RESPIRATORY SYMPTOMS AND VENTILATORY FUNCTION IMPAIRMENT AMONG CAR SPRAY PAINTERS IN BENIN CITY, NIGERIA

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ABSTRACT

Background

Car spray painters are routinely exposed to organic solvents, isocyanates and aerosolized particulates that predispose them to respiratory disorders. International and African studies consistently show high levels of respiratory symptoms and impaired lung function among workers in informal automotive workshops. In Nigeria, poor ventilation and inconsistent use of respiratory protective equipment may further heighten these risks.

Objective

To assess respiratory symptoms and ventilatory function impairment among car spray painters compared with age-matched controls.

Methodology

A comparative cross-sectional study was conducted among 100 car spray painters and 100 age-matched controls in Benin City, Nigeria. Data on sociodemographic characteristics, smoking history and respiratory symptoms were obtained using a structured interviewer-administered questionnaire. Spirometric parameters including FEV_1, FVC, FEV_1/FVC ratio and PEF were measured in accordance with American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines. Data were analyzed using IBM SPSS version 25, with Student's *t*-test and Chi-square statistics applied at a 5% level of significance.

Results

Spray painters reported significantly more respiratory symptoms, including nasal discharge (52.2% vs 0%; χ^2=91.113; p<0.002), cough with sputum (22.2% vs 5%; χ^2=8.220; p=0.004) and chest pain (13.3% vs 1%; χ^2=4.749; p=0.040). Mean ventilatory values were significantly lower among spray painters: FEV_1 (2.78 ± 0.79 L vs 3.01 ± 0.72 L; p<0.001), FVC (3.01 ± 0.08 L vs 3.65 ± 0.07 L; p<0.001) and PEF (311.34 ± 105.9 L/min vs 451.75 ± 153.5 L/min; p<0.001). Abnormal ventilatory patterns were more common in spray painters (60% vs 19%; χ^2=61.243; p=0.002), with higher obstructive (25% vs 13%) and restrictive (35% vs 6%) defects.

Conclusion

Car spray painters demonstrated a higher burden of respiratory symptoms and significant ventilatory impairment compared with controls, reflecting the impact of chronic exposure to paint fumes and solvent aerosols. Improved respiratory protection, adequate workshop ventilation and routine spirometric monitoring are essential to safeguard workers' respiratory health.

Keywords: Spray painters, respiratory symptoms, ventilatory function, solvents, spirometry

BACKGROUND

Globally, work-related respiratory diseases account for a significant proportion of occupational morbidity. Studies estimate that over 386,000 workers die annually from occupational respiratory conditions, while more than 10 million workers worldwide are exposed to organic solvents and volatile chemicals, many of which are common in the automotive spray-painting industry, according to The National Institute for Occupational Safety and Health (NIOSH).[1,2] In high-income countries, regulatory measures and improved engineering controls have reduced exposure, yet studies still report significant decline in FEV_1 among automotive painters with prolonged exposure compared with unexposed workers. Chemicals such as isocyanates, one of the leading causes of occupational asthma, remain a major hazard, responsible for a majority of new occupational asthma cases globally.[3,4]

Across Africa, occupational exposure limits are inconsistently implemented, and informal-sector workshops dominate the automotive repair industry. Studies from Tanzania, Kenya and Ethiopia reveal that 40–90% of painters report chronic cough, wheeze, nasal irritation and breathlessness.[5,6,7] Spirometric assessments frequently show reduced FEV_1/FVC ratios, higher rates of obstructive defects and a noticeable decline in peak expiratory flow among exposed workers. In some African cohorts, as many as 40% of automotive painters demonstrate measurable ventilatory impairment, reflecting the limited use of personal protective equipment, poor ventilation and high solvent concentrations in small workshops.[6,7]

In Nigeria, automotive spray painting represents a growing urban trade, largely practiced in informal settings where regulatory oversight is limited.[8] Nigerian artisans are commonly exposed to high concentrations of solvents such as toluene, xylene, acetates, isocyanates and heavy metals present in paints and hardeners.[9] Local studies have documented that over 30% of spray painters experience persistent respiratory symptoms including cough, nasal discharge, chest tightness and dyspnea.[10,11] Spirometric findings in Nigerian exposed workers often show 20–35% prevalence of obstructive or restrictive ventilatory patterns, significantly higher than rates observed in unexposed populations, as well as poor use of appropriate respiratory protective equipment.[12,13]

These findings highlight a pressing need to evaluate the respiratory health of car spray painters in Nigeria, where workers remain vulnerable to chronic inhalational exposures with limited occupational health support. By comparing exposed workers with age-matched controls, this study provides evidence on the magnitude of respiratory symptoms and ventilatory function impairment attributable to workplace exposure. Understanding these patterns is essential for guiding preventive strategies, strengthening occupational health policies and reducing long-term respiratory morbidity among this high-risk population.

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METHODOLOGY

Study Design

This study adopted a comparative cross-sectional design to evaluate the respiratory health of car spray painters in relation to unexposed individuals of similar age and background.

Study Area

The research was conducted in Benin City, Edo State, Nigeria, where numerous informal automobile workshops operate without adequate engineering controls or ventilation systems. These workshops represent typical work environments in which artisans are exposed to solvent vapours, paint aerosols and isocyanate compounds that may predispose them to respiratory impairment.

Study Population

The study population comprised two groups of male respondents: professional car spray painters with at least one year of continuous occupational exposure, and age-matched controls who were not occupationally exposed to organic solvents or paint fumes. Controls were selected from administrative and technical occupations within the same locality to ensure comparable socioeconomic conditions.

Sample Size and Sampling Technique

A total of 200 participants were recruited, consisting of 100 car spray painters and 100 controls. The sample size was estimated using standard formulae for comparative studies of continuous variables, assuming a 95% confidence interval, 80% statistical power and an expected difference in mean FEV_1 between exposed and control groups. Participants were selected through systematic random sampling across registered and informal auto-repair clusters, while controls were randomly drawn from nearby non-exposed occupations.

Inclusion and Exclusion Criteria

Eligible participants were adult males aged 18 years and above who had worked for at least one year in their respective occupations. Excluded were individuals with current respiratory infections, known chronic lung or cardiac diseases, or those unwilling to provide informed consent.

Data Collection Instruments

Data were collected using a structured interviewer-administered questionnaire and spirometric assessment. The questionnaire, adapted from standard occupational-respiratory survey instruments, obtained information on demographic characteristics, duration of exposure, smoking history, and respiratory symptoms such as cough, nasal discharge, chest pain and breathlessness. Spirometric measurements were obtained using a portable digital spirometer in accordance with the American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines. The parameters recorded included Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1), FEV_1/FVC ratio, and Peak Expiratory Flow (PEF).

Smoking Assessment

Respondents were classified as current smokers, ex-smokers or non-smokers. Current smokers were those who consumed at least one cigarette or its equivalent daily, while ex-smokers were individuals who had stopped smoking for six months or longer. Non-smokers were those who had never smoked or had smoked less than one cigarette in their lifetime. The number of pack-years was computed by multiplying the number of cigarettes smoked per day by the number of years of smoking and dividing by twenty.

Anthropometric Measurements

Weight and height were measured with standardized equipment, and Body Mass Index (BMI) was derived as weight (kg) divided by height squared (m^2). These

indices served to control for body size variability in the interpretation of spirometric results.

Data Analysis

Data were analyzed using IBM SPSS version 25. Quantitative variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. The Student's *t*-test was applied to compare mean ventilatory parameters between groups, and associations between categorical variables were evaluated using Chi-square or Fisher's exact test where appropriate. Statistical significance was established at a *p*-value of less than 0.05.

Classification of Ventilatory Function

Lung function outcomes were categorized based on spirometric indices. Participants with an FEV_1/FVC ratio less than 70% were classified as having an obstructive pattern, whereas those with FVC less than 80% of the predicted value but normal or elevated FEV_1/FVC ratios were considered to have restrictive ventilatory defects. Values within normal reference ranges were regarded as normal ventilatory function.

Ethical Considerations

Ethical approval for the study was obtained from the University of Benin Teaching Hospital (UBTH) Health Research Ethics Committee. Written informed consent was obtained from all participants after the purpose and procedures of the study had been clearly explained. Confidentiality and voluntary participation were ensured throughout the study in compliance with the principles of the Declaration of Helsinki.

RESULTS

Sociodemographic Characteristics of Car Spray Painters and Controls (Table 1)

A total of 200 respondents participated in the study, comprising 100 car spray painters and 100 controls. The age distribution was similar across both groups. Among spray painters, the majority 35 (35.0%) were aged 30–39 years, followed by 31 (31.0%) aged 20–29 years, 20 (20.0%) aged 40–49 years, 11 (11.0%) aged 50–59 years, and 3 (3.0%) below 20 years. In the control group, 35 (35.0%) were aged 20–29 years, 32 (32.0%) aged 30–39 years, 17 (17.0%) aged 40–49 years, 12 (12.0%) aged 50–59 years, and 4 (4.0%) were younger than 20 years. The difference in age distribution between both groups was not statistically significant ($\chi^2 = 4.770$, $p = 0.997$).

Regarding marital status, 58 (58.0%) of the spray painters were married, 39 (39.0%) single, 2 (2.0%) divorced, and 1 (1.0%) widowed. Among controls, 48 (48.0%) were married, 48 (48.0%) single, 2 (2.0%) divorced, and 2 (2.0%) widowed. The difference in marital status between both groups was not statistically significant ($\chi^2 = 3.135$, $p = 0.792$).

A significant difference was observed in the level of education between both groups ($\chi^2 = 12.323$, $p = 0.007$). Among spray painters, most 62 (62.0%) had only primary education, while 20 (20.0%) had secondary and 18 (18.0%) tertiary education. Conversely, in the control group, 39 (39.0%) had secondary education, 48 (48.0%) primary, and 13 (13.0%) tertiary education.

In terms of religion, the majority in both groups were Christians, 90 (90.0%) among spray painters and 94 (94.0%) among controls, followed by adherents of African Traditional Religion 7 (7.0%) and 5 (5.0%) respectively, while Muslims constituted a small proportion 3 (3.0%) and 1 (1.0%) respectively. The religious distribution between both groups showed no significant difference ($\chi^2 = 0.356$, $p = 0.986$).

Anthropometric Measurements of Car Spray Painters and Controls (Table 2)

The mean anthropometric indices of car spray painters and controls were generally comparable. The mean weight of spray painters was 68.27 ± 1.7 kg, while that of controls was 67.81 ± 1.0kg, with no statistically significant difference ($t = 0.764$, $p = 0.448$). The mean height was 1.7 ± 0.1m among spray painters and 1.6 ± 0.1m among controls, also showing no significant difference ($t = 0.998$, $p = 0.271$). Similarly, the mean Body Mass Index (BMI) was 24.1 ± 3.1 kg/m² among spray painters and 24.9 ± 3.8kg/m² among controls. Although the BMI of controls was slightly higher, the difference was not statistically significant ($t = –2.112$, $p = 0.338$).

Respiratory Symptoms in the Car Spray Painters and Controls (Table 3)

Respiratory symptoms were more prevalent among car spray painters compared to controls. Among the 100 spray painters, 90 had respiratory symptoms. Out of these, over half, 47 (52.22%), reported nasal discharge, whereas none of the controls experienced this symptom, a highly significant difference ($\chi^2 = 91.113$, $p < 0.002$). Cough with sputum production was also more frequent among spray painters, occurring in 20 (22.22%) compared with 5 (83.33%) of the controls, and this association was statistically significant ($\chi^2 = 8.220$, $p = 0.004$). Chest pain was reported by 12 (13.33%) of spray painters compared to 1 (16.67%) of the controls, showing a significant difference between both groups ($\chi^2 = 4.749$, $p = 0.040$).

Breathlessness occurred in 5 (5.56%) of spray painters but in none of the controls, though this difference was not statistically significant ($\chi^2 = 2.423$, $p = 0.356$). Hemoptysis followed a similar pattern, with 6 (6.67%) cases among spray painters and none in the control group, and the observed difference remained non-significant ($\chi^2 = 2.423$, $p = 0.356$).

Mean Values of the Ventilatory Function Parameters in the Car Spray Painters and Controls (Table 4)

The mean ventilatory function indices were generally lower among car spray painters compared to controls. The mean Forced Expiratory Volume in one second (FEV_1) among spray painters was 2.78 ± 0.79L, while that of controls was 3.01 ± 0.72L, showing a statistically significant difference ($t = –5.30$, $p < 0.001$). Similarly, the mean Forced Vital Capacity (FVC) was 3.01 ± 0.08L among spray painters and 3.65 ± 0.07L among controls, also significantly lower among spray painters ($t = –5.415$, $p < 0.001$).

The mean FEV_1/FVC ratio was 0.79 ± 1.75 in spray painters compared to 0.82 ± 0.10 in controls, and this difference was statistically significant ($t = –2.44$, $p = 0.016$). In addition, the mean Peak Expiratory Flow (PEF) was markedly reduced among spray painters (311.34 ± 105.9 L/min) compared to controls (451.75 ± 153.5 L/min), and this difference was highly significant ($t = –7.48$, $p < 0.001$).

Pattern of Ventilatory Function in Car Spray Painters and Controls (Figure 1)

The distribution of ventilatory function patterns revealed marked differences between car spray painters and controls. Among spray painters, only 40 (40.0%) exhibited normal lung function compared to 81 (81.0%) of the controls. Obstructive ventilatory defects were identified in 25 (25.0%) of spray painters and 13 (13.0%) of controls, while restrictive defects were present in 35 (35.0%) of spray painters and 6 (6.0%) of controls.

These differences were statistically significant ($\chi^2 = 61.243$, $p = 0.002$), indicating that car spray painters had a substantially higher prevalence of both obstructive and restrictive ventilatory impairments than their non-exposed counterparts.

Table 1: Sociodemographic Characteristics of Car Spray Painters and Controls

Variables	Car Spray Painters n=100 (%)	Controls n=100 (%)	Chi-square (χ^2)	p-value
Age (years)			4.770	0.997
<20	3 (3.0)	4 (4.0)		
20–29	31 (31.0)	35 (35.0)		
30–39	35 (35.0)	32 (32.0)		
40–49	20 (20.0)	17 (17.0)		
50–59	11 (11.0)	12 (12.0)		
Marital Status			3.135	0.792
Married	58 (58.0)	48 (48.0)		
Single	39 (39.0)	48 (48.0)		
Divorced	2 (2.0)	2 (2.0)		
Widower	1 (1.0)	2 (2.0)		
Level of Education			12.323	**0.007**
Primary	62 (62.0)	48 (48.0)		
Secondary	20 (20.0)	39 (39.0)		
Tertiary	18 (18.0)	13 (13.0)		
Religion			0.356	0.986
Christianity	90 (90.0)	94 (94.0)		
Islam	3 (3.0)	1 (1.0)		
African Traditional Religion	7 (7.0)	5 (5.0)		

Table 2: Anthropometric Measurements of Car Spray Painters and Controls

Anthropometry	Car Spray Painters (Mean ± S.D)	Controls (Mean ± S.D)	t-test	p-value
Weight (kg)	68.3 ± 1.7	67.8 ± 1.0	0.764	0.448
Height (m)	1.7 ± 0.1	1.6 ± 0.1	0.998	0.271
BMI (kg/m^2)	24.1 ± 3.1	24.9 ± 3.8	-2.112	0.338

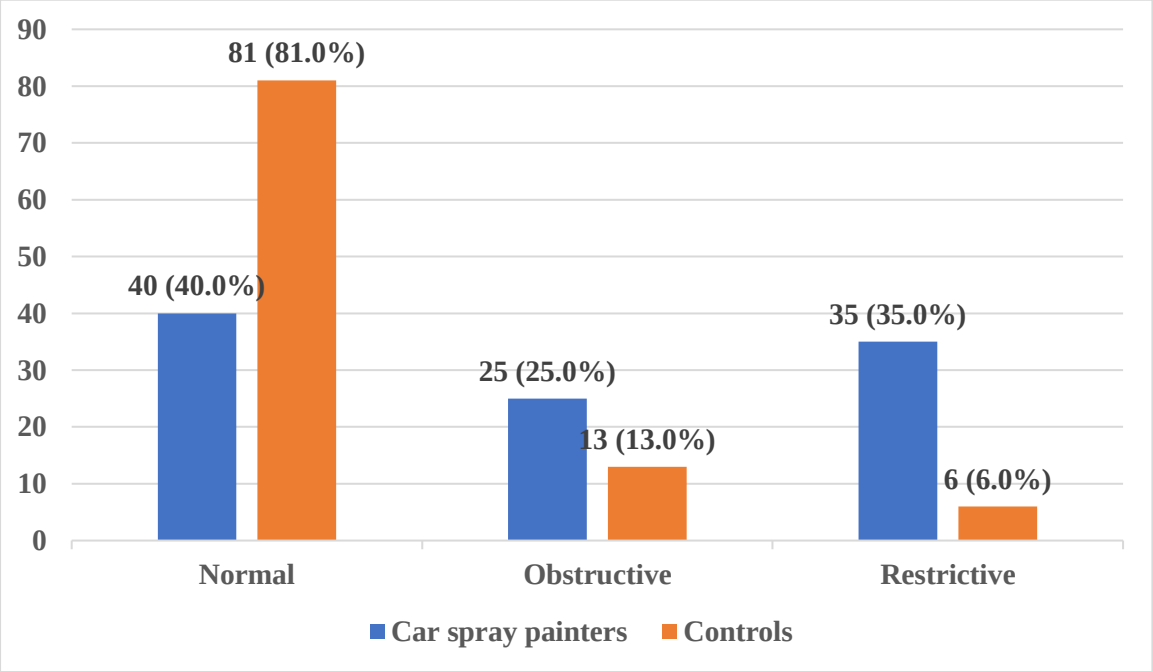
BMI = Body Mass Index, Kg= Kilogram, m=meter

Table 3: Respiratory Symptoms in the Car Spray Painters and Controls

Respiratory Symptoms	Spray Painters n=90 (%)	Controls n=6 (%)	Chi-square (χ^2)	p-value
Nasal discharge	47 (52.22)	0 (0.0)	91.113	**<0.002**
Cough with sputum production	20 (22.22)	5 (83.33)	8.220	**0.004**
Chest pain	12 (13.33)	1 (16.67)	4.749	**0.040**
Breathlessness	5 (5.56)	0 (0.0)	2.423	0.356
Hemoptysis	6 (6.67)	0 (0.0)	2.423	0.356

Table 4: Mean Values of the Ventilatory Function Parameters in the Car Spray Painters and Controls

Parameters	Spray Painters (Mean ± S.D)	Controls (Mean ± S.D)	t- test	p- value
FEV_1(L)	2.78 ± 0.79	3.01 ± 0.72	-5.30	**<0.001**
FVC(L)	3.01 ± 0.08	3.65 ± 0.07	-5.42	**<0.001**
FEV_1/FVC	0.79 ± 1.75	0.82 ± 0.10	-2.44	**0.016**
PEF(L/min)	311.34 ± 105.9	451.75 ± 153.5	-7.48	**<0.001**



Chi-square (χ^2): 61.243, p:0.002

Figure 1: Pattern of ventilatory function in car spray painters and controls

DISCUSSION

The study showed that the age distribution of car spray painters and controls was similar, with most respondents falling within the economically active 20–39 age range. This demographic pattern is important because it suggests that respiratory impairment observed later in the analysis cannot be attributed to age differences. Strengthening occupational health surveillance for young artisans is therefore essential, as this age group represents the productive workforce in many urban centres.

The educational distribution showed that spray painters had lower levels of formal education compared with controls, with a higher proportion reporting only primary education. Similar observations have been reported in studies from Nigeria by Ojo et al.[10] in Osun state, where over half of respondents had only primary levels of education. Lower education may influence awareness of chemical hazards, proper use of personal protective equipment and understanding of workplace risks. This finding is significant because limited educational attainment may further widen occupational vulnerability, making artisan workers more prone to preventable respiratory disorders. It is therefore important for regulatory agencies and unions within the informal sector to integrate safety training sessions that use simple language and practical demonstrations to improve safety behaviour among this group.

Anthropometric indices in this study were comparable between exposed workers and controls, with no significant differences in weight, height or body mass index. The lack of anthropometric disparity indicates that observed ventilatory impairments are unlikely to be confounded by variations in body habitus, thereby strengthening the internal validity of the lung function findings. Because anthropometric factors have been associated with spirometric variability, ensuring comparability in future occupational health assessments remains important. Routine nutritional and fitness counselling could further support respiratory health among these workers.

The burden of respiratory symptoms was markedly higher among car spray painters, particularly nasal discharge, cough with sputum, chest pain, and hemoptysis. Similar trends have been reported in a study conducted in Parakou, Benin Republic by Ade et al.[14], and Awodele et al.[15] in Lagos, Nigeria, where more than half of spray painters experienced persistent upper and lower respiratory tract irritation. These symptoms are plausibly linked to prolonged exposure to isocyanates, xylene, toluene and other volatile organic compounds known to irritate mucosal surfaces and lower airway structures. The public health implication is considerable, as persistent respiratory symptoms may precede chronic respiratory diseases, reducing long-term lung function and productivity. Introducing workplace ventilation standards and ensuring consistent use of cartridge respirators would significantly reduce symptomatic respiratory morbidity in this population.

The study also demonstrated significantly lower mean values of key ventilatory parameters such as FEV_1, FVC and PEF among spray painters compared with controls. Similar reductions were reported in studies done in Cross-River, Nigeria by Aribo et al.[16] and in India by Methre and Karandikar[17], where spray painters showed a 15–25% decline in FEV_1 and FVC relative to unexposed groups. The impairment in ventilatory indices is biologically plausible because organic solvents and paint aerosols induce airway inflammation, mucus hypersecretion and direct epithelial injury. This finding carries major occupational health implications, as reduced ventilatory capacity increases the risk of disability, reduced work capacity and progression to chronic airflow limitation. Regular spirometric screening, early referral for respiratory evaluation

and substitution of high-risk chemicals with safer alternatives would help mitigate the decline in ventilatory performance.

The pattern of ventilatory impairment showed that only 40% of spray painters had normal lung function compared with 81% of controls, while obstructive and restrictive patterns were substantially higher among the exposed group. These findings are consistent with research in Nigeria, Africa and Global studies, where occupational exposure to spray fumes resulted in high rates of mixed ventilatory defects.[11,12,13,18] The predominance of restrictive patterns may be linked to cumulative inhalation of particulate matter and chronic inflammatory processes gaffecting lung parenchyma, whereas the obstructive defects are consistent with the airway-narrowing effects of isocyanates.

CONCLUSION

This study demonstrated clear evidence of respiratory morbidity and ventilatory impairment among car spray painters when compared with matched controls. The exposed workers showed markedly higher rates of respiratory symptoms and significant reductions in key spirometric indices, including FEV_1, FVC and PEF.

Patterns of obstructive and restrictive defects were notably more prevalent among spray painters, indicating both airway and parenchymal involvement. These findings point to the substantial impact of chronic exposure to paint fumes, organic solvents and particulate aerosols within the automotive spray-painting environment. The results show the urgent need for improved occupational health measures to protect workers in this informal yet widely practiced trade.

RECOMMENDATION

There is a strong need to strengthen occupational safety practices among car spray painters through targeted measures that improve respiratory protection and chemical handling.

At a policy level, regulatory bodies should develop enforceable guidelines for chemical safety in informal automotive workshops and support initiatives that substitute hazardous paints with safer alternatives. Collaboration between health authorities, vocational associations and workshop owners will further reinforce long-term respiratory protection for these workers.

LIMITATIONS

The study employed a cross-sectional design, which restricts the ability to establish causality between exposure and ventilatory outcomes. Respiratory symptoms were self-reported, creating the possibility of recall bias. The assessment did not include detailed quantitative measurements of airborne solvent concentrations, which could have provided stronger exposure–response relationships. The study was conducted within a specific urban area, so findings may not fully represent spray painters in other regions with different work practices or environmental conditions. Despite these limitations, the sample size, use of spirometry and inclusion of a control group provide credible evidence of the respiratory risks faced by car spray painters.

REFERENCES

1. Driscoll T, Nelson D. I., Steenland K, Leigh J, Concha-Barrientos M, Fingerhut M, Prüss-Üstün A. The global burden of non-malignant respiratory disease due to occupational airborne

exposures. American Journal of Industrial Medicine. 2005;48(6):432–445. doi:10.1002/AJIM.20210
2. Centers for Disease Control and Prevention (CDC). Organic Solvent Neurotoxicity (87–104). National Institute for Occupational Safety and Health (NIOSH), U.S. Centers for Disease Control and Prevention. Accessed November 12, 2025. https://www.cdc.gov/niosh/docs/87-104/default.html
3. Pourbabaki R, Rajizadeh M. A., Zarandi A. F., Sadeghi-Yarandi M., Damiri Z. Chemical agents that cause occupational diseases: Toxicity, exposure routes, and health effects. IntechOpen. Published online January 24, 2025. doi:10.5772/INTECHOPEN.1008774
4. Lockey J. E., Redlich C. A., Streicher R., Pfahles-Hutchens A., Hakkinen P. J., Ellison G. L., Harber P., Utell M., Holland J., Comai A., White M. Isocyanates and human health: Multi-stakeholder information needs and research priorities. Journal of Occupational and Environmental Medicine / American College of Occupational and Environmental Medicine. 2015;57(1):44–51. doi:10.1097/JOM.0000000000000278
5. Onesmo B. M., Rongo L. M. Assessment of respiratory symptoms and associated factors among house painters in Kinondoni Municipality, Tanzania. International Journal of Research GRANTHAALAYAH.2018;6(1):156171.doi:10.29121/GRANTHAALAYAH.V6.I1.2018.1605
6. Mwatu A. K. Health Hazards Associated with Spray Painting among Workers in Small Scale Auto Garages in Embakasi Division, Nairobi, Kenya. Master's Thesis, Kenyatta University; 2013. http://ir-library.ku.ac.ke/handle/123456789/7230
7. Amenu M. Prevalence of Respiratory Diseases among Automobile Spray Painters in Selected Auto Body Shops in Addis Ababa. Master's Thesis, Addis Ababa University; 2010. http://thesisbank.jhia.ac.ke/id/eprint/4080
8. Blossom A. I., Attah U. E., Omokorie O. K., Raimi M. O. Automobile spray paint dust and human health: A multi-site environmental health risk assessment of carcinogenic and non-carcinogenic effects in South-Eastern Nigeria. Authorea Preprints. Published online October 13, 2025. doi:10.22541/AU.176038621.14623228/V1
9. Taofeeq O. Organic solvent exposure: Hepatotoxicity, nephrotoxicity, and haematotoxicity assessment amongst vehicle spray painters in Ile-Ife, Nigeria. American Journal of Environmental Protection. Published online January 23, 2015. doi:10.12691/ENV-3-3-5
10. Ojo T. O., Onayade A. A., Afolabi O. T., Ijadunola M. Y., Esan O. T., Akinyemi P. A., Awe O. O. Work practices and health problems of spray painters exposed to organic solvents in Ile-Ife, Nigeria. Journal of Health and Pollution. 2020;10(28):1–12. doi:10.5696/2156-9614-10.28.201208
11. James I. C., Imaga N. A., Dokunmu T. M., Adedeji I. O., Emmanuel O. O., Orija M. E. Effects of chronic exposure to paint fumes among artisans in Lagos State, Nigeria. Toxicology Reports. 2022;9:663–670. doi:10.1016/J.TOXREP.2022.03.027
12. Omogbeme S. I., Agboje U. O., Obazee E. Lung function impairment among paint factory workers: A cross-sectional analytical study. Cureus Journal of Medical Science. Published online September 3, 2024. doi:10.7759/cureus.68499
13. Orji O. J., Ijioma C. E., Ekeleme N. C., Uduma V. U., Abali I. O., Okeji I. E., Olusakin T. C., Odufuwa O. O., Onyeoguzoro A. C., Ayinde O. E. A., Maduku E. J., Airaodion A. I. Evaluation of respiratory symptoms and lung function in car spray painters in Ibadan, Nigeria. Journal of

Advances in Medicine and Medical Research. 2023;35(19):237–250. doi:10.9734/JAMMR/2023/V35I195156
14. Ade S., Efio M., Tchevi C. S., Fanou L., Djibril A. B., Harries A. D. Occupational asthma among car painters in Parakou City in Benin, West Africa. Open Journal of Respiratory Diseases. 2024;14(4):122–134. doi:10.4236/OJRD.2024.144012
15. Awodele O., Popoola T. D., Ogbudu B. S., Akinyede A., Coker H. A. B., Akintonwa A. Occupational hazards and safety measures amongst the paint factory workers in Lagos, Nigeria. Safety and Health at Work. 2014;5(2):106–111. doi:10.1016/J.SHAW.2014.02.001
16. Aribo E. O., Antai A. B. Lung function parameters in spray painters in Calabar, Nigeria. Annals of Biological Research. 2014;5(11):32–35. http://scholarsresearchlibrary.com/archive.html
17. Methre S. T., Karandikar M. S. A study of pulmonary functions of spray painters working in automobile garages. IOSR Journal of Dental and Medical Sciences. 2016;15(3, Version IV):1–7. doi:10.9790/0853-15340107

Sekhar L., Venguidesvarane A. G., Thiruvengadam G., Sharma Y., Venugopal V., Rengarajan S., Johnson P. Respiratory symptoms and pulmonary function in paint industry workers exposed to volatile organic compounds: A systematic review and meta-analysis. PLoS One. 2024;19(12):e0315464. doi:10.1371/JOURNAL.PONE.0315464