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 nasal irritation as well as mild nervous system effects. Formaldehyde is a known carcinogenic. Toluene has been shown to cause reproductive harm and affect the central nervous system. EMA was detected in only one salon. In that salon, the EMA concentration exceeded EPA’s standard CO₂ of 800ppm (Fig. 1).

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 8533/7585; 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 DataTrak (Model 8280; 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 v. 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 ppbRAE photoionization detector.

Results

Our data show high acetone concentrations in the personal breathing zones of the workers. Acetone was found at levels of 1000 ppm or greater in 7 of the 15 salons. Acetone levels were higher in personal samples than area samples. Installation of proper mechanical ventilation (Fig. 3) and the use of safer products (where possible) rather than enforcing personal protective equipment (Fig. 4) could be promising solutions to reducing occupational exposure to hazardous chemicals.

Conclusions

• Some salons had levels of CO₂ that indicated they did not meet the ASHRAE ventilation standard CO₂ of 800ppm (Fig. 1).
• Our findings showed high levels of formaldehyde in the air of some salons (Fig. 2).
• 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. 4).
• 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 (Fig. 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
• Research short-term worker exposure to specific chemicals (with task-based monitoring)