

Assessing the Impact of Smoke-Free Legislation on Secondhand Smoke Exposure in Spain (2006-2011)

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Abstract

Introduction: In 2011, the Spanish partial smoke-free legislation was extended to affect all enclosed settings, including hospitality venues and selected outdoor areas. This study evaluated the change in self-reported exposure to secondhand smoke among the adult, nonsmoking population.

Methods: Two cross-sectional surveys were conducted on nationally representative samples of the adult (≥ 18 years) nonsmoking Spanish population. One was conducted in 2006 (6 months after the first ban) and the other in 2011, 6 months after the new ban was implemented. We assessed the prevalence and 95% confidence interval (CI) of self-reported exposure to secondhand smoke in various settings, and the corresponding adjusted prevalence ratios (PR) and 95% CIs.

Results: Overall, the self-reported exposure to secondhand smoke fell from 71.9% (95% CI: 70.1%–73.7%) in 2006 to 45.2% (95% CI: 43.1%–47.3%) in 2011 (PR = 0.43; 95% CI: 0.39–0.47). Specifically, self-reported exposure significantly decreased from 29.2% to 12.7% (PR = 0.36; 95% CI: 0.31–0.42) in the home, from 35.0% to 13.0% (PR = 0.40; 95% CI: 0.33–0.49) at work/education venues, from 56.2% to 32.2% (PR = 0.44; 95% CI: 0.39–0.48) during leisure time (mainly hospitality venues, but also venues other than work/education venues and home), and from 40.6% to 12.7% (PR = 0.24; 95% CI: 0.21–0.29) in transportation vehicles/stations.

Conclusions: The prevalence of secondhand smoke exposure among nonsmokers decreased after implementation of a comprehensive smoke-free legislation in Spain. In addition to the expected reduction in exposure during leisure time, we observed reductions in settings that were not subject to the new legislation, such as homes, outdoor bus stops, and train stations.

Implications: Exposure to secondhand smoke in selected outdoor settings may be further reduced by extending smoke-free legislation.

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Introduction

Exposure to secondhand smoke (SHS) occurs in a variety of settings, including the home, the workplace, and other private and public places (bars, restaurants, cafes, transports, stations, etc.). Exposure to SHS has been causally associated with many adverse health effects.¹ In 2004, 33% of male nonsmokers and 35% of female nonsmokers worldwide reported exposure to SHS.² In a given country, the prevalence of smoking, the stage of the tobacco epidemic, and the comprehensiveness of its smoke-free legislation are major determinants of nonsmoker exposure to SHS.^{2,3,4}

On January 1, 2006, Spain introduced its first national, comprehensive smoke-free legislation (Law 28/2005) to protect the health of nonsmokers. The legislation banned smoking in all enclosed workplaces and public places, with the exception of hospitality venues (bars, pubs, cafeterias, restaurants, and hotels).⁵ The first national data on SHS exposure 6 months following the 2006 ban indicated that 74.3% of nonsmoking men and 70.1% of nonsmoking women were exposed to SHS.⁶ Compared to 2005, important reductions were observed in the exposure to SHS at the workplace,⁷ but no significant changes were observed at home or during leisure time (which mainly included hospitality venues, but also places other than work/study places and home).^{7,8,9} Five years later, on January 2011, the smoking ban was extended (Law 42/2010) to include all hospitality venues (bars, cafes, pubs, restaurants, discos, and casinos) without exception,¹⁰ and all outdoor areas adjacent to health care centers, schools, and playgrounds. Four to six months after the introduction of the new law, environmental

This study had a before-after design. We conducted two independent cross-sectional surveys, the first in 2006 (June and July) and the second in 2011 (September to November). We assessed specific factors related to tobacco consumption and SHS exposure in representative samples of the non-institutionalized Spanish population, aged 18 years and older. The two surveys were similar in design, and details have been reported elsewhere.^{6,13} Briefly, we conducted computer-assisted telephone interviews, which included a single set of core questions. The questionnaire was developed within the framework of a European study.⁶ Participants were selected according to a two-stage sampling strategy. In the first stage, the households were the units of stratification. To guarantee national representativeness, we stratified households by geographical region and the size of the municipality. In the second stage, we selected one person at random from the residents in each household selected in stage one.¹⁴ Households within each municipality were randomly selected from a landline telephone directory (non-residential landlines were excluded). At the time of the surveys, 80.6% of Spanish households had landline telephones (18.9% had only mobile phones and 0.5% had no phones). In cases of non-response, substitutions were made using the same methodology to select the households, and then, asking for a person of equal age and sex as the original index person. The substitution rate was 21.3% in the first survey and 24.6% in the second survey.

Each survey included approximately 2500 participants. In each group of participants, sex and age demographics were representative of the overall Spanish population. A total of 2522 adults were interviewed in 2006 and 2504 adults were interviewed in 2011.

Main Variables

A current smoker was defined as an individual that identified him/herself as a tobacco smoker at the time of the survey. A former smoker was

Methods

Study Design

defined as an individual that had a history of smoking, but no longer identified him/herself as a current smoker. A “never smoker” was defined as an individual that reported that he/she had never smoked. The present analysis was restricted to current nonsmokers, including both former and never smokers. We analyzed 1931 nonsmokers in 2006 and 1986 nonsmokers in 2011.

The participants were asked about their perceived SHS exposure in several settings;⁶ for example, “Does anybody smoke in close proximity to you at work?” and “How many hours per day do you think you are exposed to tobacco smoke at your education venue?” (questionnaires are available in Spanish upon request). The different settings included the home, the workplace or educational center, during leisure time, and in transportation. Exposure to SHS in these settings was recorded separately for working and nonworking days, except for the workplace and the educational center. Based on the quantitative estimations of exposure (daily hours of exposure), dichotomous variables were created for each environment. We defined “unexposed” as no exposure (0 h/day) and “exposed” as anything more than 0 h/day of exposure, including any averaged exposure time between 1 and 60 minutes. Exposure during public and private transportation was assessed with a dichotomous variable (no/yes) for the following environments: subway, subway station, train or tram, train or tram station, bus, bus stop or station, taxis, and private car. A dichotomous variable was also used for “total exposure” or exposure in any environment, when subjects reported exposure to SHS at home, in the workplace or educational center, during leisure time, or while using some form of transport. Participants were grouped into three age categories (18–39 years, 40–59 years, and ≥ 60 years) for analysis.

Statistical Analysis

We calculated the prevalence (%) and 95% confidence interval (CI) for exposure to SHS among nonsmokers in each setting. The combined estimations of prevalence were adjusted for age with the direct method, based on a projected Spanish reference population (≥18 years old in 2006) according to data from the Spanish National Institute of Statistics (www.ine.es/jaxiT3/Datos.htm?t=9663). We also performed analyses stratified by age group and sex. We fitted multivariate log-binomial models to compute the age-adjusted prevalence ratios (PR) and their 95% CIs¹⁵ for SHS exposure among nonsmokers in 2006 and in 2011. These years represent times before (2006) and after (2011) enforcement of the most recent smoke-free legislation (Law 42/2010). We observed that the *Nicotine & Tobacco Research*, 2017, Vol. 00, No. 00 quantitative data for SHS exposure (h/day) at home, in the workplace or educational center, and during leisure time were not normally distributed. Therefore, we computed geometric means and corresponding 95% CIs and performed comparisons with the Wilcoxon rank-sum test. We

considered a p -value < .05 statistically significant. All analyses were performed with Stata 12.1 and MS-Excel.

Results

Overall, self-reported SHS exposure fell from 71.9% (95% CI: 70.1–73.7) in 2006 to 45.2% (95% CI: 43.1–47.3) in 2011 (PR = 0.43; 95% CI: 0.39–0.47). Specifically, self-reported SHS exposure decreased significantly from 29.2% to 12.7% (PR = 0.36; 95% CI: 0.31–0.42) in the home, from 35.0% to 13.0% (PR = 0.40; 95% CI: 0.33–0.49) at work/education venues, from 56.2% to 32.2% (PR = 0.44; 95% CI: 0.39–0.48) during leisure time (mainly hospitality venues, but also other places different from the work/study place and home), and from 40.6% to 12.7% (PR = 0.24; 95% CI: 0.21–0.29) in transportation vehicles/ stations (Table 1). Reductions in the prevalence of SHS exposure were directly related to age; the largest relative reductions were observed among the youngest group of nonsmokers, but the largest absolute reductions were observed among nonsmokers aged 40–59 years (Table 1). The overall pattern of reduction was similar when data were analyzed separately for men and women; no noticeable differences between men and women were observed across the studied settings and across age groups (data not shown). Moreover, the patterns of reduced SHS exposure were not different between working and nonworking days for the home and leisure time venues (data not shown).

We observed reductions in the prevalence of SHS exposure in each type of transport, except in the subway (Figure 1). Among individuals that used any form of transport, the greatest and most significant reductions occurred in trains/trams and in train/tram stations (PR = 0.07; 95% CI: 0.02–0.32 and PR = 0.11; 95% CI: 0.07–0.18, respectively), subway stations (PR = 0.15; 95% CI: 0.08–0.26), taxis (PR = 0.09; 95% CI: 0.02–0.40), and bus stops (PR = 0.17; 95% CI: 0.14–0.21). No meaningful differences were observed, when results were stratified by sex (data not shown).

Among nonsmokers that reported SHS exposure, the daily geometric mean of exposure time did not significantly change after legislation, at home (1.1 h/day, 95% CI: 1.0–1.2 in 2006 vs. 1.3 h/day, 95% CI: 1.1–1.4 in 2011) or at the work/educational center (1.5 h/day, 95% CI: 1.4–1.6 in 2006 vs. 1.5 h/day, 95% CI: 1.4–1.7 in 2011). However, we observed a significant reduction in exposure during leisure time (from 1.1 h/day, 95% CI: 1.0–1.1 in 2006 to 0.9 h/day, 95% CI: 0.9–1.0 in 2011; $p < .05$, Wilcoxon rank-sum test).

Discussion

Our findings suggest that self-reported SHS exposure among adult nonsmokers in Spain significantly decreased after implementing the current smoke-free legislation. The data from these nationally representative surveys showed that, in addition to the reduction in exposure at workplaces and during leisure time, exposure also declined in settings not regulated by the law, such as homes, public transport vehicles, and in transport stations/stops. The same surveys showed that there was no statistically significant change in the overall prevalence of smokers from 2006 (23.4%) to 2011 (20.7%).¹³ Given the design of the study, we may not have completely elucidated whether the reduction was due to the first law (Law 28/2005) or to the second law (Law 42/2010). However,

the effects of smoke-free laws appear to decay with time,¹⁶ and these studies were conducted within 6 months of each law enactment. Moreover, in the present study, the reductions observed were mainly due to reductions in SHS exposure in settings that were not previously covered by Law 28/2005. Thus, our findings most likely reflected the effect of the

more recent law. In addition, we observed a sustained reduction of SHS exposure in workplaces, which had previously declined after the first law; this finding supported the notion that the current results reflected effects of the current law. The reduction observed in leisure time was important, both in absolute (24% difference in prevalence) and in relative terms (56% relative reduction). Also, this setting was not previously covered by the first smoke-free legislation. This result indicates the effectiveness of the more recent law in protecting nonsmokers from SHS, even though smoking in cafeterias, bars, and restaurants was a rooted practice in Spain. In Scotland, after its national legislation, self-reported SHS exposure fell in all the settings assessed, including homes.¹⁷ The reduction of SHS exposure in the home confirmed a positive effect of the smokefree legislation beyond its primary focus.^{9,18,19,20} Thus, smoking was not displaced to the home setting. Our results are consistent with those from a study in Barcelona, Spain, that indicated a significant reduction from 32.5% to 27.6% in the home and from 12.3% to 3.7% in public transportation vehicles, after the ban.²¹

This study was limited by the lack of an individual biomarker of SHS exposure. The self-report information obtained with the questionnaire may have underestimated true SHS exposure. There is, however, prior evidence of a strong relationship between SHS exposure reported in questionnaires and the cotinine concentrations in saliva.²² The surveys were conducted in June–July of 2006 and September–November of 2011; thus, the data may reflect some seasonal bias. June–July are summer months in Spain, with high temperatures throughout the country; in this season, enclosed spaces are better ventilated than in September–November, when the temperature drops, and natural ventilation decreases in enclosed settings. This potential systematic error, however, should bias the results against the null hypothesis of no changes in exposure, because higher exposure to SHS was more likely to occur and to be recalled in poorly ventilated, enclosed settings (ie, in the post-legislation survey). We also acknowledge that the use of substitution does not guarantee the correction of a non-response bias; it only minimized the bias. Nevertheless, this procedure is widely used, and it assures the required sample size.²³ Finally, also related to a potential selection bias, both surveys included households with landline telephones. The proportion of households with only mobile phones has increased in the last decade, from approximately 10% in 2006 to 19% in 2011. A study conducted in Barcelona in 2010–2011²⁴ showed that the profile of the population with only mobile phones differed from the population with landline telephones. That study showed that individuals that only used mobile phones were more likely to be foreigners, to have relatively low educational levels, and to be smokers, compared to individuals contacted through a landline telephone. Previous studies have shown that a lower socioeconomic status was linked to higher SHS exposure, in some populations.^{25,26} Thus, in our sample, a bias towards a higher average education than that observed in the general population could result in an underestimation of the true SHS exposure.

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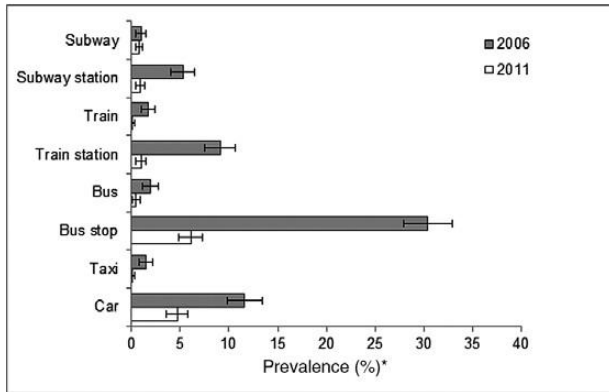
Table 1. Prevalence (%), Prevalence Ratios (PR), and 95% Confidence Intervals (95% CI) for Exposure to SHS in Spain, in 2006–2011; Sub-Analyses Are Shown for Different Exposure Settings, Age Groups, and Sex

Setting of exposure	Year 2006			n _a
	n _a	%	95% CI	
Total exposure Total ^b	1931	71.9	70.1–73.7	1986
By age groups 18–39				
y	745	85.1	82.5–87.7	617
40–59 y	562	73.0	69.3–76.6	699
≥ 60 y	624	48.2	44.3–52.2	670
By sex Males ^b				
	891	74.1	71.4–76.8	903
Females ^b	1040	70.1	67.5–72.7	1083
Home Total ^b	1931	29.2	27.2–31.2	1986
By age groups 18–39				
y	745	34.2	30.8–37.6	617
40–59 y	562	27.0	23.4–30.7	699
≥ 60 y	624	22.9	19.6–26.2	670
By sex Males ^b				
	891	26.4	23.5–29.3	903
Females ^b	1040	31.4	28.5–34.3	1083
Work/education venues Total ^b	963	35.0	27.0–43.0	986
By age groups 18–39				
y	602	40.4	36.4–44.3	469
40–59 y	319	24.8	20.0–29.5	455
≥ 60 y	42	31.0	17.0–44.9	62
By sex Males ^b				
	523	39.8	33.5–46.1	506
Females ^b	440	30.7	24.2–37.2	480
Leisure time Total ^b	1931	56.2	54.1–58.3	1967
By age groups 18–39				
y	745	72.3	69.1–75.6	609
40–59 y	562	56.2	52.1–60.3	694
≥ 60 y	624	27.9	24.4–31.4	664
By sex Males ^b				
	891	61.1	58.1–64.1	890
Females ^b	1040	51.9	49.0–54.8	1077
Transport Total ^b	1267	40.6	37.9–43.3	1745
By age groups 18–39				
y	555	44.7	40.5–48.8	573
40–59 y	370	38.4	33.4–43.3	631
≥ 60 y	342	37.7	32.6–42.9	541
By sex Males ^b				
	601	35.7	31.9–39.5	802
Females ^b	666	45.2	41.5–48.9	943

^aFrequency of subjects. ^bAge-adjusted prevalence (%) with the direct method, and age-adjusted prevalence (%) with binomial regression.

In conclusion, this study indicated that SHS exposure was reduced among Spanish adult nonsmokers after the enactment of the current comprehensive smoke-free legislation. Beyond the expected reduction in SHS exposure in the workplaces and leisure time settings covered by this legislation, we also observed a significant reduction in some transport settings and in homes. This finding emphasizes the profound impact of smoke-free policies on social norms about smoking in the vicinities of

nonsmoking individuals.^{17,18} This result contradicts the hypothesis driven by the tobacco industry, which claimed that smoke-free legislations would merely displace smoking from public to private places. Our results indicate that, on the contrary, comprehensive smoke-free legislation, as proposed by Article 8 of the WHO Framework Convention on Tobacco Control,²⁸ has been a successful tool for preventing SHS exposure in public places. Moreover, its beneficial effects appeared to extend beyond its initial target (public places and workplaces) to selected private settings, such as homes and cars, which further reduced SHS exposure in nonsmokers.



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Figure 1. Age-adjusted prevalence and 95% confidence intervals of exposure to secondhand smoke among nonsmoking individuals that used the indicated forms of transport in Spain, 2006–2011. *Age-adjusted prevalence (%) with the direct method. Bars indicate 95% confidence intervals.

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Declaration of Interests

None declared.

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