Curr Atheroscler Rep (2014) 16:418
DOI 10.1007/s11883-014-0418-0

CARDIOVASCULAR DISEASE AND STROKE (P PERRONE-FILARDI AND S. AGEWALL, SECTION EDITORS)

An International Smoking Ban—How Many Lives Will Be Saved?

Cecily C Kelleher · Kate Frazer

Published online: 26 April 2014

Abstract Multicomponent tobacco control strategies are crucial to combat the ongoing global smoking challenge. In the twenty-first century, many countries have signed up to the World Health Organization Framework Convention on Tobacco Control, and in recent years a mounting number of countries and regions have implemented partial or complete smoking bans to protect the general public from passive smoke exposure. There is substantial evidence that workers, particularly in the hospitality sector, benefit from reduced exposure. More recently, several reports have appeared from different countries showing a temporal relationship between the introduction of a smoking ban and reduced hospital admissions for cardiovascular, respiratory and maternity outcomes. This will have a measurable benefit for public health, saving many lives. Multicomponent strategies could also reduce active smoking significantly if successfully implemented worldwide.

This article is part of the Topical Collection on *Cardiovascular Disease and Stroke*

C. C. Kelleher (✉)
UCD School of Public Health, Physiotherapy and Population Science, University College Dublin,
Belfield, Dublin 4, Republic of Ireland
e-mail: cecily.kelleher@ucd.ie

C. C. Kelleher
Department of Preventive Medicine and Health Promotion,
St Vincent's University Hospital,
Elm Park, Dublin 4, Republic of Ireland

K. Frazer
UCD School of Nursing, Midwifery and Health Systems,
University College Dublin, Belfield, Dublin 4, Republic of Ireland
e-mail: kathleen.frazer@ucd.ie

Keywords Passive smoke exposure · Active smoking · Bans · Country · Region · State

Introduction

It is a paradox that there has never been more active smoking in human history, yet the momentum for tobacco control has been gathering significantly in many countries in the twenty-first century. A report from the Institute for Health Metrics and Evaluation in the USA, examined the prevalence of smoking across 187 countries and found that although the prevalence worldwide has fallen since the 1980s and varies considerably according to sex, social class and country, in absolute terms, because of population expansion, it is estimated that of the seven billion global population, one seventh of these, or almost one billion individuals, are now smokers [1]. The consequent burden of disease, in all its multisystem presentations, is scarcely calculable in human and economic terms.

Accordingly, the global public health challenge to eliminate smoking remains as pressing as ever, and the strategies for achieving this must be considered carefully. One of these, the banning of active smoking in public places to minimize passive smoke exposure of others, is a key factor. The World Health Organization (WHO) Framework Convention on Tobacco Control [2] was adopted in 2003 and has become one of the most widely embraced treaties in United Nations history. The public health measures to tackle smoking are well known, and the WHO recommends a comprehensive framework, called the MPOWER package, which advocates and includes provisions such as tax and price measures, smoke-free places, health warnings, a ban on tobacco advertising and promotion and a ban on sales to minors. A recent review of the data on the progress in every member state

suggests that the highest-level MPOWER policies adopted from 2007 to 2010 will result in 15 million fewer smokers, and 7.4 million premature deaths will consequently be averted by 2050 [3].

Outright prohibition of smoking and the production of tobacco products has not been seriously entertained in recent decades, although tobacco is as dangerous as many illicit drugs, and indeed part of the argument to legalize, for instance, cannabis rests on the logic that it is no more or less harmful than tobacco or alcohol [4]. The revenue generated by governments and the income received by producers and suppliers is weighed against any argument against direct prohibition. However, there is a legitimate case for discontinuation of subsidies to the tobacco industry, and yet they are still widespread in many countries, including those in the European Union [5]. Measures to reduce access and market attractiveness, particularly for the young, are also widespread, with selling to minors considered illegal in many jurisdictions. Plain packaging and explicit health warnings [6], introduced in, for instance, Australia have encountered more resistance by both free market and civil liberties lobbies, and headway in curtailing supply is slow.

The biggest boost received in tobacco control has been the introduction at national, regional and institutional levels of active smoking in confined or indoor spaces because of the risks of involuntary or passive smoke exposure. The evidence for such deleterious exposure was painstakingly amassed by international health and tobacco control agencies, and today few doubt the causal relationship between such exposure and adverse outcomes at a population level, although at the individual level the absolute risk of an outcome is low; because of the widespread exposure, the WHO estimates second-hand smoke kills 600,000 people annually [7].

In 2010, our group published a Cochrane systematic review on the impact of state-level or regional-level bans on passive smoke exposure, active smoking status and health outcomes [8]. In that review we concluded that legislative smoking bans did lead to a reduction in passive smoke exposure, particularly in the workplace and for certain categories of workers, especially in the hospitality industry. There was less clear evidence of an effect on active smoking, and the strongest emerging evidence was for reductions in admissions for acute coronary syndrome. We also found that there was an increase in support for and compliance with smoking bans after the introduction of the legislation. For the purposes of the present report, we performed an updated literature search of all studies published since 2010, which will ultimately feed into an update of our systematic review.

In those 4 years there has continued to be a sizeable published literature on all aspects of tobacco control policy. Serious consideration is again being given to the outright banning of cigarettes and nicotine products [9]. The scientific literature in recent years has continued to focus on the evaluation of state-level legislative bans which strictly prohibit smoking in public places, including workplaces. Reports range from general discussions on the process and acceptability of putting bans into force [10], to studies that report more explicitly population attitudes to bans [11]. There is also a substantial body of literature which reports on the impact of bans in particular settings. Increasingly, there has been interest in other specific settings, such as acute-care and psychiatric hospitals, institutions, including prisons, and domestic settings such as homes and cars.

There is a growing body of data on the impact of bans on active smoking, which we also summarize and discuss further herein. The strongest emerging data are from studies that relate in temporal terms the impact of bans on morbidity at the hospital level, especially for respiratory conditions in adults and children, cardiovascular outcomes and maternal health indicators, including preterm delivery. This, in turn, has led to economic analyses of the burden of disease scenarios in terms of potential health gain if smoke exposure can be curbed and the converse if it cannot [12]. We discuss each of these areas in more detail.

There is a large policy literature too which looks at the other measures to control tobacco use and its economic impact [13–15], the possible banning of specialist products such as menthol cigarettes popular with initiating smokers [16] and specifically in relation to young people, what kind of efforts are effective, including in the school environment to deter uptake [17]. A topic only starting to be researched and reported on is the emergence of e-cigarettes, which might be efficacious substitutes for real cigarettes but may require regulation and arguably return the visibility of public smoking [18–20].

Bans at the Level of Country, State or Region

Ireland was the first country to put in place a comprehensive smoking ban in public places, followed by Scotland and England and many countries in Europe, including Italy, France and Spain. Many of the federal states of the USA have reported on their ban experiences. There is also considerable discussion in the literature about large countries such as Russia [21] and China [22] which have an enormous logistical challenge to meet, and countries such as India, which has a huge epidemic of cardiovascular disease, significantly attributable to smoking [12].

To assess the impact of bans on active smoking, reports at the national level mainly use prevalence surveillance data from routine sources. Anger et al. [23], for instance, used the longitudinal German Socio-Economic Panel Study and found no change in average smoking behaviour in the population, but did find that individuals who go out more frequently to

bars and restaurants were less likely to smoke and also smoked less. Buonanno and Ranzini [24] estimated from their analysis in Italy that smoking prevalence fell by 1.3 % and daily cigarette consumption by 8 %. In another Italian analysis, which summarized a number of findings from different sources, both cigarette consumption and smoking prevalence were reported as falling in relation to the introduction of the ban, as were admissions for acute myocardial infarction (AMI) [25]. In Taiwan, where a comprehensive tobacco control programme was introduced in 2009, there was a rise in the annual cessation rate [26]. In New Zealand, there was no clear evidence of an effect on adult smoking prevalence [27]. In England, Hackshaw et al. [28] used national household survey data and reported a significant, if temporary, increase in the percentage of smokers attempting to stop, equally effective across all social grades. Lewis et al. [29] looked at over-the-counter sales of nicotine-replacement therapy and again found a short-term increase in sales in the first half of the year in which the ban in England was introduced. A small-scale study in Albania showed rates of smoking rose, particularly in women and young people, but attributed this to a lack of enforcement and failure to adopt a comprehensive approach to tobacco control measures [30].

From a comprehensive simulation model, Nagelhout et al. [31] concluded that smoking prevalence and smoking-related diseases in the Netherlands could be reduced substantially through a combination of tax increases, legislation, media and advertising campaigns, comprehensive cessation treatment and youth access laws. Similarly, Basu et al. [12] created a comprehensive microsimulation model that suggested that tobacco control interventions in India could avert 25 % of myocardial infarctions and strokes over the next decade in India, substantially more than would be achieved by combined pharmacological intervention for other risk factors.

Settings-Level Interventions

There is a very large evaluation literature on the impact of control of second-hand smoke on the working environment, showing almost universally that where bans are adequately implemented, the clean air environment improves, and most authors argue for comprehensive rather than partial bans [32–34]. Many of these studies measured smoke particulates or nicotine or cotinine exposures. Relatively few reported active smoking rates, but rather reported smoke exposure effects on smokers and non-smokers to establish if they differ between these two groups of employees. The largest volume of data examines the general workplace with different situations in various countries. Many of these workplace reports do not address explicitly health outcomes, apart from minor symptoms such as upper respiratory tract exposures at work [35–37].

Of particular recent interest is the focus on specialist settings. Hospitals, for instance, play a flagship role as leaders in their community and can take a lead in promoting a smoke-free environment, but also in creating the opportunity for patients and staff to quit smoking or reduce their smoking rates. In Ireland, St Vincent's University Hospital banned smoking outright on the campus and won a gold-level award from the European Network of Smoke-Free Hospitals, and has sustained high levels of support for the ban from both staff and patients since, including an explicit exemption procedure where deemed necessary on compassionate grounds [38, 39]. Kennedy et al. [40] state that health care professionals are well placed to provide smoking cessation encouragement to their patients. Lewis et al. [41], in a group of UK hospitals, reported that a higher proportion of physicians (69 %) than nurses (52 %) favoured a complete hospital smoking ban, and this difference in attitudes according to professional category was also seen in Ireland [42]. McCaffrey et al. [43] highlight that long-stay residents of nursing homes, psychiatric hospitals and prisons have been given exemptions from the legislation on compassionate or civil liberties grounds, but both staff and inmates are passively exposed to measurable levels of smoke as a consequence. In many countries attempting to move forward bans, there is difficulty of enforcement in health care facilities as in Egypt [44] and China, where results are mixed [45, 46].

There will, and should be, increasing focus on psychiatric hospitals and facilities. The UK Royal College of Physicians and Royal College of Psychiatrists [47] recognize the right of this group of patients, who tend to have high smoking rates and consequent comorbidities, to a comprehensive smoking support service. In a setback for the tobacco control lobby, a Scottish judge recently ruled that a smoking ban in a psychiatric hospital breached a patient's human rights [48]. There are also a number of legal and health and safety concerns to be addressed [49]. In prisons, it was traditionally regarded as a challenge to ban smoking because, again, of the very high prevalence in this population, but this too may be changing. In Switzerland, where a partial smoking ban was implemented, both prisoners and staff had less passive smoke exposure in two studies [50, 51]. A total smoking ban came into effect in New Zealand in 2011 [52] and second-hand smoke exposure has been improved as a result [53]. In the USA, most correctional facilities have introduced restrictions, and in one Ohio study, despite the high smoking prevalence, prisoners knew the health risks and most desired to quit smoking [54].

There was considerable concern in many places that the banning of smoking in the workplace would lead to increased smoking in the home. This does not seem to be borne out by the evidence to date in many countries, including India [55] and the UK, where significantly more children with smoking parents lived in smoke-free homes after the ban [56]. Mons

et al. [57] reviewed data from Ireland, France, Germany and the Netherlands and found significant between-country variability, but most smokers had at least partial smoking restrictions in their homes. There is also considerable focus on banning smoking in private cars because of the clear risk of passive smoke exposure in a closed environment. However, the observational data are relatively sparse, with relatively low reported rates of active smoking in cars [58, 59] perhaps because effective self-policing is starting to occur, as in the home setting.

Initiatives with Schools and Young People

There is clear acceptance in the literature that if people do not take up smoking in their youth, they are unlikely to do so as adults [17]. Creating a supportive framework at home and at school is therefore important, and two systematic reviews have recently been published on the effectiveness of such interventions, again with mixed results, suggesting that robust, theory-driven interventions are most appropriate in a framework of strong tobacco control and the shifting of social attitudes where young people regard non-smoking as the norm. Grimshaw and Stanton [60] indicate that complex intervention for young people shows promise, and Veeranki et al. [61], reviewed data from 168 countries worldwide from the Global Youth Tobacco Survey, and suggested that a comprehensive approach as advocated by the WHO is the best strategy.

Health Outcomes

Circulatory and Respiratory Diseases

A persuasive body of evidence has accumulated over recent years showing a temporal association with the incidence of new admissions for circulatory events related to smoking bans. There have been several recent reports from the USA. Barr et al. [62] analysed AMI rates in 387 US counties that had enacted comprehensive smoking bans and found a statistically significant ban-associated decrease in admissions for AMI in the 12 months following a ban, although this was dependent on the statistical model assumptions they used. Dove et al. [63] showed that the comprehensive statewide workplace law in Massachusetts was associated with an estimated 270 fewer AMI deaths per year. Head et al. [64], in a city in Texas, found reductions in admissions for AMI and strokes in both black and white citizens, but discharge rates for respiratory conditions were reduced for white citizens only. In Arizona too, there were significant reductions in hospital admissions for circulatory and respiratory conditions [65]. Another study from the USA examined various model assumptions in relation to the New Jersey statewide smoking ban [66]. Johnson and Beal [67] reviewed electronic medical records in North Dakota and reported a 30.6 % reduction in the heart attack rate associated with the ban. By contrast, Rodu et al. [68] reported no consistent picture when comparing 44 states without bans with those which had implemented a comprehensive ban.

Using the data from the REGICOR study, Aguero et al. [69] reported from Spain that AMI incidence and mortality rates fell significantly after the introduction of the ban in 2006, in both sexes, but especially in women and in older people. Barone-Adesi et al. [70] reported across 20 Italian regions a 4 % reduction in hospital admissions for acute coronary events after the introduction of that country's ban. Two reports in the Republic of Ireland showed a significant impact on cardiovascular events. In the southwest of Ireland, Cronin et al. [71] showed an early decrease in hospital admissions for acute coronary syndrome, and Stallings-Smith et al. [72] in a time-series analysis found an immediate 13 % decrease in all-cause mortality and reductions also in the risk of ischaemic heart disease and stroke. Kent et al. [73] also reported a decrease in admissions with pulmonary illness in the Republic of Ireland after the ban. In Liverpool, in the UK, a review of hospital admissions data found a significant and sustained reduction in myocardial infarction admissions beginning within a year of the ban [74].

Christensen et al. [75], in Denmark, also found a significant reduction in the number of AMI admissions, having taken account of a number of possible confounding factors. In Graubunden in Switzerland, the incidence of AMI remained significantly lower after the ban, compared with that in a region without such legislation [76]. Another Swiss review [77] estimated from a meta-analysis that environmental tobacco smoke exposure in public places causes 32,000 preventable hospital days. In the Netherlands, there was a small but significant 6.8 % reduction in the number of sudden circulatory arrest cases after the workplace smoking ban had been in place for 1 year [78]. Gaudreau et al. [79] reported a reduction in AMI incidence immediately after the ban in Prince Edward Island in Canada, but no change in the incidence of respiratory conditions.

The association is therefore reasonably consistent, although the mechanism of benefit is as yet unclear; that is, is the sustained reduction in tobacco smoke exposure the direct cause of this improvement, or is it mediated by a consequent reduction in active smoking? Studies which provide data on active smoking status and the degree of severity of the presenting condition help us to understand the directly causal pathway. Pell et al. [80] reported early after the ban was introduced in Scotland that there had been a 17 % reduction in acute coronary syndrome admissions in Scotland after the

ban compared with a 4 % fall in England, which had not by then introduced a ban. However, there was an association according to smoking status, from a 14 % reduction in smokers, to 19 % in ex-smokers and 21 % in non-smokers, and 67 % of the decrease involved non-smokers, suggesting a gain attributable to the improved smoke-free environment. This group also reported a reduction in the rates of childhood asthma admissions in both preschool and school-age children [81]. Schmucker et al. [82] used the cardiac registry in Bremen in northwest Germany, which serves the entire catchment area, and found an overall 16 % reduction in the incidence of the more serious ST-elevated myocardial infarctions (STEMI); there was no change for smokers, but in non-smokers there was a significant fall, consistently observed in all age groups and in both sexes.

Maternal Health and Preterm Delivery

Reduction of active maternal smoking is important as it is overwhelmingly known to be causally related to birth outcomes. By extension, passive smoke exposure is also potentially damaging to fetal growth and development. Adams et al. [83] performed an economic analysis which indicated that a $1 increase in taxes and prices would increase third-trimester quit rates by 45 %, and advocated that states should use multiple tobacco control policies to reduce active maternal smoking. Been et al. [84] reviewed the evidence in relation to second-hand smoke exposure of particular benefit to children now emerging, including low-birth-weight deliveries, preterm birth and asthma exacerbations. Cox et al. [85] reviewed all singleton live births in Flanders in Belgium. They found no trend in pre-term deliveries in advance of the ban but a stepwise decrease in such deliveries, first after the initial smoking ban in restaurants, and a further decrease after this ban was also extended to bars. These patterns were again across the social gradient and were not explained by adjustment for either personal or environmental factors. Kabir et al. [86] also reported a significant reduction in the rate of small-for-gestational-age births both immediately and sustained over the postban period. Nguyen et al. [87] compared women living in municipalities with local indoor clean air ordinances in Massachusetts and found that such women were less likely to smoke during pregnancy. In Colorado, two cities were compared, Pueblo and El Paso, the former having a citywide smoking ban. The odds of both maternal smoking and preterm births were significantly lower, although there was no impact on birth weight [88].

Conclusion

There is mounting literature suggesting the effectiveness of smoking bans in reducing morbidity associated with passive smoke exposure, and this is becoming widely established now in workplaces and settings such as prisons, hospitals and health-care settings and in private homes and cars. Bans as part of a multicomponent strategy for tobacco control could make a substantial impact on smoking globally, with enormous potential for health gain if successfully implemented. Economic evaluations often have to work with limited data, particularly in developing-country settings. Our best estimate is that many lives would be saved if the concerted global strategy is delivered.

Conflict of Interest Cecily C. Kelleher declares that she has no conflict of interest.

Kate Frazer received a grant from a Health Research Board Cochrane Fellowship during the conduct of the study.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

1. Ng M, Freeman MK, Fleming TD, Robinson M, Dwyer-Lindgren L, Thomson B, et al. Smoking prevalence and cigarette consumption in 187 countries, 1980-2012. JAMA. 2014;311(2):183–92.
2. World Health Organization. Framework convention on tobacco control. Geneva: World Health Organization; 2003.
3. Levy DT, Ellis JA, Mays D, Huang A-T. Smoking-related deaths averted due to three years of policy progress. Bull World Health Organ. 2013;91:509–18.
4. van Amsterdam J, Pennings E, Brunt T, van den Brink W. Physical harm due to chronic substance use. Regul Toxicol Pharmacol. 2013;66(1):83–7.
5. Illman J. European commission publishes cancer code, continues providing subsidies to tobacco farmers. J Natl Cancer Inst. 2003;95(16):1187–8.
6. Freeman B, Chapman S, Rimmer M. The case for the plain packaging of tobacco products. Addiction. 2008;103(4):580–90.
7. Öberg M, Jaakkola MS, Prüss-Üstün A, Schweizer C, Woodward A. Second-hand smoke: Assessing the environmental burden of disease at national and local levels. WHO environmental burden of disease series no 18. Geneva: World Health Organization; 2010.
8. Callinan JE, Clarke A, Doherty K, Kelleher C. Legislative smoking bans for reducing secondhand smoke exposure, smoking prevalence and tobacco consumption. Cochrane Database Syst Rev. 2010;4: CD005992.
9. Proctor RN. Why ban the sale of cigarettes? The case for abolition. Tob Control. 2013;22 Suppl 1:i27–30.
10. Lunze K, Migliorini L. Tobacco control in the Russian Federation- a policy analysis. BMC Public Health. 2013;13:64.
11. Gallus S, Rosato V, Zuccaro P, Pacifici R, Colombo P, Manzari M, et al. Attitudes towards the extension of smoking restrictions to selected outdoor areas in Italy. Tob Control. 2012;21(1):59–62.
12. Basu S, Glantz S, Bitton A, Millett C. The effect of tobacco control measures during a period of rising cardiovascular disease risk in India: a mathematical model of myocardial infarction and stroke. PLoS Med. 2013;10(7):e1001480.
13. Cornelsen L, Normand C. Impact of the smoking ban on the volume of bar sales in Ireland: evidence from time series analysis. Health Econ. 2012;21(5):551–61.

14. Dobson A, Amato K, Rivard C, Lipsher J, Hyland A. Five years after Hawaii smoke free law: tourism and hospitality economic indicators appear unharmed. Hawaii J Med Public Health. 2013;72(10):355–61.
15. Bala MM, Strzeszynski L, Topor-Madry R, Cahill K. Mass media interventions for smoking cessation in adults. Cochrane Database Syst Rev. 2013;6:CD004704.
16. Giovino GA, Villanti AC, Mowery PD, Sevilimedu V, Niaura RS, Vallone DM, et al. Differential trends in cigarette smoking in the USA: is menthol slowing progress? Tob Control. 2013. doi:10.1136/tobaccocontrol-2013-051159.
17. Johnston V, Liberato S, Thomas D. Incentives for preventing smoking in children and adolescents. Cochrane Database Syst Rev. 2012;10:CD008645.
18. Bullen C, Howe C, Laugesen M, McRobbie H, Parag V, Williman J, et al. Electronic cigarettes for smoking cessation: a randomised controlled trial. Lancet. 2013;382(9905):1629–37.
19. Bell K, Keane H. Nicotine control: E-cigarettes, smoking and addiction. Int J Drug Policy. 2012;23(3):242–7.
20. Hajek P, Foulds J, Le Houezec J, Sweanor D, Yach D. Should e-cigarettes be regulated as a medicinal device? Lancet Respir Med. 2013;1(6):429–31.
21. Holmes D. Smoking in Russia: will old habits die hard? Lancet. 2011;378(9795):973–4.
22. Au WW, Su D, Yuan J. Cigarette smoking in China: public health, science, and policy. Rev Environ Health. 2012;27(1):43–9.
23. Anger S, Kvasnicka M, Siedler T. One last puff? Public smoking bans and smoking behavior. J Health Econ. 2011;30(3):591–601.
24. Buonanno P, Ranzani M. Thank you for not smoking: evidence from the Italian smoking ban. Health Policy. 2013;109(2):192–9.
25. Gorini G. Impact of the Italian smoking ban and comparison with the evaluation of the Scottish ban (Valutazione di impatto della Legge Sirchia e confronto con La Scozia). Epidemiol Prev. 2011;35(3-4 Suppl 1):4–18.
26. Chang FC, Sung HY, Zhu SH, Chiou ST. Impact of the 2009 Taiwan Tobacco Hazards Prevention Act on smoking cessation. Addiction. 2014;109(1):140–6.
27. Edwards R, Gifford H, Waa A, Glover M, Thomson G, Wilson N. Beneficial impacts of a national smokefree environments law on an indigenous population: a multifaceted evaluation. Int J Equity Health. 2009;8:12.
28. Hackshaw L, McEwen A, West R, Bauld L. Quit attempts in response to smoke-free legislation in England. Tob Control. 2010;19(2):160–4.
29. Lewis SA, Haw SJ, McNeill A. The impact of the 2006 Scottish smoke-free legislation on sales of nicotine replacement therapy. Nicotine Tob Res. 2008;10(12):1789–92.
30. Zaloshnja E, Ross H, Levy DT. The impact of tobacco control policies in Albania. Tob Control. 2010;19(6):463–8.
31. Nagelhout GE, Levy DT, Blackman K, Currie L, Clancy L, Willemsen MC. The effect of tobacco control policies on smoking prevalence and smoking-attributable deaths. Findings from the Netherlands SimSmoke Tobacco Control Policy Simularion Model. Addiction. 2012:107(2):407–16.
32. Apsley A, Semple S. Secondhand smoke levels in Scottish bars 5 years on from the introduction of smoke-free legislation. Tob Control. 2012;21(5):511–3.
33. Bohac DL, Hewett MJ, Kapphahn KI, Grimsrud DT, Apte MG, Gundel LA. Change in indoor particle levels after a smoking ban in Minnesota bars and restaurants. Am J Prev Med. 2010;39(6 Suppl 1):S3–9.
34. Reijula J, Johnsson T, Kaleva S, Tuomi T, Reijula K. Total prohibition of smoking but not partial restriction effectively reduced exposure to tobacco smoke among restaurant workers in Finland. Int J Occup Med Environ Health. 2013;26(5):682–92.
35. Durham AD, Bergier S, Morisod X, Locatelli I, Zellweger JP, Huynh CK, et al. Improved health of hospitality workers after a Swiss cantonal smoking ban. Swiss Med Wkly. 2011;141:w13317.
36. Lai HK, Hedley AJ, Repace J, So C, Lu QY, McGhee SM, et al. Lung function and exposure to workplace second-hand smoke during exemptions from smoking ban legislation: an exposure-response relationship based on indoor PM2.5 and urinary cotinine levels. Thorax. 2011;66(7):615–23.
37. Madureira J, Mendes A, Almeida S, Teixeira JP. Positive impact of the Portuguese smoking law on respiratory health of restaurant workers. J Toxicol Environ Health, Part A. 2012;75(13–15):776–87.
38. Fitzpatrick P, Gilroy I, Doherty K, Conlon G, Daly L, Kelleher C. Exempting patients from a smoke-free hospital policy on compassionate grounds. BMJ. 2014;348:g389.
39. Fitzpatrick P, Gilroy I, Doherty K, Corradino D, Daly L, Clarke A, et al. Implementation of a campus-wide Irish hospital smoking ban in 2009: prevalence and attitudinal trends among staff and patients in lead up. Health Promot Int. 2009;24(3):211–22.
40. Kennedy RD, Behm I, Craig L, Thompson ME, Fong GT, Guignard R, et al. Smoking cessation interventions from health care providers before and after the national smoke-free law in France. Eur J Public health. 2012;22 Suppl 1:23–8.
41. Lewis KE, Shin D, Davies G. Smoking habits and attitudes toward tobacco bans among United Kingdom hospital staff and students. Int J Tuberc Lung Dis. 2011;15(8):1122–6.
42. Fitzpatrick P, Gilroy I, Doherty K, Clarke A, Comerford D, Daly L, et al. Smoke free campus: strong positive shift in attitudes post implementation but paradox in nursing and medical attitudes. Clin Health Promot. 2012;2(1):12–8.
43. McCaffrey M, Goodman P, Gavigan A, Kenny C, Hogg C, Byrne L, et al. Should any workplace be exempt from smoke-free law: the Irish experience. J Environ Public Health. 2012;2012:545483.
44. Radwan GN, Loffredo CA, Aziz R, Abdel-Aziz N, Labib N. Implementation, barriers and challenges of smoke-free policies in hospitals in Egypt. BMC Res Notes. 2012;5:568.
45. Stillman FA, Kaufman MR, Zhen A, Yang J, Wang JS, Zhao N. Smoke free or not: a pilot evaluation in selected Beijing hospitals. BMC Public Health. 2013;13:964.
46. Xiao D, Wang C, Chen H, Hajek P. Making hospitals in China smoke free: a prospective study of implementing the new standard. Nicotine Tob Res. 2013;15(12):2076–80.
47. Royal College of Physicians and Royal College of Psychiatrists. Smoking and mental health. A joint report by the Royal College of Physicians and Royal College of Psychiatrists. London: Royal College of Physicians; 2013.
48. Dyer C. Scottish judge rules smoking ban in psychiatric hospital breached patient's human rights. BMJ. 2013;347:f5343.
49. Lawn S. Cigarette smoking in psychiatric settings: occupational health, safety, welfare and legal concerns. Aust N Z J Psychiatry. 2005;39(10):886–91.
50. Etter JF, Ritter C, Christie DH, Kunz M, Rieder JP, Humair JP, et al. Implementation and impact of anti-smoking interventions in three prisons in the absence of appropriate legislation. Prev Med. 2012;55(5):475–81.
51. Ritter C, Huynh CK, Etter JF, Elger BS. Exposure to tobacco smoke before and after a partial smoking ban in prison: indoor air quality measures. Tob Control. 2012;21(5):488–91.
52. Gautam J, Glover M, Scott A, Welch D. Smokefree prisons in New Zealand: maximising the health gain. N Z Med J. 2011;124(1338):100–6.
53. Thornley S, Dirks KN, Edwards R, Woodward A, Marshall R. Indoor air pollution levels were halved as a result of a national tobacco ban in a New Zealand prison. Nicotine Tob Res. 2013;15(2):343–7.
54. Kauffman RM, Ferketich AK, Murray DM, Bellair PE, Wewers ME. Tobacco use by male prisoners under an indoor smoking ban. Nicotine Tob Res. 2011;13(6):449–56.
55. Bhaumik S. Ban on smoking in workplaces in India has led to more smoke free homes. BMJ. 2013;346:f2186.

56. Jarvis MJ, Sims M, Gilmore A, Mindell J. Impact of smoke-free legislation on children's exposure to secondhand smoke: cotinine data from the Health Survey for England. Tob Control. 2012;21(1):18–23.
57. Mons U, Nagelhout GE, Allwright S, Guignard R, van den Putte B, Willemsen MC, et al. Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe surveys. Tob Control. 2013;22(e1): e2–9.
58. Gilroy I, Donnelly N, Matthews W, Doherty K, Conlon G, Clarke AT, et al. Smoking in vehicles is lower than mobile telephone use while driving, but is socially patterned. Ir Med J. 2013;106(4):118–20.
59. Glover M, Maifeleni T, Yeh CJ, Lee A, Gentles D. No need to ban smoking in cars with children present—it's almost snuffed out. N Z Med J. 2012;125(1358):84–8.
60. Grimshaw GM, Stanton A. Tobacco cessation interventions for young people. Cochrane Database Syst Rev. 2006;4:CD003289.
61. Veeranki SP, Mamudu HM, Anderson JL, Zheng S. Worldwide never-smoking youth susceptibility to smoking. J Adolesc Health. 2014;54(2):144–50.
62. Barr CD, Diez DM, Wang Y, Dominici F, Samet JM. Comprehensive smoking bans and acute myocardial infarction among Medicare enrollees in 387 US counties: 1999-2008. Am J Epidemiol. 2012;176(7):642–8.
63. Dove MS, Dockery DW, Mittleman MA, Schwartz J, Sullivan EM, Keithly L, et al. The impact of Massachusetts' smoke-free workplace laws on acute myocardial infarction deaths. Am J Public Health. 2010;100(11):2206–12.
64. Head P, Jackson BE, Bae S, Cherry D. Hospital discharge rates before and after implementation of a city-wide smoking ban in a Texas city, 2004-2008. Prev Chronic Dis. 2012;9:E179.
65. Herman PM, Walsh ME. Hospital admissions for acute myocardial infarction, angina, stroke, and asthma after implementation of Arizona's comprehensive statewide smoking ban. Am J Public Health. 2011;101(3):491–6.
66. Huesch MD, Ostbye T, Ong MK. Measuring the effect of policy interventions at the population level: some methodological concerns. Health Econ. 2012;21(10):1234–49.
67. Johnson EL, Beal JR. Impact of a comprehensive smoke-free law following a partial smoke-free law on incidence of heart attacks at a rural community hospital. Nicotine Tob Res. 2013;15(3):745–7.
68. Rodu B, Peiper N, Cole P. Acute myocardial infarction mortality before and after state-wide smoking bans. J Community Health. 2012;37(2):468–72.
69. Aguero F, Degano IR, Subirana I, Grau M, Zamora A, Sala J, et al. Impact of a partial smoke-free legislation on myocardial infarction incidence, mortality and case-fatality in a population-based registry: the REGICOR study. PLoS One. 2013;8(1):e53722.
70. Barone-Adesi F, Gasparrini A, Vizzini L, Merletti F, Richiardi L. Effects of Italian smoking regulation on rates of hospital admission for acute coronary events: a country-wide study. PLoS One. 2011;6(3):e17419.
71. Cronin EM, Kearney PM, Kearney PP, Sullivan P, Perry IJ. Impact of a national smoking ban on hospital admission for acute coronary syndromes: a longitudinal study. Clin Cardiol. 2012;35(4):205–9.
72. Stallings-Smith S, Zeka A, Goodman P, Kabir Z, Clancy L. Reductions in cardiovascular, cerebrovascular, and respiratory mortality following the national Irish smoking ban: interrupted time-series analysis. PLoS One. 2013;8(4):e62063.
73. Kent BD, Sulaiman I, Nicholson TT, Lane SJ, Moloney ED. Acute pulmonary admissions following implementation of a national workplace smoking ban. Chest. 2012;142(3):673–9.
74. Liu A, Guzman Castillo M, Capewell S, Lucy J, O'Flaherty M. Reduction in myocardial infarction admissions in Liverpool after the smoking ban: potential socioeconomic implications for policymaking. BMJ Open. 2013;3(11):e003307.
75. Christensen TM, Møller L, Jørgensen T, Pisinger C. The impact of the Danish smoking ban on hospital admissions for acute myocardial infarction. Eur J Prev Cardiol. 2014;2(1):65–73.
76. Bonetti PO, Trachsel LD, Kuhn MU, Schulzki T, Erne P, Radovanovic D, et al. Incidence of acute myocardial infarction after implementation of a public smoking ban in Graubunden Switzerland: two year follow-up. Swiss Med Wkly. 2011;141: w13206.
77. Hauri DD, Lieb CM, Rajkumar S, Kooijman C, Sommer HL, Roosli M. Direct health costs of environmental tobacco smoke exposure and indirect health benefits due to smoking ban introduction. Eur J Public health. 2011;21(3):316–22.
78. de Korte-de BD, Kotz D, Viechtbauer W, van Haren E, Grommen D, de Munter M, et al. Effect of smoke-free legislation on the incidence of sudden circulatory arrest in the Netherlands. Heart. 2012;98:995–9.
79. Gaudreau K, Sanford CJ, Cheverie C, McClure C. The effect of a smoking ban on hospitalization rates for cardiovascular and respiratory conditions in Prince Edward Island Canada. PLoS One. 2013;8(3):e56102.
80. Pell JP, Haw S, Cobbe S, Newby DE, Pell AC, Fischbacher C, et al. Smoke-free legislation and hospitalizations for acute coronary syndrome. N Engl J Med. 2008;359(5):482–91.
81. Mackay D, Haw S, Ayres JG, Fischbacher C, Pell JP. Smoke-free legislation and hospitalizations for childhood asthma. N Engl J Med. 2010;363(12):1139–45.
82. Schmucker J, Wienbergen H, Fach A, Seide S, Fiehn E, Gunther K, et al. Smoking ban in public areas is associated with reduced incidence of hospital admissions due to ST-elevation myocardial infarctions in non-smokers-results from the Bremen STEMI Registry. Circulation. 2013. doi:10.1177/2047487313483610.
83. Adams J, Giles EL, Robalino S, McColl E, Sniehotta FF. A systematic review of the use of financial incentives and penalties to encourage uptake of healthy behaviors: protocol. Syst Rev. 2012;1:51.
84. Been JV, Nurmatov U, van Schayck CP, Sheikh A. The impact of smoke-free legislation on fetal, infant and child health: a systematic review and meta-analysis protocol. BMJ Open. 2013;3:e002261.
85. Cox B, Martens E, Nemery B, Vangronsveld J, Nawrot TS. Impact of a stepwise introduction of smoke-free legislation on the rate of preterm births: analysis of routinely collected birth data. BMJ. 2013;346:f441.
86. Kabir Z, Daly S, Clarke V, Keogan S, Clancy L. Smoking ban and small-for-gestational age births in Ireland. PLoS One. 2013;8(3): e57441.
87. Nguyen KH, Wright RJ, Sorensen G, Subramanian SV. Association between local indoor smoking ordinances in Massachusetts and cigarette smoking during pregnancy: a multilevel analysis. Tob Control. 2013;22(3):184–9.
88. Page RL, Slejko JF, Libby AM. A citywide smoking ban reduced maternal smoking and risk for preterm births: a Colorado natural experiment. J Womens Health. 2012;21(6):621–7.