Alcohol-attributable mortality in France

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Background: Alcohol consumption is high in France. Aim: Estimation of alcohol-attributable mortality in France by sex, age and dose, for year 2009. Method: We combined survey and sales data to estimate the prevalence of alcohol consumption by age, sex and dose category. For each cause of death, the relative risk of death as a function of dose was obtained from a meta-analysis and combined with prevalence data to obtain the attributable fraction; this fraction multiplied by the number of deaths gave the alcohol-attributable mortality. Results: A total of 36 500 deaths in men are attributable to alcohol in France in 2009 (13% of total mortality) versus 12 500 in women (5% of total mortality). Overall, this includes 15 000 deaths from cancer, 12 000 from circulatory disease, 8000 from digestive system disease, 8000 from external causes and 3000 from mental and behavioural disorder. The alcohol-attributable fractions are 22% and 18% in the population aged 15 to 34 and 35 to 64, respectively, versus 7% among individuals aged 65 or more. Alcohol is detrimental even at a low dose of 13 g per day, causing 1100 deaths. Conclusion: With 49 000 deaths in France for the year 2009, the alcohol toll is high, and the effect of alcohol is detrimental even at low dose. Alcohol consumption is responsible for a large proportion of premature deaths. These results stress the importance of public health policies aimed at reducing alcohol consumption in France.

Introduction

In many countries, the majority of adults consume alcohol. In France, the amount of alcohol available for consumption was traditionally high and reached a maximum of 65 g per adult per day at the end of the thirties. Since 1960, it has decreased regularly by 1.7% per year and was equal to 27 g per adult and per day in 2009.¹

The estimation of alcohol-attributable mortality provides a useful indicator for developing national public health strategies. These estimates are available for many countries.²⁻¹⁰ In France, estimations were published by Pignon and Hill for the years 1985 and 1995.¹¹,¹² In 2007, the International Agency for Research on Cancer (IARC) published an estimation of alcohol-attributable cancer morbidity and mortality for the year 2000.¹³ Recently, Rey et al. published estimations of alcohol-attributable deaths for the year 2006.¹⁴ The aim of this study was to estimate the number of alcohol-attributable deaths for the year 2009, overall and by cause of death, according to gender, age and alcohol dose.

Methods

To estimate the number of deaths attributable to alcohol, we need to know the distribution of alcohol consumption by gender and age group in the French population, we need to identify all causes of deaths with a risk modified by alcohol consumption and we need to know the dose–effect relationship between exposure to alcohol and the risk for each of these alcohol-related causes of death. This study is based on the French mortality data for the year 2009.

Alcohol consumption by gender and age

A representative sample of 20 178 French individuals aged 15+ were interviewed on their alcohol drinking habits in 2002–03 by the National Institute of Statistics and Economic Studies. The data on alcohol consumption have not been published, but they are available from Réseau Quetelet on request.¹⁵ There was a marked discrepancy between the reported average alcohol consumption in this survey (11 g/day) and the average estimated based on the French alcohol sales statistics reported to the tax authorities (27 g/day in 2009). This corresponds to a rate of underreporting equal to 2.4 (27/11); therefore, we multiplied the daily alcohol consumption each individual declared in the national survey by 2.4 to adjust the declared daily alcohol consumption on 2009 alcohol sales. Supplementary table 1 shows the adjusted results of the survey, by gender and age category, for five dose categories. The alcohol-attributable number of deaths in 2009 was estimated based on these adjusted consumption data.

Causes of deaths associated with alcohol

Conditions wholly attributable to alcohol

A number of conditions, listed in supplementary table 2, are, by definition, wholly attributable to alcohol consumption.

Conditions partly attributable to alcohol

Supplementary table 3 lists all conditions partly attributable to alcohol. Cancer sites with a risk increased by alcohol consumption are the oral cavity, pharynx, oesophagus, colon and rectum, liver, larynx and breast.¹⁶⁻²¹ Alcohol increases the risk of cardiac arrhythmias,²² haemorrhagic stroke²³ and of hypertensive diseases among men and decreases the risk of hypertensive diseases among women for a daily consumption below 12 g of ethanol.²⁴ Alcohol reduces the risk of ischemic heart disease¹⁹ and ischemic stroke²⁵ at daily doses below 78 and 35 g of ethanol, respectively. The risk of cholelithiasis is reduced by alcohol consumption.²² Alcohol increases the risk of pancreatitis.²⁵ The risks of accidents, falls, suicides and homicides, that is external causes of death, are increased by alcohol consumption. Low to moderate alcohol consumption is known to have a protective effect on type 2 diabetes.²⁶,²⁷ The risk of death from epilepsy is increased by alcohol.²⁸
Risk functions

For each alcohol-attributable condition except for external causes, the dose–response relationship between alcohol consumption and the risk of death was provided by the most recent meta-analysis of epidemiological studies comparing groups of individuals with at least three categories of alcohol consumption. Supplementary table 3 shows, for each cause of death, the estimated fractional polynomial provided by the corresponding meta-analysis and the relative risks for the doses of alcohol of supplementary table 1. The dose–effect relationships are shown in web figure.

Supplementary table 3 also shows the dose–effect relationships between alcohol consumption and the risk of liver cirrhosis used to distribute the alcohol-attributable deaths for conditions wholly attributable to alcohol between dose categories, see below.

Alcohol-attributable fraction

Partially alcohol-attributable conditions

The alcohol-attributable fraction (AAF) for a specific cause of death is the proportion of deaths from this specific cause due to alcohol consumption. The AAF was estimated for each condition, gender and age group using Levin’s formula:

\[
AAF = \frac{\sum_{i=1}^{4} p_i(RR_i - 1)}{\sum_{i=1}^{4} p_i(RR_i - 1) + 1}
\]

where \( p_i \) is the proportion of the population exposed to the \( i \)th dose category (13, 28, 46 and 117 g of pure alcohol per day for men and 13, 28, 46 and 85 g of pure alcohol per day for women) and \( RR_i \) is the relative risk associated with the \( i \)th dose category compared with non-regular drinkers (see supplementary table 3). From this formula, one can deduct the AAF associated with the \( i \)th dose category (AAFi):

\[
AAFi = \frac{p_i(RR_i - 1)}{\sum_{i=1}^{4} p_i(RR_i - 1) + 1}
\]

External causes

For external causes, particularly for accidents which represent a main external cause, the increase in risk depends on acute rather than on average exposure. The risk is also increased for any individual, drinker or non-drinker, involved in an accident caused by a drunker. For these reasons, we have used the attributable fractions proposed by Ezzati et al. for the main external causes in Western Europe. We have not included external causes of death in the estimation of mortality according to alcohol dose.

Wholly alcohol-attributable conditions

By definition, all deaths associated with wholly alcohol-attributable conditions are due to exposure to alcohol. To distribute this total number of deaths between the four dose categories, we need a dose–response relationship. Liver cirrhosis is the unique wholly alcohol-attributable condition for which we have an estimation of the dose–response relationship in the literature. The AAF associated with each dose category \( i \): AAFi was estimated using the relative risks of liver cirrhosis presented in supplementary table 3 with ‘13 g per day’ as the reference dose category:

\[
AAFi = \frac{p_iRR_i}{\sum_{i=1}^{4} p_iRR_i}
\]

This estimation was used for each wholly alcohol-attributable condition.

Sensitivity analysis

Sensitivity analyses estimated the number of alcohol-attributable deaths in 2009 under the assumptions that 10 or 20% of the alcohol available in 2009 was not consumed, but wasted or undrinkable. The daily alcohol consumption estimated from sales was then equal to 24-3 or 21.6 g, respectively, of pure alcohol per adult per day. We multiplied the daily alcohol consumption each individual declared in the national survey by 2-2 (24-3/11) in the first situation and by 2-0 (21-6/11) in the second one, to adjust the 2003 declared daily alcohol consumption on 2009 alcohol actually consumed.

In another sensitivity analysis, the consumption of alcohol was taken as declared and, therefore, not corrected to account for the amount of available alcohol estimated from sales.

Mortality data

The number of deaths observed in 2009 was obtained from the National Institute of Health and Medical Research for each condition related to alcohol, by gender and 5-year age group (http://www.cepidec.vesinet.inserm.fr) (table 1). The number of deaths attributable to alcohol was calculated for each condition, by gender and age group, for each dose category by multiplying the total number of deaths by the corresponding AAF. For each cause of death and each gender, the age-specific numbers of deaths attributable to alcohol were summed, and the result was divided by the total number of deaths to generate the AAF.

Results

Out of 535,000 deaths in 2009, 49,000 were attributable to alcohol: 36,500 among men and 12,500 among women, which represent 13 and 5%, respectively, of total deaths. Table 1 shows by gender for each cause of death, the number of deaths observed in 2009, the estimated AAF and the number of deaths attributable to alcohol or prevented by alcohol consumption. The total of about 36,500 deaths attributable to alcohol among men is obtained after subtracting 50 deaths from cholelithiasis prevented by alcohol. Similarly among women, the 12,500 deaths due to alcohol are obtained by subtracting about 700 deaths, mostly from ischemic heart disease and type 2 diabetes, prevented by alcohol. Alcohol consumption is a major cause of premature death. The AAFs are highest in the populations aged 15 to 34 (22%) and 35 to 64 (18%) versus 7% in the population aged 65 or over (table 2). This is particularly true among men with one death in four attributable to alcohol between ages 15 and 34 and one death in five between ages 35 and 64.

Table 3 presents mortality in France for 2009, excluding external causes, according to the dose of alcohol. The AAF increases with the dose of alcohol from 0-4% at a dose of 13 g per day to 32% at the dose of 117 g per day among men and from 2 to 29% at the dose of 85 g per day among women. Figure 1 shows the total number of deaths and the number of deaths attributable to alcohol among men and women, for each dose category. The number of deaths not attributable to alcohol reflects the distribution of alcohol consumption in the population.

The sensitivity analyses gave estimations of 45,000 and 42,000 alcohol-attributable deaths in 2009 when 10 and 20%, respectively, of 2009 alcohol sales were supposed not to have been consumed. Using the declared alcohol consumption gave an estimation of 28,000 deaths.

Discussion

We estimate a total of 49,000 alcohol-attributable deaths in France for 2009, 36,500 among men and 12,500 among women. Alcohol consumption is responsible of a large proportion of premature deaths. Even at the lowest dose of 13 g per day, where alcohol is associated with a reduced risk of cholelithiasis, ischemic heart
These estimates rely on many assumptions and are, therefore, subject to uncertainty. Major sources of uncertainty are the distribution of alcohol consumption, the lag time between alcohol consumption and mortality, the pattern of drinking, the selection of causes of death with risk modified by alcohol, the quality-adjusted life-years, and the estimation of the risk functions.

**Alcohol consumption estimation**

The literature discussing the various sources of bias in alcohol consumption measurement is considerable, and there is no consensus on the estimators that should be used to assess alcohol-attributable mortality. Estimations of alcohol consumption from survey data and alcohol available from national statistics are markedly different, resulting in different estimates in number of alcohol-attributable deaths: 28,000 versus 49,000 in our study. The dose–effect relationships are estimated from epidemiological studies based on self-reported alcohol consumption, and therefore, survey data may be preferable. However, underreporting may be less in epidemiological studies than in surveys of a national sample of the population because individuals interviewed in the context of an epidemiological study, knowing its public health objective, may be more truthful about their consumption of alcohol. The aim of this study being a realistic estimation of the number of deaths attributable to alcohol for the year 2009, we chose to use the distribution of drinkers available in a large recent representative survey of the French population, adjusted on the amount of alcohol consumed by the French population, and independent multiple sites (ICD code: C97) equal to the gender- and age-specific fraction of cancers of specified sites attributed to alcohol.

A fraction of ill-defined and unknown causes of death (ICD codes: R96–R99) equal to the fraction of specified causes of deaths attributable to alcohol was attributed to alcohol for the year 2009, we chose to use the distribution of drinkers available in a large recent representative survey of the French population, adjusted on the amount of alcohol consumed by the French population.
alcohol-related harm have been suggested; however, the problem of time lags is not well addressed. The choice of the lag time is more crucial in France than in other countries, because the consumption of alcohol has decreased by 50% over the last 50 years. It was 33 g per adult per day in 1994, 30 g in 2002–03 and 27 g in 2009. For cancer, it would probably have been more appropriate to use alcohol consumption 15 or 20 years before 2009. However, most published estimates combine consumption and mortality data for the same year.

Characteristics of drinking habits

We studied the effect of alcohol drinking, summarizing consumption by the average daily alcohol intake. This ignores possible different effects of binge drinking versus regular daily exposure. There is only fragmentary information on this factor. A recent meta-analysis showed that the cardioprotective effect of moderate alcohol consumption on ischemic heart disease disappeared when light to moderate drinking was mixed with irregular heavy drinking episodes. Mortality from external causes is increased by binge drinking.

Causes of death associated with alcohol

We did not include conditions for which a link with alcohol is probable but not proven. Recent meta-analyses show no evidence of an association between alcohol consumption and prostate cancer, oesophageal and gastric cardia adenocarcinoma, and bladder cancer. There is some uncertainty in the sorting out of causes of death between the underlying cause and associated causes. We have not taken secondary causes into account.

Previous estimations of alcohol-attributable mortality in France

Several estimations of alcohol-attributable mortality have been published for France. Early studies, estimating alcohol exposure from a 1974 survey by the Institut Français d’Opinion Publique uncorrected for the amount of available alcohol, and ignoring the protective effects of alcohol, estimated 52 000 deaths in 1985 and 45 000 deaths in 1995. An estimation of alcohol-attributable cancer deaths in France was published by the IARC for the year 2000, using the total amount of alcohol available in 1985.
who.int); AAFs for all cancers were estimated at 9% for men and 3% for women in 2000 versus 12 and 6% in our study, and the total number of cancers attributable to alcohol was equal to 9900 versus 15 200 in our study; the difference comes essentially from different dose–effect relationships for oesophageal, colorectal and breast cancer. A recent estimation used data from a 2002 survey: the number of deaths attributable to alcohol for the year 2006 was equal to 33 000 after adjustment for the available amount of alcohol in 2002; this estimation is lower than ours due to the use of different surveys and risk equations. None of the previous studies presented the results by dose category.

Comparison with other countries

The proportion of deaths attributable to alcohol in France among men is 13%, much higher than in other countries; for instance, it is 6.8% in Scotland, 5% in Switzerland, 3% in East Germany and Italy, 1% in West Germany and Denmark and −2.8 or −0.8%, that is a protective effect in the United Kingdom. Among women, the proportion of deaths attributable to alcohol is 4-7%, also higher than the 3-3% estimated for Scotland, the 2% observed in Italy, 1.4% in Switzerland, 1% in Denmark, 0.3% in West Germany and effects varying between 0.1 and −0.9% in the United Kingdom and −0.3% in East Germany. Liang et al. found that 4.4% of all cancer deaths were attributable to alcohol consumption in China in 2005, which is to be compared with 10% in our study.

The overall protective effect of alcohol in England and Wales can be directly compared with the highly detrimental effect of alcohol in France inasmuch as the methods used are quite similar. White et al. use the consumption as declared in the general household survey, whereas we adjust the declared consumption to account for the alcohol available for consumption. When we use the declared consumption, in our sensitivity analysis, we attribute 28 000 deaths to alcohol in France, whereas alcohol has an overall protective effect in England and Wales with 1800 deaths avoided. However, the distributions of causes of deaths in the populations are different. Our results in terms of age and dose effects are nevertheless similar to those observed by White et al.: an increased risk of mortality exists even among people drinking a low dose of alcohol, especially among young people.

Alcohol is a major public health issue in France

This study demonstrates the overall detrimental effect of moderate alcohol consumption, even at the low dose of 13 g of pure alcohol per day. More generally, it shows the major harmful effect of alcohol on health in France, leading to 49 000 deaths in the year 2009, 40% among individuals younger than 65 years. Our study addresses the effect of alcohol on mortality; it ignores the morbidity of drinkers, the morbidity of individuals involved in alcohol-related accidents and the morbidity of newborns exposed in utero. In 2005, France had the fourth highest consumption of alcohol among 48 European Member States after the Czech Republic, Estonia and Ireland. Efforts should be made to reduce further alcohol consumption in France and thus avoid many premature deaths.

Supplementary data

Supplementary data are available at EURPUB online.

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Conflicts of interest: None declared.
Key points

- Our work presents an estimation of the number of deaths attributable to alcohol in France, in 2009, for each cause of death related to alcohol consumption.
- The harmful effect of alcohol is larger in the younger population.
- We estimated the number of deaths and the risks for different dose categories and showed that the overall effect of a moderate alcohol consumption is detrimental in France.

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