SPECIAL ARTICLE

Smoke-free Legislation and Hospitalizations for Acute Coronary Syndrome

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ABSTRACT

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BACKGROUND

Previous studies have suggested a reduction in the total number of hospital admissions for acute coronary syndrome after the enactment of legislation banning smoking in public places. However, it is unknown whether the reduction in admissions involved nonsmokers, smokers, or both.

METHODS

Since the end of March 2006, smoking has been prohibited by law in all enclosed public places throughout Scotland. We collected information prospectively on smoking status and exposure to secondhand smoke based on questionnaires and biochemical findings from all patients admitted with acute coronary syndrome to nine Scottish hospitals during the 10-month period preceding the passage of the legislation and during the same period the next year. These hospitals accounted for 64% of admissions for acute coronary syndrome in Scotland, which has a population of 5.1 million.

RESULTS

Overall, the number of admissions for acute coronary syndrome decreased from 3235 to 2684 — a 17% reduction (95% confidence interval, 16 to 18) — as compared with a 4% reduction in England (which has no such legislation) during the same period and a mean annual decrease of 3% (maximum decrease, 9%) in Scotland during the decade preceding the study. The reduction in the number of admissions was not due to an increase in the number of deaths of patients with acute coronary syndrome who were not admitted to the hospital; this latter number decreased by 6%. There was a 14% reduction in the number of admissions for acute coronary syndrome among smokers, a 19% reduction among former smokers, and a 21% reduction among persons who had never smoked. Persons who had never smoked reported a decrease in the weekly duration of exposure to secondhand smoke (P<0.001 by the chi-square test for trend) that was confirmed by a decrease in their geometric mean concentration of serum cotinine from 0.68 to 0.56 ng per milliliter (P<0.001 by the t-test).

CONCLUSIONS

The number of admissions for acute coronary syndrome decreased after the implementation of smoke-free legislation. A total of 67% of the decrease involved nonsmokers. However, fewer admissions among smokers also contributed to the overall reduction.

THE SMOKING, HEALTH AND SOCIAL CARE Act, which was passed in 2005, prohibited smoking in all enclosed public places and workplaces in Scotland after the end of March 2006. Smoke-free legislation aims to protect non-smokers from secondhand smoke, but it may also reduce the risk among smokers because of reduced smoking or increased smoking cessation.[1-4] Eight studies have shown reduced numbers of hospital admissions for acute coronary syndrome after the enactment of such legislation.[5-12] These studies were limited by retrospective data collection,[5-12] the use of clinical diagnostic labels,[5-12] confounding by seasonal variations,[7] and small numbers of patients.[5,8,12] Only one study, involving 22 patients, included information on smoking status,[12] and none included information on exposure to secondhand smoke. Therefore, the investigators were unable to show the extent to which the overall reduction in hospital admissions was due to protection from secondhand smoke. Our aim was to prospectively compare the number of admissions for acute coronary syndrome before and after implementation of national legislation, overall and according to smoking status.

METHODS

SETTING

Scotland has a population of 5.1 million. We collected data prospectively on all patients with acute coronary syndrome admitted to nine hospitals during the 10 months before implementation of the legislation (June 2005 through March 2006) and during the same 10 months thereafter (June 2006 through March 2007). The hospital catchment areas did not change; these areas accounted for 63% of admissions for acute coronary syndrome in Scotland before the legislation and 64% of these admissions after the legislation.[13] We compared two periods involving the same months of the year to rule out seasonal effects, and we examined the change in hospital admissions by month to ensure that the change was not due to an atypically hot or cold month.

CASE ASCERTAINMENT

The West Glasgow Research Ethics Committee approved the study, including access to case notes and specimens obtained from patients who died before recruitment. Acute coronary syndrome was defined as a detectable level of cardiac troponin

after an emergency admission for chest pain. During the study periods, the troponin level was measured routinely in all patients admitted with chest pain. Therefore, our case definition could be applied consistently across all hospitals and patients, irrespective of day or time of admission or the unit to which the patient was admitted. To ensure complete case ascertainment, the hospital laboratories produced daily lists of troponin assays in patients who underwent those tests. Research nurses who were dedicated to the study identified all eligible patients and conducted structured interviews. Written, informed consent was obtained from all patients.

SMOKING STATUS AND EXPOSURE TO SECONDHAND SMOKE

The level of cotinine was measured in residual serum from clinical samples obtained on admission. All samples were centrifuged and stored locally at –20°C and then transported on dry ice to a central laboratory (ABS Laboratory, London), where cotinine was assayed with the use of gas chromatography with a specific nitrogen phosphorus detector.[14] Cotinine and the internal standard 5-methyl cotinine were extracted with the use of dichloroethane from 100-μl samples after alkalization with the use of sodium hydroxide. The lower limit of detection was 0.1 ng per milliliter. Cotinine assays were used to validate self-reported smoking status and provide an objective measurement of exposure to secondhand smoke. Current smokers were defined as persons who classified themselves as being smokers and persons with a serum cotinine level of more than 12 ng per milliliter. Persons who had never smoked were defined as persons who classified themselves as never having smoked and persons with a cotinine level of 12 ng per milliliter or less. Former smokers were defined as persons who classified themselves as being former smokers and persons with cotinine levels of 12 ng per milliliter or less. Nonsmokers comprised former smokers and persons who had never smoked.

HISTORICAL AND GEOGRAPHIC COMPARISONS

To account for unrelated lifestyle or treatment changes, we studied the historical trend in Scotland and contemporaneous data from England, which is similar with regard to demographic profile, lifestyle, climate, and free health care. The Scottish Morbidity Record 01 routinely collects in-

formation on all hospital admissions, including the date and type of admission and disease codes.[15] We used these data to determine trends in admissions for acute coronary syndrome (*International Classification of Diseases, 10th revision* [ICD-10], code I21) in the preceding 10 years. Hospital Episode Statistics collects similar information in England, where legislation banning smoking in public places was not implemented until July 2007.[16] We used admissions for acute coronary syndrome (ICD-10 code I21) in England during the periods June 2005 through March 2006 and June 2006 through March 2007 as a geographic control. The General Registrar's Office for Scotland collates all death-certificate data, including date, place, and cause of death.[17] We used these data to determine whether changes in the number of admissions could be explained by changes in the number of patients who died without being hospitalized.

STATISTICAL ANALYSIS

We analyzed the percentage reduction in the number of admissions, overall and according to smoking status, and we performed subgroup analyses according to the patients' sex and age group. We analyzed two groups of admissions: the first group included men 55 years of age or younger and women 65 years of age or younger, and the second group included older patients. Since the denominators for these reductions in admissions were random quantities, confidence intervals were derived from confidence intervals for the percentage of admissions during the two periods that occurred after enactment of the legislation. Assuming that the numbers of events before (N_{pre}) and after (N_{post}) legislation are Poisson random variables, the result of the equation N_{post} divided by the sum of N_{post} and N_{pre} will follow a binomial distribution. Transformation to an odds scale results in a confidence interval for N_{post} divided by N_{pre}, from which a confidence interval for the percentage reduction can be derived.

In the absence of catchment-population denominators for subgroups of patients categorized according to smoking status, we were unable to determine a change in incidence. However, any population change would comprise a reduction in the number of smokers and an increase in the number of former smokers. Therefore, among former smokers, a reduction in the number of admissions will underestimate a reduction in incidence. Smoke-free legislation may reduce the prevalence of smoking in a population or the number of cigarettes smoked, but it will not alter the relative risk associated with smoking a given number of cigarettes. Among smokers, a decrease in prevalence would reduce the number of admissions but have no effect on incidence, and therefore, a change in the number of admissions is more meaningful than population-based incidence. The prevalence of smoking in a population of persons who had never smoked is unlikely to change in 1 year among patients in the age group at risk for acute coronary syndrome, since smoking usually commences at a much earlier age. Therefore, among persons who had never smoked, the percentage reduction in the numbers of cases of acute coronary syndrome will equate to the percentage reduction in the incidence of acute coronary syndrome.

Binary and ordinal data were compared with the use of chi-square tests and tests for trend, respectively. We applied two-sample t-tests to logarithmically transformed data on cotinine levels. Analyses were performed with the use of SPSS software for Windows, version 13.0 (SPSS).

RESULTS

ADMISSIONS FOR ACUTE CORONARY SYNDROME

Before enactment of the legislation banning smoking from public places, 3235 patients were admitted to the hospital for acute coronary syndrome. After enactment of the legislation, this number decreased by 17% (95% confidence interval [CI], 16 to 18), to 2684. The number of monthly admissions during the whole period decreased; this decrease became more pronounced over time after the implementation of the legislation (P=0.02 by the chi-square test for trend) (Fig. 1). In England, the number of admissions for acute coronary syndrome decreased by 4% during a similar period. In Scotland, the trend during the 10 years before legislation was a 3% mean annual reduction (95% CI, 3 to 4), with a maximum reduction of 9% in 2000; this reduction could not be attributed to the number of patients who were not hospitalized and who died from acute coronary syndrome. The number of patients who were not hospitalized and who died from acute coronary syndrome decreased by 6%, from 2202 patients during the period 2005 through 2006 to 2080 patients during the period 2006 through 2007.

Of the 3235 patients with acute coronary syn-

Figure 1. Admissions for Acute Coronary Syndrome According to Month before and after Smoke-free Legislation.
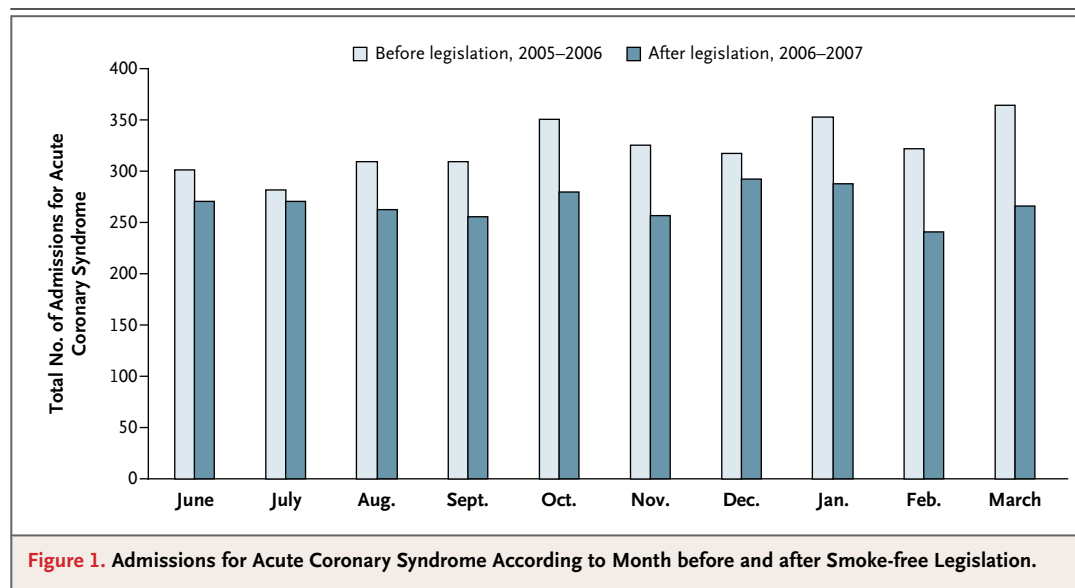
drome admitted to the hospital before enactment of the legislation, 2806 (87%) provided written informed consent to participate in the study, 252 (8%) were unable to provide written informed consent, and 177 (5%) declined to participate. Of the 2684 patients with acute coronary syndrome admitted to the hospital after enactment of the legislation, 2322 (87%) consented, 207 (8%) were unable to consent, and 155 (6%) declined. Therefore, the same percentage of patients provided information during both periods (P=0.80 by the chi-square test). Among smokers, the number of admissions decreased by 14% (95% CI, 12 to 16), from 1176 to 1016. The number of admissions among former smokers decreased from 953 to 769 (19%; 95% CI, 17 to 21), and the number of admissions among persons who had never smoked decreased from 677 to 537 (21%; 95% CI, 18 to 24) (Table 1). Therefore, 67% of the admissions prevented after the enactment of legislation involved nonsmokers.

Among current smokers, the reduction was greater among women (19%; 95% CI, 15 to 23) than among men (11%; 95% CI, 9 to 13) (Table 1). Similarly, there was a greater decrease among women who were nonsmokers (23%; 95% CI, 20 to 26) than among men who were nonsmokers (18%; 95% CI, 16 to 20). Among current smokers, the decrease was lower among men 55 years of age or younger and women 65 years of age or younger (9%; 95% CI, 6 to 12) than among older patients (18%; 95% CI, 15 to 21) (Table 1). The same was

true for nonsmokers (8% [95% CI, 4 to 12], vs. 22% [95% CI, 20 to 24]).

EXPOSURE TO SECONDHAND SMOKE

Among nonsmokers, 1614 (99%) provided information on their exposure to secondhand smoke before enactment of the legislation, and 1285 (98%) provided information about exposure after enactment. The correlation between cotinine and the self-reported duration of exposure to secondhand smoke was similar before (r=0.33, P<0.001) and after (r=0.33, P<0.001) enactment of the legislation. The percentage of persons who had never smoked who reported no exposure to secondhand smoke increased from 57% to 78% (P<0.001) (Table 2), largely because of reduced exposure to smoke in pubs, bars, and clubs. The percentage of persons who reported no exposure to smoke in these locations increased from 77% to 96% (P<0.001) (Table 2). Self-reported reductions in exposure to smoke were confirmed by a reduction in the geometric mean level of serum cotinine from 0.68 to 0.56 ng per milliliter (P<0.001). Former smokers also reported reduced exposure to smoke (Table 2). The geometric mean level of cotinine in these persons decreased from 0.71 to 0.57 ng per milliliter (P<0.001). Before the legislation was enacted, men who were nonsmokers had the same geometric mean level of cotinine as women (i.e., 0.66 ng per milliliter). After the legislation was enacted, this level decreased by 38%,

Table 1. Number of Admissions for Acute Coronary Syndrome (ACS) According to Age, Sex, and Smoking Status before and after Enactment of Smoke-free Legislation.*

Variable	ACS in Men ≤55 Yr and Women ≤65 Yr			ACS in Men >55 Yr and Women >65 Yr			All Patients with ACS		
	Before Legislation	After Legislation	Relative Risk Reduction (95% CI)†	Before Legislation	After Legislation	Relative Risk Reduction (95% CI)	Before Legislation	After Legislation	Relative Risk Reduction (95% CI)
	no. of patients		*%*	*no. of patients*		*%*	*no. of patients*		*%*
Men									
Current smokers	331	315	5 (3 to 7)	470	396	16 (13 to 19)	801	711	11 (9 to 13)
Nonsmokers	102	104	−2 (−5 to 1)	885	705	20 (17 to 23)	987	809	18 (16 to 20)
Former smokers	48	45	6 (−1 to 13)	605	473	22 (19 to 25)	653	518	21 (18 to 24)
Persons who never smoked	54	59	−9 (−1 to 17)	280	232	17 (13 to 21)	334	291	13 (9 to 17)
Women									
Current smokers	203	172	15 (10 to 20)	172	133	23 (17 to 29)	375	305	19 (15 to 23)
Nonsmokers	97	80	18 (10 to 26)	546	417	24 (20 to 28)	643	497	23 (20 to 26)
Former smokers	46	42	9 (0 to 18)	254	209	18 (13 to 23)	300	251	16 (12 to 20)
Persons who never smoked	51	38	25 (11 to 39)	292	208	29 (24 to 34)	343	246	28 (23 to 33)
Both men and women									
Current smokers	534	487	9 (6 to 12)	642	529	18 (15 to 21)	1176	1016	14 (12 to 16)
Nonsmokers	199	184	8 (4 to 12)	1431	1122	22 (20 to 24)	1630	1306	20 (18 to 22)
Former smokers	94	87	7 (2 to 12)	859	682	21 (18 to 24)	953	769	19 (17 to 21)
Persons who never smoked	105	97	8 (3 to 13)	572	440	23 (20 to 26)	677	537	21 (18 to 24)

* CI denotes confidence interval.
† Negative numbers indicate an increase in risk.

Table 2. Self-Reported Hours of Exposure to Secondhand Smoke per Week According to Location among Former Smokers and Persons Who Never Smoked.

Location and No. of Hours	Former Smokers			Persons Who Never Smoked		
	Before Legislation (N=937)	After Legislation (N=748)	P Value*	Before Legislation (N=677)	After Legislation (N=537)	P Value*
	no. (%)			no. (%)		
Own home						
0 hr	778 (83)	635 (85)	0.39	565 (83)	460 (86)	0.64
1–5 hr	71 (8)	48 (6)		41 (6)	18 (3)	
≥6 hr	88 (9)	65 (9)		71 (10)	59 (11)	
Other people's homes						
0 hr	860 (92)	698 (93)	0.42	617 (91)	495 (92)	0.34
1–5 hr	64 (7)	38 (5)		34 (5)	28 (5)	
≥6 hr	13 (1)	12 (2)		26 (4)	14 (3)	
Work						
0 hr	902 (96)	740 (99)	<0.001	640 (95)	519 (97)	0.04
1–5 hr	21 (2)	6 (1)		15 (2)	5 (1)	
≥6 hr	14 (1)	2 (0)		22 (3)	10 (2)	
Pubs, bars, or clubs						
0 hr	709 (76)	737 (99)	<0.001	522 (77)	515 (96)	<0.001
1–5 hr	174 (19)	4 (1)		107 (16)	8 (1)	
≥6 hr	54 (6)	7 (1)		48 (7)	14 (3)	
Cars, buses, or trains						
0 hr	918 (98)	733 (98)	0.74	644 (95)	519 (97)	0.33
1–5 hr	14 (1)	13 (2)		32 (5)	18 (3)	
≥6 hr	5 (1)	2 (0)		1 (0)	0 (0)	
Other public places						
0 hr	826 (88)	733 (98)	<0.001	579 (86)	518 (96)	<0.001
1–5 hr	91 (10)	15 (2)		66 (10)	8 (1)	
≥6 hr	20 (2)	0 (0)		32 (5)	11 (2)	
All locations						
0 hr	489 (52)	589 (79)	<0.001	385 (57)	418 (78)	<0.001
1–5 hr	231 (25)	89 (12)		177 (26)	49 (9)	
≥6 hr	217 (23)	70 (9)		115 (17)	70 (13)	

* P values were calculated using the chi-square test for trend.

to 0.41 ng per milliliter in men (P<0.001), and by 47%, to 0.35 ng per milliliter in women (P<0.001). Among the admissions for acute coronary syndrome involving men 55 years of age or younger and women 65 years of age or younger, the geometric mean level of cotinine decreased 34%, from 0.90 to 0.59 ng per milliliter (P<0.001). Among older patients, it decreased 42%, from 0.62 to 0.36 ng per milliliter (P<0001).

Overall, cotinine concentrations decreased less among patients with acute coronary syndrome than among persons in the general population. Among nonsmokers with acute coronary syndrome, the geometric mean level of serum cotinine decreased 18%, from 0.68 to 0.56 ng per milliliter. Among nonsmokers 45 years of age or older in the general population, the geometric mean level of cotinine in saliva was lower in both

periods but decreased by 42%, from 0.43 to 0.25 ng per milliliter.[14] The percentage of people with a cotinine concentration of more than 0.7 ng per milliliter decreased more among patients with acute coronary syndrome (from 42% to 9%, P<0.001) than among persons in the general population (from 35% to 26%, P=0.02).

Among smokers admitted to the hospital because of acute coronary syndrome, there was no significant reduction in the self-reported number of cigarettes smoked or the geometric mean level of cotinine (from 152 to 147 ng per milliliter; P=0.72); the cotinine level among smokers in the general population decreased from 167 to 103 ng per milliliter.[18]

DISCUSSION

We found a 17% reduction in the number of hospital admissions for acute coronary syndrome after enactment of smoke-free legislation; this reduction was greater than the underlying trend and the contemporaneous change in a neighboring country without such legislation. The number of prevented admissions involving nonsmokers accounted for 67% of the reduction.

Early compliance with the Scottish legislation was high.[19] Two weeks after implementation of this legislation, the levels of secondhand smoke in bars had decreased by 86%. Concerns about displacement of smoking from public places into homes have not been realized. The results of cotinine assays in schoolchildren[20] and adults who are nonsmokers[18] have confirmed a reduced overall exposure to smoke. In the adult population of nonsmokers in Scotland, cotinine concentrations have decreased by 42%, similar to the 47% reduction after the enactment of smoke-free legislation in New York.[21] In our study, nonsmokers with acute coronary syndrome who were admitted to hospitals had higher cotinine concentrations than persons in the general population; these findings are consistent with secondhand smoke being a risk factor for acute coronary syndrome. Our difference is an underestimate, since the level of cotinine was measured in serum and saliva, and the values from saliva specimens are 25% higher than those from serum.[22] The decrease in the cotinine concentration among nonsmokers with acute coronary syndrome who were admitted to the hospital was less than that in the general population; this finding is consistent with admissions being

prevented through the protection of persons who were previously exposed to secondhand smoke. The percentage of nonsmokers with very high cotinine concentrations decreased more among persons who were admitted to the hospital than among the general population, suggesting that the number of events prevented among persons with a very high exposure to smoke before the enactment of the legislation was disproportionately high.

The excess risk of acute coronary syndrome associated with smoking decreases within days after smoking cessation, and it is reduced by 50% at 1 year.[23,24] The primary aim of smoke-free legislation is to protect nonsmokers from secondhand smoke. However, studies in other countries suggest that anticipation of legislation also encourages reduced smoking and cessation among smokers.[1-4,24,25] In the 3 months before the enactment of the legislation in Scotland, the number of telephone calls to smoking-cessation services was 67% higher than it was in the subsequent 3 months.[26] The lack of reduced cotinine concentrations among smokers who were admitted to the hospital is not surprising, since admissions were prevented among persons who reduced the number of cigarettes smoked. These smokers contribute to a decrease in the cotinine concentration in the population but not to the decrease in the number of hospital admissions.

One Italian study suggests reductions in acute coronary syndrome among persons 60 years of age or younger, but not among older patients.[7] A subsequent Italian study reported reductions in both age groups.[10] In Scotland, we observed an 8% reduction (95% CI, 6 to 10) in acute coronary syndrome among men who were 55 years of age or younger and women 65 years of age or younger as compared with a 20% reduction (95% CI, 18 to 22) in admissions involving men who were older than 55 years of age and women who were older than 65 years of age. The age effect was apparent among both smokers and nonsmokers. Among nonsmokers, younger patients had a higher baseline cotinine concentration but a similar reduction in acute coronary syndrome (38% vs. 42%). Caution should be heeded in extrapolating the effects of age and sex to a population in another country. Culture and climate may produce demographic differences in smoking patterns in the home, public places, and outdoor spaces.

Our study suggests that the reduction in acute

coronary syndrome among nonsmokers may be greater among women than among men. Exposure to smoke may have decreased more among women; among nonsmokers, the cotinine concentration decreased by 37% in men and 47% in women. Alternatively, a similar reduction in exposure to secondhand smoke may produce a greater effect in women than in men. Acute coronary syndrome is caused by thrombus formation at the site of a disrupted atherosclerotic plaque. Plaque rupture is the most common cause of this syndrome, although thrombus formation on an eroded plaque is particularly common in women.[27] Although some risk factors for acute coronary syndrome, such as dyslipidemia, predispose to plaque rupture, smoking increases the risk through acute thrombosis.[28] Hence, the relative risk associated with smoking is greater among women than among men and is associated with a steeper dose response.[29]

Three studies have examined local legislation banning smoking in public places in geographically isolated communities. Sargent et al. showed a 40% reduction (95% CI, 1 to 79) in the number of hospital admissions for myocardial infarction among the 68,140 inhabitants of Helena, Montana, as compared with a nonsignificant increase in hospital admissions involving patients living outside Helena.[5] This study comprised only 64 admissions over 12 months. Pechacek and Babb suggested that a 40% reduction in hospital admissions was implausible, and they calculated 19% as the theoretical maximum reduction achievable through a reduction in exposure to secondhand smoke.[30] Khuder et al. showed a 39% reduction in hospital admissions after enactment of smoke-free legislation in Bowling Green, Ohio, which has a population of less than 30,000.[8] Among residents of Pueblo, Colorado, which has a population of 148,000, the number of hospital admissions for myocardial infarction decreased by 27%, as compared with a 15% decrease among nonresidents who were admitted to the same hospital and a 3% decrease in another city without such legislation.[6]

The number of admissions for acute coronary syndrome decreased by 13% after the enactment of smoke-free legislation in Saskatoon, SK, Canada, which has a population of 220,000[11]; this finding is concomitant with a 25% reduction in the prevalence of smoking (from 24% to 18%). A modest 8% reduction in the prevalence of smoking

occurred in New York because of local and partial restrictions (i.e., restrictions in some public places but not in others) during the 8-year period before enactment of statewide smoke-free legislation and because of an atypically low baseline level of exposure to smoke.[9] The investigators estimated that the reduction in prevalence would have been 19% if the local restrictions had not occurred. Barone-Adesi et al. compared the number of hospital admissions for myocardial infarction before and after enactment of smoke-free legislation in Piedmont, Italy, with the number of admissions during the same periods in the previous year.[7] The number of admissions decreased among patients who were 60 years of age or younger (odds ratio, 0.89; 95% CI, 0.81 to 0.98), but not among older patients. In Rome, which has a population of 2.7 million, acute coronary events decreased by 7.9% among persons 65 to 74 years of age (95% CI, 3.4 to 12.2) and by 11.2% among younger patients (95% CI, 6.9 to 15.3).[10]

All studies to date were retrospective and used clinical diagnostic labels. The studies described above did not include information on smoking status or exposure to secondhand smoke, and the investigators were unable to determine whether the overall reduction in hospital admissions involved nonsmokers or smokers. Only one previous study included information on smoking status. Seo and Torabi reported a 71% reduction in the number of admissions to Bloomington Hospital in Bloomington, Indiana, because of acute coronary syndrome among self-reported nonsmokers, from 17 admissions during the 22-month period before the enactment of smoke-free legislation to 5 admissions during the 22-month period after the legislation.[12] There was a nonsignificant 11% reduction in admissions to a control hospital. There was no reduction in the number of admissions among smokers (8 vs. 7). The investigators were unable to corroborate self-reported smoking status on the basis of biochemical tests.

A meta-analysis of four early studies reported a pooled relative-risk estimate of 0.73.[31] Later studies have provided lower effect estimates, but the 95% confidence intervals associated with the pooled estimate (0.56 to 0.89) nonetheless were consistent with the 17% overall reduction in hospital admissions that we observed. Between-country differences are inevitable because of different levels of baseline exposure to smoke.

Our study has a number of strengths. The nine

hospitals served a population of more than 3 million. We ascertained the number of admissions prospectively using a standard definition that included confirmation based on biochemical tests. We linked our data to the Scottish Morbidity Record 01 database. Only 52% of our subjects received a clinical diagnosis of ICD-10 code I21 (acute myocardial infarction), with no difference in the diagnosis between the two study periods (1966 diagnoses [52%] vs. 1663 diagnoses [51%]). The remainder received uninformative codes: predominantly I251 (atherosclerotic disease), I200 (unstable angina), R074 (chest pain, unspecified), and I248 (other forms of acute ischemic heart disease); these findings highlight the limitations of retrospective studies with the use of routine data. We had information on both the underlying trend before the study and the contemporaneous change in a neighboring country. We collected detailed information prospectively on smoking and exposure to secondhand smoke using both questionnaires and biochemical assays.

Further studies are required to determine whether the early improvements will be sustained.

Smokers who quit may subsequently relapse. Conversely, changing social attitudes may discourage young people from beginning to smoke, producing an additional benefit in the future. Our overall results are consistent with those of other studies. The World Health Organization's Framework Convention on Tobacco Control is the first international legal treaty to focus on improving public health.[32] In Article 8, the signatories commit to protect the public from exposure to secondhand smoke. Our findings provide support for the treaty.

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