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Hospital admissions for acute myocardial infarction before and after implementation of a comprehensive smoke-free policy in Uruguay: experience through 2010

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Abstract

Background—Comprehensive smoke-free laws have been followed by drops in hospitalisations for acute myocardial infarction (AMI), including in a study with 2 years follow-up for such a law in Uruguay.

Methods—Multiple linear and negative binomial regressions for AMI admissions (ICD-10 code 121) from 37 hospitals for 2 years before and 4 years after Uruguay implemented a 100% nationwide smoke-free law.

Results—Based on 11 135 cases, there was a significant drop of –30.9 AMI admissions/month (95% CI –49.8 to –11.8, $p=0.002$) following implementation of the smoke-free law. The effect of the law did not increase or decrease over time following implementation ($p=0.234$). This drop represented a 17% drop in AMI admissions following the law (IRR=0.829, 95% CI 0.743 to 0.925, $p=0.001$).

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Contributors EMS initiated the collaborative project, designed data collection tools, monitored data collection, analysed the data and drafted and revised the paper. He is guarantor. ES implemented the study in Uruguay, monitored data collection, designed data collection tools, cleaned and analysed the data and drafted and revised the paper. EB implemented the study in Uruguay, monitored data collection and revised the draft paper. AH and KMC revised the draft paper. SAG conducted the statistical analysis and wrote the first draft of the paper.

Competing interests None.

Ethics approval Roswell Park Cancer Institute and School of Medicine, University of the Republic in Montevideo, Uruguay.

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Data sharing statement There are no unpublished data. All data used in the analysis appear in figure 1.

Conclusions—Adding two more years of follow-up data confirmed that Uruguay's smoke-free law was followed by a substantial and sustained reduction in AMI hospitalisations.

We¹ reported that there was a significant drop in hospital admissions for AMI during the first 2 years (through February 2008) following implementation of comprehensive national legislation, which ended smoking in all indoor public places and workplaces, including restaurants and bars, on 1 March 2006. This paper adds two additional years of data, through February 2010.

METHODS

The methods and ethics of review were the same as for our original publication.¹ Briefly, we performed a medical records review to identify patients admitted to 37 public and private hospitals in Uruguay at least 20 years old with a primary diagnosis of AMI (ICD-10 code I21). The original sample, collected between 1 March 2004 (2 years before the law took effect) and 28 February 2008, included 7949 admissions, accounting for 79% of all AMI admissions for the entire country. Adding two additional years of data (through 28 February 2010) increased the total number of admissions to 11 135, representing 79% of all AMI admissions over the study period.

Statistical analysis

As before, we tested for the effect of the smoke-free law using multiple regression for the number of AMIs per month with the independent variables time (a continuous variable measured in years, with time 0 at March 2006, the month the smoke-free law took effect), a dummy variable (Law) set to 1 beginning in March 2006 and 0 before then, the time (in years) after the law took effect (to test for a change in the secular trend in AMI hospital admissions) and 11 dummy variables for a month to account for seasonal variability. We tested for serial correlation using the Durbin Watson statistic, examining a residual plot, and computing a correlogram and associated Q statistics.

We also fit the data using a negative binomial regression to predict the number of AMIs each month using the same independent variables.

Calculations were done with Stata V.12.1.

Ethics review

A research protocol was reviewed and received ethics clearance through the Office of Research Subject Protection at Roswell Park Cancer Institute in Buffalo, New York, and at the School of Medicine, University of the Republic in Montevideo, Uruguay.

RESULTS

Of the 11 135 cases included in our sample, 7287 (65%) were men, the same fraction as in our earlier study.¹ Figure 1 shows the observations and multiple linear regression fit to the monthly number of AMI admissions:

Adm/month=	185.8	+2.41 year	-31.0 law	-8.07 (years after law)	+(monthly seasonal terms)
SE	±10.1	±6.65	±9.62		±6.94
p		0.716	0.002		0.250

Thus, there was a significant drop of -31.0 AMI admissions/month (95% CI -49.9 to -12.1, $p=0.002$) following implementation of the smoke-free law. The effect of the law did not increase or decrease over time following implementation ($p=0.250$). There was no evidence of serial correlation or heteroscedasticity in the residuals, based on the Durbin-Watson statistic of 1.940, by examination of a residual plot against time, or examination of a correlogram and associated Q statistics ($Q=0.117, 0.593, 12.455$ and 18.254 for lags of 1, 2, 12 and 24 months; corresponding p values are 0.732, 0.743, 0.410 and 0.791).

The fit using a negative binomial yielded nearly an identical fit to the data (mean difference in predicted number of AMI admissions/month=.02, $SD=2.9$ compared to an average 155 admissions/month). There was a 17% drop in AMI admissions following the law ($IRR=0.828$, 95% CI 0.741 to 0.924, $p=0.001$). Examination of a correlogram and associated Q statistics showed no evidence of serial correlation in the residuals ($Q=0.066, 0.352, 11.682$ and 17.740 for lags of 1, 2, 12 and 24 months; corresponding p values were 0.800, 0.839, 0.472 and 0.815).

DISCUSSION

The addition of two more years of follow-up data confirmed our earlier finding,¹ based on 2 years of follow-up, that Uruguay's smoke-free law was associated with a substantial drop in AMI admissions. The magnitude of the drop observed in the current study was similar to the earlier estimate of absolute (-35.9, 95% CI -55.7 to -16.1) and relative ($IRR\ 0.84$, 95% CI 0.78 to 0.91) from our earlier study. The drop in AMI admissions observed in this study and the fact that the decline remained stable is also quantitatively similar to the results of a meta-analysis of 38 comprehensive laws,² which found a relative risk of 0.848 (95% CI 0.816 to 0.881) for the effect of comprehensive smoke-free laws on AMIs and other coronary events and no difference in risk over time. In addition, with 4 years of data after the law went into effect, this study is the longest follow-up of any study of the effect of comprehensive smoke-free laws on AMI. (The previous longest follow-up was 39 months in Ireland.³) This paper adds to the case that comprehensive smoke-free laws have an immediate and substantial effect of reducing AMI hospital admissions.

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What this paper adds

- ▶ Comprehensive smoke-free laws have been followed by drops in hospitalisations for acute myocardial infarction (AMI), including in a study with 2 years follow-up for such a law in Uruguay.
- ▶ Adding two more years of data (for a total of 4 years of follow-up), continued to show a significant drop in AMI admissions following implementation of the smoke-free law that persisted over time, adding to the case that comprehensive smoke-free laws have an immediate and substantial effect of reducing AMI hospital admissions.

Figure 1.

The solid line shows the linear regression fit to the number of AMI hospitalisations per month in Uruguay from 1 March 2004 through 28 February 2010. The dashed line is the counterfactual of no law by setting the “law” dummy to zero in the regression equation. The vertical line shows the date of smoke-free law implementation (1 March 2006).