

# Air Quality in Bars of São Paulo/Brazil before and after the Smoke-Free Law in Indoor Places

*Qualidade do Ar em Bares de São Paulo/Brasil antes e depois da Lei de Ambientes Fechados Livres de Fumo*

*La Calidad del Aire en los Bares de São Paulo/Brasil antes y después de la Ley Libre de Humo en Lugares Cerrados*

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## **Abstract**

**Introduction:** Secondhand smoke is currently considered the main pollutant in indoor environments, with no safe levels of exposure. **Objective:** The present study aims to quantify levels of air nicotine in bars in São Paulo, Brazil, before and after the state law that bans smoking in indoor places. **Method:** The study was conducted in partnership between the Alliance for the Control of Tobacco Use - Brazil, and the Johns Hopkins Bloomberg School of Public Health – USA. Air nicotine was measured using passive air monitors containing a filter treated with sodium bisulfate. The quantity of air nicotine absorbed by the filters was measured in the laboratory at Johns Hopkins University. The study was conducted in 16 bars and the total amount of valid samples was 72. **Results:** On average, a 72% reduction in air nicotine was found in the surveyed establishments after the smoking ban in indoor places in the state of Sao Paulo was adopted. This indicates improvement in air quality within these environments and a decreased risk of exposure to secondhand smoke for both clients and workers. **Conclusion:** The results of this study provide local evidence for the effectiveness of such policies and support the need for federal legislation guaranteeing 100% smoke-free indoor environments to all Brazilians.

**Key words:** Tobacco; Nicotine; Air Quality Control; Tobacco Smoke Pollution; Public Health

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## INTRODUCTION

Secondhand smoke (SHS) is currently considered the main pollutant in indoor environments, with no safe levels of exposure<sup>1</sup>. Of about 4,800 constituents identified in SHS, at least 250 are toxic, and at least 50 compounds have “sufficient evidence for carcinogenicity” as defined by the International Agency for Research on Cancer - IARC, with eleven proven carcinogens for humans<sup>2-3</sup>. Nicotine, the addictive substance in cigarette smoke, is toxic when inhaled, causing excessive stress on both circulatory and nervous systems, and has been associated with increased susceptibility to cancer development<sup>4</sup>.

Pollutants in tobacco smoke disperse homogeneously in the environment, and separation of smokers and nonsmokers in indoor places does not eliminate the risk of exposure to toxic components of smoke, even if ventilation systems or air renovation is used<sup>5-8</sup>. Based on scientific evidence regarding the health risks related to secondhand smoke exposure, public education campaigns and the adoption of effective measures to protect people from SHS exposure have become a public health priority. Furthermore, Article 8 of the Framework Convention on Tobacco Control (FCTC), a global public health treaty developed under the auspices of the World Health Organization (WHO), requires that signatory countries promote effective action to protect people from secondhand smoke and recommends a smoking ban in indoor public and work places, among others<sup>9</sup>.

In Brazil, it is estimated that 200,000 deaths occur annually due to active smoking, and at least 7 deaths daily are related to secondhand smoke exposure<sup>10</sup>. Despite having ratified the FCTC treaty, Brazil has not yet adopted a national 100% smoke-free policy. Under the current national law, Act 9,296/1996, smoking rooms are allowed, which is not in accordance with Article 8 of the FCTC.

With about 40 million inhabitants, the State of São Paulo took an important step towards reducing the impact caused by exposure to secondhand smoke by banning the consumption of tobacco products in collective indoor places. The “*Lei Antifumo*” [Antismoking Law] in São Paulo, as it is known, was approved in April 2009, signed in May 2009 and enforced as of 7<sup>th</sup> August 2009<sup>11</sup>. Recently, a study was published demonstrating the impact of the smoking ban in indoor places in the city of São Paulo. The carbon monoxide concentration was measured in restaurants, bars, night clubs and similar venues and in their workers, and a significant reduction was verified<sup>12</sup>. In order to measure improvements in indoor air quality after law enforcement and provide additional evidence of effectiveness, bars in the capital of São Paulo were chosen to be monitored by a study conducted in partnership between the NGO Alliance for the Control of Tobacco Use - Brazil, and the Johns Hopkins Bloomberg School of

Public Health - USA. This present study aims to quantify levels of air nicotine in bars in São Paulo before and after the law that bans smoking in indoor places was adopted.

## METHOD

Air nicotine was measured using passive air monitors containing a filter treated with sodium bisulfate (Figure 1). The monitors were placed in bars and kept there for seven consecutive days (Figure 2). The first phase of data collection occurred from June 3 to July 30, 2009 (prior to the smoke-free law enforcement in São Paulo), and the second phase from November 12 to December 23, 2009 (after the enforcement, which occurred on August 7). In addition to the monitors, for each establishment, an observational questionnaire was completed, which included general information such as opening hours, use of ventilation or heating systems, and the accurate location of the monitors in the environment.

The quantity of air nicotine absorbed by the filters was measured in the laboratory at Johns Hopkins University. The concentration of air nicotine is considered a good indicator of SHS because it can be easily identified and quantified and is highly specific, which makes it an objective parameter of secondhand smoke exposure.

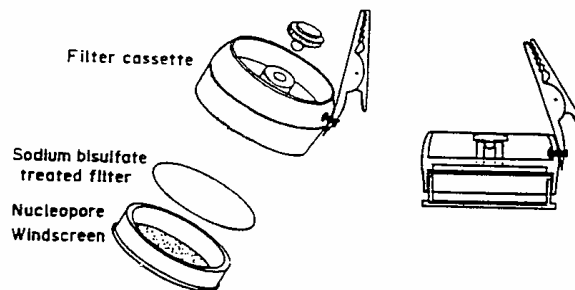


Figure 1. Nicotine monitor based on sodium bisulfate treated filter

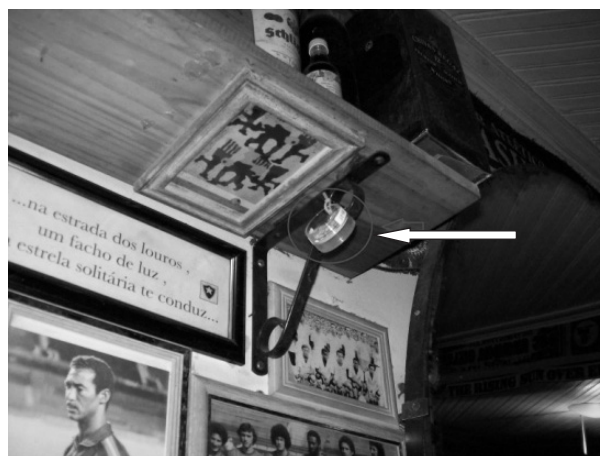


Figure 2. Air nicotine monitor hung in a bar in São Paulo, Brazil

Follow-ups were conducted to verify monitor location and condition, and after seven days the monitors were collected. Two monitors were installed for each establishment and were hung at different locations in the serving area of the establishment. To ensure measurement accuracy, 10% duplicates and 10% field blanks were deployed for quality control purpose.

The study was conducted in 16 bars located in the western region of São Paulo (Capital) in Vila Madalena, a neighborhood known for its large concentration of bars and restaurants. Sampling locations were selected through contact with AGEAC, the Association of Gastronomy, Entertainment, Art and Culture of Vila Madalena, which pointed out the bars available for the research. After obtaining consent from the establishment's representatives, observational data was collected at each location and air nicotine monitors were placed.

In total, 78 samples were collected. As six of them had to be discarded because they were damaged, the total amount of valid samples was 72. Having the building as the unit of analysis, descriptive statistics were generated and levels of air nicotine were compared using the Stata 11 statistical software (Stata Corporation).

## RESULTS

On average, a 72% reduction in air nicotine was found in the surveyed establishments after the smoking ban in indoor places in São Paulo State was adopted. Percent reduction ranged from 6% to 94%, with a median of 73% ( $p < 0.0001$ ). In seven out of the sixteen locations surveyed (44%), the reduction was 80% or greater (Figure 3). In just one of the bars, the reduction was only 6%, but in this specific establishment the original concentrations were already low in comparison to other establishments before the enforcement of the law (Figure 4).

The highest level of air nicotine found prior to the implementation of the smoke-free law was  $14.21 \mu\text{g}/\text{m}^3$ , and the highest post-implementation concentration was  $4.79 \mu\text{g}/\text{m}^3$ , both in the same establishment. The lowest pre-law concentration was  $0.44 \mu\text{g}/\text{m}^3$  and the lowest post-law,  $0.24 \mu\text{g}/\text{m}^3$ , in different establishments (Figure 4). The pre-law average rate considering all surveyed establishments was  $3.52 \mu\text{g}/\text{m}^3$  and post-law,  $0.59 \mu\text{g}/\text{m}^3$ .

## DISCUSSION

The results show a dramatic reduction in air nicotine levels in bars of São Paulo after the adoption of the smoke-free law. This indicates significant improvement in air quality within these environments and a decreased risk of exposure to secondhand smoke for both clients and workers. In places where there are still measurable levels

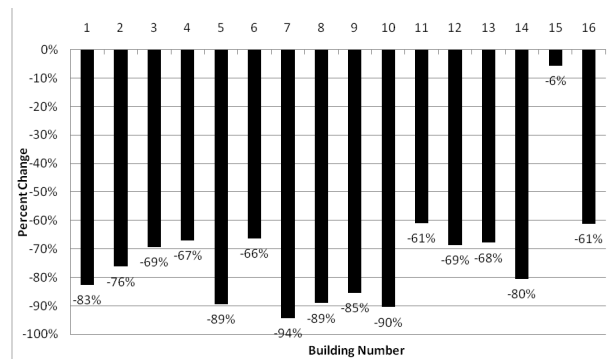


Figure 3. Air nicotine levels in selected bars before and after implementation of the smoke-free law in São Paulo, Brazil

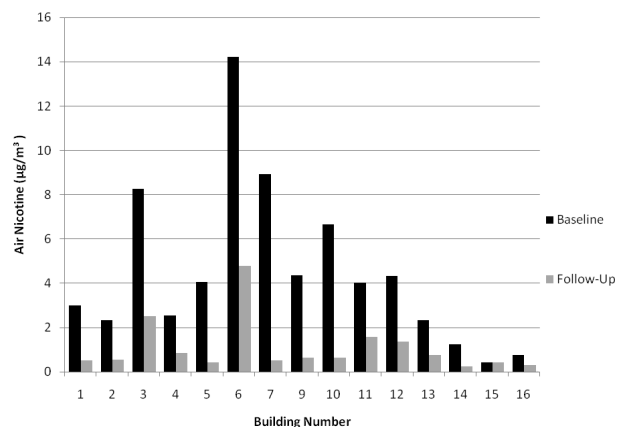


Figure 4. Reductions of air nicotine concentrations in selected bars in São Paulo, Brazil, after the implementation of the smoke-free law

of air nicotine (average of  $0.59 \mu\text{g}/\text{m}^3$ ), it is likely that the smoke-free law is not fully enforced, or that there is an inefficient system of separation between the areas where you can smoke (open areas) and where you cannot (indoor areas). As limitations of this study, the small amount of sampling locations (16 bars) and the relatively short period of evaluation post-law could be mentioned. Other studies with similar methods with greater coverage are desirable and an additional follow-up study should be conducted to confirm that establishments are still complying with the law.

The average concentration of air nicotine found in bars in the period prior to implementation of the smoke-free law was  $3.52 \mu\text{g}/\text{m}^3$ . It is similar to that found in the Navas-Acien et al. and cols' study<sup>13</sup> from 2004. It investigated exposure to secondhand smoke in public places in Latin American countries (Argentina, Brazil, Chile, Costa Rica, Paraguay, Peru and Uruguay), where smoke-free policies had not yet been enacted, and found an average nicotine concentration of  $3.65 \mu\text{g}/\text{m}^3$  in bars.

This shows that even though there are smoking restrictions that allow designated smoking areas, such

as the Brazilian federal law of 1996<sup>14</sup>, people are still exposed to high levels of tobacco smoke. These exposure levels demonstrate the need for comprehensive smoking bans, as opposed to partial bans in indoor places, to fully protect workers and the general public. Follow-up air nicotine concentrations found in the sampled bars in São Paulo after the implementation of the smoke-free law demonstrate the effectiveness of such policies and reinforce why they have been internationally recognized as one of the most effective and inexpensive ways to protect people's health. Not only are smoke-free policies effective, as demonstrated by this study, but have also been supported by the public. A survey conducted by the state government one month post-enforcement of the smoke-free law in São Paulo reported that 94% of the state of São Paulo citizens support the measure, and 87% among smokers. Among people over 45 years of age, the proportion of those in support of the new law reaches 95%<sup>15</sup>. Similar studies in other countries, such as Mexico, also show that there is popular support for smoke-free policies, with these types of feelings generally increasing post-implementation of the policy<sup>16</sup>.

A survey conducted with 60 bars and restaurants owners in the city of São Paulo after one year of the law implementation reveals that 82% agree with the law, and 95% report there was either hire increase or no dismissals. In addition, governmental data reveals high compliance with the law since its implementation: over 99% of the establishments inspected<sup>17-18</sup>. Results of this policy in São Paulo mirror results in other areas of the world. Successful policy implementation and reduction of SHS levels have been found in Mexico, Guatemala, and Uruguay, among others<sup>16, 19-20</sup>.

## CONCLUSIONS

In order to protect workers and the general public from the harmful effects of SHS, it is critical that a 100% smoke-free policy, such as the one adopted in the state of São state, be enacted at the national level. Such policy is scientifically incontestable and has wide-ranging public support, lacking only political will to achieve it. A comprehensive smoking ban is the only way to ensure protection from SHS exposure, especially for professionals in the hospitality sector, such as waiters, who are most at risk in their place of work. Arguments against the adoption of 100% smoke-free indoor places lack rationality and credibility and are, most of times, clearly associated with the commercial interests related to tobacco consumption. The results of this study provide local evidence for the effectiveness of such policies and support the need for federal legislation guaranteeing 100% smoke-free indoor environments to all Brazilians.

## ACKNOWLEDGEMENTS

Clarissa Homs, Marina Seelig and Raquel Topfstedt, for your contribution during the survey design and data collection period.

Part of this research (monitors and lab analysis) was supported by a grant from Pfizer Foundation. Note: The funding organization had no role in the outcome of this study or preparation of the article.

## CONTRIBUTIONS

Mônica Andreis worked with the design, planning, data collection and interpretation of the research project, as well as with the final writing of the paper; Jessica Elf worked with the design, planning, data analysis, interpretation and the final revision of the paper; Paula Johns worked with the design, planning of the research project and the final revision of the paper; Adriana Carvalho worked with the design, planning, data collection and interpretation of the research project, as well as with the final revision of the paper; Jie Yuan worked with the data analysis and interpretation; Benjamin Apelberg worked with the design, planning, data analysis, interpretation and the final revision of the paper.

**Conflict of Interest: None**

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## Resumo

**Introdução:** O fumo passivo é atualmente considerado o principal poluente em ambientes internos, sem nível seguro de exposição. **Objetivo:** O presente estudo visa a quantificar os níveis de nicotina no ar em bares de São Paulo, Brasil, antes e depois da lei estadual que proíbe o fumo em locais fechados. **Método:** O estudo foi realizado em parceria entre a ONG Aliança de Controle do Tabagismo - Brasil, e a Johns Hopkins Bloomberg School of Public Health - EUA. A nicotina no ar foi medida através de monitores passivos contendo um filtro tratado com bissulfato de sódio. A quantidade de nicotina no ar absorvida pelos filtros foi medida no laboratório da Universidade Johns Hopkins. O estudo foi realizado em 16 bares e a quantidade total de amostras válidas foi de 72. **Resultados:** Em média, uma redução de 72% da nicotina no ar foi encontrada nos estabelecimentos pesquisados após a proibição de fumar em locais fechados no Estado de São Paulo. Isso indica uma melhora na qualidade do ar nesses ambientes e uma diminuição do risco de exposição ao fumo passivo por clientes e trabalhadores. **Conclusão:** Os resultados deste estudo oferecem evidências locais da eficácia de tais políticas e apoio à necessidade de uma legislação federal que garanta ambientes fechados 100% livres de fumo a todos os brasileiros.

**Palavras-chave:** Tabaco; Nicotina; Controle da Qualidade do Ar; Poluição por Fumaça de Tabaco; Saúde Pública

## Resumen

**Introducción:** El humo de tabaco es actualmente considerado el principal contaminante de ambientes interiores, sin niveles seguros de exposición. **Objetivo:** El presente estudio tiene como objetivo cuantificar los niveles de nicotina del aire en los bares de São Paulo, Brasil, antes y después de la ley estatal que prohíbe fumar en lugares cerrados. **Método:** El estudio se llevó a cabo en colaboración entre la Alianza para el Control del Tabaquismo - Brasil, y la Johns Hopkins Bloomberg School of Public Health - EE.UU. La nicotina del aire se midió mediante monitores pasivos de aire que contiene un filtro tratado con bisulfato de sodio. La cantidad de nicotina absorbida por el aire de los filtros se midió en el laboratorio de la Universidad Johns Hopkins. El estudio fue realizado en 16 bares y la cantidad total de muestras válidas fue de 72. **Resultados:** En promedio, una reducción de 72% de la nicotina en el aire se observó en los establecimientos después de la prohibición de fumar en lugares cerrados en São Paulo. Esto indica una mejora en la calidad del aire dentro de estos ambientes y un menor riesgo de exposición al humo de segunda mano para los clientes y trabajadores. **Conclusión:** Los resultados de este estudio proporcionan evidencias locales de la eficacia de esas políticas y apoyan la necesidad de una legislación federal que garantice ambientes cerrados 100% libres de humo a todos los brasileños.

**Palabras clave:** Tabaco; Nicotina; Control de Calidad del Aire; Contaminación por Humo de Tabaco; Salud Pública