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Exposure to second-hand smoke in primary health care centres in Catalonia, Spain (2006)☆

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ABSTRACT

The aim of this study was to assess the exposure to second-hand smoke (SHS) in 90 primary health care centres in Catalonia, Spain. We conducted a cross-sectional study between March and October 2006. We measured vapour-phase nicotine as a marker of SHS in main halls, staff rooms, direction areas, and continued care. Sampler devices were exposed for 7 days, and samples were analysed by gas chromatography/mass spectrometry. We compared the median airborne nicotine concentrations with the non-parametric test for medians by sanitary region, sampled location, affiliation to the Smoke-free Primary Health Care Programme, and urban–rural area. From 300 sampler devices installed, 4 were lost, and detectable levels of nicotine were found in 89 samples (30.0%) in 48 different centres (53.3%). The overall median was 0.01 μg/m^3, with an interquartile range (IQR) of 0.01–0.07 μg/m^3. Median nicotine levels by locations were: reception hall 0.01 μg/m^3 (IQR: 0.01–0.06); staff room 0.01 μg/m^3 (IQR: 0.01–0.08); direction area 0.01 μg/m^3 (IQR: 0.01–0.01); continued care 0.01 μg/m^3 (IQR: 0.01–0.07). Results showed that airborne nicotine levels were very low, with 46.7% of primary health centres being free of SHS.

1. Introduction

Tobacco smoking is the main cause of premature mortality in developed countries. It represents a risk factor for cardiovascular disease, chronic obstructive pulmonary disease, and cancer, and it increases the risk of infectious diseases, such as influenza, invasive pneumococcal disease, and tuberculosis (Arcavi and Benowitz, 2004). Passive smoking, or the exposure to second-hand smoke (SHS), also favours a variety of diseases. Second-hand smoke has been defined as a carcinogenic in humans (IARC, 2004) and 50% of the non-smoking population is exposed (WHO, 2000). It has been estimated that 9–13% of cancer cases in the non-smoking population can be attributed to SHS (WHO, 2000).

Control measures of SHS are relevant for public health. In this context, a comprehensive law on public health measures against tobacco smoking came into effect in Spain in January 2006. The law regulates sales, supply, consume, and publicity of tobacco products (Fernandez, 2006). Specifically, this law prohibits smoking in all enclosed public places, including workplaces, health care centres, study centres, transportation, and, with some exceptions, in the hospitality sector, in an attempt to minimise the risk of SHS exposure (Ministerio de Sanidad y Consumo, 2005). The law is highly known and appreciated by the Spanish population (Saltó et al., 2006), although some incoherent aspects of the law became evident in time, specially in relation to the attention given to hospitality venues (Fernandez et al., 2009). Nevertheless, this national law took a step forward and categorically steps up the previous rules about the regulation of tobacco

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smoking in public places, including health care centres, because it eliminates smoker rooms that were permitted in previous national and regional legislations (Galán and Lopez, 2009).

Several procedures have been used for evaluating SHS exposure in different contexts, using indirect methods, such as face-to-face (Nebot et al., 2004) or telephone (Lushchenkova et al., 2008), or observational methods (Nebot et al., 2001); and direct methods, such as the measurement of suspended particles with diameter $<2.5\,\mu m$ ($PM_{2.5}$) (Nardini et al., 2004) or airborne nicotine (Navas-Acien et al., 2004; Nebot et al., 2005; Barnoya et al., 2007; Stillman et al., 2007). This last one is highly sensible and specific of tobacco, because tobacco smoke is the only source of nicotine in the air (Jaakkola and Jaakkola, 1997; Lopez and Nebot, 2003).

Besides the attempts to evaluate SHS exposure, public health programmes have been developed to help the compliance with the regulations about tobacco smoking. The Smoke-free Primary Health Care Programme implemented in Catalonia since 1992 aims to improve the knowledge, attitudes, believes, and behaviour in relation to tobacco in professionals working in primary health care centres, facilitating their implication in tobacco cessation, and promoting the compliance of the norms about tobacco smoking (Mataix-Sancho and Lozano-Fernandez, 2006; Valverde et al., 2007).

There is scant information about SHS exposure in primary health care centres, and previous studies before tobacco control laws came into effect involved only a few centres (Jané et al., 2002; Lopez et al., 2004). The present study was planned as a part of the periodical assessment of the Smoke-free Primary Health Care Programme, and its objective was to describe the SHS levels in a sample of primary health care centres in Catalonia, Spain, after the law on public health measures against tobacco smoking came into effect.

2. Materials and methods

2.1. Study design

A cross-sectional study was carried out between March and October 2006 in a convenience sample of 90 primary health care centres in Catalonia. We considered two criteria in the selection of participant centres: (1) their geographical location, in such a way that all sanitary regions were proportionally represented; and (2) their affiliation to the Smoke-free Primary Health Care Programme, according to the proportion of participation in the Programme at the time of the study design. We contacted the medical directors or nursing assistants by telephone as the centres' responsibles for the coordination of the airborne nicotine measures.

2.2. Measures and variables

Vapour-phase nicotine was used for the quantification of SHS exposure, because it is a highly sensitive and specific marker of SHS (Lopez and Nebot, 2003). We used passive sampler devices for the airborne nicotine measurements. Samplers contained a filter of 37 mm of diameter treated with sodium bisulphate. We installed a sampler device in every location on interest for 7 days, according to a method described and validated by Hammond and Leaderer (1987) as used in previous studies (Jané et al., 2002; Lopez et al., 2004; Nebot et al., 2005). Second-hand smoke levels were measured in reception halls, staff rooms, direction areas (or meeting rooms), and, if present, in continued care rooms (24 h non-stop attention). Thus, 3 or 4 samplers were installed in each centre (2 when the centres shared some of these venues because of their reduced size, as in some rural areas).

We registered for each sampler device the day and time of device's installation and collection, the volume and ventilation of the sampled room, and the presence of any signal banning smoking. Airborne nicotine concentration was expressed in $\mu g/m^3$, with a quantification limit of 5 ng per filter, equivalent to $0.02\,\mu g/m^3$ of nicotine per an exposure time of 1 week. Samples with values below the quantification limit were assigned the half of this value ($0.01\,\mu g/m^3$). Nicotine analyses were made by the Laboratory of the Public Health Agency of Barcelona by gas chromatography/mass spectrometry (GC/MS). The time-weighted average nicotine concentration ($\mu g/m^3$) was estimated by dividing the amount of nicotine extracted by the volume of sampled air (estimated air flow 24 ml/min) multiplied by the total number of minutes the filter had been exposed. We included a non-exposed blank filter every 20 used filters to check absence of contamination during preparation and manipulation of sampler devices, and no contamination was confirmed.

2.3. Data analyses

Due to the skewed distribution of airborne nicotine levels, we used medians and interquartile ranges (IQR) to describe the data. We compared the median airborne nicotine levels with the non-parametric test for medians by sanitary region, sampled location, affiliation to the Smoke-free Primary Health Care Programme, and by urban or rural area. The analyses were made with the statistical package SPSS v15.0 (SPSS Inc., Chicago, IL).

3. Results

From the 90 primary health care centres studied, 74% were in urban areas, and 60% were in the Barcelona sanitary region. Seventy-nine percent of centres were affiliated to the Smoke-free Primary Health Care Programme in the period in which measures were done.

We installed 300 sampler devices in the centres studied, and 4 had disappeared at the time of collection (1.3%). Nicotine was present in 89 samples (30.0%), corresponding to 48 different centres (53.3%); the rest of centres (46.7%) had total absence of airborne nicotine. Airborne nicotine levels were globally low, with an overall median of $0.01\,\mu g/m^3$ (IQR: 0.01–0.07) (Table 1). We found significant differences by sanitary region; the highest median nicotine concentrations were found in Alt Pirineu i Aran ($0.08\,\mu g/m^3$; IQR: 0.05–0.16) and in Lleida ($0.07\,\mu g/m^3$; IQR: 0.07–0.07). By sampled location, whilst all the median nicotine concentrations were in the limit of quantification, there were statistically significant differences in the distributions: the highest airborne nicotine levels were found in staff rooms and in reception halls, with maximum values of 1.40 and $0.60\,\mu g/m^3$, respectively. We observed significant differences by affiliation to the Smoke-free Primary Health Care Programme, with the highest values in non-affiliated centres (Table 1). We observed no differences between urban and rural areas.

4. Discussion

Airborne nicotine levels in the primary health care centres studied were very low; 30% of samples had detectable nicotine levels. The rest of samples did not exceed $1\,\mu g/m^3$, except one sample with $1.40\,\mu g/m^3$. This reflects a good level of compliance with the tobacco law and the impact of the Smoke-free Primary Health Care Programme. Locations with the highest levels of SHS were staff rooms and reception halls. Staff rooms serve as relax rooms and, in the case of continued care, it operates 24 h per day, and hence the norm prohibiting smoking can be more easily broken. Furthermore, smoking used to be allowed in these locations before the new law.

Studies conducted before the tobacco law showed higher airborne nicotine concentrations. Lopez et al. (2004) found that 58% of samples in the primary health care centres measured had quantifiable SHS levels, and 8% had concentrations higher than $2.3\,\mu g/m^3$, a level associated with a lung cancer mortality risk of 3/10,000 for 40 years of exposure (Repace and Lowrey, 1993). Some of those samples had been taken in locations where smoking was permitted at that time (smoker rooms and meeting rooms), and, in contrast, the median airborne nicotine levels in the locations where smoking was prohibited showed absence of SHS. On the other hand, in an earlier study by Jané et al. (2002) the airborne nicotine levels detected in the only primary health care centre studied averaged $1.1\,\mu g/m^3$, corresponding to a consultation office

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Table 1
Medians and interquartile ranges (IQR) of airborne nicotine concentrations (μg/m^3) by different categories.

	Centres[a] (*n*)	Analysed samples (*n*)	Lost samples (*n*)	Median nicotine concentration (μg/m^3)	IQR[b] (μg/m^3)	Maximum value (μg/m^3)	*p*-value[c]
All the centres	90	296	4	0.01	0.01–0.07	1.40	–
Sanitary region							<0.01
Alt Pirineu i Aran	2	6	–	0.08	0.05–0.16	0.41	
Barcelona	54	172	4	0.01	0.01–0.06	1.40	
Camp de Tarragona	13	44	–	0.01	0.01–0.07	0.39	
Catalunya Central	5	17	–	0.01	0.01–0.01	0.15	
Girona	9	32	–	0.01	0.01–0.01	0.10	
Lleida	5	18	–	0.07	0.07–0.07	0.60	
Terres de l'Ebre	2	7	–	0.01	0.01–0.06	0.08	
Sampled location							<0.01
Reception hall	90	88	2	0.01	0.01–0.06	0.60	
Staff room	89	87	2	0.01	0.01–0.08	1.40	
Direction area	86	86	–	0.01	0.01–0.01	0.26	
Continued care	35	35	–	0.01	0.01–0.07	0.14	
Programme affiliation[d]							<0.01
Affiliated	71	237	3	0.01	0.01–0.06	1.40	
Not affiliated	19	63	1	0.01	0.01–0.08	0.60	
Area							0.784
Urban	67	221	3	0.01	0.01–0.07	1.40	
Rural	23	79	1	0.01	0.01–0.07	0.41	

[a] Number of Primary Health Care Centres
[b] IQR: interquartile range
[c] Non-parametric test for medians
[d] Smoke-free Primary Health Care Programme.

and to the centre stairs, where smoking was already banned (but compliance was null).

Little but significant differences were found in airborne nicotine levels between affiliated and non-affiliated centres to the Programme. This could reflect the positive effect of the Programme, giving to the affiliated centres useful and effective tools for competently facing up the challenge of promoting totally smoke-free spaces and favouring cessation among staff and users.

This is one of the first attempts to systematically assess the compliance of a tobacco law in the context of primary health care, covering an important sample of primary health care centres in Catalonia, and using an objective and sensible method of measurement of SHS exposure. Similar assessments were made previously in hospitals in Catalonia in 2005 and 2006. The results showed a significant decrease in global airborne nicotine concentrations, from 0.23 μg/m^3 before the tobacco law to 0.10 μg/m^3 after the law, and the decrease was also significant in each location studied (Fernandez et al., 2008).

There are some limitations to take into account in the interpretation of these results. The study design considered only one assessment, so it does not necessarily represent the usual situation, and therefore it would be interesting to perform periodical monitoring. Nevertheless, we consider that the period of time used for the measurements (7 days) is enough for collecting such usual situation, as in previous studies in hospitals (Fernandez et al., 2008) or other public places (Nebot et al., 2005; Jané et al., 2002; Lopez et al., 2004). The selection of primary health care centres was deliberately not at random to assure participation. While the results cannot be generalised to all primary health care centres in Catalonia, it is noteworthy that we included almost 30% of all the centres, taking into account the geographical distribution and affiliation to the Programme. The relatively small number of measurements per centre could be considered another limitation, although oversampling centres with more measurements not necessarily permits to increase the study validity but its costs. In a previous study in hospitals (Fernandez et al., 2008) we used 5–7 samplers per hospital, with satisfactory results. We cannot rule out some kind of manipulation of sampler devices by staff or users in the centres, although we consider it unlikely. In this sense, the lost of only 1% of the installed devices in our study were lower than that observed in hospitals (Navas-Acien et al., 2004; Fernandez et al., 2008). Besides, we did not observed signs of tobacco smoking (butts, tobacco smell, ashes, ashtrays, or persons smoking) in those locations where devices were not found at the removal moment, so it is unlikely that an underestimation of SHS exposure exists because of these missings.

In conclusion, the low airborne nicotine levels found in primary health care centres studied demonstrate a good compliance with the tobacco law, although there is still some infringement to the law. Reinforcing tobacco control measures is necessary to eliminate SHS exposure, especially in continued care and staff room, and promoting the inclusion of all centres in the Smoke-free Primary Health Care Centre Programme. Use of objective techniques to monitor SHS levels (measurement of airborne nicotine or other objective and reliable markers, as respirable suspended particles as $PM_{2.5}$ (Hyland et al., 2008)) is a useful and effective tool to assess and reinforce the smoking control measures, not only in public places (Nebot et al., 2005) and hospitals (Fernandez et al., 2008), but also in primary health care centres.

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Authors' contributions: MF, MJL, ES, CMartín, CMartínez, and EF conceived the study. MF, GO, and AV coordinated collection of data. MF was responsible for data management. MF, JMMS, and EF performed statistical analyses. All authors participated in the interpretation of results. MF drafted the manuscript, and all authors contributed to the critical review and revision of the manuscript. All authors approved the final version of the manuscript. EF is the guarantor.

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