Assessing Occupational Exposure in Nail Salons

Margaret Back, Katherine Chin, Morgan Dashko, Alisa Feinswog, Aliza Heeren, Tasneem Islam, Benjamin Krause, Molly Pearlman, Maia Rodriguez-Semp, Madeline Rosenberg, Emily Scharf, Shanlai Shangguan, Emily Weisfeld, Joseph Allen, Matt Fragala, Theodore Myatt, James Stewart, Laura Goldin, Brett Aronson

Introduction

The nail salon industry has become one of the fastest growing categories of Asian American businesses; Vietnamese hold 40% of the licenses across the country and most workers are women. Many products used in nail salons contain volatile organic compounds (VOCs) that are linked with negative health effects. These chemicals can be found in polishes, removers, gels and acrylic nails. Some examples of VOC’s in nail salons are acetone, formaldehyde, toluene, and ethyl methacrylate. Acetone is one of the most abundant chemicals found in nail products and is quickly absorbed into the body by inhalation and dermal exposure. It causes eye and nose irritation as well as mild nervous system effects. Formaldehyde is a known carcinogen. Toluene has been shown to cause reproductive harm and affect the central nervous system. EMA was recommended to replace the more toxic methyl methacrylate that was banned from use in Boston. EMA, contained in nail polishes, is known to cause asthma, skin and eye irritation, and possible reproductive damages to women over long periods of exposure. Workers often work 40 or more hours per week. A study focused on nail technicians in Boston documented that these workers reported “musculoskeletal disorders, skin problems, respiratory irritation and headaches.” To gain a deeper understanding of the exposures that occur in the nail salons and to provide a basis for change in Boston and the United States, the Environmental Health and Justice JBS (“Justice Brandeis Semester”) at Brandeis University, in collaboration with a local community group (Viet-AID) and the Boston Public Health Commission, conducted a study that assesses nail salon workers’ exposure to specific volatile organic compounds.

Methods

We conducted a study of occupational exposure to chemicals in 15 nail salons in the Boston area, from September to December 2013. Full-shift (~8 hours) air monitoring in the nail salons consisted of two parts. The first part involved the use of sampling media to test for exposure to acetone, formaldehyde, toluene, and ethyl methacrylate (EMA) using colorimetric tubes. Second, a TSI Q-Trak (Model 8553/7565; TSI, Inc.) was used to demonstrate the efficiency of the salon’s ventilation by measuring carbon dioxide (CO2) levels, as well as relative humidity and temperature and a TSI DustTrak (Model 8520; TSI, Inc.) was used to record particulate matter (PM2.5). To ensure the quality of measurements in this study, we collected duplicate and blank samples. Duplicate samples of all media tested were taken in two salons and showed good agreement and all blank samples were non-detect (ND). We also created a questionnaire and observation log that was to be completed upon entering and leaving sample sites that collected information such as salon capacity, number of workers in the salon, the geographic location of the salon, whether the salon was in an enclosed building structure (i.e. a multiple floor office building vs. a ground-level store front), the number and location of workstations, the number of acrylic and lacquer nail services performed during the sampling day, as well as other parameters. Data analysis was performed using Google Spreadsheet and Microsoft Excel. Descriptive statistics included calculating the average and range for the target compounds. To estimate steady-state ventilation conditions, 90th percentile CO2 concentrations were calculated. In addition to our full shift testing, we video recorded one acrylic manicure done and two lacquer manicures while simultaneously recording changes in total volatile organic (TVOC), as measured with a ppbAE photionization detector.

Table 1: Summary of Measured Concentrations in Nail Salons and Health-Based Limits

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measured in # of salons</th>
<th>Average</th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
<th>Limitation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide (CO2)</td>
<td>15</td>
<td>85.87%</td>
<td>46.7%</td>
<td>73.4%</td>
<td>178.2%</td>
<td>60ppm</td>
<td>ASHRAE</td>
</tr>
<tr>
<td>Acetone (personal)</td>
<td>14</td>
<td>1.09%</td>
<td>0.0%</td>
<td>0.72%</td>
<td>1.56%</td>
<td>1000ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Acetone (area)</td>
<td>14</td>
<td>1.06%</td>
<td>0%</td>
<td>0.72%</td>
<td>1.56%</td>
<td>1000ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Formaldehyde (personal)</td>
<td>15</td>
<td>0.93%</td>
<td>0%</td>
<td>0.58%</td>
<td>1.26%</td>
<td>0.5ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Formaldehyde (area)</td>
<td>14</td>
<td>1.09%</td>
<td>0%</td>
<td>0.72%</td>
<td>1.56%</td>
<td>0.5ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Toluene (personal)</td>
<td>15</td>
<td>1.28%</td>
<td>1.25%</td>
<td>1.25%</td>
<td>1.26%</td>
<td>200ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Toluene (area)</td>
<td>14</td>
<td>1.25%</td>
<td>1.25%</td>
<td>1.25%</td>
<td>1.26%</td>
<td>200ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Toluene (personal)²</td>
<td>14</td>
<td>0.07%</td>
<td>0%</td>
<td>0.08%</td>
<td>0.09%</td>
<td>200ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>Toluene (area)²</td>
<td>14</td>
<td>0.06%</td>
<td>0%</td>
<td>0.05%</td>
<td>0.06%</td>
<td>200ppm</td>
<td>OSHA</td>
</tr>
<tr>
<td>EMA (personal)</td>
<td>14</td>
<td>0.04%</td>
<td>0%</td>
<td>0.02%</td>
<td>0.04%</td>
<td>10ppm</td>
<td>EPA</td>
</tr>
</tbody>
</table>

Key: colorimetric tube¹ passive diffusion badge²

Results

Figure 2: 90th percentile of CO2 levels as an indicator of ventilation

Figure 3: Comparison of acetone levels in personal and area samples

Figure 4: Comparison of personal and area results for formaldehyde¹ to the OSHA PEL

Conclusion

• Some salons had levels of CO2 that indicated they did not meet the ASHRAE ventilation standard for nail salons (Fig. 2).
• Our findings showed high levels of formaldehyde in the air of the salons and in the personal breathing zones of the workers (Fig. 4).
• Most salons showed levels of formaldehyde that exceeded the OSHA PEL (8-hour TWA) (Fig. 5).
• Our data show high acetone concentrations in the personal breathing zones of the workers (Fig. 3).
• Our data show a strong correlation between low acetone concentrations and mechanical ventilation (Fig. 5); this finding was not as pronounced for formaldehyde (Fig 6).
• Toluene was detected at minimal levels (Table 1).
• EMA was detected in only one salon. In that salon, the EMA concentration exceeded EPA’s health-based guideline for EMA (Table 1).

Recommendations

• Install proper mechanical ventilation, if not already installed.
• Opt for safer products (where possible) rather than enforcing personal protective equipment for workers.
• Research nail products to provide accurate knowledge of their contents to users and regulators.
• Educate nail salon workers, clients, and owners on safer practices.
• Further evaluate occupational exposure to formaldehyde.

Thank you to our collaborators:

Healthy Cosmetology Committee

[Image 105x23 to 199x31]