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Global Smokefree Partnership

Public Health Agency

Report on

Air Quality Assessment

for Second Hand Smoke

in Hospitality Venues in Mauritius

Study conducted under

African Tobacco Situation Analysis (ATSA) Initiative of the International Development Research Centre (IDRC) & Bill and Melinda Gates Foundation (BMGF)

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Summary

The new FCTC-compliant regulations were adopted in Mauritius in November 2008 and came in force as from 1st March 2009. The objective of this study was to monitor compliance by assessing the quality of indoor air. For this reason, nicotine and particles measurements were taken on a convenient sample of 60 hospitality venues and shopping malls covering the whole island of Mauritius. This sample included 5 types of venues: 12 snack/café or tea shops, 12 bars, 12 restaurants, 12 night/private clubs and 12 shopping malls.

35% of the PM indoor measurements are higher than the Air Quality Standard published by the U.S. Environmental Protection Agency (35 µg/m3). The overall median PM2.5 concentration found is 20.28 µg/m3. In 42% of the venues studied the PM2.5 concentration found indoor is 1.5 or higher than the concentration found outdoor. In the case of night clubs, 83% of them had ratios higher. In hospitality venues where nicotine was measured, presence of Second Hand Smoke (SHS) was found in 69% of the samples. In those venues, the median nicotine levels found (0.08 µg/m3) are, however, significantly lower than those found in other studies carried out in countries where smoking is still allowed. The highest concentrations of both markers have been found in private and night clubs, where the median PM2.5 concentration is more than 38 times the concentration found outdoor.

Overall, we can conclude that there is presence of SHS in a considerable number of the venues studied. Although the levels of SHS found in most venues are not very high, there are still some “hot spots”, mainly private and night clubs, with very high levels of SHS that may be associated with an important health risk for workers and clients. Therefore, surveillance and enforcement actions should be done in order to progressively improve the situation.

INTRODUCTION

Exposure to secondhand smoke (SHS) has been recognized as a risk factor for a variety of diseases among exposed adults, including coronary heart disease and lung cancer. Besides, SHS exposure causes respiratory symptoms and infections, exacerbation of asthma and increased risk for sudden infant death syndrome in children. Current estimates suggest that exposure to SHS might be responsible for as many as 19,400 annual deaths among non-smokers, only – reference in Europe. In response to this growing evidence, smokefree programs and policies have been widely promoted and implemented in public places and at workplace. In the last few years several countries have also introduced smoking prohibition in bars and restaurants, showing a strong support of public opinion and a positive impact on health.

In response to the Framework Convention on Tobacco Control (FCTC) a National Action Plan on Tobacco Control (2008-2012) was developed and being implemented in the Republic of Mauritius. The objectives of this Action Plan are:

(1) to reduce tobacco related mortality and morbidity by preventing tobacco use.
(2) to promote cessation
(3) to protect for exposing to SHS.

The new FCTC-compliant regulations were adopted in Mauritius in November 2008 and came in force as from 1st March 2009. The regulations under 1999 legislation on environmental tobacco smoke was strengthened in order to reduce exposure to tobacco smoke in public transport, private vehicles carrying passengers and most public places including workplaces, bars, cafes, restaurants, nightclubs and public gardens.

However, passing smoke-free legislation is not enough. It should be followed by an effective implementation and adequate enforcement. Together with the passing of the smoke-free regulations which is considered as an administrative strategy of change, there is a need for an educational strategy (in terms of advocacy and consciousness-raising campaign). It is to be noted that as from February 2009, the government started a national awareness campaign on the new regulations through mass media and other channels. This effort need to be strengthened and sustained by other strategic activities targeting specific groups with respect to smoke-free regulations. Along with the implementation of the smoke-free regulations rigorous monitoring of the smoke-free policy is imperative to guide enforcement. The objective of this study is to monitor compliance by assessing the quality of indoor air through SHS level measurements in public and workplaces. This would provide evidence as up to what extent the new regulations are making all indoor places and workplaces (including cafes, bars, nightclubs and restaurants) 100% smoke-free.

OBJECTIVES

(1) To assess air quality with reference to SHS in hospitality venues.

(2) To evaluate the effectiveness of smoke-free policies

METHODS

Nicotine and particles measurements were taken on a convenient sample of 60 hospitality venues and shopping malls covering the whole island of Mauritius. This sample includes 12 venues per each type of hospitality venue selected: cafés (12 venues), bars (12 venues), restaurants (12 venues), night clubs (12 venues) and shopping malls (6 venues x 2 measurements). In shopping malls, two measurements were taken in each of the 6 malls selected: one in the food court and one in the public toilet. The fieldwork was carried out during December 2009.

Vapour-phase nicotine has been widely used in numerous studies assessing SHS exposure, since SHS is the only source of nicotine. Furthermore, sampling and analysis methods have been developed to measure nicotine simply and accurately. These methods are very sensitive, showing extremely low limits of detection. Particulate matter less than 2.5mm in diameter ($PM_{2.5}$) has been also widely used in studies measuring SHS exposure. It is not an specific marker like nicotine, but in absence of other combustion sources is a good and reliable marker of SHS. PM2.5 is dangerous to human health because it can be inhaled and lodged deep in the lungs.

PM2.5 was measured using an aerosol monitor (TSI SidePak AM510 Personal Aerosol Monitor, TSI) fitted with an impactor to sample the concentration of PM2.5. The monitor was calibrated to zero each day before use. The measurements were taken during a minimum of 30 minutes indoor and 5 minutes outdoor in each place. A total of 119 measurements (60 measurements indoor and 59 outdoor) were carried out.

Vapor phase nicotine was measured using SHS passive samplers (37 mm diameter plastic cassette containing a filter treated with sodium bisulphate). The samplers were fixed at places where they were left for 7 days unhampered. For each sample the following data were recorded: sample's code, country, public place, sample location, date and time placed and removed, presence of smoking signs, presence of cigarette butts, presence of people smoking and

presence of ash-trays. Information on sampling area, sampling volume and ventilation in each establishment was also recorded for evaluation of extreme or inconsistent values. The nicotine analysis was conducted at the Laboratory of the Public Health Agency in Barcelona, by gas chromatography/mass spectrometry (GC/MS) method. 30 samples were taken in a sub-sample of venues selected for PM 2.5 measurements.

Given the skewed distribution of PM and nicotine concentration, we used median and interquartile ranges (IQR) to describe the nicotine concentration by type of venue.

RESULTS

60 hospitality venues were sampled, including 5 type of venues: 12 snack/café or tea shops, 12 bars, 12 restaurants, 12 night/private clubs and 12 shopping malls. 60 PM2.5 indoor measurements and 59 outdoor measurements were taken. Nicotine samples were taken in 30 venues, although one of them could not be analysed because two filters were placed into the same sampler.

The overall median PM2.5 concentration found was 20.28 µg/m^3 [IQR: 13.00 – 59.80]. The median nicotine concentration in those venues with presence of nicotine (concentration above the limit of quantification) is 0.08 µg/m^3 [IQR: 0.05 – 0.45] (Table 1). The highest concentration was found in night clubs/ private clubs, where the median nicotine concentration is 1.19 µg/m^3 [IQR: 0.62 – 2.14], and the median PM2.5 concentration is 375.96 µg/m^3 [IQR: 12.22 – 1240.98] (Table 2).

35% of the PM indoor measurements are higher than the Air Quality Standard published by the U.S. Environmental Protection Agency (35 µg/m^3)[1]. This standard set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. The ratio between the median PM concentration indoor and outdoor is higher than 1.5 in 2 of the 5 types of venues studied. These ratios show a PM concentration considerably higher indoor, that can be interpreted, in absence of other combustion sources, as a SHS exposure. In night clubs and private clubs, this ratio is 38.05 (Table 3). Selecting only those venues where both markers (Table 4) -PM2.5 and nicotine- were measured, the highest concentration is also found in night clubs. Furthermore, the correlation (Table 5) between PM2.5 and nicotine is positive and significant (Pearson correlation=0.847, $p<0.01$).

Table 6 and 7 show the concentrations of nicotine and PM found in each venue. Nicotine was found in 69% of the samples. 42.4 % of the venues have a PM2.5 concentration higher than 1.5 times the concentration found outdoor of the

venue. In the case of the night clubs, 83% (10/12) of them had ratios higher than 1.5.

Figure 1 and Figure 2 show the difference between a hospitality venue where the PM2.5 concentration found indoor is similar to that found outdoor, and one night club where the PM2.5 indoor concentration is much higher than outdoor.

Table 1: Nicotine and PM concentration (µg/m^3). Mauritius, 2009.

	n	Median (IQR)	Average (SD)
PM 2.5 indoor	60	20.28 (13.00 – 59.80)	179.75 (503.73)
PM 2.5 outdoor	59	15.60 (8.32 – 23.4)	21.68 (24.56)
Nicotine overall	29	0.05 (<L.Q – 0.17)	0.34 (0.73)
Nicotine (presence only)*	20	0.08 (0.05 – 0.45)	0.48 (0.84)

*Including only those samples with nicotine concentration above the limit of quantification

Table 2: Nicotine and PM2.5 concentration (µg/m^3) by type of venue. Mauritius, 2009.

	Nicotine		PM2.5	
	n	Median (IQR)	n	Median (IQR)
Snacks/café/tea shops	6	0.05 (0.01 – 0.07)	12	34.06 (15.86 – 96.64)
Bars	5	0.16 (0.06 – 0.27)	12	16.12 (7.28 – 26.26)
Restaurants	6	0.03 (<L.Q – 0.05)	12	17.68 (11.18 – 35.62)
Night clubs /Private clubs	6	1.19 (0.62 – 2.14)	12	375.96 (12.22 – 1240.98)
Shopping malls	6	0.02 (<L.Q – 0.04)	12	19.24 (11.44 – 41.08)
TOTAL	29	0.05 (<L.Q -0.17)	60	20.28 (13.00 – 59.80)

Table 3: PM 2.5 concentration (µg/m^3) indoor, outdoor and ratio indoor/outdoor by type of venue. Mauritius, 2009.

	PM 2.5 indoor		PM 2.5 outdoor		Ratio indoor/ outdoor
	n	Median (IQR)	n	Median (IQR)	
Snacks/café/ tea shops	12	34.06 (15.86 – 96.64)	12	21.32 (18.46 –26.78)	1.60
Bars	12	16.12 (7.28 – 26.26)	12	17.68 (9.36 – 30.94)	0.91
Restaurants	12	17.68 (11.18 – 35.62)	12	15.08 (8.06 – 18.98)	1.17
Night clubs /Private clubs	12	375.96 (12.22 – 1240.98)	12	9.88 (4.42 – 29.90)	38.05
Shopping malls	12	19.24 (11.44 – 41.08)	11	13.00 (8.32 – 15.60)	1.48
TOTAL	60	20.28 (13.00 – 59.80)	59	15.60 (8.32 – 23.4)	1.3

Table 4: Nicotine and PM2.5 concentration (µg/m^3) by type of venue (only venues where both markers were measured). Mauritius. 2009.

	Nicotine		PM2.5	
	n	Median (IQR)	n	Median (IQR)
Snacks/café/tea shops	6	0.05 (0.01 – 0.07)	6	75.92 (42.12 – 101.40)
Bars	5	0.16 (0.06 – 0.27)	5	26.00 (17.16 – 39.52)
Restaurants	6	0.03 (<L.Q – 0.05)	6	14.30 (8.84 – 16.12)
Night clubs /Private clubs	6	1.19 (0.62 – 2.14)	6	129.22 (9.36 – 508.56)
Shopping malls	6	0.02 (<L.Q – 0.04)	6	19.24 (12.48 – 23.92)
TOTAL	29	0.05 (<L.Q -0.17)	29	20.28 (13.52 – 66.56)

Table 5: Correlation between nicotine and PM2.5 concentrations (µg/m³).

		Nicotine	PM2.5
Nicotine	Pearson correlation	1	,847**
	Sig. (bilateral)		,000
	N	29	29
PM2.5	Pearson correlation	,847**	1
	Sig. (bilateral)	,000	
	N	29	29

** The correlation is significant at level 0.01 (bilateral).

Table 6: PM2.5 concentration (µg/m³) indoor , outdoor , ratio and nicotine concentration (µg/m³) by venue (Team A). Mauritius, 2009.

Code (Team A)	PM indoor	PM outdoor	Ratio indoor/outdoor	Nicotine
SNACKS/CAFE/TEA SHOPS				
MA 101	13.52	17.16	0.79	0.06
MA 102	63.96	28.08	2.28	-
MA 103	9.36	9.36	1.00	-
MA 104	101.40	20.28	5.00	<L.Q.
MA 105	42.12	39.52	1.07	0.08
MA 106	294.84	131.56	2.24	-
BARS				
MA 201	39.52	44.72	0.88	0.27
MA 202	2.08	17.16	0.12	-
MA 203	5.72	8.32	0.69	-
MA 204	26.00	36.40	0.71	0.06
MA 205	26.52	5.72	4.64	-
MA 206	7.80	12.48	0.63	0.16
RESTAURANTS				
MA 301	29.12	17.68	1.65	-
MA 302	13.52	9.36	1.44	0.05
MA 303	6.24	6.76	0.92	-
MA 304	16.12	18.20	0.89	<L.Q.
MA 305	55.64	28.08	1.98	-
MA 306	15.08	16.64	0.91	0.05
NIGHTS CLUBS / PRIVATE CLUBS				
MA 401	9.36	3.12	3.00	0.63
MA 402	593.84	3.64	163.14	-
MA 403	194.48	36.40	5.34	-
MA 404	1763.32	4.68	376.78	3.08
MA 405	718.64	5.20	138.20	-
MA 406	15.08	4.16	3.63	<L.Q
SHOPING MALLS				
MA 501	4.16	5.72	0.73	<L.Q.
MA 502	8.84	8.32	1.06	-
MA 503	12.48	15.60	0.80	0.17
MA 504	10.40	8.84	1.18	-
MA 505	18.20	13.52	1.35	<L.Q.
MA 506	42.64	6.24	6.83	-

Table 7: PM2.5 concentration concentration (µg/m3) indoor, outdoor, ratio and nicotine concentration (µg/m3) by venue (Team B). Mauritius, 2009.

Code (Team B)	PM indoor	PM outdoor	Ratio indoor/ outdoor	Nicotine
SNACKS/CAFE/TEA SHOPS				
MB 101	15.60	9.36	1.67	-
MB 102	16.12	19.76	0.82	<L.Q .
MB 103	26.00	25.48	1.02	-
MB 104	87.88	22.36	3.93	0.03
MB 105	22.88	22.88	1.00	-
MB 106	219.96	19.76	11.13	0.07
BARS				
MB 201	14.56	10.40	1.40	-
MB 202	17.16	25.48	0.67	0.04
MB 203	15.08	18.72	0.81	-
MB 204	6.76	7.80	0.87	-
MB 205	18.72	18.20	1.03	-
MB 206	48.88	45.24	1.08	0.27
RESTAURANTS				
MB 301	19.24	19.76	0.97	-
MB 302	5.20	3.12	1.67	<L.Q
MB 303	42.12	34.84	1.21	-
MB 304	8.84	11.96	0.74	0.08
MB 305	20.28	13.52	1.50	-
MB 306	69.16	6.24	11.08	<L.Q
NIGHTS CLUBS / PRIVATE CLUBS				
MB 401	2543.84	40.04	63.53	-
MB 402	508.56	67.60	7.52	1.74
MB 403	6.24	15.08	0.41	-
MB 404	243.36	14.04	17.33	2.14
MB 405	2431.52	23.40	103.91	-
MB 406	6.24	5.72	1.09	0.62
SHOPING MALLS				
MB 501	23.92	13.00	1.84	<L.Q
MB 502	39.52	13.00	3.04	-
MB 503	66.56	13.52	4.92	0.17
MB 504	45.24	135.20	0.33	-
MB 505	20.28	20.80	0.97	-
MB 506	15.08	-	-	-

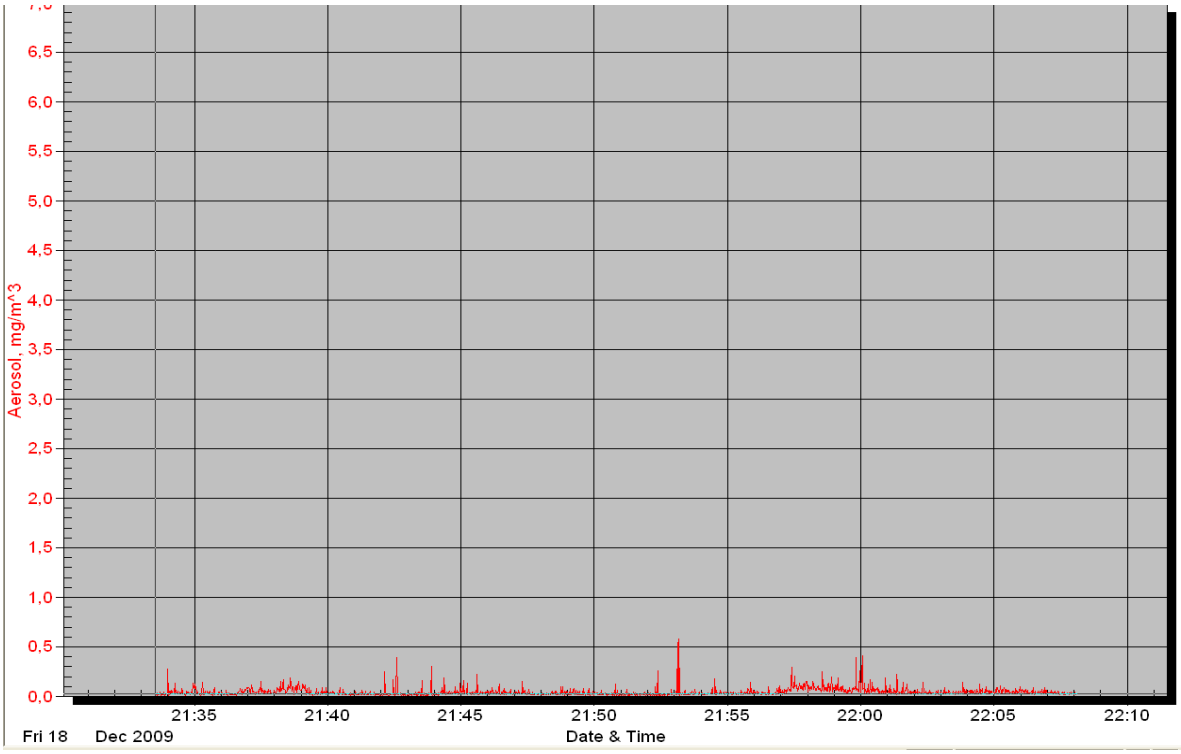

Figure 1: Example of measurement of PM concentration in a snack.

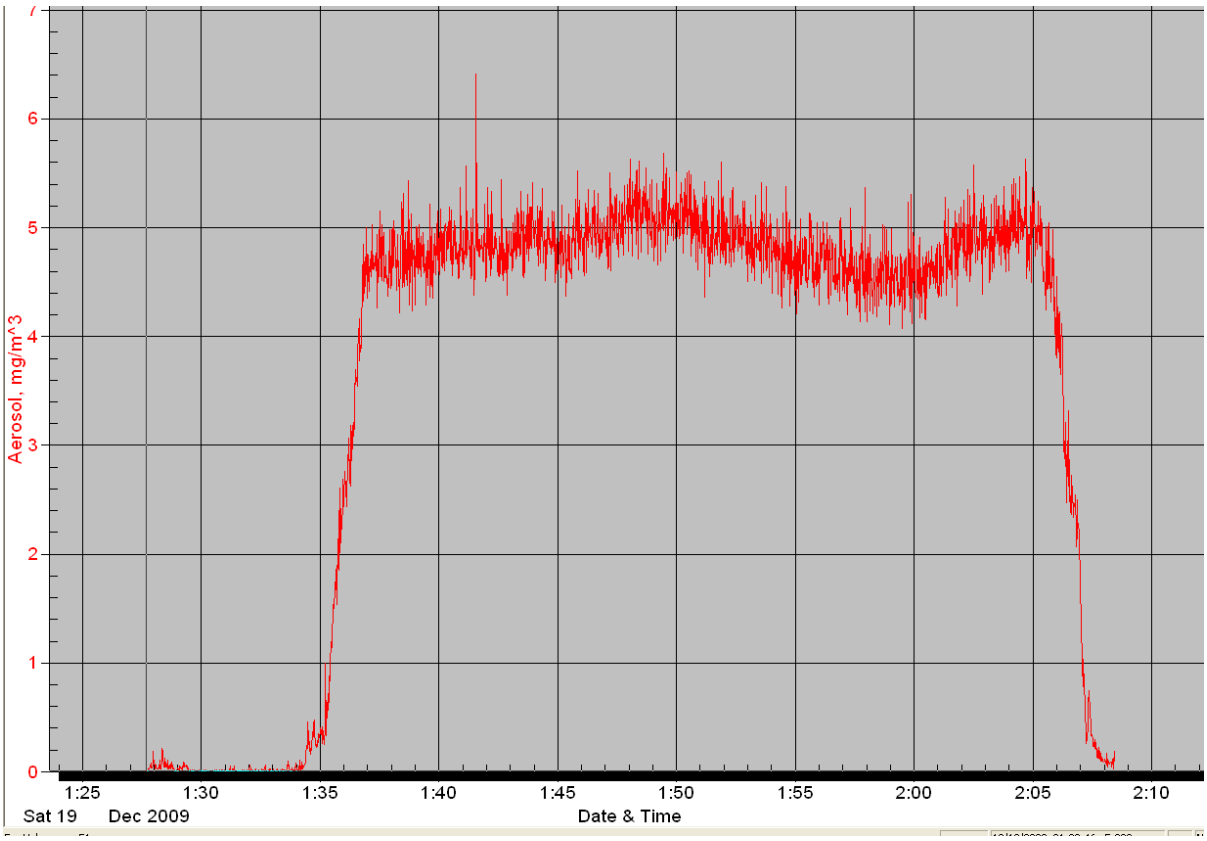

Figure 2: Example of measurement of PM concentration in a night club.

CONCLUSIONS

In 42% of the venues studied the PM2.5 concentration found indoor is 1.5 or higher than the concentration found outdoor. Furthermore, 35% of the PM indoor measurements are higher than the Air Quality Standard published by the U.S. Environmental Protection Agency (35 μg/m^3).

In hospitality venues where nicotine was measured, SHS presence was found in 69% of the samples. In those venues, the nicotine levels found (0.08 μg/m^3) are, however, significantly lower than those found in other studies carried out in countries where smoking is still allowed.

The highest concentrations of both markers have been found in private and night clubs, where the median PM2.5 concentration is more than 38 times the concentration found outdoor.

Overall, we can conclude that, there is presence of SHS in a considerable number of the venues studied. Although the levels of SHS found in most venues are not very high, there are still some “hot spots”, mainly private and night clubs, with very high levels of SHS that may be associated with an important health risk for workers and clients.

Therefore, surveillance and enforcement actions should be done in order to progressively improve the situation. First, routine inspections should be done periodically in random samples so as to monitor the situation and time trends. Secondly, a system of sanctions and follow-up of changes after the fines should be established. Finally, it is important to keep carrying out information campaigns about the health risk of SHS and the benefits of smokefree environments.

[1] U.S. EPA. National Ambient Air Quality Standards (NAAQS). Available at: http://www.epa.gov/air/criteria.html. [Consulted March 2010]