Estimate of deaths attributable to passive smoking among UK adults: database analysis

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Abstract

Objective To estimate deaths from passive smoking in employees of the hospitality industry as well as in the general workforce and general population of the United Kingdom.

Design Calculation, using the formula for population attributable proportion, of deaths likely to have been caused by passive smoking at home and at work in the UK according to occupation. Sensitivity analyses to examine impact of varying assumptions regarding prevalence and risks of exposure.

Setting National UK databases of causes of death, employment, structure of households, and prevalences of active and passive smoking.

Main outcome measures Estimates of deaths due to passive smoking according to age group (< 65 or ≥ 65) and site of exposure (domestic or workplace).

Results Across the United Kingdom as a whole, passive smoking at work is likely to be responsible for the deaths of more than two employed people per working day (617 deaths per year), including 54 deaths in the hospitality industry each year. Each year passive smoking at home might account for another 2700 deaths in persons aged 20-64 years and 8000 deaths among people aged ≥ 65.

Conclusion Exposure at work might contribute up to one fifth of all deaths from passive smoking in the general population aged 20-64 years, and up to half of such deaths among employees of the hospitality industry. Adoption of smoke free policies in all workplaces and reductions in the general prevalence of active smoking would lead to substantial reductions in these avoidable deaths.

Introduction

Evidence that exposure to passive smoking increases the risk of adults developing fatal diseases first emerged in 1981.[1 2] Many epidemiological studies have been carried out, and reviews in three continents have now concluded that passive smoking is a cause of serious disease in adults and children.[3–5] Smoke free policies have been introduced in various settings, but some workplaces still permit smoking and making hospitality venues (pubs, bars, nightclubs, hotels, and restaurants) smoke free is contentious. As the generation of tobacco smoke is not intrinsic to the process of selling food and drink, such venues could be made smoke free to protect the health of employees. Nevertheless, some organisations and individuals in the hospitality industry vigorously oppose this, claiming that such policies are an infringement of the personal liberty of their customers and will lead to damage to themselves.

Objective evidence has shown that smoke free policies have no adverse economic impact on the hospitality industry.[6 7] By contrast, there have not been any calculations of the harm done to health from smoking in hospitality venues and certain other workplaces. I estimated the number of deaths due to passive smoking in employees of the hospitality industry and in the general workforce and general population of the United Kingdom.

Methods

Study population

In mid-2002, an estimated 39.4 million people aged 20 years and older lived in England and Wales; the figure for the United Kingdom was 12.9% larger at 44.5 million.[8] The corresponding figures for people aged ≥ 65 years were 8.4 million and 9.4 million, respectively.[8] At the same time 29.8 million people were in employment in the United Kingdom,[9] of whom 320 262 (1.1%) worked in pubs, bars, and nightclubs, and 829 401 (2.8%) worked in hotels and restaurants.[10]

Prevalence of passive exposure to tobacco smoke

Among adults of working age, around 30% are smokers,[11] and the estimated prevalence of passive smoking at home is 42%,[12 13] but this figure has been discounted to 37% to allow for the 13% of individuals who live alone. In people aged ≥ 65, the prevalence of active smoking is 15%[11] but partnering is non-random with respect to smoking status and 37% of people live alone. Allowance for both of these factors leads to an estimated prevalence of passive exposure at home of 13%. Nearly all pubs, bars, nightclubs, hotels, and restaurants currently permit smoking in at least some areas, leading to some passive exposure in all of their employees. The prevalence of passive smoking at work in the general workforce is 11%.[14]

ELPS *This is the abridged version of an article that was posted on bmj.com on 2 March 2005: http://bmj.com/cgi/doi/10.1136/bmj.38370.496632.8F*

Risks associated with exposure to tobacco smoke

After a report by Woodward and Laugesen to the New Zealand Ministry of Health,[15] based on earlier calculations by Kawachi et al,[16] I have adopted relative risks of 1.24 and 1.30, respectively, for lung cancer and ischaemic heart disease, irrespective of age or sex. Studies of exposure at work suggest that figures of 1.24 and 1.20, respectively, are appropriate for both sexes.[15]

Seven studies, varying considerably in size and design, have examined the association between passive smoking and risk of stroke.[17–23] According to the method used by the Australian National Health and Medical Research Council Working Party,[4] I have used the median of the available values (1.45) as the best estimate of the probable relative risks and the lower and upper quartiles of the series (1.15 and 1.76, respectively) to define the uncertainty surrounding this estimate. As there are no equivalent estimates available for passive exposure at work, I applied the same figures for that setting.

Though there are no published studies of the association between mortality in hospitality staff and passive smoking, Jarvis reported that non-smoking bar staff in London had a median salivary cotinine of 3.65 ng/ml, a figure 3.04 times higher than the median found in the same study for non-smokers married to smokers.[24] Application of this figure to the typical excess risks for workplace exposure used by Woodward and Laugesen[15] suggests that pub, bar, and nightclub staff experience relative risks of 1.73, 1.61, and 2.52 for lung cancer, heart disease, and stroke, respectively. Because staff working in hotels and restaurants are exposed to less smoke[25] I set their risks at the same level as for the general workforce.

Mortality from target conditions

I obtained counts of deaths from lung cancer (International Classification of Diseases, 10th revision, codes C33, C34), ischaemic heart disease (I20-I25), and stroke (I60-I69) in England and Wales during 2003 from the Office for National Statistics[26] according to age (<65 or ≥ 65). I adjusted the figures upwards by 12.9% and 12.4%, respectively,[8] to obtain UK estimates. To calculate the numbers of deaths in all employed people I multiplied the relevant figure for those aged 20-64 by 0.85 (the size of the total workforce relative to that of the whole population aged 20-64 in mid-2002). Similarly, multiplying the relevant estimated figure for deaths in the workforce by 1.1% and 2.8% gave numbers for cause specific deaths in workers in pubs or bars and in restaurants.

Statistical methods

I derived estimates of the cause specific numbers of deaths for both sexes combined for people aged <65 and ≥ 65 years and for each site of exposure (home or work), using the formula $\{[p.(RR-1)]/[1+p.(RR-1)]\}$ for population attributable proportion (where p = prevalence of passive smoking at home and RR = relative risk) and applying the resulting fraction to the relevant total numbers of deaths from a specific cause. The number for total attributable deaths is the sum of the three cause specific numbers of deaths for a particular age group and setting.

I assumed that all employees in the hospitality industry were exposed to the same amount of passive smoking at home as the rest of the population. The proportion of staff for whom hospitality work represents their chief lifetime occupation is not known but I estimated it at 20%. Accordingly, I divided by five the attributable numbers of deaths from passive smoking in hospitality venues derived from the size of the industry wide workforce.

I tested the sensitivity of the results to some of the assumptions underlying the calculations. The calculations were repeated using the upper and lower 95% confidence limits of the relative risks, as given by Woodward and Laugesen.[15] The effect of setting the relative risk for stroke to that for ischaemic heart disease was also tested. Finally, I performed a new set of calculations using the original relative risks but setting the prevalences of smoking to those currently observed in Australia (24% in middle aged adults; 10% in those aged ≥ 65)[27] and assuming all hospitality venues had become smoke free, as has occurred recently in the Republic of Ireland and Norway.

Table 1 Deaths attributable to passive smoking by cause, age, occupation, and site of exposure, United Kingdom, 2003

	General population			Hospitality employees			
				Exposed at work		Exposed at home	
	20-64 years exposed at home	All workforce exposed at work	≥65 years exposed at home	Fifth of pub, bar, nightclub workers	Fifth of hotel and restaurant workers	All pub, bar, nightclub workers	All hotel and restaurant workers
Prevalence of passive exposure	0.368	0.11	0.134	1.0	1.0	0.368	0.368
Relative risk							
Lung cancer	1.24	1.24	1.24	1.73	1.24	1.24	1.24
IHD	1.30	1.20	1.30	1.61	1.20	1.30	1.30
Stroke	1.45	1.45	1.45	2.37	1.45	1.45	1.45
Population attributable risk (expressed as proportion)							
Lung cancer	0.081	0.026	0.031	0.422	0.194	0.081	0.081
IHD	0.099	0.022	0.039	0.379	0.167	0.099	0.099
Stroke	0.142	0.047	0.057	0.578	0.310	0.142	0.142
Attributed deaths							
Lung cancer	594	160	778	7	8	6	17
IHD	1486	274	3753	12	14	16	41
Stroke	646	182	3428	6	8	7	18
Total*	2726	617	7959	24	30	29	76

IHD=ischaemic heart disease.
*May be affected by rounding in component estimates.

Table 2 Results of sensitivity analyses for deaths attributable to passive smoking

| Assumption
applied	General population			Hospitality employees			
				Exposed at work		Exposed at home	
	20-64 years exposed at home	All workforce exposed at work	≥65 years exposed at home	Fifth of pub, bar, nightclub workers	Fifth of hotel and restaurant workers	All pub, bar, nightclub workers	All hotel and restaurant workers
Lower 95% confidence limit*							
Subtotal	1684	204	4357	11	11	18	47
Difference (%)†	−1454 (−44)‡		−3602 (−45)	−32 (−59)§		—	
Upper 95% confidence limit*							
Subtotal	3683	1085	11426	33	46	40	102
Difference (%)†	1426 (43)‡		3467 (44)	25 (46)§		—	
Relative risk for stroke equivalent to relative risk for ischaemic heart disease							
Subtotal	2532	518	6860	22	26	27	70
Difference (%)†	−293 (−9)‡		−1099 (−14)	−6 (−10)§		—	
Australian prevalence plus smoking regulations as in Republic of Ireland¶							
Subtotal	2211	0	5384	0	0	24	61
Difference (%)†	−1131 (−34)‡		−2575 (−32)	−54 (−100)§		—	

*Taken from Woodward and Laugesen.[15]
†Difference relative to equivalent figures in table 2.
‡For all aged 20-65 years.
§For workplace exposure in all hospitality employees.
¶Figures for prevalence from White et al[27]; all workplaces in the Republic of Ireland are now smoke free.

Results

In 2003, an estimated 617 people died from the effects of passive smoking at work across the whole of the United Kingdom, 54 of whom were long term employees of the hospitality industry (table 1). Of the 54 people who died, almost half were employed in the pub/bar/nightclub sector, despite the smaller size of its workforce, because staff are exposed to higher concentrations of tobacco smoke. In the whole population aged 20-64, more than 2700 deaths attributable to passive smoking at home brought the total fatalities related to passive smoking to 3343. In those aged ≥65, the total number of attributable deaths approaches 8000, with fatal strokes and heart disease each contributing more than three thousand events.

Table 2 shows the effects of varying key assumptions. When I used the lower confidence limits of the relative risks for each of the three conditions linked to passive smoking, the number of attributable deaths related to domestic exposure fell by about 45% and those secondary to exposure at work by two thirds. All totals are distinctly sensitive to the relative risks used to calculate deaths attributable to stroke, where there is least information available on the risks associated with passive smoking. Finally, if all workplaces in the United Kingdom became smoke free, as has occurred in the Republic of Ireland, and if the general prevalence of smoking fell to levels presently seen in Australia, not only would all deaths attributable to passive smoking at work eventually disappear, but those in the general population related to passive smoking at home would also fall by a third.

What is already known on this topic

Passive smoking is accepted as a cause of fatal diseases in adults

Existing studies have shown these risks for both domestic exposure and exposure at work

What this study adds

Passive exposure to tobacco smoke at work may cause more than 600 deaths each year, including over 50 in people employed in the hospitality industry

Exposure at home may account for 2700 deaths in those aged 20-64 and 8000 in those aged ≥65

Discussion

My calculations indicate that passive exposure to tobacco smoke at work is likely to be responsible for the deaths of more than two employed people every working day across the United Kingdom as a whole (617 deaths a year). They suggest that at least one employee in the hospitality industry dies from such exposure each week (54 deaths a year). Passive smoking at home might account for a further 2700 deaths in people aged 20-64 years (approaching eight a day) and a further 8000 deaths a year among people aged ≥65. Even using the lowest statistically defensible estimates of the risks associated with passive smoking, the numbers of attributable deaths remain sizeable (see bmj.com).

As with any epidemiological assessment of attributable risk, the present calculations depend on an assumption of cause and effect and do not identify specific individuals affected. Given that authorities on three continents have concluded that passive smoking causes disease in adults,[3–5] my calculations have a firm foundation.

My calculations do not formally take into account the well documented issue of a time lag between exposure to tobacco smoke and impact on health. As the prevalence of active smoking has been falling in the United Kingdom for several decades, however, the intensity of passive smoking in hospitality venues is also likely to have been falling, as have the intensity and prevalence of passive exposure in other settings, including domestic ones. Thus, use of current estimates for the prevalence of passive exposure is again conservative.

Adoption of smoke free policies in all workplaces in the United Kingdom might prevent several hundred premature deaths each year, while the reduction of the prevalence of active smoking to that already achieved in other parts of the English speaking world might avoid several thousand more.

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Impact of misclassification of in vitro fertilisation in studies of folic acid and twinning: modelling using population based Swedish vital records

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Abstract

Objective To determine whether failure to adequately adjust for a reported 40% misclassification of use of in vitro fertilisation (IVF) as reported in a Swedish study could have led to a false finding that folic acid increases dizygotic twinning.
Design Modelling with population based data.
Setting Swedish vital records for 1995-9.
Main outcome measures Rates of twinning calculated according to whether women used IVF to become pregnant. Estimated unadjusted and adjusted odds ratios of the association between use of folic acid and twinning by use of IVF.
Results In 1995-9, Swedish women who used IVF had almost 20 times the chance of having twins than women who did not use IVF (rate ratio 19.7, 95% confidence interval 18.7 to 20.6). In the absence of a true effect of folic acid, the use of a 40% misclassified surrogate variable to adjust for use of IVF would have resulted in a false finding that folic acid was associated with a more than twofold increase in twinning.
Conclusion Use of IVF is a strong confounder because it is associated with both use of folic acid and twinning. Even when misclassification of IVF was reduced to 5%, this bias persisted in the adjusted model. Using a 40% misclassified surrogate to adjust for IVF, as reported in the Swedish study, probably led to a false finding that folic acid increased dizygotic twinning.

Introduction

Folic acid is recommended throughout most of the world for women of childbearing age to prevent neural

Further details of the analysis, a figure, and an extra table are on bmj.com.

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