Indoor Air Quality Survey of Boston Nail Salons

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Introduction

The number and popularity of nail salons in the U.S. has grown tremendously within the past two decades, resulting in a 67% increase in revenue and over $6.5 billion for 2003 (Protecting the Health of Nail Salon, 2004). An overwhelming majority of nail salon workers are of Asian descent; Vietnamese-Americans make up 37% of licensed nail salon owners and workers nationwide (Design for the Environment, 2011). Nail salon employees typically are of reproductive age and are exposed to chemicals on a daily basis, which have the potential for causing harm to them and to their unborn children. According to the EPA, xylene, toluene, acetone, and methyl ethyl ketone in nail polishes and hardeners are neurological toxicants. Short-term effects are headaches, nausea, dizziness, and irritability. These solvents may cause neuropsychological and neurobehavioral effects, such as difficulty learning numbers and concentrating. For example, toluene in nail polish remover can be a reproductive and developmental toxicant, and may retard the development of fetuses exposed in the uterus. A 1992 epidemiological study by Ng et al. suggests that spontaneous abortion in workers exposed to toluene may occur nearly 3 times more than a control group. In addition, a 2008 occupational health survey by Roelofs et al. showed an elevation of respiratory symptoms, skin problems, and headaches among nail salon workers as compared to the general population. According to a 2011 study by Harris-Roberts et al. chemicals found in nail salon products are associated with occupational asthma and contact dermatitis. Researchers in the JBS Environmental Health and Justice program at Brandeis worked in collaboration with the Nail Salon Partners, including Boston Public Health Commission and Viet-Aid, to further understand potential chemical exposure in nail salons.

Table 1: Descriptive Characteristics of Nail Salons: Boston, MA, 2011

		Percentiles					
	Mean	Min	25th	50th	75th	95th	Max
Salon Layout (n=21)							
Volume (m^3)	218	89	117	157	295	491	613
Number of Measurement Locations in Salon	7	4	6	7	7	9	9
Number of Manicure Stations	6	3	5	6	8	14	18
Number of Pedicure Stations	5	2	4	5	6	11	12
Ventilation[1]							
Number of Ventilation Systems	2	1	2	3	3	5	5
Measurement Data							
TVOC's (ppb)	9,519	45	1,409	5,475	16,225	35,711	37,767
CO_2 (ppm)	1,085	641	809	1,055	1,257	1,544	2,057
$PM_{2.5}$ ($\mu g/m^3$)	20	6	11	16	23	49	68

[1]Five most common ventilation systems: central ventilation system, ceiling fan, open door/window, table fan, local exhaust

Methods

Brandeis Environmental Health & Justice students conducted sampling in 21 salons in Roxbury, Dorchester, Mattapan and Jamaica Plain between September and December, 2011. All information gathered was kept confidential and individuals and salons were not identified. The study protocol was reviewed by the Institutional Review Board (IRB) at Brandeis University. Study visits consisted of three parts: indoor environmental quality measurements, site observations, and a short interview with each salon owner. Field sampling teams created a diagram including general dimensions and ventilation characteristics such as locations of doors, windows, fans and vents. Observational data included what services were being provided at the time: acrylic, silk, gel, airbrushing, manicure, or pedicure, as well as the number of employees and customers present. Six to eight sampling locations were selected in each salon. A Q-Trak was used to measure carbon dioxide (CO_2), temperature and relative humidity. A DustTrak was used to measure airborne particles, and a ppbRae was used to measure total volatile organic compounds (TVOCs). Outdoor measurements were taken at each salon before entering as quality control indicators.

Results

Figure 1. Impact of services being performed on TVOC and $PM_{2.5}$ concentrations

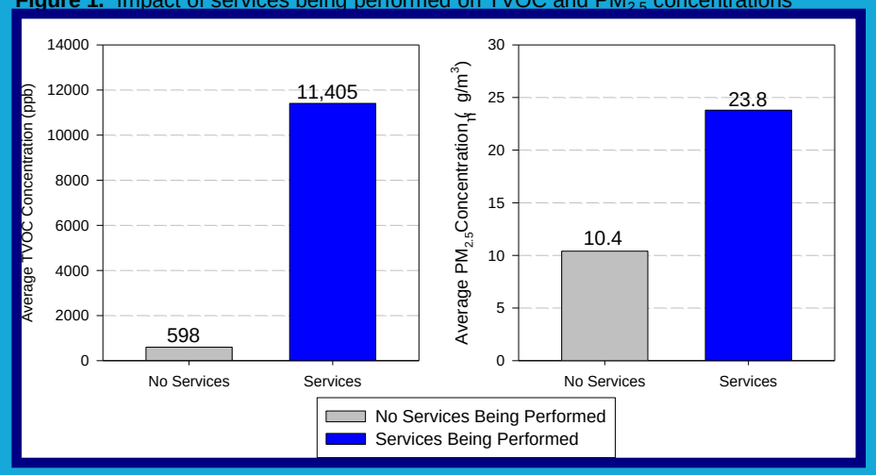


Figure 2. Average measured CO_2 (ppm) concentrations as an indicator of ventilation

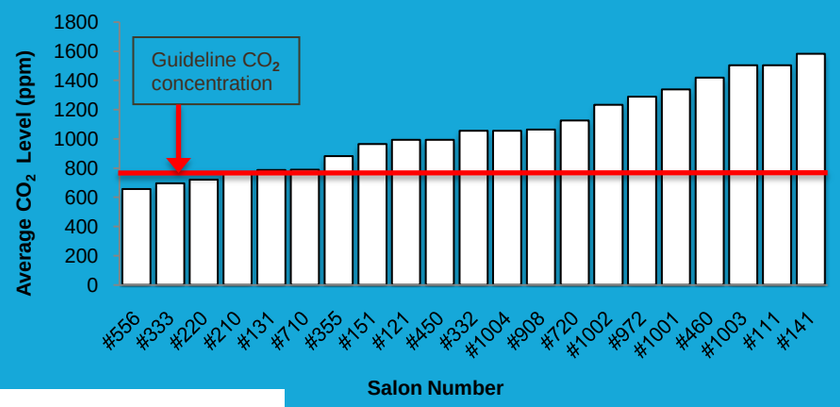


Figure 3. CO_2 (ppm) vs. $PM_{2.5}$ ($\mu g/m^3$)

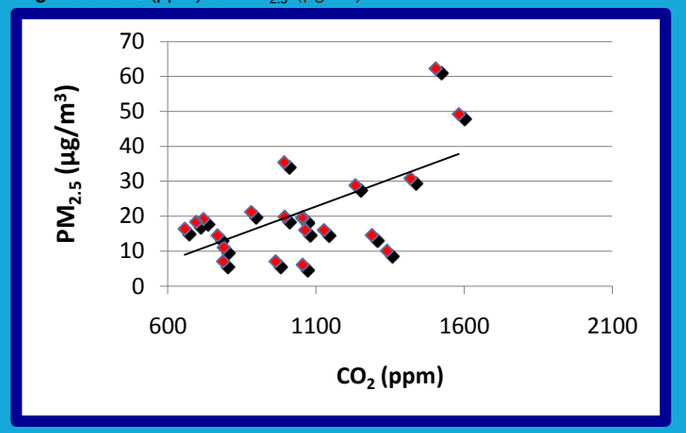
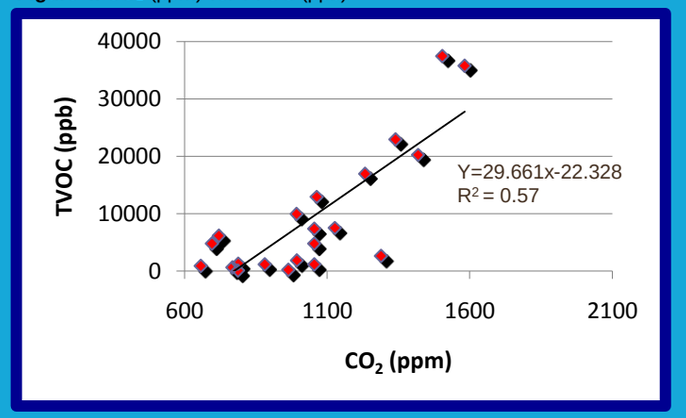


Figure 4. CO_2 (ppm) vs. TVOC (ppb)



Conclusions and Recommendations

- CO_2 levels in 15 of 21 salons exceeded 800 ppm indicating that these salons may have insufficient ventilation
- Higher TVOC and $PM_{2.5}$ levels were found in salons with poorer ventilation (as determined by elevated CO_2 concentrations)
- Contrary to our *a priori* hypothesis, average levels of TVOCs, CO_2 and $PM_{2.5}$ were consistent throughout salons, indicating that elevated exposures may not be restricted to areas in the salon where work is being performed (eg., at the manicure table)
- Higher TVOC concentrations were observed when tasks were being performed, and were not dependent upon the number of tasks being performed.
- Salons with open doors and/or windows had significantly reduced TVOC concentrations.
- Improving ventilation conditions in salons to meet minimum outdoor air delivery requirements can reduce exposures to TVOCs
- Weather permitting, increasing outdoor-indoor air exchange by opening doors and windows may be a simple approach to reducing exposures.
- Conduct additional studies of personal exposures to individual VOCs to characterize occupational exposure
- Evaluate the effectiveness of options to increase ventilation on TVOC exposures and filtration on reducing $PM_{2.5}$ exposures

Thank you to our collaborators :

Boston Public Health Commission · the safe nail salon project · Viet-Aid