

The three big killers: how smoking, alcohol consumption and overweight/obesity overlap and interact in the population

Summary

- Tobacco, alcohol, and overweight/obesity are the three biggest modifiable risk factors affecting the health, wellbeing, and mortality of the UK population.
- These three risk factors overlap in the population: over a fifth (22%) of the adult population of England live with two or more of these risk factors.
- Smoking and drinking above low risk guidelines are strongly associated, with each risk factor reinforcing the risk of the other.
- Multiple risk factors increase health inequalities: in England, 24% of those in the most deprived quintile have at least 2 risk factors, compared to 19% in the least deprived quintile.
- Multiple risk factors dramatically increase the risk of some conditions: the combined effect of alcohol and smoking on head and neck cancers is 3.78 times greater than the additive effect of each risk factor, and the combined effect of alcohol and excess weight on liver disease and death is 1.55 times greater than the additive effect of each risk factor.
- The industries that produce, market and sell tobacco, alcohol and unhealthy food and drink have common interests and methods. Likewise, government and public health professionals have common interventions to reduce the harm from these risk factors.
- A more integrated approach to tackling these risk factors with evidence-based prevention policies could deliver greater overall health benefits and reduce inequalities.

Introduction

Each year, millions of lives in the UK are impacted or cut short from the effects of three modifiable risk factors: tobacco, alcohol and overweight/obesity. Collectively these risk factors are responsible for tens of thousands of cases of cancer in the UK annually¹, while also increasing the risk of other largely preventable conditions including cardiovascular disease, stroke, type-2 diabetes, liver disease and mental health conditions.²

This briefing paper explores what we currently know about the prevalence and impact of these risk factors, focusing on how they overlap in the population. The paper describes:

¹ Brown, K.F., Rumgay, H., Dunlop, C. et al. The fraction of cancer attributable to modifiable risk factors in England, Wales, Scotland, Northern Ireland, and the United Kingdom in 2015. *Br J Cancer* 118, 1130–1141 (2018).

² Steel, N. et al. Changes in health in the countries of the UK and 150 English Local Authority areas 1990–2016: a systematic analysis for the Global Burden of Disease Study. *The Lancet*, 392, 1647 – 1661 (2018).

- The prevalence of multiple (co-occurring) risk factors in the adult population of England
- Associations between risk factors
- The contribution of multiple risk factors to health inequalities
- The health impacts of multiple risk factors
- The benefits of taking a coherent approach to tackling multiple risk factors

At a national level, in England at least, public health policy tends to proceed on separate tracks for separate risk factors³. This may be politically useful⁴, and practically hard to change, but there is a strong case for a coherent approach, bringing the tracks together under an integrated approach to prevention. Although progress in public health policy varies between risk factors, and targeted interventions will always be needed, the scope for greater collaboration in the delivery of integrated, coherent policy is considerable⁵. The tobacco, alcohol, and food and drink industries operate in similar ways to promote their products; likewise there is coherence in the policy approaches required to reduce the harm of these products.

The prevalence of multiple risk factors

This report focuses on smoking, drinking alcohol and overweight/obesity. Smoking is always harmful. Government guidelines recommend that weekly alcohol consumption for both men and women should not regularly exceed 14 units⁶. Overweight is defined as having a BMI of 25 or more but less than 30; obesity is defined as having a BMI of 30 or more.

We know from the Health Survey for England (HSE) that, in 2022,

- 64% of adults were overweight or living with obesity, 67% of men and 61% of women⁷
- 24% of adults drank alcohol at a level of increasing risk or higher risk, 32% of men and 15% of women⁸
- 13% of adults smoke, 14% of men and 11% of women⁵

The number of people who have more than one of these risk factors is not routinely reported. To gain a picture of the prevalence of multiple risk factors, ASH undertook a snapshot analysis of the 2021 HSE data for this report⁹ (Figure 1). Overall, 22% of people aged 16+ in England had two or more risk factors – equivalent to a total of 10.0 million).¹⁰ The prevalence of each of the pairs of risk factors was:

- 13% for overweight/obesity and increasing/higher risk drinking, but not smoking (equivalent to 5.9 million people aged 16+)

³ The Health Foundation: Addressing the leading risk factors for ill health. A review of government policies tackling smoking, poor diet, physical inactivity and harmful alcohol use in England, London 2022.

⁴ Tackling risk factors for non-communicable diseases: the pros and cons of a more integrated approach. Alcohol Health Alliance, Obesity Health Alliance, Smokefree Action, Spectrum, 2022.

⁵ Holding Us Back: Tobacco, Alcohol and Unhealthy Food and Drink, Action on Smoking and Health, Alcohol Health Alliance, Obesity Health Alliance, 2023.

⁶ Department of Health, UK Chief Medical Officers' Low Risk Drinking Guidelines, August 2016.

⁷ [NHS England. Health Survey for England, 2022 Part 2](#)

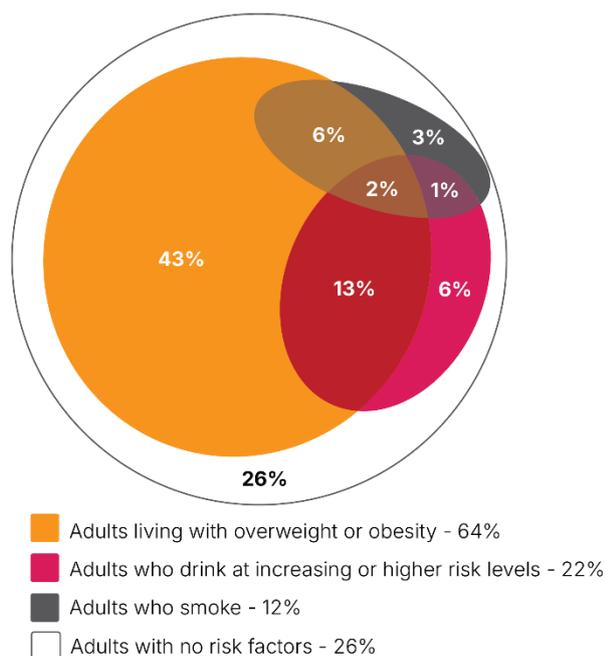
⁸ [NHS England. Health Survey for England, 2022 Part 1](#)

⁹ Source: Health Survey for England 2021, which includes adjustment for BMI self-reporting to align with measured BMI. Non-response adjustments for population subgroups were not applied. Cases with any relevant missing data were removed. See appendix for full methodology and limitations.

¹⁰ Population data source: ONS. Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland. Mid-2021 dataset, for adults in England aged 16+. Total: 46.07 million.

- 6% for overweight/obesity and smoking, but not increasing/higher risk drinking (equivalent to 2.5 million people aged 16+)
- 1% for increasing or higher risk drinking and smoking, but not overweight/obesity (equivalent to 0.6 million people aged 16+)
- 2% for all three risk factors (equivalent to 1.0 million people aged 16+)

Figure 1. Co-occurrence of risk factors in adult population of England, 2021 (ASH analysis of HSE data)



The most recent peer-reviewed literature on multiple risk factors examined HSE data from an earlier, pre-Covid period. Burton and colleagues explored the co-occurrence of smoking, drinking and overweight/obesity in England, drawing on four years of data from the HSE from 2012 to 2018¹¹. Table 1 describes the prevalence of smoking, drinking alcohol and overweight/obesity, and the prevalence of each combination of two risk factors over this period. The population prevalences are not current, especially for smoking which declined from 19% in the period examined by Burton and colleagues to 13% in 2022. Nonetheless, Table 1 is invaluable in describing the overall pattern of co-occurrence and the differences between men and women. The most prevalent risk factor combination, for both women and men, was overweight/obesity and increasing or higher-risk drinking, experienced by 17.2% of the adult population of England (24.0% of men and 10.2% of women). The prevalence of co-occurrence was higher for men compared to women for all the combinations of risk factors in Table 1.

Table 1. Co-occurrence of risk factors in English adult population 2012-2018 (Burton et al 2023)

Risk factor	Population prevalence	Prevalence of co-occurrence with other risk factor (% of whole population)
Overweight/obesity	64%	17.2%
Increasing or higher risk drinking	22%	17.2%
Smoking	12%	17.2%
No risk factors	26%	0%

¹¹ Burton R, Sharpe C, Sheron N, Henn C, Knight S, Wright VM, Cook M. The prevalence and clustering of alcohol consumption, gambling, smoking, and excess weight in an English adult population. *Prev Med.* 2023

			Increasing/higher risk drinking	Smoking
Overweight/obesity	All	63.0%	17.2%	10.9%
	Men	67.9%	24.0%	12.3%
	Women	58.1%	10.2%	9.5%
Increasing/higher risk drinking	All	26.1%		6.5%
	Men	34.2%		8.6%
	Women	17.9%		4.3%
Smoking	All	19.2%		
	Men	20.9%		
	Women	17.4%		

Associations between co-occurring risk factors

If two risk factors co-occur, this may simply reflect their overlap at population level. Lots of people smoke and lots of people drink alcohol so we would expect many people to do both. When the prevalence of their co-occurrence is greater than you would expect from their background prevalences, there is a synergistic association between them (they ‘cluster’). These synergies have many possible determinants ranging from immediate biological causes to wider determinants of health.

Analysis of associations at population level necessarily obscures the complexity of human behaviour at an individual level. Our individual patterns of consumption are mediated by our biology and physiological needs, our socio-economic conditions, our cultural expectations, and our mental health, all of which are manipulated by the industries that produce and market tobacco products, alcohol, and unhealthy food. However, even if the relationships between smoking, drinking and unhealthy eating appear to be strong for some individuals, this may not translate into associations at population level.

Of the three pairs of risk factors defined by smoking, drinking and overweight/obesity:

- There is strong evidence of an association between smoking and drinking alcohol
- There is mixed evidence of an association between drinking and overweight/obesity
- There is mixed evidence of a negative association between smoking and overweight/obesity

Smoking and drinking alcohol

In a 2016 review of UK studies by Meader and colleagues¹², the strength of the association between smoking and drinking alcohol was clear, despite differences in definitions between studies:

- People with experience of alcohol misuse were 1.8-2.9 times more likely to smoke (than would be expected from their population prevalences).

¹² Meader N, King K, Moe-Byrne T, Wright K, Graham H, Petticrew M, et al. A systematic review on the clustering and co-occurrence of multiple risk behaviours. BMC Public Health. 2016;16(1):1–9.

Burton and colleagues' analysis of Health Survey for England data reported similar results:

- Increasing or higher-risk drinkers were 1.7 times more likely to smoke
- Higher risk drinkers were 2.7 times more likely to smoke.

A UCL study, drawing on data from a nationally representative sample of adults in England, reported that heavy drinkers were nearly four times more likely to smoke: 58% of people at risk of becoming alcohol dependent were current smokers, compared to 15% among the general population¹³. Other international reviews¹⁴ and studies¹⁵ have also reported this association between smoking and drinking.

The causes of this relationship are complex. At an individual level, nicotine and alcohol interact in a variety of ways. There is a reinforcing effect, with the two drugs stimulating cravings for each other. If you drink alcohol and smoke, a drink is likely to increase your desire for a cigarette, reduce your inhibitions, and shorten the time before you light up. Furthermore, nicotine suppresses the sedative and intoxicating effects of alcohol, reducing tiredness and drunkenness and so enabling further alcohol consumption^{16,17}. Alcohol use is also associated with lower success rates in quitting smoking¹⁸.

Drinking alcohol and overweight/obesity

Burton and colleagues' analysis of Health Survey for England data found that Increasing or higher-risk drinkers were 1.1 times more likely to have a BMI classed as overweight/obese, but there was no association between increasing or higher-risk drinking and obesity, nor any between higher risk drinking and overweight/obesity.

Alcohol is highly calorific: there are almost as many calories in a gram of alcohol as there are in a gram of fat¹⁹. Recent analysis by NESTA found that alcohol comprises 5% of calories purchased by adults for consumption at home, and 8% of calories purchased outside the home²⁰. A 2021 review by Fong and colleagues of the evidence of links between alcohol consumption, dietary intake and body weight found a robust association between acute alcohol intake and greater food and energy intake²¹. However, the association between alcohol intake and excess weight was equivocal. The authors noted

¹³ Garnett, Claire et al, Characterising smoking and smoking cessation attempts by risk of alcohol dependence: A representative, cross-sectional study of adults in England between 2014-2021, *The Lancet Regional Health – Europe*, 2022, Volume 18, 100418.

¹⁴ Noble N, Paul C, Turon H, Oldmeadow C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. *Prev Med*. 2015 Dec;81:16-41.

¹⁵ Beard E, West R, Michie S, Brown J. Association between smoking and alcohol-related behaviours: a time-series analysis of population trends in England. *Addiction*. 2017 Oct;112(10):1832-1841..

¹⁶ Adams S. Psychopharmacology of Tobacco and Alcohol Comorbidity: a Review of Current Evidence, *Curr Addict Rep* (2017) 4:25-34

¹⁷ Verplaetse TL, McKee SA. An overview of alcohol and tobacco/nicotine interactions in the human laboratory. *Am J Drug Alcohol Abuse* 2017;43(2):186-196.

¹⁸ van Amsterdam J, van den Brink W. The effect of alcohol use on smoking cessation: A systematic review. *Alcohol*. 2023 Jun;109:13-22.

¹⁹ NHS: [Calories in Alcohol](#), 2023

²⁰ NESTA: What role does alcohol play in diets, and what can we do about it?, 27 March 2025.

²¹ Fong, M.; Scott, S.; Albani, V.; Adamson, A.; Kaner, E. 'Joining the Dots': Individual, Sociocultural and Environmental Links between Alcohol Consumption, Dietary Intake and Body Weight—A Narrative Review. *Nutrients* 2021, 13, 2927.

that 'the evidence of alcohol intake and body weight remains uncertain despite no shortage of research over the years.'

This uncertainty is due to the complexity of the relationship between drinking alcohol and overweight/obesity, which appears to be non-linear. The following studies reveal something of this complexity:

- A systematic review in 2021 found that heavy drinking (>28g a day) but not light (<14g/day) or moderate (14-28g/day) drinking was associated with overweight. Heavy drinkers were also more likely to have abdominal obesity²².
- In a study of 18-25 year olds in Britain, significant associations with BMI were only found for the heaviest drinkers among men (>75% RDA energy) and for high and very high consumers of alcohol among women (>50% RDA energy)²³.
- A study in Ireland found strong relationships between harmful alcohol consumption and both waist circumference and BMI. Binge drinking was also positively associated with BMI, but the frequency of alcohol consumption was inversely associated with BMI²⁴.

Overall, heavy and binge drinking are most consistently associated with overweight/obesity. Alcohol dependence, however, is associated with underweight and malnourishment²⁵, which may be caused by neglect of eating and by social isolation and a lack of incentives to cook²⁶.

Where alcohol consumption does lead to weight gain, this may be for a range of reasons. For example, energy from alcohol is usually additive rather than replacing energy from food; alcohol can suppress satiety and increase appetite; and traits that predispose individuals to binge drinking may also predispose them to binge eating²⁷. Culturally and socially, food and alcohol are profoundly linked. They are both enjoyed as part of pleasurable occasions, and their co-consumption is shaped by diverse expectations of sociability, traditions and identity²⁸.

Smoking, weight and diet

Studies tend to show that people who smoke are less likely to be overweight than non-

²² Golzarand M, Salari-Moghaddam A, Mirmiran P. Association between alcohol intake and overweight and obesity: a systematic review and dose-response meta-analysis of 127 observational studies. *Crit Rev Food Sci Nutr*. 2022;62(29):8078-8098. doi: 10.1080/10408398.2021.1925221. Epub 2021 May 17.

²³ Albani V, Bradley J, Wrieden WL, Scott S, Muir C, Power C, Fitzgerald N, Stead M, Kaner E, Adamson AJ. Examining Associations between Body Mass Index in 18-25 Year-Olds and Energy Intake from Alcohol: Findings from the Health Survey for England and the Scottish Health Survey. *Nutrients*. 2018 Oct 10;10(10):1477.

²⁴ AlKalbani, S.R., Murrin, C. The association between alcohol intake and obesity in a sample of the Irish adult population, a cross-sectional study. *BMC Public Health* 23, 2075 (2023).

²⁵ Ross LJ, Wilson M, Banks M, Rezannah F, Daghli M. Prevalence of malnutrition and nutritional risk factors in patients undergoing alcohol and drug treatment. *Nutrition*. 2012 Jul;28(7-8):738-43.

²⁶ Alcohol Change UK, The Feeding Recovery Handbook, A guide for local services to undertaking successful cooking and eating activities, 2025

²⁷ Traversy G, Chaput JP. Alcohol Consumption and Obesity: An Update. *Curr Obes Rep*. 2015 Mar;4(1):122-30

²⁸ Scott S, Muir C, Stead M, Fitzgerald N, Kaner E, Bradley J, Wrieden W, Power C, Adamson A. Exploring the links between unhealthy eating behaviour and heavy alcohol use in the social, emotional and cultural lives of young adults (aged 18-25): A qualitative research study. *Appetite*. 2020 Jan 1;144:104449.

smokers^{29,30}, though not all studies report this^{31,32}, and the association may not hold for younger age groups^{33,34}. People who smoke do not, however, have more healthy diets: a study of UK adults found that smokers ate fewer meals per week and were less likely to snack between meals, but they were also more likely to add salt and sugar to their food, more likely to overeat, and more likely to eat fried food³⁵. Meader and colleagues found that people with low fruit and vegetable consumption were 2.0-2.5 times more likely to smoke³⁶. This reflects, in part, the high prevalence of smoking in deprived communities, who are likely to have less money and have less access to healthy food.

Inequalities and co-occurring risk factors

Smoking, overweight/obesity, and alcohol consumption all contribute to health inequalities, in different ways.

- In 2022, 21% of adults in the most deprived areas of England (IMD fifth quintile) smoked, compared to 9% in the least deprived areas (IMD first quintile). Higher smoking prevalence is associated with almost every indicator of deprivation or marginalisation including low income, unemployment, homelessness, poor mental health, contact with the criminal justice system, living in social housing, lack of qualifications, lone parenting, and LGBT identity³⁷.
- In 2022, 36% of adults in the most deprived areas of England had obesity, compared to 22% in the least deprived areas. Overweight and obesity prevalence is high across the entire UK population, but there are inequalities across age, geography, gender, ethnic groups and both mental and physical disability. These inequalities are growing, as rates of children with obesity are increasing significantly faster in communities with high deprivation levels compared to those with low deprivation levels³⁸.
- In 2022, 25% of adults in the *least* deprived areas drank at increasing or high risk compared to 17% in the most deprived areas. Despite this, people from more disadvantaged communities experience greater levels of harm from alcohol than more advantaged communities (the ‘alcohol harm paradox’), linked to socio-economic inequalities in life expectancy, violence,

²⁹ Plurphanswat, N., Rodu, B. The association of smoking and demographic characteristics on body mass index and obesity among adults in the U.S., 1999–2012. *BMC Obes* 1, 18 (2014).

³⁰ Sneve M, Jorde R. Cross-sectional study on the relationship between body mass index and smoking, and longitudinal changes in body mass index in relation to change in smoking status: The Tromsø Study. *Scandinavian Journal of Public Health*. 2008;36(4):397-407.

³¹ Raptou, E., Papastefanou, G. An empirical investigation of the impact of smoking on body weight using an endogenous treatment effects model approach: the role of food consumption patterns. *Nutr J* 17, 101 (2018).

³² Kim Y, Jeong SM, Yoo B, Oh B, Kang HC. Associations of smoking with overall obesity, and central obesity: a cross-sectional study from the Korea National Health and Nutrition Examination Survey (2010-2013). *Epidemiol Health*. 2016;38.e2016020.

³³ Mackay, D.F., Gray, L. & Pell, J.P. Impact of smoking and smoking cessation on overweight and obesity: Scotland-wide, cross-sectional study on 40,036 participants. *BMC Public Health* 13, 348 (2013).

³⁴ Dare S, Mackay DF, Pell JP. Relationship between smoking and obesity: a cross-sectional study of 499,504 middle-aged adults in the UK general population. *PLoS One*. 2015 Apr 17;10(4):e0123579.

³⁵ Alruwaili A, King JA, Deighton K, Kelly BM, Liao Z, Innes A, et al. The association of smoking with different eating and dietary behaviours: A cross-sectional analysis of 80 296 United Kingdom adults. *Addiction*. 2024; 119(10): 1737–1750.

³⁶ Meader N, King K, Moe-Byrne T, Wright K, Graham H, Petticrew M, et al. A systematic review on the clustering and co-occurrence of multiple risk behaviours. *BMC Public Health*. 2016;16(1):1–9.

³⁷ Health Inequalities and Smoking. Action on Smoking and Health, 2019.

³⁸ Dietary and Health Inequalities. Obesity Health Alliance Position Statement.

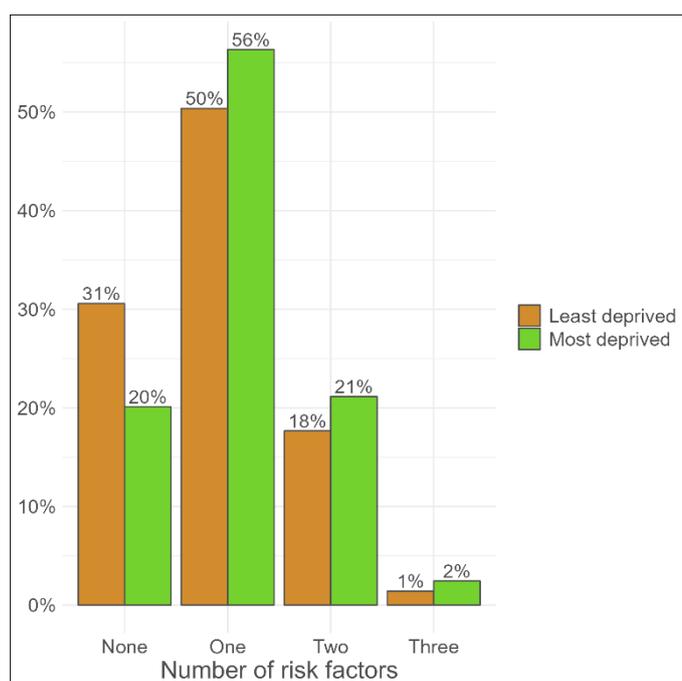
social and emotional wellbeing, child development, hospital admissions, alcohol-related cancers, infectious diseases, and mortality³⁹.

Describing the sociodemographic inequalities of multiple co-occurring risk factors is difficult because there are potentially many risk factors, risk factor combinations and demographic groups. Furthermore, as the example of alcohol demonstrates, a simple focus on prevalence may disguise the complexity of the inequalities experienced. Nonetheless, at population level, simplification is necessary.

A common approach is to explore the relationships between demographics and *any* combination of two or more risk factors. ASH's analysis of 2021 Health Survey for England data compared prevalence of smoking, at risk drinking and overweight/obesity in the most deprived quintile of the population to prevalence in the least deprived quintile (Figure 2) and found that:

- 24% of those in the most deprived quintile had at least 2 risk factors, compared to 19% in the least deprived quintile.
- Those in the most deprived quintile were 1.7 times as likely to have all three risk factors (2.4%) as those in the least deprived quintile (1.4%).

Figure 2. Prevalence of multiple risk factors by deprivation quintile (HSE 2021)



In their 2016 review of UK studies of multiple risk factors, in which unhealthy diet and lack of physical exercise were commonly identified as risk factors rather than overweight/obesity, Meader and colleagues found that:

- Lower socio-economic groups, identified either by occupational group or by educational qualifications, were more likely to have multiple risk factors than higher socio-economic groups
- White ethnic groups were more likely to have multiple risk factors than Black and Minority Ethnic groups (Asian and Black)

³⁹ Alcohol and Health Inequalities. Institute of Alcohol Studies, 2020.

- Men were more likely to have multiple risk behaviours than women but gender was a weak predictor overall

The analysis of Health Survey for England data by Burton and colleagues found that combinations of two or more risk factors (smoking, increasing or higher risk drinking, overweight/obesity, and at-risk gambling) were *most* likely to be experienced by adults:

- Aged 45-65
- In the lowest socio-economic quintile
- With no educational qualifications
- Who were unemployed

The socio-economic gradient identified by Burton and colleagues became more pronounced when they restricted their analysis to higher risk behaviours: smoking, higher risk drinking, obesity, and at-risk gambling. For this combination:

- People who had no qualifications were more than 4 times more likely to experience multiple risks than those with a degree
- People who were unemployed were around 3 times more likely to experience multiple risks than those were employed

An earlier international review identified men and those with greater social disadvantage as being more likely have multiple risk factors⁴⁰. Recent studies from Norway⁴¹, Sweden⁴² and Poland⁴³ have all found an inverse relationship between educational attainment and the number of risk factors experienced.

The effect of multiple risk factors on illness and mortality

Those who live with more than one risk factor compound their risks, making themselves more vulnerable to illness and mortality. However, co-occurring risk factors can also interact, leading to an increase in the risk of harm to the individual beyond the sum of the separate risks. These synergistic effects can be quite strong, markedly increasing individuals' vulnerability to harm.

The additive impact of multiple risk factors is seen for all risk factors. A long-term prospective study of deaths among middle-aged and older men and women in Norfolk⁴⁴ found a clear relationship between increasing risk factors and increasing risk of mortality (Figure 3). The risk factors scrutinized were

⁴⁰ Noble N, Paul C, Turon H, Oldmeadow C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. *Prev Med*. 2015 Dec;81:16-41.

⁴¹ Bjørnerud Korslund S, Hansen BH, Bjørkkjær T. Association between sociodemographic determinants and health behaviors, and clustering of health risk behaviors among 28,047 adults: a cross-sectional study among adults from the general Norwegian population. *BMC Public Health*. 2023 Mar 22;23(1):541.

⁴² Klompstra L, Löf M, Björkelund C, Hellenius ML, Kallings LV, Orho-Melander M, Wennberg P, Bendtsen P, Bendtsen M. Co-occurrence of unhealthy lifestyle behaviours in middle-aged adults: findings from the Swedish CARDioPulmonary bioImage Study (SCAPIS). *Sci Rep*. 2024 Oct 1;14(1):22853. doi: 10.1038/s41598-024-71092-0. PMID: 39353999; PMCID: PMC11445527.

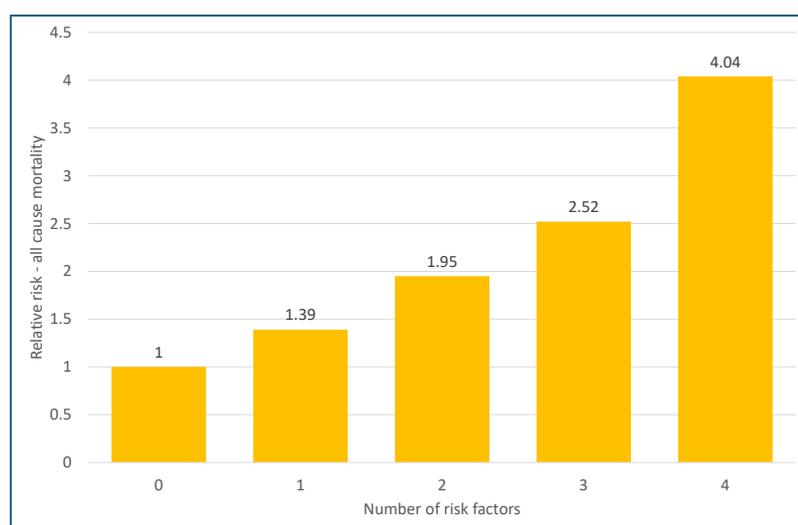
⁴³ Poznańska A, Lewtak K, Wojtyniak B, Stokwiszewski J, Moskalewicz B. Clustering of the Adult Population According to Behavioural Health Risk Factors as the Focus of Community-Based Public Health Interventions in Poland. *Int J Environ Res Public Health*. 2023 Mar 1;20(5):4402.

⁴⁴ Khaw K-T, Wareham N, Bingham S, Welch A, Luben R, Day N (2008). 'Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study'. *PLOS Medicine*, vol 5, no 1, pp e12.

smoking, physical inactivity, increasing and higher-risk drinking, and poor diet. Those who had all four risk factors were four times as likely to die early than those who had no risk factors.

A subsequent review of 21 international studies found that the avoidance of four or more risk factors (obesity, alcohol consumption, smoking, poor diet and physical inactivity) reduced the risk of mortality by 66%⁴⁵. Similar results have been reported for cancer incidence and mortality⁴⁶ and cardiovascular disease incidence and mortality⁴⁷.

Figure 3. Behavioural risk factors and relative risk of all-cause mortality (Khaw et al 2008)



The synergistic impact of multiple risk factors is not universal but is seen for specific risk factor combinations and specific harms. A recent systematic review by Burton and colleagues⁴⁸ found that:

- The combined effect of alcohol and smoking on head and neck cancers (disease and death) was 3.78 times greater than the additive effect of each risk factor
- The combined effect of alcohol and excess weight on liver disease and death was 1.55 times greater than the additive effect of each risk factor

Figure 4 illustrates the first of these findings. The size of the effect of the interaction between smoking and drinking, over and above the individual risks presented by these behaviours, is striking. However, such synergistic effects were not found for other forms of illness.

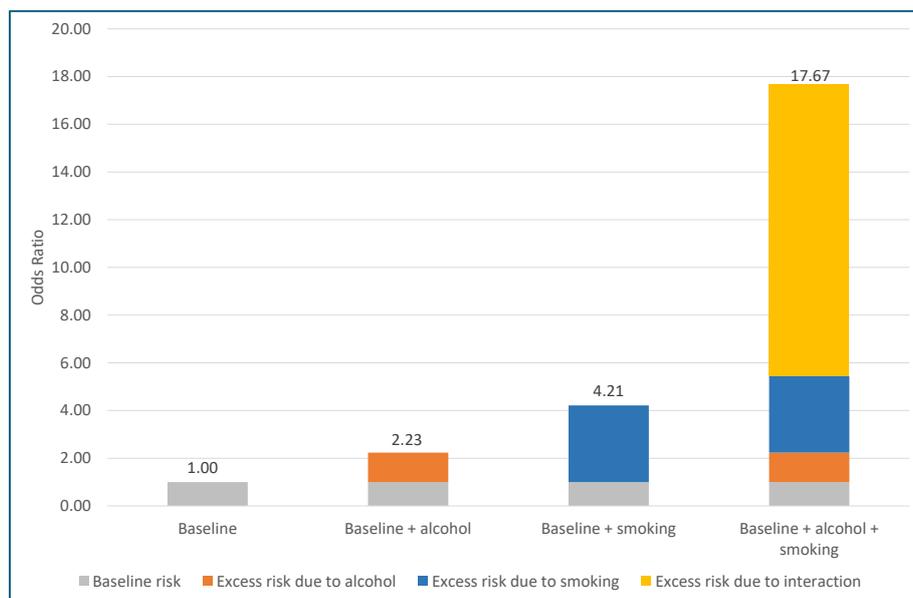
⁴⁵ Loef M, Walach H (2012). 'The combined effects of healthy lifestyle behaviors on all cause mortality: a systematic review and meta-analysis'. *Preventive Medicine*, vol 55, no 3, pp 163–70.

⁴⁶ Zhang YB, Pan XF, Chen J, Cao A, Zhang YG, Xia L, Wang J, Li H, Liu G, Pan A. Combined lifestyle factors, incident cancer, and cancer mortality: a systematic review and meta-analysis of prospective cohort studies. *Br J Cancer*. 2020 Mar;122(7):1085-1093.

⁴⁷ Zhang YB, Pan XF, Chen J, Cao A, Xia L, Zhang Y, Wang J, Li H, Liu G, Pan A. Combined lifestyle factors, all-cause mortality and cardiovascular disease: a systematic review and meta-analysis of prospective cohort studies. *J Epidemiol Community Health*. 2021 Jan;75(1):92-99.

⁴⁸ Burton R, Fryers PT, Sharpe C, Clarke Z, Henn C, Hydes T, Marsden J, Pearce-Smith N, Sheron N. The independent and joint risks of alcohol consumption, smoking, and excess weight on morbidity and mortality: a systematic review and meta-analysis exploring synergistic associations. *Public Health*. 2024 Jan; 226:39-52.

Figure 4. Pooled odds ratios for independent and joint associations of drinking and smoking and head and neck cancer disease/death, n=138,130 (Burton et al 2024)



The case for a coherent approach to prevention

The evidence described above is clear: co-occurring risk factors are common, exacerbate each other, deepen health inequalities, and significantly worsen health outcomes. By aligning policy and intervention strategies, a coherent approach could deliver greater overall health benefits and reduce inequalities. Recognising these interconnections allows for more effective public health strategies, ensuring that interventions are targeted where they are most needed and have the greatest impact on reducing preventable disease and death. Policy coherence would also enable closer co-operation between stakeholders, information-sharing, and collective action⁴⁹.

The principal interventions that have an impact on smoking, drinking and excess weight at population-level are the same. Just as the industries that promote tobacco, alcohol, and unhealthy food and drink use common methods to increase sales, so public health policy makers can and do intervene using the same tools: increasing product price, restricting marketing and promotion, and reducing availability⁵⁰. An integrated approach to tackling risk factors can maximise the effectiveness of these common interventions across markets, exploiting positive interactions and mitigating adverse outcomes.

Interventions for one risk factor can have positive outcomes for another. For example:

- An Australian review of interventions to reduce obesity identified increasing alcohol tax as the most cost-effective intervention of the 16 interventions they reviewed and modelled. The second most effective intervention was a 20% tax on sugar-sweetened drinks⁵¹.

⁴⁹ Hill SE, Johns P, Nakkash RT, Collin J. From silos to policy coherence: tobacco control, unhealthy commodity industries and the commercial determinants of health. *Tob Control*. 2022 Mar;31(2):322-327.

⁵⁰ WHO. Tackling NCDs: Best buys and other recommended interventions for the prevention and control of noncommunicable diseases. Second edition, updated 2024.

⁵¹ Ananthapavan J, Sacks G, Brown V, Moodie M, Nguyen P, et al. (2020) Priority-setting for obesity prevention—The Assessing Cost-Effectiveness of obesity prevention policies in Australia (ACE-Obesity Policy) study. *PLOS ONE* 15(6): e0234804

- In the USA, increases in cigarette taxes were associated with reductions in alcohol consumption and the frequency of binge drinking among male smokers⁵².

In contrast, adverse outcomes can result from a failure to consider risk factors together. For example, an increase in the price of sugar-sweetened drinks led to an increase in purchases of lager (as well as low-sugar drinks)⁵³, and there is anecdotal evidence that local authority restrictions on billboard advertising of HFSS foods has resulted in an increase in alcohol advertising. A coherent approach enables the identification and prevention of such displacement effects.

The sheer power and influence of the industries that produce and market health-harming products present a challenge to public health and to government⁵⁴. Arguably, single-issue policy-making draws focus away from this power towards the products and the individuals who consume them. An integrated approach to tackling risk factors helps to re-orient policy upstream, towards the ‘commercial determinants’ of health, potentially providing government with a stronger foundation upon which to pursue a consistent and robust approach to industry.

The industries involved have a record of doing everything they can to prevent regulation⁵⁵, including discrediting scientific evidence or scientists, influencing public opinion, promoting alternative policy proposals, focusing on the positive impact of industry, and threatening litigation^{56,57,58}. Although the ability of the tobacco industry to shape public policy has been curtailed through Article 5.1 of the UN Framework Convention on Tobacco Control, in other areas of policy industry remains highly influential. There is no evidence that the involvement of industry in harm reduction, for example through self-regulation and public-private partnerships, is effective^{59,60}. Public regulation and market intervention are required⁶¹.

ASH, the Alcohol Health Alliance and the Obesity Health Alliance are working together to make the case for a more joined-up approach to prevention, accelerating action on smoking, alcohol and obesity. We are calling on the Government to do the following:

⁵² Young-Wolff KC, Kasza KA, Hyland AJ, McKee SA. Increased cigarette tax is associated with reductions in alcohol consumption in a longitudinal U.S. sample. *Alcohol Clin Exp Res*. 2014 Jan;38(1):241-8.

⁵³ Quirnbach D Dr, Cornelsen L, Jebb SA, Marteau T, Smith R. Effect of increasing the price of sugar-sweetened beverages on alcoholic beverage purchases: an economic analysis of sales data. *J Epidemiol Community Health*. 2018 Apr;72(4):324-330. doi: 10.1136/jech-2017-209791. Epub 2018 Jan 23.

⁵⁴ Gilmore AB, Fabbri A, Baum F, Bertscher A, Bondy K, Chang HJ, et al. Defining and conceptualising the commercial determinants of health. *Lancet* 2023;401(Milbank Q 98 2020):1194–213.

⁵⁵ Al-Rawi O. Manufacturing dissent: How unhealthy commodity industries subvert public health action against noncommunicable diseases. *Med, Confl Surviv* 2023;39(3):271–80.

⁵⁶ Savell E, Gilmore AB, Fooks G. How Does the Tobacco Industry Attempt to Influence Marketing Regulations? A Systematic Review. *PLoS ONE* 2014;9(2):e87389.

⁵⁷ Hoe C, Weiger C, Minosa MKR, Alonso F, Koon AD, Cohen JE. Strategies to expand corporate autonomy by the tobacco, alcohol and sugar-sweetened beverage industry: a scoping review of reviews. *Glob Heal* 2020;18(1):17.

⁵⁸ Moodie AR. What Public Health Practitioners Need to Know About Unhealthy Industry Tactics. *Am J public Heal* 2017;107(7):1047–9.

⁵⁹ Knai C, Petticrew M, Durand MA, Eastmure E, James L, Mehrotra A, et al. Has a public–private partnership resulted in action on healthier diets in England? An analysis of the Public Health Responsibility Deal food pledges. *Food Polic* 2015;54:1–10.

⁶⁰ Knai C, Petticrew M, Durand MA, Scott C, James L, Mehrotra A, et al. The Public Health Responsibility deal: has a public–private partnership brought about action on alcohol reduction? *Addiction* 2015;110(8):1217–25.

⁶¹ Moodie R, Stuckler D, Monteiro C, Sheron N, Neal B, Thamarangsi T, Lincoln P, Casswell S; Lancet NCD Action Group. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. *Lancet*. 2013 Feb 23;381(9867):670-9.

- Set out a prevention vision with short and long-term targets for reductions in the prevalence of smoking, alcohol consumption and obesity rates.
- Publish roadmaps committing to evidence-based approaches to reduction of harm from smoking, alcohol consumption and unhealthy diets utilising fiscal measures, marketing and availability restrictions and improved access to treatment.
- Join up policy approaches across risk factors where feasible (e.g. extending junk food marketing restrictions to alcohol) and consider the co-benefits of policy to reduce alcohol consumption on smoking and obesity prevalence
- Consistently adopt language that highlights the wider building blocks of health (including commercial) and avoid focusing on personal responsibility.
- Protect public health policymaking from the vested interests of health harming industry stakeholders by ensuring full compliance with Article 5.3 and developing and adopting new guidelines to limit alcohol and food industry engagement and require transparency at all levels of government including advisors and parliamentarians.

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Appendix: Health Survey England Analysis

Data source – [Health Survey for England \(HSE\) 2021](#)

The data is collected on a household basis and includes children, but the only results used are for adults 16+. The three measures are self-reported.

Definitions used

- Smoking – Cigarette Smoking Status (Question cigst1_19). “Current smoker” is defined as opposed to never, ex-occasional smoker or ex-regular smoker.
- Drinking – Risk groups (2016 guidelines for men) (based on alcbase) (Question totalwug2_19). Increasing- or higher-risk drinking; Alcohol units per week > 14.
- BMI – Self-reported BMI adjusted grouped – Overweight, obese or morbidly obese.

Method

Weighting

In the HSE, responses are weighted to maximise representativeness of the population demographics. These weightings are applied in this analysis.

In HSE, BMI self-reporting is specifically adjusted to bring it in line with measured BMI responses. The adjusted values are used in this analysis.

HSE also used non-response adjustments for population sub-groups – including for IMD quintiles. For simplicity, these have not been applied in this analysis. The effect is discussed briefly in the limitations section. It only affects the results concerning the most and least deprived 20%, not for the whole of England.

Missing data

Listwise data deletion was used, counting any individual with at least one missing response as a non-response. This means that the whole person’s record was removed from this analysis if data is missing for at least one risk factor (smoking, alcohol or obesity).

Limitations

Prevalence differences from HSE

The total prevalences of each risk factor (ie the sum of every combination that includes a given risk factor) do not perfectly match the HSE totals. This is because:

- 1) Listwise deletion means that more people are removed from the sample for a given risk factor than in the HSE analysis, so the proportions will not perfectly match those calculated by HSE.
- 2) Non-response adjustments were not applied for IMD quintiles. These are done to correct for any age- and gender- differences between the IMD groups so that they can be directly compared.

Limited conclusions

The results describe the proportions of people who have different combinations of risk factors in the population of England, and in the most and least deprived in England. No statistical test for any interaction or difference has been performed. They also do not supply any evidence for causal links or explanations of differences.