PHE and the Guideline Development Group, an extension of the modelling work was commissioned in January 2016 to examine the person-years of life lost due to alcohol as a result of different levels and patterns of alcohol consumption. This short addendum to the University of Sheffield's previous report summarises the methods, results and implications of that PYLL modelling.

2.1. Why examine person-years of life lost?

PYLLs are a measure of the number of years of life lost due to premature deaths. Examining this outcome provides additional information when compared to focusing only on deaths as it accounts for the age of those who die and their expected lifespan had they not died prematurely. Thus it allows for understanding of whether high levels of drinking simply leads to more people dying from alcohol-attributable causes or whether those deaths are also occurring at younger ages.

3. Methods

The analyses presented here use the Sheffield Alcohol Policy Model (SAPM v2.7) and also use input data and methodological approaches similar to those set out in the previous report.[1] To briefly summarise the methods in that report: alcohol consumption data from each UK country were pooled and reweighted to give a dataset representative of the UK. Contemporaneous data on age- and sex-specific mortality from alcohol-related health conditions from each UK country were also pooled. Risk functions taken from published meta-analyses or calibrated to the baseline data were then used to model the relationship between levels or patterns of alcohol consumption and rates of alcohol-related harm. Estimates were produced of the number of deaths or hospitalisations occurring under scenarios where the UK population all drinks the same volume of alcohol across the same number of days per week and were compared against the number of deaths or hospitalisations in a reference scenario where the population consumes no alcohol. This comparison was used to produce estimates of the absolute risks of different consumption levels or patterns and the risk relative to abstaining.

Minor adaptations to the model are required to identify the ages at which modelled individuals die as a result of alcohol and additional data are required to estimate their expected lifespan had they not died (i.e. the estimated PYLLs for that individual due to their drinking). The additional data are taken from the Office for National Statistics age- and sex-specific life expectancy tables published in June 2014 and are based on 2010-2012 data (so as to be contemporaneous with the consumption and harm data used in the model).[3] A limitation of using these data is that ONS life expectancy estimates are, in part, a reflection of current UK alcohol consumption and adjustments cannot easily be made within SAPM to the life expectancy of modelled individuals to reflect their baseline alcohol consumption. As such, the results presented here will likely underestimate PYLLs due to alcohol for scenarios where consumption is significantly lower than is presently the case in the UK and will likely overestimate PYLLs due to alcohol in scenarios where consumption is higher.

3.1. Modelled scenarios

As in the drinking guidelines modelling report, the analyses presented here provide estimates of overall and gender-specific PYLLs over the lifetime of the modelled population in scenarios where everyone has the same level and patterns of alcohol consumption and maintains this across their adult life. The estimates are not forecasts of the outcome of any putative intervention to change alcohol consumption to a particular level and the model assumes that other factors influencing the health of the UK population, including healthcare and other risk factors such as smoking and poor diet, do not change.

Estimates of PYLLs are presented below for scenarios which compare the risks associated with consuming different amounts of alcohol per week and spreading that consumption across greater or fewer numbers of days. Modelling different consumption levels and patterns of drinking is important as SAPM assumes that risks of chronic disease are largely a function of the amount of alcohol consumed per week and are independent of the number of days across which that alcohol is consumed (although see the previous report's discussion of the ischaemic heart disease risk function). However, risks of acute harms arise from intoxication and are thus impacted substantially by the number of days across which a given level of weekly consumption is drunk. To capture this variation source and nature of risk, ten scenarios are modelled where the population drinks 14, 21, 28, 35 and 50 units of alcohol on one day each week or spread evenly across five days during the

week. These scenarios reflect average consumption levels and patterns of relevance to current or past drinking guidelines. They also reflect the riskiest drinking pattern (consuming all of one's weekly alcohol in a single day) and a lower risk pattern in line with the new guidelines (spreading that consumption across five days). Results are split by gender and into four age groups (16-24, 25-34, 35-54 and 55+).

Whereas the previous modelling evaluated chronic and acute mortality separately and in combination, these PYLL analyses only examine combined chronic and acute deaths. No sensitivity analyses are provided as the scale of uncertainty in model results was adequately demonstrated in the previous report; however, brief implications of this uncertainty are included in the Discussion section of this report.

4. Results

4.1. Population results

Table 1 shows the total number of deaths and PYLLs for different consumption scenarios and then presents PYLL results per drinker (i.e. the average potential years of life lost across all drinkers irrespective of whether they die of their alcohol consumption or not) and the PYLL results per death (i.e. the average potential years of life lost just within those drinkers who do die as a result of their alcohol consumption).

Overall, if the whole population consumes 14 units of alcohol per week spread evenly across five days, there would be 4,000 more deaths per year due to alcohol than if everyone abstained and these would correspond to 185,600 potential years of life lost. At higher consumption levels the number of deaths and the years of life lost increase. For example, if everyone consumed 28 units per week, there would be an estimated 41,700 additional deaths per year and 1.0 million years of life lost if drinkers spread their consumption across five days and 71,400 extra deaths and 1.9 million years of life lost if they consume this amount on a single day each week.

Drinkers consuming 14 units of alcohol per week across five days have, on average, similar life expectancy to abstainers. However, those consuming at higher levels lose years of life compared to non-drinkers. For example, a drinker consuming 28 units per week across five day is estimated to lose an average of 1.4 years of life relative to abstainers. This increases to 2.2 years if consuming 35 units per week and 4.5 years if consuming 50 units per week. Additional years of life are also lost if consuming the same amount of alcohol across fewer days. For example, drinkers consuming 14 units per week on a single day each week lose an average of 0.8 years compared to abstainers and those drinking 28 units per week on a single day each week lose an average of 2.6 years relative to abstainers.

These averages include the large majority of drinkers who do not die due to alcohol as well as the small minority who do die prematurely. If drinkers consume 21 units per week across their life course, spread evenly across five days, an estimated 3.6% of them will die as a result of their drinking and these individuals will lose an average of 26.8 years of life. These figures increase to 6.9% of drinkers dying and losing an average of 24.2 years of life when consuming 28 units a week spread across five days and to 19.9% of drinkers dying and losing 21.8 years of life when consuming 50 units a week spread across five days. The average number of life years lost per death is lower in

higher consumption scenarios. This somewhat counterintuitive result is predominantly due to a large increase in cardiovascular deaths among those aged 55 and over in higher consumption scenarios which outweighs the increase in deaths from conditions which disproportionately occur at younger ages (e.g. alcoholic liver disease). Thus, although the total number of deaths due to alcohol and the total number of life years lost to alcohol goes up, the average years of life lost per death go down. .

Table 1: Estimated population-level alcohol-attributable deaths and PYLL under different alcohol consumption scenarios

		Mean consumption (units/week)				
		14	**21**	**28**	**35**	**50**
Alcohol-attributable deaths	**Over 5 days**	4,000	20,800	41,700	67,000	139,400
	On 1 day	18,800	43,000	71,400	104,100	192,400
Alcohol-attributable PYLLs	**Over 5 days**	185,600	557,300	1,008,200	1,542,100	3,033,300
	On 1 day	616,500	1,203,700	1,870,100	2,619,400	4,572,400
Individual PYLLs	**Over 5 days**	0.2	0.8	1.4	2.2	4.5
	On 1 day	0.8	1.6	2.6	3.7	6.5
PYLLs per death	**Over 5 days**	46.7	26.8	24.2	23.0	21.8
	On 1 day	32.8	28.0	26.2	25.2	23.8
% of deaths due to alcohol	**Over 5 days**	0.7%	3.6%	6.9%	10.7%	19.9%
	On 1 day	3.2%	7.1%	11.3%	15.7%	25.6%

4.2. Sex-specific results

Table 2 shows the equivalent results broken down by sex. If the population consumes 14 units per week across five days, 3,000 of the deaths occurring due to drinking would be among men with just 1,000 among women. There would also be 72,700 life years lost among women compared to 112,800 lost among men. These figures reflect the larger potential protective effective received by women from moderate drinking after other risks have been taken into account. At higher levels of consumption, the number of deaths and number of life years lost is greater among women compared to men. For example, when consuming 21 units per week across five days, there would be an estimated 12,300 additional deaths and 315,700 years of life lost among women and 8,400 additional deaths and 241,600 years of life lost among men.

When spreading drinking across five days, women are estimated to lose more years of life from drinking above 14 units per week than men. For example, if drinking 28 units spread across five days, women lose an average of 1.8 years of life while men are estimated to lose an average of 1.1 years. These figures increase to 2.8 years for women and 1.6 years for men at 35 units per week and 5.9 years for women and 3.0 years for men at 50 units per week. For both men and women, the number of years of life lost are greater if drinking these amounts on a single day. These results are summarised in Figure 1.

Deaths due to heavier drinking are estimated to occur at older ages for women than men. Therefore, the average number of life years lost per death is lower for women even though there are a greater number of deaths and thus more life years lost in total. For example, women who die after

drinking 28 units per week across five days are estimated to lose 23 years of life on average compared to 26 years for males drinking the same amount.

Table 2: Estimated sex-specific alcohol-attributable deaths and PYLL under different alcohol consumption scenarios

		Mean consumption (units/week)				
		14	**21**	**28**	**35**	**50**
Alcohol-attributable deaths						
Over 5 days	**Male**	3,000	8,400	15,000	22,900	45,200
	Female	1,000	12,300	26,700	44,100	94,300
On 1 day	**Male**	12,300	22,400	33,700	46,200	78,500
	Female	6,500	20,600	37,700	57,900	114,000
Alcohol-attributable PYLLs						
Over 5 days	**Male**	112,800	241,600	393,000	568,200	1,044,900
	Female	72,700	315,700	615,200	973,900	1,988,400
On 1 day	**Male**	395,400	665,400	958,100	1,274,500	2,053,900
	Female	221,200	538,300	912,000	1,344,900	2,518,500
Individual PYLLs						
Over 5 days	**Male**	0.3	0.6	1.1	1.6	3.0
	Female	0.1	0.9	1.8	2.8	5.9
On 1 day	**Male**	1.0	1.8	2.6	3.5	5.7
	Female	0.5	1.5	2.6	3.9	7.4
PYLLs per death						
Over 5 days	**Male**	37.5	28.7	26.2	24.8	23.1
	Female	75.0[1]	25.6	23.1	22.1	21.1
On 1 day	**Male**	32.1	29.7	28.5	27.6	26.2
	Female	34.1	26.1	24.2	23.2	22.1
% of deaths due to alcohol						
Over 5 days	**Male**	1.2%	3.2%	5.6%	8.3%	15.2%
	Female	0.3%	3.9%	8.0%	12.5%	23.4%
On 1 day	**Male**	4.7%	8.1%	11.8%	15.5%	23.7%
	Female	2.1%	6.3%	10.9%	15.8%	27.0%

[1]This figure should be interpreted with caution as it results from a combination of deaths at very young ages due to acute causes and deaths being averted at older ages due to the potential protective effects of moderate drinking against chronic disease mortality.

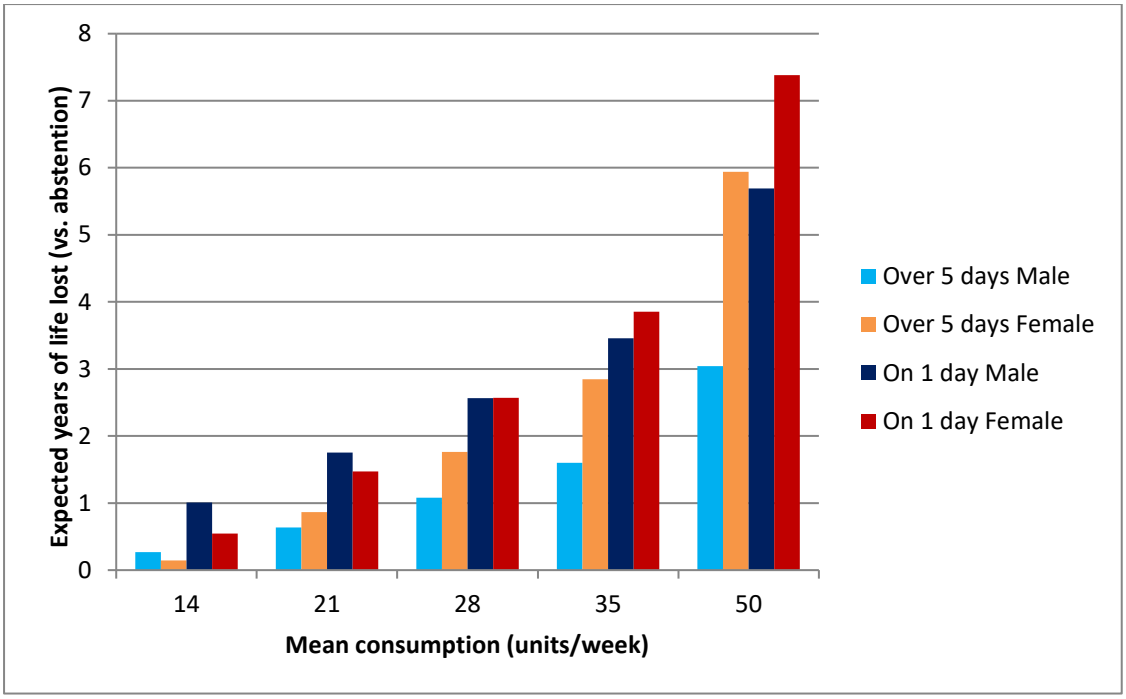

Figure 1: Estimated years of life lost under different alcohol consumption scenarios by sex

4.3. Age- and sex-specific results

Figure 2 shows the number of alcohol-attributable deaths and associated PYLLs by age and sex at different consumption levels. For clarity, results are only shown for scenarios where drinking is spread across five days each week. In line with the findings above, the figure shows that female alcohol-attributable deaths and PYLLs are concentrated in those aged 55+ and that this is particularly true at higher consumption levels. In contrast, male deaths and, particularly, male PYLLs are more evenly distributed between those aged 35-54 and those aged 55+, even at high consumption levels.

Figure 3 further illustrates how deaths and PYLLs are distributed across age groups. It shows that when the population consumes 28 units a week spread evenly across five days, 60% of male deaths and 39% of male PYLLs are in the 55+ age group compared to 80% of female deaths and 64% of female PYLLs.

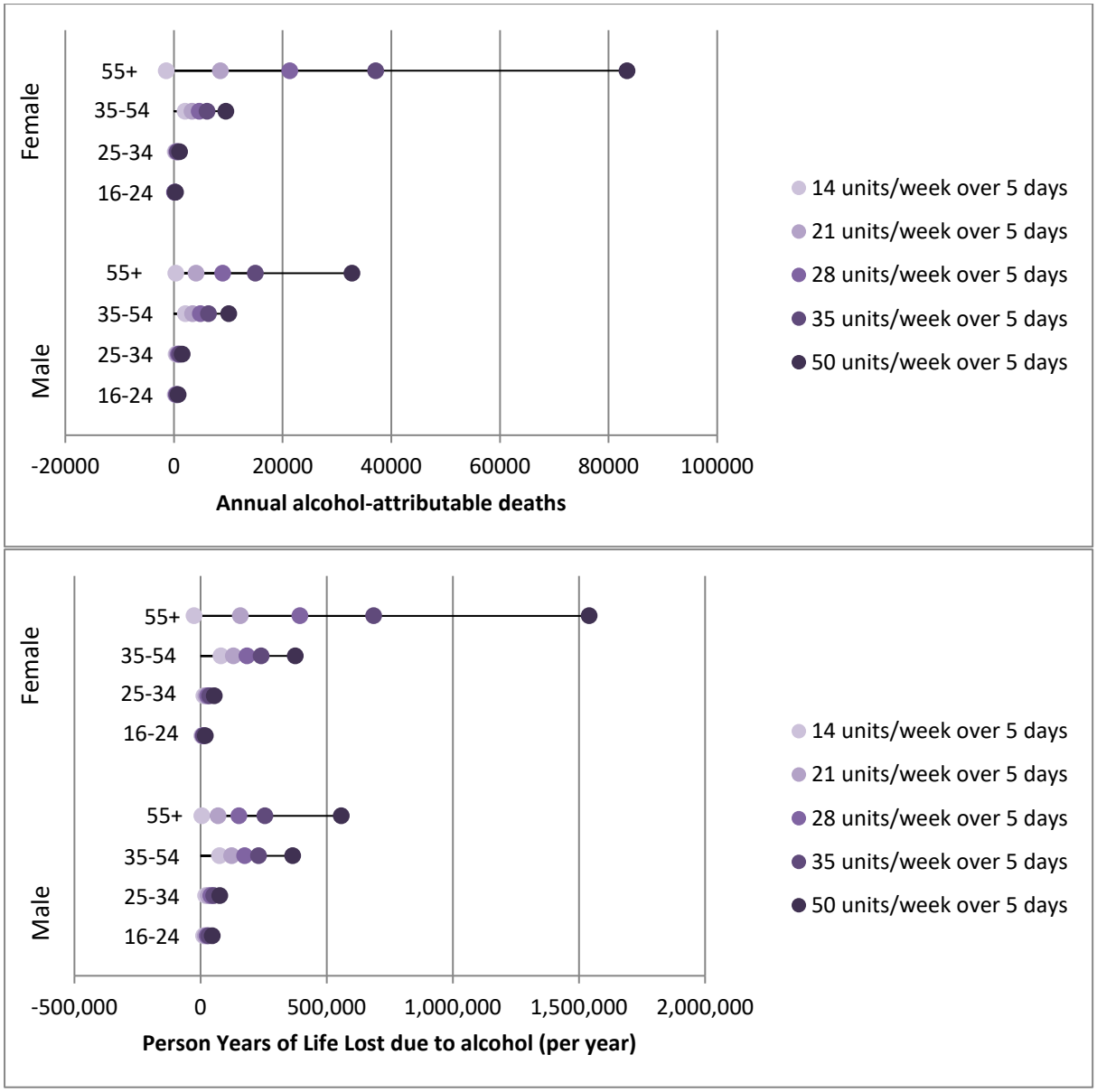

Figure 2: Estimated alcohol-attributable deaths and PYLLs for different consumption scenarios by age and sex

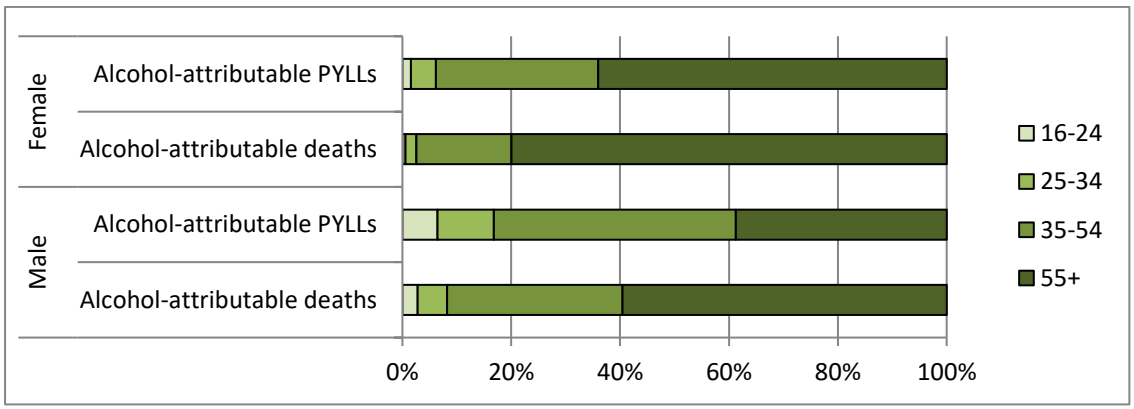

Figure 3: Proportion of deaths and PYLLs in age each age group by sex when consuming 28 units a week spread evenly across five days

5. Discussion

5.1. Key results

The above analyses provide four key findings:

First, both male and female drinkers who consume at the proposed new guidelines do not, on average, lose a significant number of years of life.

Second, drinking at higher levels entails increasingly large numbers of years of life lost relative to abstainers. For example, at 28 units per week spread across five days (double the proposed guidelines) males lose an average of 1.1 years of life and females lose an average of 1.8 years of life relative to abstainers.

Third, years of life lost from heavier drinking are, of course, concentrated in the small minority of drinkers who die from their alcohol consumption. For example, if drinking 28 units per week across five days, an estimated 5.6% of men would die from their drinking and lose an average of 26 years of life and an estimated 8.0% of women would die from their drinking and lose an average of 23 years of life.

Fourth, men and women are both most likely to die due to alcohol when aged 55+ but, for males, a significant proportion of deaths and thus a significant proportion of life years lost are also found in the group aged 35-54.

5.2. Limitations

The main limitations of SAPM in the context of estimating alcohol-related mortality risks are discussed in our previous report to PHE which was commissioned as part of the initial guideline review process.[1] Additional limitations specific to the present analysis are discussed below.

As noted in the methods, the ONS life expectancy estimates used to calculate PYLLs reflect, in part, current alcohol consumption levels and patterns in the UK and are likely to lead to underestimate PYLLs due to alcohol for scenarios where consumption is significantly lower than in the baseline data and will likely overestimate PYLLs due to alcohol in scenarios where consumption is higher than in the baseline data.

As also noted in the methods, no sensitivity analyses are undertaken here as the scale of uncertainty in model results was adequately demonstrated in the previous report. This uncertainty applies to the existence and extent of any beneficial health outcomes from moderate alcohol consumption, the shape of some risk relationships between alcohol consumption and health outcomes and the impact of underestimation of alcohol consumption within epidemiological studies. The previous report concluded that its results were sensitive to alternative model specifications or inputs and that the base case analysis should not be accepted uncritically as there were not strong grounds for preferring that analysis over the alternative sensitivity analyses. As many of the same uncertainties apply to the present report, caution is again recommended when interpreting and utilising the findings above.

This report focuses on PYLL, an outcome which adds additional information when compared to only considering deaths as it accounts for the age at which deaths occur and recognises that the societal value placed on each year of life lost. However, no account is taken of the societal value of years

spent in poor health prior to death as a result of alcohol consumption. These health losses are commonly measured using quality-adjusted life years (QALYs) or disability-adjusted life years (DALYS) and have been shown by the Global Burden of Disease study to be substantial.[4] However, accounting for QALYs or DALYs would require major revisions to SAPM which were not feasible within the current project.

5.3. Interpretation and presentation of the findings

There is substantial scope for the above results to be interpreted and presented inappropriately. In particular, it is important to understand that the analyses here compare scenarios where people drink at a single consumption level across their adult life. They do not compare scenarios where people reduce or increase their alcohol consumption during their adult life (e.g. where someone cuts down their drinking in middle age). For those drinking above the guidelines, reducing alcohol consumption will typically reduce their risk of premature death, but the analyses above do not quantify that reduction in risk.

To avoid misinterpretation, some appropriate and inappropriate presentations of the results are given below:

<u>Appropriate</u>

- Those who drink in line with the new guidelines (e.g. 14 units per week spread across five days) have, on average, similar life expectancy to abstainers.
- Men who drink most days and consume 50 units per week die, on average, 3 years earlier than men who drink in line with the new guidelines.
- Women who have heavy binges of 21 units once a week and do not drink on other days die, on average, around one year earlier than women at the guideline level.
- Men who die as a result of drinking 50 units a week spread evenly over five days die, on average, 23 years earlier than abstainers. Women who die after drinking the same amount lose, on average, 21 years of life relative to abstainers.

<u>Inappropriate</u>

- If you drink most days, cutting your alcohol consumption from 28 units a week to 14 units a week can save you one year of life.
- If you drink most days, cutting your alcohol consumption from 28 units a week to 14 units a week could save you over 20 years of life.
- If you drink 21 units in one day, switching to spread this across five days can save you nine months of life.
- Men who drink 28 units a week spread across five days lose, on average, 26 years of life.
- Women who drink 50 units a week spread across five days die around six years earlier than men who drink in line with the new guidelines.

6. Acknowledgements

This work was commissioned and funded by Public Health England

The ScHARR team would like to acknowledge the Scottish Government, Welsh Government and Northern Ireland Department of Health, Social Services and Public Safety who provided alcohol-related mortality and morbidity data used to produce this report.

7. References

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