

Original Article

Probabilistic Risk Assessment of BTEX for Automotive Painting Workers

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Email: f.ghamari@gmail.com**Abstract****Introduction:** Automotive refinishing operations are an important source of atmospheric emissions of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, primarily attributable to the evaporation of organic solvents utilized in painting and coating processes. This research employed a probabilistic risk assessment model to estimate the carcinogenic and non-carcinogenic health risks for automotive painters in Arak, Iran, due to occupational exposure to BTEX compounds.**Methods:** This cross-sectional study assessed occupational exposure to BTEX compounds among 45 auto body painters. Air sampling from the breathing zone was conducted, followed by chemical analysis by NIOSH Method 1501 using GC-FID. Health risk assessment was performed through the U.S. EPA Risk Assessment Information System (RAIS).**Results:** The results demonstrated that the mean benzene concentration ($507.5 \mu\text{g}/\text{m}^3$) significantly exceeded the ACGIH TLV-TWA threshold ($63 \mu\text{g}/\text{m}^3$). In contrast, the measured levels of toluene, ethylbenzene, and xylene isomers remained below their respective exposure limits. The probabilistic risk assessment revealed that mean lifetime cancer risks for benzene (5.54×10^{-4}) and ethylbenzene (9.9×10^{-5}) substantially surpassed the acceptable benchmark of 1.0×10^{-6} . Furthermore, the non-carcinogenic risk, expressed as the hazard quotient (HQ), exceeded the safe level of 1 for both benzene and xylene, indicating the potential for adverse health effects.**Conclusion:** Automotive painters face significant carcinogenic and non-carcinogenic risks from BTEX exposure. To mitigate these risks, implementing engineering controls, administrative measures, and transitioning to low-VOC alternative paints is strongly recommended.**Keywords:** Occupational exposure, Carcinogenic and non-carcinogenic risks, Automobile Painting, BTEX compounds**Please cite this article as follows:** Ghamari F, Almasi-Hashiani A, Koolivand A, Aghaei H, Mirhoseini SH. Probabilistic risk assessment of BTEX for automotive painting workers. J Adv Environ Health Res 2026;14(2):107-113. doi:10.34172/jaehr.1456**Introduction**

Volatile organic compounds (VOCs) represent a major class of atmospheric contaminants extensively used in numerous industries and professions.¹ Their high vapor pressure facilitates easy evaporation, leading to the release of substantial quantities into the environment. This pervasive release poses severe risks to human health and ecosystems.² In industrial coating activities, solvents are emitted into the air chiefly as complex mixtures of VOCs.³ These discharges are mainly composed of assorted organic hydrocarbons and oxygenated substances such as alcohols, esters, and ketones. BTEX chemicals (benzene, toluene, ethylbenzene, and xylenes) form a major subset of

VOCs released during paint production and utilization.^{3,4} Evaporation occurs over the application and subsequent drying/curing stages, as these volatile elements are designed to evaporate from the coating.⁵ Paint application is a common industrial practice in sectors such as automotive, shipbuilding, and furniture production, utilized at various manufacturing phases.⁶ Paints contain four essential elements: pigments (for color and opacity), binders (for adhesion and film formation), chemical additives (to improve performance), and solvents (to keep liquid consistency for application). These components combine to supply both protective and decorative finishes in industrial settings.⁷



Workers in vehicle painting shops face noticeable occupational hazards associated with different chemical dangers, involving an array of VOCs emitted during painting processes and powerful solvents used for cleaning equipment. These exposures mainly include: (1) complex combinations of organic solvents from paint formulas, (2) cleaning agents containing dangerous chemicals, and (3) airborne particles generated during surface preparation and spraying tasks.⁸

BTEX compounds are VOCs recognized for their adverse effects on human health and the environment.⁹ Long-term exposure to these substances has been linked to multiple non-carcinogenic health effects, including liver and kidney problems, heart and blood vessel diseases, nervous system damage, as well as eye and nose irritation, and allergic responses.^{10–12} The American Conference of Governmental Industrial Hygienists (ACGIH) designates benzene as a Group A carcinogen, while ethylbenzene is regarded as a potential carcinogen.¹³ Similarly, the International Agency for Research on Cancer (IARC) classifies benzene as a Group 1 carcinogen (established human carcinogen) and ethylbenzene as a Group 2B carcinogen (potentially carcinogenic to humans).⁹ Occupational contact with VOCs among automobile painting workers occurs mainly through dermal contact and inhalation,^{5,14} whereas exposure to paints arises predominantly from inhalation owing to their high volatility.⁵ Although numerous small auto body paint shops in Arak city employ many people and are required to comply with workplace regulations, the specific control of indoor air quality in these settings is poorly regulated. This gap stems from a lack of empirical data on air pollutants, especially BTEX compounds. Consequently, there is a clear need to determine BTEX levels, identify influencing factors, and evaluate health risks. Such a study is necessary to expand the knowledge base, thereby supporting future scientific research and the development of regulations aimed at ensuring safer working conditions. While the health risks for occupationally exposed groups are significant, they remain poorly characterized in auto-painting workshops due to limited research. Specifically, there is a scarcity of detailed data on exposure levels and health risks within these workshops, particularly in Arak, Iran. Therefore, the objective of the present study was to determine BTEX concentrations in these workshops and evaluating the consequent health risks to workers, a crucial step for the early identification of adverse health effects.

Materials and Methods

Study Design

This cross-sectional study recruited 45 employees from 22 automotive painting workshops in Arak, Iran, in 2023 to serve as the exposed group. First, a complete list of all auto-painting workshops in Arak was compiled. From this population, 22 workshops were randomly selected for inclusion. The participants were aged 26 to 59 years, had occupational duties involving exposure to paint

solvents, and had exposure durations ranging from 3 to 27 years. A structured questionnaire, administered via in-person interviews, was used to collect demographic and occupational information, including age, daily and weekly working hours, length of employment, and other relevant variables

Participants

The inclusion criteria for the exposed group were as follows: (1) male gender; (2) a minimum of two years of occupational experience in car painting; (3) non-smoker status at the time of data collection; and (4) provision of written informed consent.

Air Sampling and Analytical Procedures

Personal exposure to BTEX compounds was assessed for the exposed groups in accordance with NIOSH Method 1501. Active sampling was conducted during the winter of 2022 over the course of complete work shifts. The personal air samples were collected within the breathing zone of workers using adsorbent tubes containing activated coconut charcoal (SKC Inc.). Prior to use, the sampling pumps (AirChek TOUCH, 5–5000 mL/min, SKC, Inc.) were calibrated through a soap bubble flowmeter using a circuit that included a flowmeter and a dummy adsorbent tube. During sampling, the tubes were affixed to the workers' collars. The ends of the tubes were broken off and connected to the calibrated pumps, which operated at a flow rate of 200 mL/min for approximately 75 min per sample. To characterize exposure across the entire work shift, three samples were collected for each participant at the beginning, middle, and end of their shift. Concurrently, ambient temperature and humidity were recorded with a digital thermo-hygrometer (HT-3007SD LUTRON). Immediately after sampling, the tubes were sealed with plastic caps and transported to the laboratory in a cool box to prevent potential analyte loss. Next, analytes were desorbed using 1 mL of high-purity carbon disulfide (CS₂, 99.5%). Quantitative analysis was then performed via gas chromatography with flame ionization detection (GC-FID; Dany, Italy), with injections made 60 seconds after CS₂ addition. Compound separation was achieved on a CPSil 8 CB capillary column (50 m×0.53 mm I.D., 0.25 µm). The GC method utilized helium as the carrier gas at a constant flow of 2 mL/min. The injector and detector temperatures were set to 250 °C and 300 °C, respectively. The oven temperature program initiated at 40 °C, increased at a rate of 10 °C per min to 100 °C, and was held for 10 min. The recovery efficiency of the activated charcoal for BTEX was evaluated following NIOSH Method 1501. This involved spiking three sorbent tubes for each compound with 100 µL of a 5 ppm BTEX standard, followed by extraction with CS₂ and analysis. The measured recovery rates were 92.4% for benzene, 86.8% for toluene, 89.3% for ethylbenzene, and 96.2% for xylene. Quantitation was based on external calibration with CS₂ standards, which exhibited excellent linearity (mean R² = 0.9972). The precision of the analytical method

was evaluated using the Relative Standard Deviation (RSD). For all BTEX compounds, the RSD calculated from triplicate measurements at each calibration level did not exceed 6%. The method's limits of detection were 159.5 $\mu\text{g}/\text{m}^3$ for benzene, 75.4 $\mu\text{g}/\text{m}^3$ for toluene, 173.7 $\mu\text{g}/\text{m}^3$ for ethylbenzene, and 217 $\mu\text{g}/\text{m}^3$ for xylene.

Carcinogenic and Non-Carcinogenic Risk Calculation

Non-carcinogenic risks posed by inhalation of benzene, toluene, ethylbenzene, and xylene (BTEX) were evaluated following the USEPA guidelines, with risk quotients calculated using Equations 1 and 2.¹⁵

$$EC = \frac{C \times ET \times EF \times ED}{AT} \quad (1)$$

where, EC = the exposure concentration ($\mu\text{g}/\text{m}^3$), C = the raw measured concentration of contaminant in air ($\mu\text{g}/\text{m}^3$), ET = exposure time (h/day), EF = exposure frequency (day/year), ED = exposure duration (years), and AT is the averaging time (70 years $\times$ 365 days/year $\times$ 24 hours/day).

$$HQ_i = \frac{EC}{RFC \times 1000} \quad (2)$$

where, HQ_i represents the hazard quotient and RFC is the reference concentration, a benchmark that represents the estimated safe inhalation level for a chemical.

The incremental lifetime cancer risk (ILCR) associated with chronic inhalation of carcinogenic air pollutants was quantified according to a standardized risk assessment framework. Exposure concentration ($\mu\text{g}/\text{m}^3$) was determined using Equation 1. This value was subsequently applied in Equation 3 to estimate the probability of an individual developing cancer over a lifetime due to the specified inhalation exposure.

$$LRC = AUR \times EC \quad (3)$$

LCR is the life time cancer risk, AUR is the Inhalation Unit Risk (mg/m^3),⁻¹ and EC is the exposure concentration ($\mu\text{g}/\text{m}^3$). To assess the cumulative non-carcinogenic risk from exposure to BTEX compounds, a Hazard Index (HI) was calculated using the following equation 4:

$$HI = \sum HQ_i \quad (4)$$

To assess the additive carcinogenic potential of benzene and ethylbenzene, their combined risk was quantified as the Total Carcinogenic Risk (TCR) pursuant to Equation 5.

$$TLCR = LCR_{\text{Benzene}} + LCR_{\text{Ethylbenzene}} \quad (5)$$

The input variables for calculating carcinogenic and non-carcinogenic risk lack universally agreed-upon values and vary across the scientific literature. Table 1 provides a summary of the values proposed by various researchers, alongside the specific values selected for use in this study.

Results and Discussion

The characteristics of the study participants are summarized in Table 2.

Statistical analysis of BTEX monitoring data showed that the mean breathing zone concentrations for benzene, toluene, ethyl-benzene, and xylene among the automobile painters were 507.5 ± 140.65 , 1043.5 ± 381.39 , 284.45 ± 203.9 , and 1062.92 ± 314.68 $\mu\text{g}/\text{m}^3$, respectively (Figure 1).

A comparison with major occupational exposure guidelines revealed that the mean benzene concentration (507.5 $\mu\text{g}/\text{m}^3$) significantly exceeded the most protective limit, the ACGIH TLV-TWA of 0.02 ppm (63 $\mu\text{g}/\text{m}^3$), by a factor of eight. It also surpassed the NIOSH Recommended Exposure Limit (REL) of 0.1 ppm (approximately 325

Table 1. The Parameters for Calculating Health Risk Assessment

Parameter	Explanation	Unit	Value (EPA)	Value (used in this study)
ET	Exposure Time	(h/d)	8	9.54
ED	Exposure Duration (year)	Years	5-30	30
EF	Exposure Frequency (d/y)	Day/year (6d/week $\times$ 50 weeks/y)	250	300
AT	Averaging Time (h)	Hours (5-25 y)	43800-219000	For cancer 70 years is used 613200 For non-cancer 30 years is used 262800
RfCbenzene	Reference Conc.	mg/m^3		0.03
RfCtoluene	Reference Conc.	mg/m^3		5
RfCethylbenzene	Reference Conc.	mg/m^3		1
RfCxylene	Reference Conc.	mg/m^3		0.1
AUR benzene	Inhalation Unit Risk	$\text{m}^3/\mu\text{g}$	7.8E-6	7.8E-6
AUR ethylbenzene	Inhalation Unit Risk	$\text{m}^3/\mu\text{g}$	2.5E-6	2.5E-6
Acceptable cancer risk	-	-	$LCR \leq 1 \times 10^{-6}$	1×10^{-6}
Potential for cancer risk			1×10^{-6} to 1×10^{-4}	1×10^{-6} to 1×10^{-4}
Unacceptable cancer risk			$LCR \geq 1 \times 10^{-4}$	$LCR \geq 1 \times 10^{-4}$
Acceptable Hazard Quotient	-	-	1	1

$\mu\text{g}/\text{m}^3$). In contrast, exposure levels for toluene, ethylbenzene, and xylene isomers were all below their respective TLV-TWA limits.

The carcinogenic and non-carcinogenic health risks, assessed using the U.S. EPA's Risk Assessment Information System (RAIS) methodology (Table 3).

Carcinogenic risk was evaluated via a cancer risk assessment, while non-carcinogenic risk was determined using the HQ. As shown in Table 3, occupational exposure to benzene and ethylbenzene was associated with a mean lifetime cancer risk of 5.54×10^{-4} and 9.9×10^{-5} respectively; both values substantially exceed the acceptable risk level of 1.0×10^{-6} . The potential for non-carcinogenic health effects from BTEX exposure was evaluated using the HQ (Equation 2) and HI (Equation 4), with results detailed in Table 3. HQ, representing non-carcinogenic risk from occupational exposure to BTEX compounds, was calculated to be 2.36 for benzene, 0.029 for toluene, 0.039 for ethylbenzene, and 1.48 for xylene. Benzene exhibited the highest non-carcinogenic hazard quotient (HQ), followed by xylene, ethylbenzene, and toluene. According to the U.S. EPA and WHO guidelines, an HQ value exceeding 1.0 indicates unacceptable exposure conditions associated with potential chronic non-carcinogenic risks to target organs. In the present study, the mean HQ for both benzene and xylene in the breathing zone of automobile painting workers exceeded this threshold ($\text{HQ} > 1$), signifying an unacceptably high non-carcinogenic risk to employee health in this occupational setting.

BTEX compounds—comprising benzene, toluene, ethylbenzene, and xylenes—are a group of hazardous VOCs that are pervasive in industrial settings, particularly within automotive paint shops.¹⁶ As is well established in the scientific literature, these substances represent the

most toxic constituents of paints and are consistently detected at significant concentrations in this occupational environment. The American Conference of Governmental Industrial Hygienists (ACGIH) has established threshold limit values (TLV-TWA) for BTEX compounds, set at 0.02 ppm (approximately $63 \mu\text{g}/\text{m}^3$) for benzene, 20 ppm (approximately $75 \text{ mg}/\text{m}^3$) for toluene, 20 ppm (approx. $87 \text{ mg}/\text{m}^3$) for ethylbenzene, and 20 ppm (approximately $87 \text{ mg}/\text{m}^3$) for xylene.^{17–20} In the present study, empirical measurements from automotive painting workshops in Arak revealed that the mean concentration of benzene in the breathing zone of workers was $507.5 \mu\text{g}/\text{m}^3$, a value that significantly exceeds the ACGIH permissible exposure limit by a factor of approximately eight. Elevated benzene concentrations in workshop air stem from its presence in paints and solvents combined with its inherent volatility. Owing to its high vapor pressure (0.126 atm at 25°C), benzene evaporates considerably faster than other aromatic hydrocarbons present in these formulations. Consequently, benzene becomes disproportionately represented in the ambient air relative to its original concentration in the liquid mixtures. Conversely, the measured concentrations of toluene ($1043.5 \mu\text{g}/\text{m}^3$), ethylbenzene ($284.4 \mu\text{g}/\text{m}^3$), and xylene ($1062.9 \mu\text{g}/\text{m}^3$) remained within their respective TLVs. This finding of elevated benzene exposure is consistent with a body of international studies reporting similar exceedances in automotive painting environments,^{4,5,7,21–24} highlighting a persistent and widespread occupational health concern. The observed variations in BTEX concentrations

Table 2. Demographic Information and Job Characteristics of the Exposed Individuals in This Study

Characteristics	(N = 45)	
	Mean $\pm$ S.D	(Min-Max)
Age (year)	40.12 $\pm$ 7.69	(26–59)
Weight (kg)	79.68 $\pm$ 12.67	(61–98)
Height (cm)	179.73 $\pm$ 8.43	(162–197)
BMI	25.78 $\pm$ 2.89	(22.60–31.18)
Working hour / day	9.54 $\pm$ 2.45	(8–14)
Year of exposure	11.08 $\pm$ 8.10	(3–27)

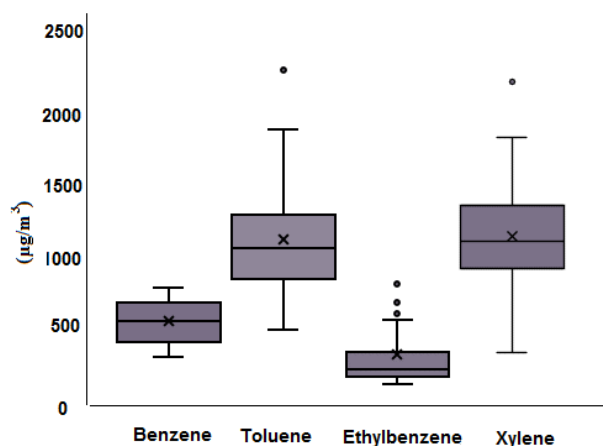


Figure 1. Levels of BTEX Compounds Measured in the Breathing Area of Automotive Painting Workers

Table 3. The Results of the Assessment Calculating the LCR and HQ for Non-Carcinogenic Health Effects in Automotive Paint Shop Workers

Compound	Benzene		Toluene		Ethyl-benzene		Xylene	
	Mean	Min-Max	Mean	Min-Max	Mean	(Min-Max)	Mean	(Min-Max)
EC ($\mu\text{g}/\text{m}^3$)	71.059	37.8–101.09	146.10	63–302.44	39.82	12.18–104.59	148.70	41.44–291.37
HQ	2.36	1.26–3.36	0.029	0.012–0.06	0.039	0.012–0.10	1.48	0.41–2.91
LCR	5.54 E-04	2.94 E-04 7.88 E-04	-	-	9.9 E-05	3.1 E-05 2.6 E-04	-	-
HI Mean (Min-Max)	3.895(1.69–6.43)							
TLCR Mean (Min-Max)	6.53 E-04(3.2 E-04 -1 E-03)							

across different workplaces can be attributed to several factors. Primarily, these include the type and brand of paints and solvents used, as their chemical composition dictates the initial VOC load. Furthermore, the physical characteristics of the workshop itself are critical; confined, poorly organized spaces promote vapor accumulation, whereas large, well-designed facilities facilitate dispersion. Many automotive shops operate in repurposed industrial units that lack adequate ventilation systems, exacerbating this issue. Finally, work practices significantly influence exposure levels; suboptimal procedures such as leaving solvent containers open, using excessive thinner for cleaning, and performing cleaning operations outside designated spray booths substantially contribute to the overall BTEX burden in the ambient air. Also, sampling techniques (e.g., passive vs. active), ventilation efficiency, paint composition (solvent- vs. water-based), and proximity to emission sources all influence detected levels.

Evaluations of occupational health risks for car painting personnel demonstrate that exposure to BTEX constituents is associated with considerable carcinogenic and non-carcinogenic hazards. Empirical studies have consistently reported exposure concentrations that exceed established occupational exposure limits, pointing to an urgent requirement for interventions to reduce these risks. As shown in Table 3, the non-carcinogenic risk assessment for car painting workshop workers revealed HQ values for long-term exposure to benzene and xylene of 2.36 (range: 1.26–3.36) and 1.48 (range: 0.41–2.91), respectively. Both mean values exceed the acceptable risk ($HQ > 1$), indicating a significant potential for adverse health effects. In the EPA's risk assessment framework, the RfC is a public health benchmark designed to protect the entire population, including sensitive groups, from serious chronic and developmental health effects due to lifetime exposure. Because the RfC for xylene is very low, the non-carcinogenic risk can be high even when its concentration is below occupational exposure limits. Furthermore, the HQ values for toluene and ethylbenzene, which are non-carcinogenic risk indices, were 0.029 and 0.039, respectively. As these values were substantially below the safety threshold of 1.0, the results indicated that these specific compounds did not pose a serious non-carcinogenic health risk to auto painting workers. The study found that occupational exposure to benzene and ethylbenzene posed noticeable carcinogenic risks, with calculated mean lifetime cancer risks of 5.54×10^{-4} and 9.9×10^{-5} respectively. These values substantially exceed the widely accepted safety threshold of 1.0×10^{-6} , indicating a considerable potential health threat to exposed automotive painters.

The findings of Shojaei and Rostami align closely with the present study. They reported that auto painters faced the highest non-carcinogenic risk from benzene and xylene, with mean HQ values of 1.38 and 1.14, respectively; both exceed the safety threshold ($HQ > 1$). Conversely, their HQ values for toluene and ethylbenzene were also below 1, illustrating no significant non-carcinogenic

risk from these compounds, which is consistent with our results. Furthermore, they calculated a LCR of 3.24×10^{-4} for benzene and 2.8×10^{-5} for ethylbenzene.²⁵ These values indicate a significant cancer risk according to the regulatory guidelines (USEPA, WHO) and are in complete agreement with the risk levels observed in our investigation. The study by Badjagbo et al reported a nuanced risk profile for occupational BTEX exposure.²⁶ Their assessment indicated a low non-carcinogenic risk, as all Hazard Quotient (HQ) values were below the threshold of unity ($HQ < 1$). This suggests an absence of significant chronic non-carcinogenic health effects for workers. However, the LCR specifically attributed to benzene was calculated at 6.2×10^{-6} . While this value may indicate a lower risk than other studies, it remains at a level often considered unacceptable by many regulatory bodies (e.g., USEPA), highlighting a persistent concern regarding carcinogenic outcomes. The study by Dölek et al identified significant health risks associated with benzene exposure. Their analysis determined a LCR range of 2.87×10^{-5} to 1.28×10^{-3} , which substantially exceeds the widely accepted regulatory safety benchmark of 1×10^{-6} . Furthermore, the non-carcinogenic risk, quantified by HQ of 1.21 for benzene, also surpassed the acceptable threshold ($HQ > 1$), indicating potential chronic health effects.⁷

Research on occupational BTEX exposure is extensive for the painting sectors of large automotive manufacturers but is severely limited for smaller automotive paint shops.

Harati et al in 2016 investigated an automobile manufacturing paint shop and reported substantial occupational health risks associated with BTEX exposure.²³ The study determined that the mean lifetime cancer risk from exposure to benzene and ethylbenzene reached 3.21×10^{-2} and 3.63×10^{-2} respectively—values that substantially exceed internationally recognized safety thresholds. Moreover, the hazard index for non-carcinogenic risks surpassed the guideline value of 1.0, indicating a considerable likelihood of systemic health impairments among exposed workers. These findings are consistent with more recent research, such as the study by Sadeghi Amin et al performed in 2024, which reported cancer risks in factory paint shops ranging from 1.1×10^{-4} to 2.28×10^{-3} , also markedly higher than the U.S. Environmental Protection Agency's acceptable risk level of 10^{-6} .²⁷ The highest HQs were observed in paint shop environments, further emphasizing the elevated risk.^{3,24,28–}

³¹ Collectively, these studies affirm that in automotive painting operations—both in manufacturing and repair settings—the carcinogenic risks associated with benzene and ethylbenzene, as well as cumulative non-carcinogenic hazards, consistently exceed recommended exposure limits, highlighting a critical need for enhanced regulatory and technical interventions. This study found that while concentrations of toluene, ethylbenzene, and xylene isomers were within occupational limits, benzene levels significantly exceeded the TLV-TWA threshold. Probabilistic risk assessment confirmed serious

health concerns: the lifetime cancer risk for benzene and ethylbenzene surpassed acceptable benchmarks, and the non-carcinogenic risk for benzene and xylene exceeded safe levels. These findings highlight the need for enhanced oversight, specifically targeting small urban auto body shops, through regular monitoring and stricter regulatory control.

Conclusion

Although the EPA guide offers a robust health-protective framework, its practical application in this context has notable constraints. These include a potential underestimation of risk because of the exclusion of dermal absorption pathways and the synergistic toxic effects of combined BTEX exposure, as well as a misalignment with existing occupational regulations and the heterogeneous conditions of real-world workplaces. Given the persistent nature of BTEX hazards, a multi-faceted risk mitigation strategy is imperative. A cornerstone of this approach is source control, primarily through the substitution of conventional paints with low- or zero-VOC alternatives and stringent container management. This must be reinforced by enhanced engineering controls, particularly local exhaust ventilation, and supported by robust administrative protocols that include ongoing air monitoring, health surveillance, and strict enforcement of approved personal protective equipment (PPE) use. This integrated framework facilitates a targeted and cost-effective defense against occupational exposure. Future research should prioritize biological monitoring to assess total body burden, investigate the prophylactic use of antioxidant agents, and conduct longitudinal evaluations of the efficacy of implemented control measures.

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Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Approval

This study was approved by the Ethics Committee of Arak University of Medical Sciences (Ethical code: IR.ARAKMU.REC.1398.108).

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