



# HOW DOES THE IRISH SMOKING BAN MEASURE UP? A BEFORE AND AFTER STUDY OF PARTICLE CONCENTRATIONS IN IRISH PUBS

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## ABSTRACT

On March 29<sup>th</sup> 2004, Ireland became the first country to ban smoking in indoor workplaces. The effectiveness of this major public health initiative on exposure and risk for bar workers in Galway city was assessed. 9 city pubs were sampled for particulate matter as a marker of second-hand smoke (SHS) concentrations. Sampling was carried out on five Saturday nights, three prior to, and two following the ban. The observed PM<sub>10</sub> and PM<sub>2.5</sub> concentrations are presented, and these include a post-ban drop in PM<sub>2.5</sub> concentrations of 75-96% relative to pre-ban levels, and a drop in PM<sub>10</sub> concentrations of 47-74% relative to pre-ban levels. In the light of these findings, the risk reduction impact of the ban on those in the hitherto high risk hospitality sector is discussed.

## INDEX TERMS

Particulate matter, Risk reduction, Pubs, second-hand smoke

## INTRODUCTION

The Irish smoking ban was introduced (Office of Tobacco Control, Ireland 2004) to protect workers and others from the now well established risks of heart disease, cancer and asthma and to re-establish the basic human right to good quality air in view of the ineffectiveness of current ventilation technologies as a safeguard for workers' health (Allwright et al 2002).

SHS is a complex mixture of several thousand individual gaseous and particulate compounds, many with known adverse health effects (California EPA 2004) and for which no safe exposure level has been established (WHO 2000). Particulate pollution has also been associated with increased hospital admissions and prolonged exposure is implicated in reducing overall life expectancy (Schwarz and Dockery 1992)

Although the ban relates to virtually all indoor workplaces, the debate surrounding its implementation has centred on the pub and in particular its potentially beneficial impact on bar-workers' health. Previous research had indicated that Irish bar-workers were exposed to high concentrations of SHS and consequently were at high risk (Mulcahy and Repace 2002). Those studies that have examined the impact of bans in other jurisdictions point to reduced exposure and risk (Repance 2004, Sargent et al 2004, Ott et al 1996). The present study sought to measure the impact of the smoking ban on concentrations of respirable air particles, a popular marker of SHS (California EPA 2004) in a sample of city centre pubs before and after the ban.

## RESEARCH METHODS

Particle mass concentrations were measured in 9 pubs in Galway City, Ireland, on three Saturday nights prior to the introduction of the smoking ban, and two Saturday nights following the ban. The pubs were categorised as "small", "medium", "large" and "superpub", as shown in Table 1; Venues ranged in size from 37 m<sup>2</sup> to 267 m<sup>2</sup> and generally represent the range of sizes commonly found in Galway.

Particle mass concentrations were measured over a four minute interval in each pub using a GT- 331 particle counter (which was pre-calibrated for SHS), which records the mass of PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>7</sub>, PM<sub>10</sub>, as well as total suspended particulate (TSP). The short sampling time interval allowed measurement personnel to move between the different pubs, and also to make a second reading on the same night in each pub. Sampling in the first pub commenced at the same time on each Saturday night. During all measurements, the approximate number of

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occupants in each pub was recorded, and the number of smoking occupants (before the ban; total compliance was observed after the ban) was noted. Occupancy data are presented in Table 2. A background outdoor measurement was made following the first nightly survey of the 9 pubs and before the second nightly survey at the junction of two streets in the city centre to which vehicles had no access.

**Table 1. Classification of pubs by size**

Size Categorisation	Pub Identity Number
Small	1, 2, 3, 4
Medium	5
Large	6, 7
Superpub	8, 9

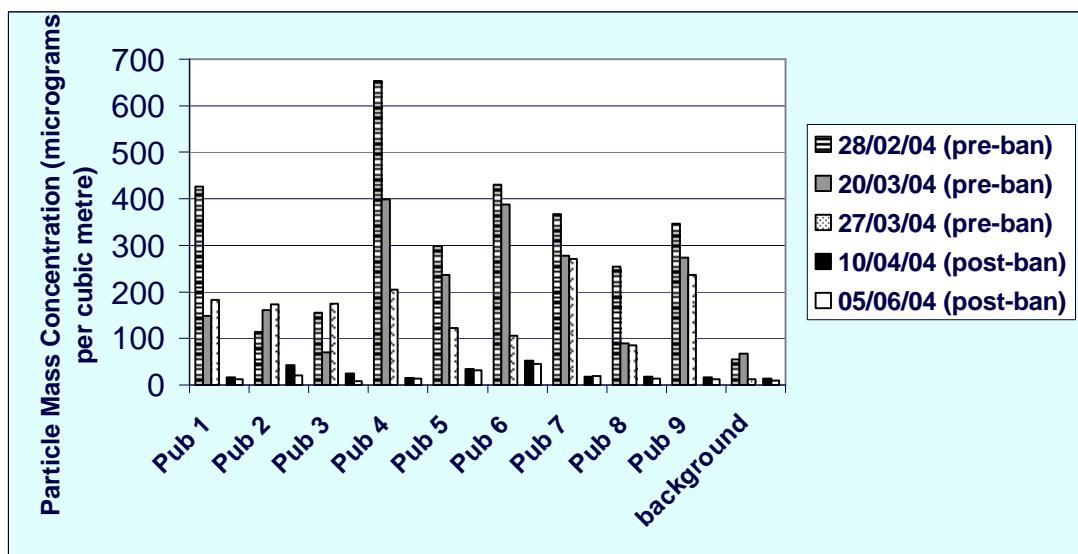
## RESULTS

The number of occupants and active smokers is shown in Table 2. It can be seen that occupancy levels were not substantially different after the ban. No smoking was observed indoors after the ban.

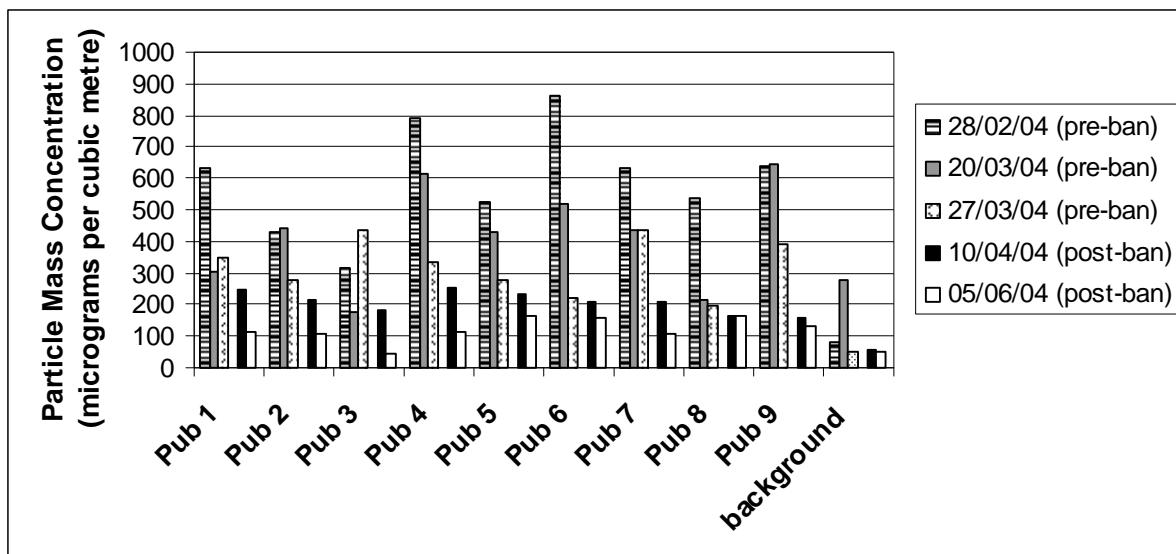
Concentrations of particulates PM<sub>2.5</sub> reduced substantially for all venues following the ban, falling by 75-96% relative to pre-ban levels (as shown in Figure 1) and with a drop in PM<sub>10</sub> concentrations by 47-74% relative to pre-ban levels (as shown in Figure 2). PM<sub>2.5</sub> concentrations following the ban approximated to background levels (outside air).

**Table 2. Occupancy and smoking data in the pubs during particle concentration measurements**

	Pub 1	Pub 2	Pub 3	Pub 4	Pub 5	Pub 6	Pub 7	Pub 8	Pub 9	Date	
Occupant count	81	49	146	47	105	117	92	213	225	28/02/04	Pre-ban
Smoker count	4	3	6	3	2	3	10	10	10	28/02/04	Pre-ban
Occupant count	76	44	115	40	70	95	55	110	170	20/03/04	Pre-ban
Smoker count	3	3	6	3	4	5	5	7	8	20/03/04	Pre-ban
Occupant count	65	80	150	53	120	100	85	200	205	27/03/04	Pre-ban
Smoker count	4	6	7	3	5	5	6	9	10	27/03/04	Pre-ban
Occupant count	63	63	115	50	75	170	110	170	175	10/04/04	Postban
Occupant count	55	41	238	33	158	103	75	260	193	05/06/04	Postban
Average pre-ban count	74	58	137	47	99	104	78	174	200		
Average post-ban count	59	52	177	42	117	137	93	215	184		



**Figure 1. Observed pre-ban and post-ban PM<sub>2.5</sub> concentrations**



**Figure 2.** Observed pre-ban and post-ban  $\text{PM}_{10}$  concentrations

## DISCUSSION

Significant reductions in particulate concentrations were observed in this study, and this combined with the absence of smokers after the ban indicates that workers were enjoying a less smoky if not a smoke free environment following the implementation of this landmark legislation.

The ‘natural experiment’ afforded by the smoking ban was conducted using particulate matter as a marker for SHS levels. Although particulate matter may be generated by other sources (e.g. infiltrated street dust) the discernable reduction following the ban, particularly in  $\text{PM}_{2.5}$  (fine particles are commonly considered to represent SHS levels) appears to confirm that the reduction was due to the absence or reduction of tobacco smoke pollution rather than to any other chance event; the lower reduction observed in  $\text{PM}_{10}$  can be probably attributed to the residual presence of coarse particles re-suspended by the air turbulence created by the presence of people, which are not detected in the  $\text{PM}_{2.5}$  class. The contribution of smoking to air pollution levels (75-96%  $\text{PM}_{2.5}$ ) is also of the same order found in studies following smoking prohibitions conducted in Delaware (Repaece 2004) and California (Ott et al 1996) in the USA

An earlier study (by Lambert et al 1993) of smoking and no-smoking sections in 7 restaurants showed a less effective reduction in particulate levels with a 40% reduction in the no-smoking area (and 65% for vapour phase nicotine). In this study, some restaurants had higher particulate levels in the no-smoking section than the smoking section of other restaurants ( $53\text{-}69 \mu\text{g}/\text{m}^3$  versus  $21.7\text{-}53.2 \mu\text{g}/\text{m}^3$ ). In 20 restaurants and bars in Vancouver (Brauer et al 1998), mean particulate ( $\text{PM}_{2.5}$ ) levels were found to be 70% higher in venues without smoking restrictions compared to those with partial smoking restrictions. Concentrations in non smoking restaurants were reduced by a further 20-30%. This study did not use nicotine as a marker and concluded that occupants may experience substantial particulate exposures due to cooking emissions.

The studies cited above indicate that segregation serves to reduce pollution levels, but does not eliminate pollutants. Although smoking bans do not appear to completely eliminate exposure either, this may be due to a greater extent to the non specific nature of the markers employed than the level of smoker compliance. Future studies of smoking bans should employ additional markers such as vapour phase nicotine so as to control for possible confounding of results.

Relatively short sampling periods were employed in the present work, in common with previous studies (Ott et al 1996: Repace 2004). Although this may raise the question of how representative the recorded particle concentrations were, the use of a short sampling time affords researchers the opportunity to measure particulate concentrations in a number of venues (nine in the present work) over the course of a single evening during which important parameters, such as wind speed, direction etc. can be seen to have uniform values.

In the present study, it was observed that post-ban  $\text{PM}_{10}$  levels in the nine pubs were 2-3 times ambient background levels (average value  $56.85 \mu\text{g m}^{-3}$ ), measured over a time period of equal length at a city centre location. Ireland is



subject to a limit of 50 µg m<sup>-3</sup> for 24-hour ambient PM<sub>10</sub> concentrations as defined by the European Commission (Council Directive 1999/30/EC) and data from a PM<sub>10</sub> monitor located at a busy roundabout on the outskirts of Galway City indicate that this limit has not been exceeded in the January–March 2005 period (Environmental Protection Agency, 2005)

The reductions in particle concentration levels observed should translate into reduced health impacts for both workers and patrons of such venues; a good example of a study that makes this linkage is that carried out in Helene Montana (Sargent et al 2004), which indicates the positive effect of a smoking ban on hospital admissions for acute myocardial infections. Given the apparent neutral impact on bar occupancy levels of the ban observed in the present study, it would seem that good health is not bad for business.

## CONCLUSION AND IMPLICATIONS

The implementation of a national smoking ban in Ireland, accompanied by widespread public support and high levels of observed compliance results in a dramatic reduction in SHS generated pollution. Although SHS smoke levels do not appear to be eliminated, because of the increasing evidence of a non-linear relationship between SHS and cardiovascular disease (Law et al 1997, Whincup et al 2004, Sargent et al 2004, Ostuka et al 2001) these reductions may result in very substantial reductions in mortality and morbidity. Given the non specificity of particulate markers it is advisable to enhance future such studies with additional markers such as vapour phase nicotine

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