



Volatile Organic Compounds Exposure and Monte Carlo Cancer Risk Assessment in Zanjan Beauty Salons, Iran



Mahnaz Abdolmohammadi ^a , Zohre Farahmandkia ^a , Ali Behroozi ^b , Behnam Pourali Moghanlou ^c , Mehran Mohammadian Fazli ^{d*}

a. Department of Environmental Health Engineering, School of Public Health, Zanjan University of Medical Sciences, Zanjan, Iran.

b. Department of Occupational Health and Safety, School of Public Health, Zanjan University of Medical Sciences, Zanjan, Iran.

c. Department of Health, Safety and Environment (HSE), School of Health, Tabriz University of Medical Sciences, Tabriz, Iran.

d. Social Determinants of Health Research Center, Health and Metabolic Diseases Research Institute, Zanjan University of Medical Sciences, Zanjan, Iran.

***Corresponding author:** Social Determinants of Health Research Center, Health and Metabolic Diseases Research Institute, Zanjan University of Medical Sciences, Zanjan, Iran. Postal Code: 4515613191. E-mail: mhrnmoh@zums.ac.ir

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ABSTRACT

Background: The use of cosmetic products in beauty salons leads to the emission of chemical pollutants, exposing staff to volatile organic compounds (VOCs). This study examines the VOCs concentration and their influencing factors within Zanjan beauty salons in 2023.

Methods: This study investigated thirty beauty salons in Zanjan across different seasons. VOCs were measured using the PhoCheck Tiger device. Subsequently, the collected data were analyzed with SPSS statistical software version 26 compared to Iranian and OEHHA occupational limits, and incorporated into assessments of respiratory risk and cancer risk via Monte Carlo simulation.

Results: VOC concentrations were found to be influenced by the type of services provided and the operation of air conditioning systems. While the non-carcinogenic risk assessment showed levels within a safe range of risk, the carcinogenic risk of benzene was considered unacceptable.

Conclusion: Although the average concentration of VOCs in Zanjan's beauty salons is below the permissible occupational exposure limits, the instantaneous nature of these measurements provides an indicative overview rather than a definite comparison. Crucially, the benzene cancer risk assessment, informed by Monte Carlo simulations, demonstrates a significant carcinogenic risk to workers. This underscores the essential need for targeted training and vigilant monitoring of health guideline compliance to protect the well-being of staff and patrons.

1. Introduction

In recent years, complaints regarding indoor air quality (IAQ) have increased due to the accumulation of pollutants (Oliaei et al., 2013). IAQ refers to the physical, chemical, and biological characteristics of indoor air, directly impacts human health and comfort, making it a critical factor in occupational environments with continuous chemical exposure, such as beauty salons (Weschler, 2009). Beauty salons, due to their inherent use of chemical substances and

often inadequate ventilation, require particular attention to their air quality. Hairdressers are continuously exposed to over 3,000 types of chemicals present in cosmetic products, which can lead to various health issues. Volatile organic compounds (VOCs) are also emitted at high concentrations in these establishments (Mohammadi et al., 2024; Ojrati et al., 2023). Furthermore, the International Agency for Research on Cancer (IARC) has identified hairdressers as being at risk of bladder cancer due to exposure to hair dyes (Mirmohammadi et al., 2018). To provide real-time data, this



study utilized the PhoCheck Tiger device. Assessing VOC concentrations and inhalation exposure provides a reliable approach to quantify both cancer and non-cancer health risks in occupational environments. Therefore, in this study, we measured the concentration of VOCs in women's beauty salons in Zanjan and evaluated the associated cancer and non-cancer risks, with probabilistic analysis using the Monte Carlo simulation. Monte Carlo simulation is a probabilistic method that uses repeated random sampling to account for variability and uncertainty in exposure parameters such as pollutant concentration, exposure duration, and inhalation rate. Compared to deterministic approaches, this method provides a more realistic estimation of health risks by generating percentile-based risk distributions, which is particularly important in occupational health risk assessment. Zanjan City, located in northwestern Iran, has a population of over 430,000 and a high density of beauty salons, with more than 1,000 active establishments. These characteristics make Zanjan a relevant and representative setting for evaluating occupational exposure to volatile organic compounds in beauty salon environments.

2. Materials and Methods

2.1 Measurements

This cross-sectional study was conducted in Zanjan City. A complete list of registered beauty salons in Zanjan was obtained from the Zanjan Health Center. Initially, salons were screened based on the following inclusion criteria: operating a minimum of 8 hours per day, providing cosmetic services, and willingness to participate. After applying these criteria, all eligible salons were numbered, and 30 were selected using a simple random sampling method. Measurements were conducted during both morning and evening sessions, inside and outside the salons, across two seasons-winter 2023 and summer 2024-resulting in a total of 266 measurements. VOCs were assessed at a distance of 30 cm from both the workers and customers (the breathing zone) and in various service lines within the salons. Additionally, outdoor measurements were taken 3 m away from the salon entrance.

2.2 Equipments

The concentration of VOCs in the indoor air of beauty salons was measured using the portable PhoCheck Tiger device (PhoCheck Tiger, Ion Science Ltd, Fowlmere, Cambridgeshire, UK; equipped with a PID lamp model 6,10 eV; minimum sensitivity of 0.001 ppm, or 1 ppb). In previous studies (Acharya et al., 2020; Ana et al., 2019; Ebrahemzadih et al., 2018), pollutant concentrations were commonly measured using air sampling or portable detectors, and health risk assessments were based on comparisons with occupational standards and calculations of HQ and LTCR. In the present study, VOC concentrations were measured using the PhoCheck Tiger device, and both carcinogenic and non-carcinogenic risks were assessed using EPA formulas and Monte Carlo simulation to estimate probabilistic exposure scenarios for salon workers (Baghani et al., 2018; EPA, 2011;

Harati et al., 2016). The PhoCheck Tiger device was calibrated by the Engineering, Laboratory, Occupational Health, and Environmental Equipment Company using a 100-ppm standard isobutylene gas cylinder traceable to the National Institute of Standards and Technology (NIST), USA, and a valid calibration certificate was obtained. According to the manufacturer's recommendation, this calibration is valid for one year. The relative humidity and temperature in the salons were measured using a Testo device. A data collection form was completed to identify the type of air ventilation, the services provided, the number of simultaneous services, the salon area, and the number of staff. In addition, the measured VOC concentrations were compared with permissible exposure limits, including TLV-TWA values from ACGIH (2023) and OEHHA reference standards, to evaluate occupational safety and indoor air quality.

2.3 Calculation of Carcinogenic and Non-Carcinogenic Risks

In this study, the cancer risk assessment of benzene for workers in Zanjan's beauty salons was calculated using the EPA method. Due to the use of gloves while handling chemicals, dermal risk assessment was not performed. To evaluate the lifetime inhalation cancer risk (LTCR) for benzene, the Equation (1) was used (Harati et al., 2016):

$$\text{Cancer Risk} = \text{CDI} \times \text{CSF} \quad (\text{Equation 1})$$

Additionally, CDI is calculated using (Equation 2) (Farahmandkia et al., 2017a).

$$\text{CDI} = (\text{CA} \times \text{IR} \times \text{ET} \times \text{ED} \times \text{EF}) / (\text{AT} \times \text{BW}) \quad (\text{Equation 2})$$

The values of the parameters used for calculating the LTCR are presented in Table 1 (Lee et al., 2018; Olanreaju Clement & Adeniyi Patrick, 2017).

If the Cancer Risk $\leq 1.00 \times 10^{-6}$, it is considered acceptable by the WHO and the US EPA. If $1.00 \times 10^{-4} < \text{Cancer Risk} < 1.00 \times 10^{-6}$ necessitates the formation of a crisis management committee. However, if the Cancer Risk $> 1.00 \times 10^{-4}$, it indicates a significant carcinogenic risk (Farahmandkia et al., 2017b).

Furthermore, the non-carcinogenic risk of VOCs can be assessed using the Hazard Quotient (HQ), which is calculated according to Equation (3), and the TLV-TWA values are presented in Table 2.

$$\text{HQ} = \frac{\text{Exposure concentration} \left(\frac{\text{mg}}{\text{m}^3} \right)}{\text{TLV-TWA} \left(\frac{\text{mg}}{\text{m}^3} \right)} \quad (\text{Equation 3})$$

Table 1. Values of parameters used for inhalation risk assessment

parameter	Parameter Description	value
CA	Contaminant Concentration in air (mg/m ³)	-
CDI	Chronic Daily Intake (mg/kg/day)	-
CSF	Cancer Slope Factor (mg/kg/day) ⁻¹	0.027
IR	Inhalation rate (m ³ /h)	0.80
ET	Exposure time (h)	8
ED	Exposure duration (years)	30
EF	Exposure frequency (days/year)	350
BW	Body weight (kg)	70
AT	Average lifespan (days)	25550

Note: Values are based on the age group of 21 to 81 years

Table 2. Tlv-TWA values for inhalable VOCs (ACGIH, 2023)

Volatile Organic Compound	Reference Inhalation Concentration (PPM)	Reference Inhalation Concentration (mg/m ³)
Benzene	0.5	1.6
Ethylbenzene	20	434
Toluene	20	75
Xylene	20	86
Acetone	250	590

In this study, the risk assessment of exposure to VOCs among individuals aged 21 to 81 years in the indoor air of beauty salons was investigated. $HQ > 1$ indicates an undesirable non-carcinogenic risk, while an $HQ \leq 1$ signifies an acceptable risk (Baghani et al., 2018).

2.4 Monte Carlo simulation

Using a single number to assess and quantify cancer risk increases uncertainty. Therefore, Monte Carlo simulation technique was used to assess cancer risk. Oracle Crystal Ball software developed by Oracle Corporation (USA) was used and the best distribution of concentration data was obtained. By considering 100,000 defined scenarios in the concentration range, from the best case (5%) which represented exposure to the lowest concentration, to the worst case (95%) which represented exposure to the highest concentration, the cancer risk for inhalation exposure to benzene was obtained.

2.5 Statistical Analysis

Statistical analyses were performed using SPSS software version 26 (IBM Corp., Armonk, NY, USA). The normality of the data was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Since the significance levels obtained from both tests were less than 0.05, the assumption of normal distribution was rejected. Therefore, non-parametric statistical methods were applied. Spearman's rank correlation test was used to evaluate the relationships between VOC concentrations and environmental variables, including temperature, relative humidity, and salon area. Statistical significance was considered at $p < 0.05$.

3. Results and Discussion

3.1 VOC Concentrations in Beauty Salons

The average concentrations of acetone, benzene, ethylbenzene, toluene, and xylene in the indoor air of 30 beauty salons during the summer were 1.43, 0.80, 1.87, 1.62 and 1.82 mg/m³ (0.6, 0.25, 0.43, 0.43, and 0.42 ppm), respectively. In the winter, these concentrations were 0.55, 0.42, 0.48, 0.41 and 0.87 mg/m³ (0.23, 0.13, 0.11, 0.11, and 0.2 ppm). The mean and standard deviation of VOC concentrations for all sampling events are presented in Table 3. Although 30 beauty salons were selected as sampling

locations, the number of valid measurements differed slightly between seasons and locations due to field conditions and data screening; therefore, N represents the total number of valid measurements for each scenario (summer indoor: N = 65; summer outdoor: N = 65; winter indoor: N = 71; winter outdoor: N = 65).

The average concentrations of benzene, ethylbenzene, toluene, xylene, and acetone in both summer and winter were compared with Iran's occupational exposure limits established in the 1400 standard (OEL, 2021) (benzene 0.5 ppm, ethylbenzene 20 ppm, toluene 20 ppm, xylene 20 ppm, and acetone 250 ppm). These measurements are instantaneous and intended to provide an indicative overview of VOC levels, not a direct comparison with occupational exposure limits. However, the average benzene concentration in summer (0.51 mg/m³ (0.25 ppm)) and winter (0.27 mg/m³ (0.13 ppm)) exceeds the short-term exposure limits established by the California Office of Environmental Health Hazard Assessment for indoor air (OEHHA, 2025). This finding is particularly important given the carcinogenic nature of benzene and suggests that compliance with national standards alone may not fully protect salon workers from potential health risks. This finding aligns with the study by Baghani et al. (2018), which reported that the average benzene concentration in a survey of 50 beauty salons in Ardabil was above the recommended levels by Health Canada, with the highest concentration attributed to ethylbenzene.

Similar to our study, the concentrations of these compounds were influenced by the type of ventilation system and the nature of services provided. The maximum concentration in the indoor air of beauty salons during summer was related to acetone at 6.43 mg/m³ (2.57 ppm), while the minimum concentration was related to toluene at 0.02 mg/m³ (0.002 ppm). In winter, the maximum concentration was for xylene at 7.00 mg/m³ (2.8 ppm), and the minimum concentrations were for toluene and ethylbenzene at 0.003 mg/m³ (0.001 ppm) (Mehrasbi et al., 2015; OEHHA, 2025). These variations indicate that short-term peak exposures may occur during specific activities or under inadequate ventilation conditions, even when average concentrations remain relatively low. The ratios of concentrations for acetone, benzene, ethylbenzene, toluene, and xylene from summer to winter are 2.5, 1.9, 3.8, 3.8, and 2, respectively. This seasonal pattern suggests that reduced ventilation efficiency and changes in operational practices during colder months can significantly influence indoor VOC levels. A study by Hadei et al. (2018) in Tehran also demonstrated that pollutant concentrations in the indoor environment of salons were significantly higher than those outdoors.

Table 3. Mean, standard deviation, and number of valid measurements (N) of VOC concentrations (as PPM) in Zanjan beauty salons

Season & Location	Acetone Mean (SD)	Benzene Mean (SD)	Ethylbenzene Mean (SD)	Toluene Mean (SD)	Xylene Mean (SD)	N
Summer-Inside	0.6 (0.7)	0.25 (0.31)	0.43 (0.51)	0.43 (0.55)	0.42 (0.46)	65
Summer-Outside	0.093 (0.056)	0.021 (0.017)	0.026 (0.018)	0.035 (0.020)	0.040 (0.022)	65
Winter-Inside	0.23 (0.62)	0.13 (0.31)	0.11 (0.26)	0.11 (0.29)	0.2 (0.64)	71
Winter-Outside	0.041 (0.055)	0.018 (0.022)	0.028 (0.030)	0.013 (0.014)	0.021 (0.024)	65

3.2 Impact of Environmental Conditions on VOC Concentrations in Beauty Salons

The correlation among VOCs, temperature, and humidity levels was analyzed using Spearman's correlation test. The results indicated a high correlation between acetone and benzene (0.906), acetone and ethylbenzene (0.674), acetone and toluene (0.696), and acetone and xylene (0.689), suggesting that these compounds typically increase or decrease together. This strong inter-correlation suggests that these VOCs likely originate from similar emission sources, such as cosmetic products used simultaneously during specific beauty services. Benzene also demonstrated a strong correlation with other VOCs, indicating a common source for these compounds.

Temperature showed no significant correlation with any of the VOCs, but relative humidity exhibited a significant negative correlation with all VOCs. This suggests that as relative humidity increases, the concentration of these compounds decreases. This inverse relationship may be attributed to enhanced removal or dilution of airborne VOCs under higher humidity conditions, particularly in salons using evaporative cooling or natural ventilation.

The correlation between area size and VOC concentrations was not significant, and due to the localized measurement of

VOC concentrations, the effect of area size on VOC levels could not be analyzed. This finding implies that micro-environmental conditions around the breathing zone and immediate emission sources may play a more critical role than overall salon size in determining workers' exposure.

3.2.1 Impact of Ventilation Type on VOC Concentrations in Beauty Salons During Summer

Figure 1 illustrates the effect of ventilation type on the concentrations of VOCs during the summer. The highest VOC concentrations were observed in salons utilizing air conditioning, while the lowest concentrations were found in salons that employed both mechanical and natural ventilation simultaneously. This pattern may be explained by the recirculation of indoor air in air-conditioned salons, which can limit the effective removal of VOCs when adequate fresh air exchange is not provided. This finding aligns with the results of Senthong & Wittayasilp (2021), which demonstrated that the installation of local ventilation and natural ventilation significantly reduces VOC concentrations. The combined use of mechanical and natural ventilation likely enhances pollutant dilution and removal, particularly during high-emission beauty services commonly performed in summer.

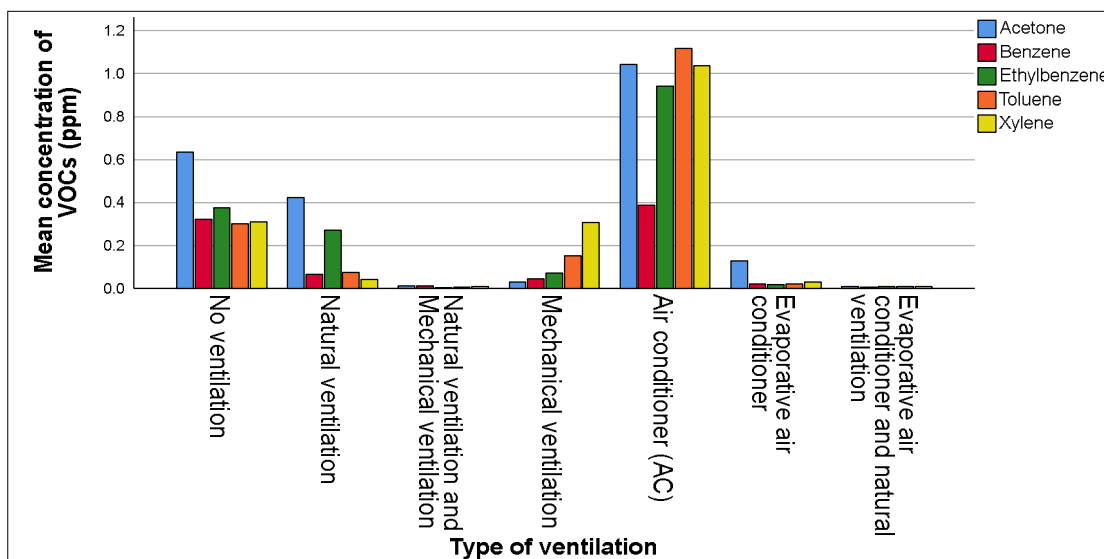


Figure 1. Impact of ventilation type on VOC concentrations in beauty salons during summer

3.2.2 Impact of Ventilation Type on VOC Concentrations in Beauty Salons During Winter

Figure 2 illustrates the effect of ventilation type on the concentrations of VOCs in beauty salons during the winter. The highest VOC concentrations were found in salons with no ventilation, while the lowest concentrations were observed in salons utilizing a combination of mechanical and natural ventilation. This increase in VOC levels in non-ventilated salons can be attributed to reduced air exchange during winter, as windows and doors are often kept closed to maintain thermal comfort. This pattern underscores the

importance of effective ventilation in reducing VOC levels during colder months. Maintaining adequate ventilation during winter is therefore critical to preventing the accumulation of hazardous pollutants, despite seasonal constraints on natural air flow.

3.3 Impact of Operational Conditions on VOC Concentrations in Beauty Salons

To understand the impact of operational conditions on the concentrations of target compounds in beauty salons, this study examined several operational factors, including the

type of services offered and the number of simultaneous services. The results indicated that the type of services significantly affected VOC concentrations, while the number of services did not show a meaningful correlation with VOC levels. This suggests that the nature and chemical composition of products used during specific services play a more decisive role in VOC emissions than the overall workload or number of concurrent activities.

3.3.1 Impact of Service Type on VOC Concentrations in Beauty Salons During Summer

According to the types of services provided in the salons, as analyzed in Figure 3, the highest VOC concentrations during summer were associated with nail manicures, hair keratin treatments, facial makeup, and hairstyling. Toluene, ethylbenzene, and acetone showed the highest concentrations in nail manicures, while benzene was highest in hair keratin treatments, and xylene was predominant in facial makeup and hairstyling. These findings reflect the extensive use of solvent-based products, adhesives, and hair straightening formulations during these services, which are known sources of BTEX compounds and acetone. A study by de Gennaro et al. (2014) in Italy also demonstrated that VOC concentrations were more influenced by the type of products used, with salon area size having a negligible effect on VOC

levels. Our findings support this notion, indicating that both the type of services and the type of ventilation significantly influenced VOC concentrations. The consistency between these studies highlights the critical role of product selection and service-specific practices in determining occupational exposure levels in beauty salons.

3.3.2 Impact of Service Type on VOC Concentrations in Beauty Salons During Winter

Analysis of Figure 4 revealed that the highest VOC concentrations in beauty salons during the winter were associated with nail manicures. In nail manicures, acetone, benzene, toluene, and xylene exhibited the highest concentrations, while in hair coloring, ethylbenzene had the highest concentration. The predominance of these compounds during nail services can be attributed to the frequent use of solvents, nail polish removers, and resin-based products, whose emissions may accumulate more readily during winter due to limited ventilation.

A study by Ebrahimi et al. (2023) also indicated that the products used in nail salons are a primary source of Benzene, Toluene, Ethylbenzene, Xylene emissions, and there is a significant correlation between the number of services and pollutant concentrations. This further emphasizes the impact of service type on VOC levels in beauty salons.

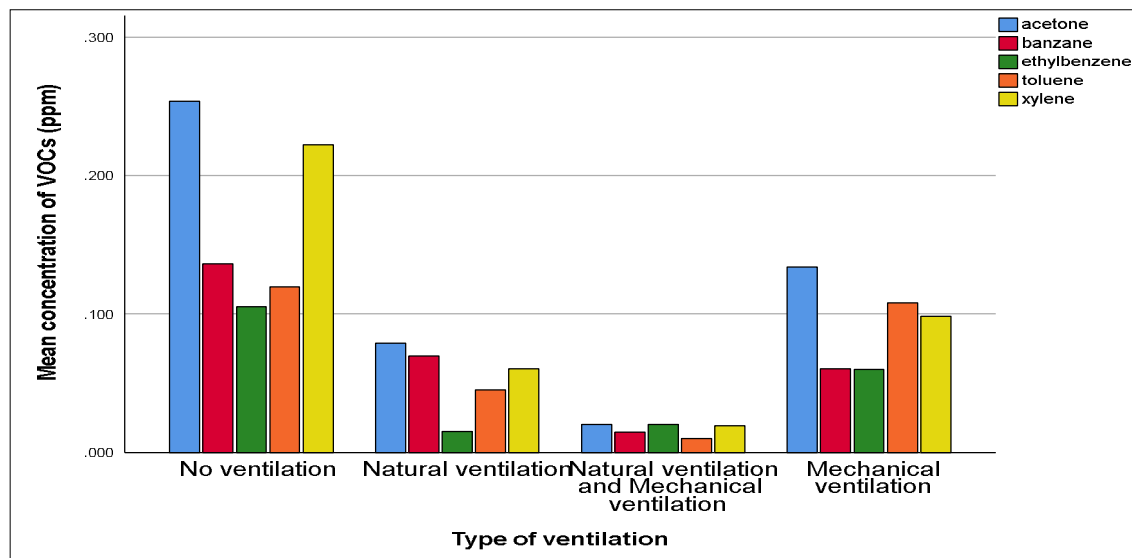


Figure 2. Impact of ventilation type on VOC concentrations in beauty salons during winter

3.3.3 Impact of Number of Services on VOC Concentrations in Beauty Salons

In examining the effect of the number of beauty services offered in salons on VOC concentrations, the number of services showed a significant positive correlation only with ethylbenzene (0.523). This finding indicates that while the overall number of services provided may not directly influence all VOC levels, there is a notable relationship with ethylbenzene concentrations specifically. This selective association suggests that ethylbenzene emissions may be

more sensitive to cumulative service activity, potentially due to its presence in frequently used cosmetic products applied repeatedly throughout the operational day. The lack of correlation with other VOCs implies that emission intensity and product type, rather than service frequency alone, are the dominant factors governing indoor VOC concentrations.

3.4 Cancer Risk Assessment

The risk assessment conducted in this study, using the EPA method, indicated that the mean lifetime inhalation cancer

risk (LTCR) for benzene is 1.37×10^{-3} . This value is substantially higher than the acceptable cancer risk level (1.00×10^{-4}) recommended by the WHO and the U.S. EPA (Baghani et al., 2018). The estimated lifetime inhalation cancer risk (LTCR) for benzene exceeded the acceptable risk level (1×10^{-4}), highlighting a significant health concern for salon workers. These findings were not consistent with the results of the studies by Mohebbi et al. (2024) and Senthong & Wittayasilp (2021). This discrepancy may be attributed to differences in the prevalence and intensity of benzene-emitting services, particularly hair straightening and nail treatments, which were more frequently observed in the studied salons. Additionally, variations in ventilation efficiency, especially the presence of salons with no ventilation, could have led to higher cumulative exposure levels compared to those reported in previous studies. Differences in exposure assumptions applied in the risk assessment models, such as exposure duration, working hours, and concentration inputs based on peak rather than average conditions, may have further contributed to the elevated LTCR values observed in this study. The observation of peak concentrations, especially in salons without ventilation and during high-emission services, likely contributed to the elevated cancer risk observed in this study. This underscores the need for enhanced monitoring, strict adherence to proper ventilation principles, and targeted training programs for beauty salon staff regarding the hazards of VOC exposure.

3.5 Monte Carlo Simulation for Carcinogenic Risk

To predict the multiplicative exposure factor distributions, Crystal Ball used the Latin Hypercube sampling technique to perform Monte Carlo simulations of the probability

distributions of unknown exposure parameters. Figure 5 shows the 5th, 50th, median, and 95th percentiles based on a probabilistic assessment of human health risk. The results show that in the 100000 defined scenarios, the best situation of risk is 1.5×10^{-4} , and in the worst situation of cancer risk is 1.2×10^{-3} . These probabilistic results indicate that even under the most favorable exposure conditions, the cancer risk approaches or exceeds the threshold considered acceptable by the WHO and the U.S. EPA.

The wide range between the 5th and 95th percentiles highlights the variability in exposure among different salons and services, emphasizing the need for targeted interventions and stricter control measures in high-risk settings. Therefore, very serious attention and more supervision are needed in these places.

3.6 Non-Cancer Risk Assessment

The non-cancer risk assessment for worker exposure was calculated using the Hazard Quotient (HQ) method for all VOCs (Baghani et al., 2018). The results indicated the following non-cancer risk values: benzene at 0.375, ethylbenzene at 0.000069, toluene at 0.0136, xylene at 0.016, and acetone at 0.0017.

Since all calculated values are less than 1 ($HQ \leq 1$), the non-cancer risk assessment for the target compounds is also deemed acceptable by the WHO and the U.S. EPA. This suggests that, under current operating conditions and ventilation practices, acute or chronic non-carcinogenic health effects are unlikely for salon workers.

However, continuous monitoring and adherence to occupational hygiene standards are recommended to maintain these safe levels, particularly in salons with high service intensity or inadequate ventilation.

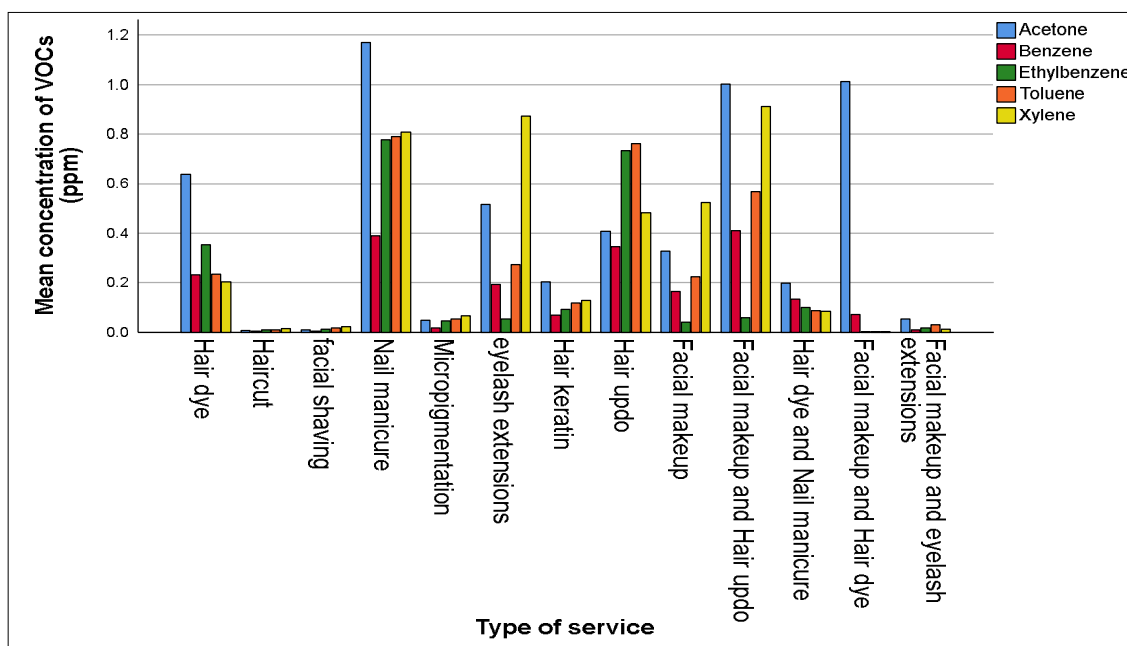


Figure 3. Impact of service type on VOC Concentrations in beauty salons during summer

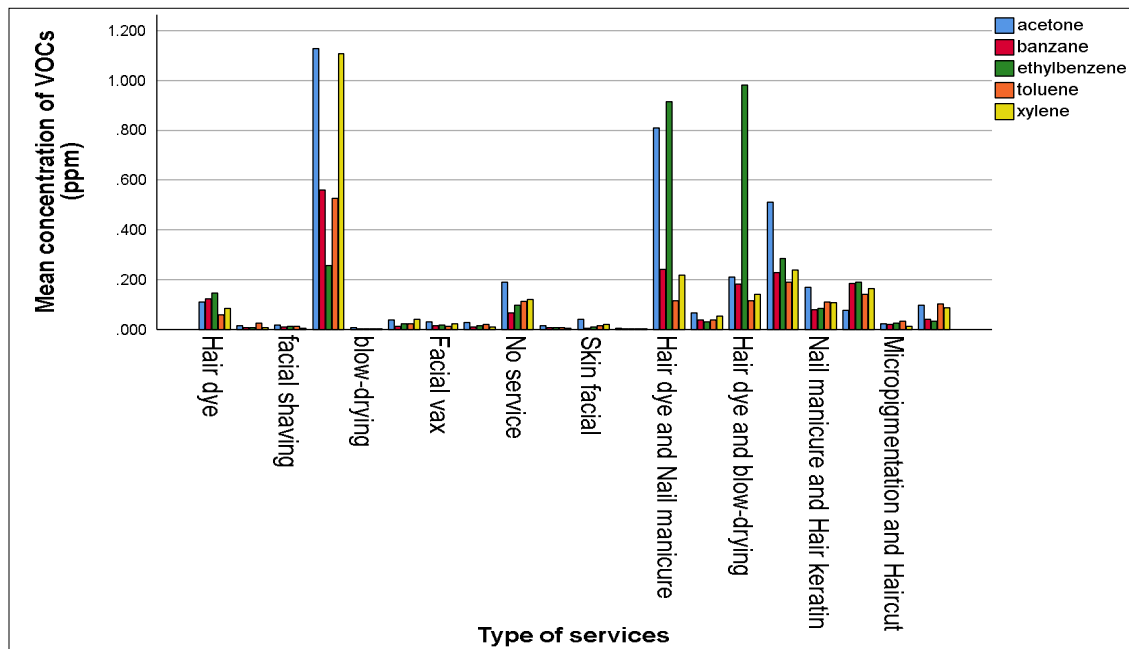


Figure 4. Impact of service type on VOC concentrations in beauty salons during winter

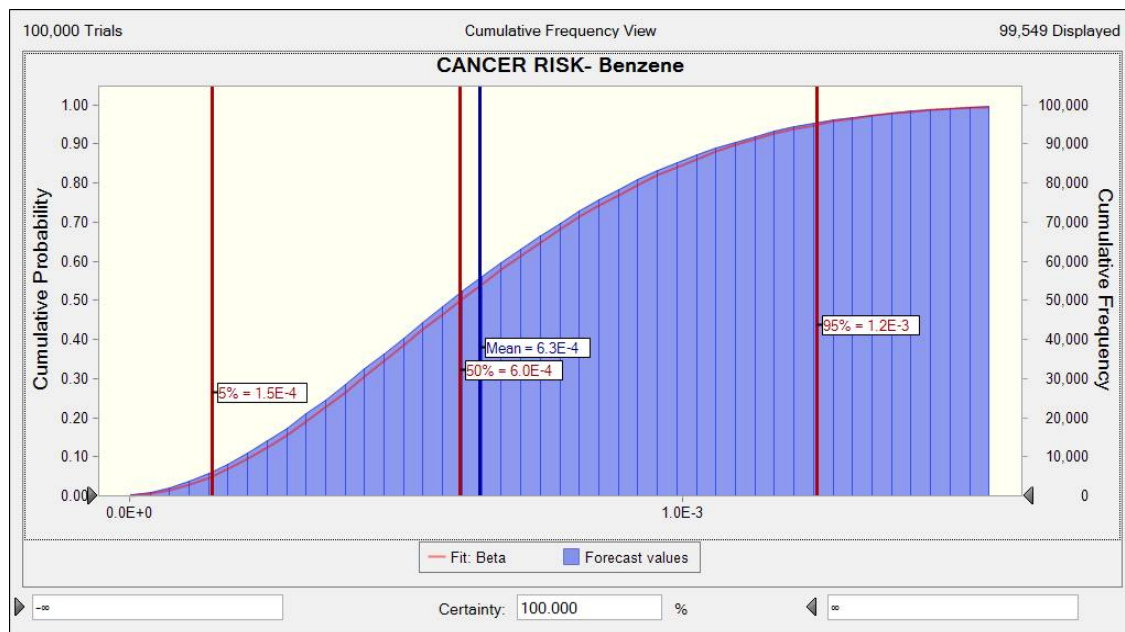


Figure 5. Monte Carlo simulation of Cancer Risk of benzene

4. Conclusion

The average concentrations of benzene, ethylbenzene, toluene, xylene, and acetone in the salons were below national standards. However, benzene concentrations in both seasons (especially in summer) exceeded California's short-term exposure standards. The highest VOC concentrations in summer were associated with acetone, while toluene exhibited the lowest levels. In winter, the highest concentrations were found in salons without ventilation, and the lowest in those with simultaneous

mechanical and natural ventilation. In summer, salons with air conditioning had the highest concentrations, while those with mechanical and natural ventilation as well as evaporative air conditioner showed the lowest. Based on these findings, exposure to benzene and other VOCs poses a potential health risk to salon workers, particularly in salons with inadequate ventilation. Relative humidity had an inverse relationship with VOC concentrations, likely due to the use of evaporative air conditioners. Temperature and salon area did not significantly impact VOC levels. The highest VOC concentrations in summer were linked to nail

manicures, hair keratin treatments, facial makeup, and hairstyling. In nail manicures, toluene, ethylbenzene, and acetone were the most prevalent, while benzene and xylene were the highest in hair keratin treatments and hairstyling, respectively. The cancer risk assessment of benzene and the Monte Carlo simulation model showed that the carcinogenic risk of benzene is between 1.5×10^{-4} and 1.2×10^{-3} , highlighting the need for proactive interventions and continuous monitoring in these locations. therefore, very serious attention and further monitoring are needed in these locations. The non-cancer risk assessments for VOCs were also below 1, deemed acceptable by the WHO and the U.S. EPA. To mitigate risk, the mandatory installation of local exhaust ventilation (LEV) systems at points of high emission (e.g., nail tables, hairdressing stations) is recommended, as they are more effective than general air conditioning. Public health authorities should also require structured training programs for salon workers on the chemical hazards of products and the proper use of ventilation systems and personal protective equipment (PPE). Given the elevated benzene risks observed, a review and potential tightening of national occupational exposure limit (OEL) for benzene in beauty salon environments is warranted, particularly considering prolonged low-level exposure.

Authors' Contributions

Mahnaz Abdolmohammadi: Research; Data collection and analysis; Writing the draft and final version. **Mehran Mohammadian Fazli:** Methodology; Project management; Correspondence and coordination with Zanjan Health Center for access to the research environment; Supervision; Overall review of the article; and suggestions for improvement; Participate in writing the draft and approve the final version before submission. **Zohre Farahmandkia:** Consultation on measuring compounds & data collection; Methodology; Especially in risk assessment; Participate in writing the draft and approve the final version before submission; Supervision. **Ali Behroozi:** Consultation on occupational health; Providing access to necessary equipment for the research; Participating in writing the draft and approving the final version before submission; Supervision. **Behnam Pourali Moghanlou:** Participation in statistical data analysis using SPSS software; Translation and preparation of specialized resources; Participation in interpretation of results.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Ethical Considerations

This research was approved by the Ethics Committee of Zanjan University of Medical Sciences with code (IR.ZUMS.BLC.1402.046). Data collection was conducted with the awareness and consent of the beauty salon operators.

Using Artificial Intelligence

No artificial intelligence was used in this research.

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