Impact of tobacco control policies on exhaled carbon monoxide in non-smokers
Isabella Annesi-Maesano, Severine Tual, Jean-Pierre Piau, Bertrand Dautzenberg, Martin Jarvis

To cite this version:

HAL Id: hal-00557365
https://hal.archives-ouvertes.fr/hal-00557365
Submitted on 19 Jan 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Type of article: Short report

Title: Impact of tobacco control policies on exhaled carbon monoxide in non-smokers

Authors: Séverine Tual¹,², Jean-Pierre Piau¹,², Martin J. Jarvis³, Bertrand Dautzenberg⁴, Isabella Annesi-Maesano¹,²

Affiliations:
1. INSERM, UMR S 707, EPAR, F-75012, Paris, France;
2. UPMC Univ Paris 06, UMR S 707, EPAR, F-75012, Paris, France;
4. Service de Pneumologie, Pitié-Salpêtrière, UPRES EA 2397, UPMC Univ Paris 06, OFT France;

Corresponding author:
Dr Isabella Annesi-Maesano
Epidemiology of Allergic and Respiratory diseases Department (EPAR)
UMR S 707 INSERM & UPMC Paris 6
Medicine’s School Saint-Antoine
27, rue Chaligny
75571 Paris CEDEX 12
France
Tel: +33 1 44738449
Fax: +33 1 44738454
E-mail: annesi-maesano@u707.jussieu.fr

The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd and its Licensees to permit this article (if accepted) to be published in JECH editions and any other BMJPLG products to exploit all subsidiary rights, as set out in our licence.

Short title: CO and tobacco control policies in non-smokers

Key words: Passive smoking, public health policy, air pollution

Abstract word count: 201

Manuscript word count: 1074

Contributors: BD initiated the study, contributed to the design of the study and was responsible for data collection as president of French office for tobacco prevention (OFT). ST, JPP and IAM were responsible for data management and statistical analysis, plan of data and wrote the paper. BD and MJJ contributed to interpretation of findings. All authors provided critical comments to the paper and gave final approval of the version to be published.

Ethics approval was not required.
ABSTRACT

Background
Passive smoking is a serious health risk in non-smokers. The strength of tobacco control policies of the EU countries vary. This study aimed to investigate the relationship between second-hand smoke exposure, as assessed by exhaled carbon monoxide (eCO), and the strength of national tobacco control policies, in non-smokers in the EU.

Methods
Data were provided from the EU campaign “HELP: for a life without tobacco” during national events settled in the 27 EU countries in 2006-2007. Individual information on age, gender, and eCO were obtained from 58,919 self-reported non-smokers. The strength of national tobacco control policies was scored by the Tobacco Control Scale (TCS). The relationship between eCO and TCS score was investigated using both an ecological and a multilevel approaches.

Results
Both analyses reported a significant linear decrease in eCO per unit increase in TCS score, with a smaller estimation resulting from the multilevel analysis ($\beta = -0.03$ ppm, 95% CI: –0.04-0.02 vs. 0.05 (0.02-0.08)).

Conclusion
Our study confirms, in a large European non-smoker population, the relevance of strong anti-smoking policies in reducing exposure to passive smoking. Our findings give further reason to encourage European countries to strengthen their tobacco control policies to protect non-smokers from second-hand smoke.
Exposure to second-hand smoke (SHS) has been shown to be responsible for a wide range of diseases and premature deaths in non-smokers.[1] This has led supranational authorities, including the European Union (EU), to launch initiatives promoting a smoke-free lifestyle, by both enforcing the legislative framework and by encouraging health promotion.[2] National policies to limit exposure to second-hand smoke nevertheless vary widely among EU Member States. Instruments have been developed to evaluate national policies, based on the six most effective tobacco control measures, providing a quantitative ranking of EU countries.[3] To raise awareness, the EU funded in 2005 the 4-year campaign “HELP: for a life without tobacco” using media and national events in the 27 EU Member States. The present study explores, using data collected during this campaign, the relationship between SHS exposure, as assessed by exhaled carbon monoxide (eCO) and the strength of national-level tobacco control policies, as scored by the Tobacco Control Scale (TCS), in non-smokers in the 27 EU Member States.[3]

Methods

The campaign HELP enabled to collect data between March 2006 and July 2007 on a convenience sample of 111,835 people interviewed in several cities of the 27 EU countries where national events were organized. Stands were settled in various places such as public places and health care facilities. The present cross sectional study included 58,919 self-reported non-smokers with eCO concentration lower than 10 parts per million (ppm). This threshold was chosen to exclude smokers who denied their status (5.6% of self-reported non-smoker participants).[4]

Individual information were obtained on age, gender and smoking habits from a standardised interview and on exhaled CO in expired air after breath-holding with a portable CO analyser, using an established protocol.[5] An ecological variable, the TCS score, was used to measure the strength of the national tobacco control policies. The TCS, first published in 2005 and updated in 2007, provides an overall national score based on six different tobacco control interventions, namely price and taxes level, clean indoor air laws, comprehensive advertising bans, funding for tobacco control programs, characteristics of health warnings on tobacco packs, and affordability of tobacco dependence treatments.[3, 6] The 2005 TCS score was attributed if no change in tobacco control policies had occurred in the country between 2005 and the date of interview; the 2007 score was attributed, otherwise. This score increases with the strength of tobacco control policies up to a possible maximum of 100 points.

An ecological analysis was initially carried out to estimate the effect of TCS score on exhaled CO, averaged over the country level, using a linear model. Examination of residuals scatterplots found no important deviation from the assumption of normality. A multilevel linear analysis was also performed to assess the association between TCS score and eCO, measured at individual-level, after adjusting for age, gender, and survey setting.[7] In the multilevel approach, the possible clustering of non-smokers within countries in relation to individual eCO was also analysed by the intraclass correlation coefficient (ICC).[8] In both analyses, the strength of the association between TCS score and eCO was appraised by the β coefficient (95% CI). The percentage of country differences in eCO explained by the adjusted model was estimated by the adjusted R² for the ecological analysis and by the R² as described by Merlo et al. for the multilevel analysis.[8]

Results

Non-smokers in the sample were interviewed most frequently in public places (49%), followed by health care (13%) and educational (13%) facilities, sport (10%), cultural (7%), and music (4%) events, and lastly in workplaces (4%). More than 50% of non-smokers were less than 30 years old and 48.7% were males. Mean eCO ranged from 1.6 ppm (SD=2.1 ppm) in Ireland to 6.6 ppm (SD=1.9 ppm) in Greece. The TCS score varied from 26 in Luxembourg to 74 in Ireland. A significant linear 0.05 ppm decrease in mean eCO per unit increase in TCS
score was estimated by the ecological analysis (95% CI= 0.02 to 0.08) (p=0.00245) (figure 1, table 1). This model explained 23.6% of the variation in mean eCO. The multilevel model showed a noticeable clustering of non-smokers within countries by an intraclass correlation equals to 0.28 (table 1). Although individual variables (age, gender, and survey setting) were significantly associated with individual eCO, they explained only 4% of the differences in eCO between countries (table 1). Adjustment for individual variables and TCS score led to an intraclass correlation decrease and explained 27.7% of the differences in eCO between countries. A significant linear 0.03 ppm decrease in eCO per unit increase in TCS score was estimated by the multilevel analysis (95% CI= 0.02 to 0.04) (p<0.0001) (table 1).

Discussion

We found that exhaled carbon monoxide concentration decreased with the strength of tobacco control policies, as scored by the Tobacco Control Scale in a large non-smoker European population.

However, this study has several limitations. The HELP campaign aimed to highlight the consequences of active and passive smoking and to promote tobacco-free lifestyles throughout the EU. The CO concentration was used to sensitize individuals to the role of tobacco smoke as a pollutant of the whole body. Its measurement in expired air was chosen since it could be performed non-invasively and for its cost-effectiveness advantages. Exhaled CO was thus, in this study, the most appropriate marker of individual SHS exposure. However, carbon monoxide is not specific to tobacco smoke, as it can also reflect exposure to other environmental sources such as traffic, occupational, or domestic emissions. Therefore, further investigations are needed to validate our results. They should include more detailed information on tobacco smoke exposure of non-smokers relating to sources and intensity of involuntary exposure at home or at work. In smaller-scale studies, cotinine is commonly used as a specific marker. However, its measure in saliva or urine is costly and complex to perform. Nevertheless, Haw et al. showed, by using cotinine concentrations in a national-level study, a large and significant reduction in SHS exposure in non-smoking adults after the implementation of smoke-free legislation.[9]

Our exploratory findings support these results on a large sample from 27 countries, at the European Union level, by confirming the relevance of strong anti-smoking policies integrating a set of tobacco control interventions for the reduction of passive smoking. They constitute a further reason to encourage the EU Member States with the weakest tobacco control policies to strengthen them, in particular to protect non-smokers from second-hand smoke. This could be achieved by launching comprehensive smoke-free legislation with the support of the population, by following the example of Ireland.[10]
Table 1: Effects of individual and country-level variables on exhaled carbon monoxide in 58,919 non-smokers, EU-27, 2006-2007

<table>
<thead>
<tr>
<th></th>
<th>Multilevel analysis (individual eCO)</th>
<th>Ecological analysis (mean eCO)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change in eCO (95% CI) in ppm</td>
<td>Change in eCO (95% CI) in ppm</td>
</tr>
<tr>
<td></td>
<td>ICC</td>
<td>R² (%)</td>
</tr>
<tr>
<td>Empty model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without any independent variable</td>
<td>-</td>
<td>0.280 Reference</td>
</tr>
<tr>
<td>Adjusted model†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without TCS score</td>
<td>Not shown</td>
<td>0.275 4.0</td>
</tr>
<tr>
<td>With TCS score‡</td>
<td></td>
<td>(-0.037;0.018) 0.222 27.7</td>
</tr>
</tbody>
</table>

* R² defined as \([\Omega_{u0}-\Omega_{u1})/\Omega_{u0}\]*100 ; \(\Omega_{u0} = \)country-level variance of the empty model; \(\Omega_{u1} = \)country-level variance of the adjusted model
† Adjusted for age, gender, and survey setting
‡ In the ecological analysis, adjusted only for TCS score

Figure 1: Association between the Tobacco Control Scale (TCS) score and mean eCO estimated by the ecological analysis, EU-27, 2006-2007
Acknowledgments: We wish to thank the 27 of the study and all Help events organisers and participants. national correspondents

Competing interest: None declared

Funding: BD manages the Office Français de Prévention du Tabagisme (OFT), a Non Governmental Organisation, that received partial funding from the European Union for this study.

What this study adds

Passive smoking is a serious health risk in non-smokers. In the European Union, the scope and character of national tobacco control policies vary widely among the Member States, as indicated by scores on the “Tobacco Control Scale”.

Our measures of exhaled carbon monoxide concentration in a large sample of European non-smokers support the relevance of strong anti-smoking policies, as scored by the TCS, for the reduction of passive smoking.

Policy implications

These findings give further reason to encourage European countries to strengthen their tobacco control policies.
References