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Validity of self-reported exposure to second-hand smoke in hospitality venues

Iñaki Galán [a,b,*], Elga Mayo [a], María J. López [c,d,e], Mónica Pérez-Ríos [d,f,g], Marcela Fu [h,i,j], Jose M. Martínez-Sánchez [h,i,k], Anna Schiaffino [h], Albert Moncada [l], Agustín Montes [d,g], Manel Nebot [c,d,e,m,†], Esteve Fernández [h,i,j]

[a] National Centre for Epidemiology, Instituto de Salud Carlos III, Madrid, Spain
[b] Department of Preventive Medicine and Public Health, School of Medicine, Universidad Autónoma de Madrid/IdiPAZ, Madrid, Spain
[c] Public Health Agency of Barcelona, Barcelona, Spain
[d] Biomedical Research Centre Network for Epidemiology and Public Health (CIBERESP), Spain
[e] Institute of Biomedical Research (IIB Sant Pau), Barcelona, Spain
[f] Epidemiology Unit, Galician Directorate for Public Health, Galician Health Authority, Santiago de Compostela, Spain
[g] Department of Preventive Medicine and Public Health, University of Santiago de Compostela, Santiago de Compostela, Spain
[h] Tobacco Control Unit, Cancer Control and Prevention Programme, Institut Català d' Oncologia – ICO, L'Hospitalet de Llobregat, Barcelona, Spain
[i] Cancer Control and Prevention Group, Institut d'Investigació Biomèdica de Bellvitge – IDIBELL, L'Hospitalet de Llobregat, Barcelona, Spain
[j] Department of Clinical Sciences, School of Medicine-Campus de Bellvitge, Universitat de Barcelona, L'Hospitalet de Llobregat, Barcelona, Spain
[k] Biostatistics Unit, Department of Basic Sciences, Universitat Internacional de Catalunya, Sant Cugat del Vallès, Barcelona, Spain
[l] Community Health Unit, Terrassa City Council, Terrassa, Spain
[m] Department of Experimental and Health Sciences, Pompeu Fabra University, Barcelona, Spain

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ABSTRACT

The aim was to assess the validity of self-reported exposure to second-hand smoke (SHS) in 50 hospitality venues of Madrid (Spain) in 2010, taking as a reference vapour-phase nicotine measured by active sampling. The questions posed in the questionnaire permitted distinguishing between the different levels of SHS. However, the moderate relationship found (Spearman's correlation = 0.387, $p < 0.001$) suggests that intensity of exposure to SHS in hospitality venues, based solely on self-reported information, should be used with caution.

1. Introduction

Exposure to second-hand smoke (SHS) increases the risk of ischaemic heart disease, lung cancer, and obstructive respiratory diseases, among other health problems, and it is responsible for 0.7% of the burden of disease worldwide (Oberg et al., 2011; US Surgeon General, 2006).

During the present decade, numerous European countries have introduced comprehensive tobacco control regulations, among which should be emphasized those aimed at preventing passive exposure to SHS, especially in hospitality venues (Gorini et al., 2010). In Spain, the tobacco control law came into force in January 2006 banning smoking in all workplaces except in hospitality venues. Subsequently, this exception was amended by a new law that came into force in January 2011.

The use of questionnaires is the most common indirect method for measuring exposure to SHS (Pérez-Ríos et al., 2013) because they are simple and quick to implement in low-resource settings, and they are able to find out the particular characteristics of the person reporting the exposure. However, they can lead to measurement errors (Jaakkola and Jaakkola, 1997), which still have not been sufficiently evaluated. Such information is relevant because many of the smoking regulations are aimed at controlling SHS in this particular setting, and because the assessment of this impact has mainly been based on self-reported data obtained using questionnaires (Callinan et al., 2010).

* Correspondence to: Centro Nacional de Epidemiología,Instituto de Salud Carlos III, Monforte de Lemos 5, 28029 Madrid, Spain.
E-mail address: igalan@isciii.es (I. Galán).
† Manel Nebot died on October 18, 2012. He was a pioneer and leader on tobacco control research and evaluation of public health interventions.

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The aim of this study was to assess the validity of measuring exposure to SHS using questionnaires in hospitality venues, taking as a reference the objective measurement of airborne nicotine.

2. Material and methods

2.1. Study design

A cross-sectional study was carried out in hospitality venues of the city of Madrid (Spain) in 2010.

2.2. Study population

A sample of 50 hospitality venues was obtained, as part of a study assessing the impact of the 2011 Spanish tobacco control law, banning indoor smoking in all hospitality venues. The field work was carried out in November–December 2010, prior to when the law came into force. In a first stage, a representative sample of the municipal districts and census sections of the city of Madrid was selected, weighted by population size. Subsequently, in each census section, a random sample of the following hospitality venues was selected: bars, cafeterias, and restaurants with bar or cafeteria service. Fast food outlets, pubs and restaurants without a bar service were excluded, as were those premises where smoking was banned or that had less than 3 clients at the time the survey was conducted. In each selected hospitality venue, 3 clients were chosen following a convenience procedure with age and sex quotas, and if subjects refused to participate they were not substituted. The people interviewed did not know that the environmental nicotine level of the premises was being simultaneously measured. The response rate was 92% ($n=138$).

2.3. Measurements

The self-reported information was gathered using face-to-face interviews. The questionnaire had two questions about the perception of the intensity of exposure to SHS: (1) "*How would you describe the second-hand smoke in this hospitality venue?* High, medium, low, and very low intensity of exposure"; (2) *"What score from 0 to 10 would you give this hospitality venue regarding the amount of tobacco smoke, bearing in mind that 0 would be minimum contamination and 10 maximum contamination?"* In addition, information was gathered about sex, age, and tobacco consumption. Simultaneously to completing the questionnaire, vapour-phase nicotine was measured using nicotine samplers, following Hammond's validated method, as previously described (Hammond, 1993; López et al., 2013). The sampler consisted of a 37-mm diameter plastic cassette containing a filter treated with sodium bisulphate. The samplers were attached to an air pump with a flow rate of 3 L/min, and 30-min measurements were performed. The nicotine analysis was estimated using a gas chromatography/mass spectrometry method. The limit of quantification was 5 ng per filter. Samples with values under the limit of quantification were assigned half of this value. The time-weighted average nicotine concentration ($\mu g/m^3$) was estimated by dividing the amount of extracted nicotine by the volume of air sampled (estimated flow rate multiplied by the total number of minutes the filter had been exposed).

The size of the venues was on average 43 m^2. The time of the day at which the questionnaires and nicotine samples were collected ranged between 9.30 am and 8:30 pm.

2.4. Statistical analysis

Geometric means were calculated for airborne nicotine concentration. The Kruskal–Wallis test and the Spearman correlation coefficient were used to compare the exposure to SHS as reported in the questionnaire with that obtained from objective measurements. The linear trend was estimated for the question "*How would you describe the second-hand smoke in this hospitality venue?*"

3. Results

For the four perceived SHS environments, the geometric means for airborne nicotine in the hospitality venues were as follows: "very low intensity" 5.0 $\mu g/m^3$ (95% CI: 2.8–8.8); "low intensity" 9.6 (95% CI: 7.6–12.2); "medium intensity" 10.5 (95% CI: 6.5–16.8); and "high intensity" 15.9 (95% CI: 10.0–25.2) ($p=0.015$). The increase in the environmental nicotine concentration rose in line with the increase in the perception of greater SHS contamination and showed a linear trend with a p value $=0.007$.

Table 1
Correlation between the airborne nicotine concentration[a] and the score[b] for the perception of exposure to second-hand smoke (SHS) according to sex, age and smoking status. Madrid (Spain), 2010.

	N	Spearman coefficient	*p* Value
Total	138	0.387	<0.001
Sex			
Men	66	0.272	0.027
Women	72	0.483	<0.001
Age			
25–39 years	37	0.404	0.013
40–54 years	70	0.405	<0.001
≥ 55 years	31	0.327	0.071
Smoking status			
Non-smoker	66	0.476	<0.001
Smoker	41	0.352	0.024
Ex-smoker	31	0.312	0.008

[a] Vapour-phase nicotine measured by active sampling.
[b] Score from 0 to 10 (0 minimum SHS contamination, 10 maximum SHS contamination).

Table 1 presents the values for the Spearman correlation coefficients between the score (on a scale from 0 to 10) for the perception of the intensity of exposure to SHS and the level of airborne nicotine. Overall, the estimated correlation was moderate $r=0.387$ ($p<0.001$), and it was higher among women ($r=0.483$; $p<0.001$) than men ($r=0.272$; $p<0.027$), as well as moderately higher in young and middle-aged people than in those of 55 years or older. Nevertheless, the differences between the correlation coefficients of sex and age were not statistically significant. Regarding the pattern of tobacco consumption, a higher correlation was found for those who had never smoked ($r=0.476$; $p<0.001$) in contrast to smokers or ex-smokers ($r=0.352$ and $r=0.312$; $p<0.05$, respectively), although the difference between the Spearman coefficients was not significant. Finally, adjusting simultaneously sex and tobacco consumption in a regression model, smokers had a lower score compared to non-smokers for the perception of exposure to SHS ($p=0.021$), independently of sex and airborne nicotine concentration, while no differences were observed between men and women (data not shown).

4. Discussion

The results of this study show that self-reported assessment of SHS through questionnaires permits distinguishing between the levels of airborne nicotine concentration in hospitality venues, although only moderately positive correlations were found.

To our knowledge, this is the first study that describes the validity of self-reported SHS exposure in hospitality venues. Other studies, which have evaluated self-reported exposure by comparing it to airborne nicotine measured in other settings, have also found moderate correlations. For example, in the workplace, Willemsen et al. observed correlations of 0.41–0.65 for several variables of the questionnaire related to exposure to SHS (Willemsen et al., 1997). In a similar way, Coultas et al. found a correlation of 0.54 (Coultas et al., 1990). For general exposure to SHS, and when comparing it with personal nicotine samplers, two studies reported fairly similar results to those found in our study (Eisner et al., 2001; Scherer et al., 1999).

A notable result was the higher correlation found for never smokers than for smokers. Furthermore, never smokers had a higher score for the perception of exposure to SHS. Smokers usually estimated exposure to SHS less reliably than non-smokers (Pron

et al., 1988), which could be related to a higher "tolerance" to SHS among smokers. However, these findings merit future in-depth research.

One of the arguments used to explain why high correlations are not found when measuring exposure using questionnaires is recall bias, which is usually higher when the reference period is longer (Coughlin, 1990). However, in our study, the questions asked about perceived exposure took place at the same time as the measurement of environmental nicotine concentration. Therefore, the difference between the estimates could not be attributed to this bias, but to the differing perception of the respondents.

To aid correct interpretation of the results, several limitations of the study should be mentioned. First, the sample size was too small to be able to carry out stratified analyses with sufficient statistical power, and the selection of the interviewees was not random, given the special circumstances of the field work. Second, as self-reported assessment is sensitive to cultural context (Avila-Tang et al., 2013), caution is needed about generalizing the results to other geographical settings. The main strength of this study is that, to our knowledge, it is the first one to analyse the validity of self-reported information in hospitality venues, comparing this information with that obtained using the best possible measurement available for exposure to SHS, which is airborne nicotine concentration.

5. Conclusions

Self-reported measurement of SHS through questionnaires permitted distinguishing between different levels of SHS in hospitality venues, especially in those who had never smoked. However, the magnitude of the correlation with environmental nicotine concentration was moderate. Therefore, it is recommended that assessment of the intensity of exposure to SHS in hospitality venues based solely on self-reported information should be used with caution.

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