Changes in ETS Following Anti-Smoking Legislation

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Although the link between cigarette smoking and morbidity and mortality from a number of diseases is well established,[1,2] only recently have the harmful effects of exposure to environmental tobacco smoke (ETS) been investigated. These studies provide evidence that ETS is associated with a number of smoking-related diseases, particularly heart disease,[3-5] and respiratory disorders such as asthma, bronchitis, and wheezing.[6-8] The harmful effects of ETS are so well established that the United States Environmental Protection Agency has concluded that it causes lung cancer in adults and increases the risk of other respiratory disorders among children.[9]

The evidence linking ETS and smoking-related diseases highlights the importance of reducing human exposure to second-hand smoke. One way of doing this is to restrict smoking in public places. In November 1994, the Ontario government passed the Tobacco Control Act (TCA). This comprehensive legislation contained a provision which either bans or strictly limits smoking in a wide variety of public places, including retail establishments, financial institutions, hospitals, educational institutions, health facilities, and video and amusement arcades. The purpose of this study was to evaluate the effectiveness of the legislation by comparing the levels of airborne nicotine in operations before and one year after its introduction.

METHODS

A stratified random sampling procedure, based on geographic location, population and type of operation, was employed to select 180 sites from across Ontario to be monitored for ETS. This sample of 180 represent the nine different types of operations affected by the TCA. All of those sites contacted agreed to participate and, although the possibility exists, there is no reason to believe that the presence of the monitors influenced behaviour during the study period. Due to theft, damage and business closure, however, both baseline and follow-up readings were obtained for only 160 sites.

Environmental tobacco smoke is a mixture of sidestream smoke, that which is emitted directly from the cigarette into the environment, exhaled midstream smoke, and gases that diffuse through the cigarette paper during smoking. ETS is a complex mixture of thousands of compounds in both particulate and gas phases. Various proxies, or markers, for ETS have been used, including particles, carbon monoxide, acrolien and nitrosamines. These markers generally are of only limited use because they either are not unique to tobacco, are not present in sufficient quantities to be measured in low ETS levels, or cannot be measured easily and inexpensively. By contrast, the only significant environmental source of nicotine is cigarette smoke. Nicotine is present in all cigarette smoke and is a major constituent in the smoke so that environmental concentrations are at easily measured levels even for low smoking areas.[10]

Operators of establishments selected for the study were contacted by local health unit personnel, who sought informed consent for the monitors to be placed voluntarily in their premises twice over a one-year period: the first time approximately one month prior, and the second approximately one year following, passage of the TCA. The level of nicotine in each operation was measured using air quality monitors identical to those employed in previous studies.[11,12] In each establishment the monitors were positioned six to eight feet above floor level in places that were not thought to be obvious targets for vandalism or theft, away from air filtration and ventilation systems, and not in designated smoking areas. All monitors were exposed for a seven-day period, after which they were collected by health unit personnel,

TABLE I
Mean Levels of Airborne Nicotine (Micrograms) in Various Locations One Month Before and One Year After Passage of the TCA

Location (n)	Pretest		Post-Test		Differences	
	Mean	s.d.	Mean	s.d.	t	p*
Hospital (19)	0.04	0.08	0.11	0.28	1.14	0.27
School/University/College (22)	0.94	2.57	0.07	0.22	-1.56	0.14
Day nursery (18)	0.02	0.04	0.02	0.07	0.27	0.79
Nursing home (15)	0.19	0.48	0.05	0.11	-1.13	0.50
Retail store (24)	0.20	0.40	0.06	0.14	-1.74	0.09
Arcade (14)	1.09	1.18	0.05	1.35	-1.80	0.10
Mall common area (18)	0.24	0.31	0.08	0.14	-2.57	0.02
Laundry (13)	0.29	0.35	0.09	0.12	-1.34	0.20
Hair salon (17)	0.12	0.08	0.11	0.22	-0.35	0.73
Overall (160)	0.34	1.09	0.11	0.44	-1.70	0.09

* two-tailed test for significance

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placed in sealed zip-lock bags, and forwarded to the Ontario Ministry of Labour, Occupational Health Laboratory in Weston, Ontario, where the samples were analyzed according to an established protocol[13] using gas chromatography to test for levels of nicotine.

RESULTS

The purpose of this study was to determine whether nicotine levels in public places were different prior to and one year following passage of the TCA. The result was an overall decrease of about two-thirds, from an average of 0.34 micrograms to 0.11 micrograms, across all the sites tested (t= -1.70, p=0.09). Reductions were present in seven of the nine types of operations monitored (Table I), most notably arcades, retail areas and common areas of malls. In two operations (hospitals and day nurseries) the baseline readings were close to zero, indicating that they were in compliance with the Act before its passage, and therefore had no opportunity for improvement.

DISCUSSION

While it is impossible to determine to what extent these results can be attributed to the legislation, they do suggest that the latter may be an effective instrument for reducing levels of environmental tobacco smoke in public places. In each of the types of operations monitored the levels of ETS either declined following passage of the TCA, or they already were in compliance before it was enacted. Although these findings are encouraging, there are other issues involved in controlling ETS exposure. One is the potential economic impact on businesses. Current research[14] implies that restricting smoking in public places does not have an adverse effect. A survey[15] of 3,200 residents in the greater Toronto area suggests that restaurant business would not decline with the implementation of anti-smoking legislation and could, in fact, increase. When asked whether they would frequent restaurants more, less, or equally often, specifically because there was no smoking allowed, 39% of respondents indicated they would go more often, 16% less, and 45% that it would make no difference. Educating operators that smoking restrictions likely will not harm their business, and could even increase it, may serve to reduce resistance to future legislation and increase willingness to enforce it within their establishments.

Another important issue involves ways to reduce ETS in environments, such as private homes, that are unlikely to be affected by legislation. Family members, including children, in homes with smokers are likely to be exposed to relatively high levels of ETS. Although there is evidence[16,17] that many smokers ignore the effects of their behaviour, anti-smoking legislation such as the TCA may serve to increase their awareness of the dangers of ETS, and change their beliefs and attitudes about smoking in the presence of others.

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