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Factors Associated with Affected Breathing among Diesel Automotive Garage Workers: A Cross-Sectional Study in Bogra District Town

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Abstract **Original Research Article**

Introduction: Automotive garage workers are frequently exposed to harmful pollutants from diesel fumes, posing significant risks to respiratory health. Chronic exposure can lead to pulmonary impairments, such as bronchitis and lung function decline, particularly in occupational settings like garages where ventilation is poor and protective measures are limited. ***Objective:*** To investigate the prevalence and factors associated with affected breathing among diesel automotive garage workers in Bogra district town, Bangladesh. ***Methods:*** A descriptive cross-sectional study was conducted over six months, involving 199 male garage workers aged 14 to 55 years with at least one year of work experience. Participants with pre-existing respiratory conditions were excluded. Data collection included a structured questionnaire and Peak Expiratory Flow Rate (PEFR) measurements using a peak flow meter. Logistic regression analyses were performed to identify significant predictors of affected breathing. ***Results:*** The prevalence of affected breathing was found to be 39%. Significant factors included age (OR = 1.128; p = 0.020), monthly income ≥10,000 BDT (OR = 5.189; p = 0.0004), and nuclear family structure (OR = 2.289; p = 0.014). Older workers and those with higher incomes exhibited greater risk, likely due to prolonged exposure. Family size also influences respiratory health, as larger households often lack adequate ventilation. Education and history of lung disease showed near-significant associations, emphasizing the need for targeted interventions. ***Conclusion:*** Age, income, and family size significantly impact respiratory health among garage workers. Regular health screenings, improved living conditions, and educational initiatives are recommended to reduce exposure and enhance workplace safety. Further research is needed to address other occupational health risks.

Keywords: Automotive workers, respiratory health, diesel fumes, occupational exposure, public health, etc.

INTRODUCTION

The modern transportation system significantly contributes to air pollution, posing serious risks to human health [1]. Research has demonstrated that airborne contaminants from automobile emissions can damage airways and lung tissue, as the lungs are the primary point of contact between the body and environmental pollutants [2]. According to O Chattopadhyay, automotive garage workers are particularly vulnerable due to their exposure to harmful chemicals and toxic substances from vehicle exhaust. This exposure has been associated with a high prevalence of respiratory symptoms among these workers [3].

The lungs, processing approximately 7 liters of air per minute, are especially sensitive to air pollution [4]. Vehicular emissions release both primary reactive species (e.g., carbon monoxide, benzene) and secondary reactive species (e.g., ozone, nitrogen oxides), along with other pollutants like nitric oxide, carbon dioxide, sulfur dioxide, hydrocarbons, and particulate matter. These pollutants damage the airways and lung parenchyma, causing bronchoconstriction, increased mucus secretion, and alveolar swelling [5]. Chronic exposure to nitrogen dioxide and sulfur dioxide leads to obstructive and restrictive lung impairments. Additionally, long-term employment in transportation-related roles, such as bus drivers and mechanics, combined with smoking, has been strongly linked to chronic respiratory diseases and reduced lung function [6].

Diesel exhaust, classified as a probable human carcinogen by the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer, poses an even greater threat. Studies have shown that prolonged exposure to diesel fumes increases the risk of lung cancer and mortality by 20% to 50% among railroad, dock, trucking, and bus garage workers [6]. In animal models, high levels of diesel

exhaust have been linked to lung tumor development, emphasizing its hazardous nature.

Short-term exposure to high concentrations of these pollutants can cause acute respiratory symptoms, which are often reversible with the cessation of exposure. However, prolonged exposure leads to a steady decline in lung function [7]. Another significant concern is asbestos, a natural silicate mineral once widely used for its heat resistance and insulating properties. Though now recognized as highly carcinogenic, it remains in use in the automotive industry, further exacerbating health risks [7].

In Bangladesh, air pollution from unregulated fuel sales, including diesel, petrol, and kerosene, persists despite government bans. The situation is dire in urban areas, where black smoke from vehicles contributes to respiratory tract infections (RTIs) in approximately 25% of the population. The consequences are severe, ranging from bronchitis and upper RTIs to cardiac conditions. Vulnerable groups such as schoolchildren suffer disproportionately from this pollution. The contamination is exacerbated by uncleaned underground oil tanks, which introduce lead into the environment. Additionally, the use of adulterated diesel has surged due to rising fuel prices, further polluting the air with carbon monoxide and other harmful gases [8].

Given this context, diesel automotive garage workers in Bangladesh face heightened risks of respiratory issues. These workers, often uneducated and unaware of occupational hazards, lack access to preventive measures. Therefore, this study focuses on identifying respiratory health problems among diesel automotive workers in Bogra's sadar upazila. The findings aim to highlight the public health implications of air pollution in this vulnerable group and guide interventions to improve their health outcomes.

OBJECTIVE OF THE STUDY

- To find out the commonly associated factors with affected breathing among diesel automotive garage workers in Bogra district town.

METHODOLOGY

Study Design

The study employed a descriptive cross-sectional design conducted over six months (March to August 2016) to assess the respiratory health of male garage workers aged 14 to 55 years in Bogra, Rajshahi Division, Bangladesh. Participants were required to have at least one year of work experience, while those with pre-existing respiratory conditions, severe obesity (BMI > 30), or on bronchodilator medication were excluded. From a target population of approximately 300 workers, 199 participants were selected using a finite population correction formula. Data were collected through a structured questionnaire based on the ATS-DLD-78 model to capture demographic, occupational, and behavioral details, alongside lung function assessments using a peak flow meter to measure Peak Expiratory Flow Rate (PEFR)

Inclusion Criteria:

- Automotive workers who are working for at least one year.
- Male workers (usually women do not work in this occupation)
- Age is within 14-55 years.
- Respondents who were willing to give consent.

Exclusion Criteria:

- Workers who had respiratory disease before starting work in garage.
- Workers who were on bronchodilating medication.
- Who were known as CHD (Coronary Heart Disease) patients.
- Severe obese (BMI> 30)

Ethical Considerations

The study adhered to ethical guidelines, including obtaining informed consent, ensuring participant confidentiality, and allowing voluntary withdrawal.

Data Analysis

Data were analyzed using R software. Statistical tests, including chi-square and logistic regression, were performed to identify significant predictors of affected breathing.

RESULTS

The study included 199 male automotive garage workers aged 14 to 55 years, among whom 78 (39%) exhibited affected breathing, while 121 were unaffected. Key participant characteristics such as marital status, education level, monthly income, cough, phlegm, breathlessness, lung disease history, years of work, smoking habits, and family structure were analyzed.

Older workers and those with prolonged years of employment were more likely to experience respiratory issues, as indicated by the box plots for age and work duration. This suggests a significant association between longer exposure to occupational hazards and affected breathing.

Table 1 presents the unadjusted association between various covariates and the occurrence of affected breathing among diesel automotive garage workers. The variables analyzed include marital status, educational level, monthly income, smoking habits, and family size, along with respiratory health indicators like cough, phlegm, wheezing, and breathlessness.

- Monthly income emerged as a highly significant factor ($p < 0.001$), with workers earning ≥10,000 BDT more likely to have affected breathing compared to those earning less.
- Family size also showed significance ($p = 0.038$), with workers from nuclear families being more prone to respiratory issues.
- Years of working was moderately significant ($p = 0.019$), indicating that longer employment duration is associated with affected breathing.

Other variables, such as marital status, educational level, smoking habits, and history of lung disease, were not statistically significant but may warrant further investigation due to potential trends.

The table highlights the prevalence and potential associations of various demographic and occupational factors with respiratory health, providing insights for targeted interventions.

Table 1: Unadjusted Association Between Each of the Covariates and Breathing

Variables	Categories	Breathing		X^2 value	P-value
		Affected	Normal		
Marital status	Married	39	46	2.315	0.128
	Unmarried	39	75		
Educational level	Above primary	30	52	0.234	0.628
	Primary or below	48	69		
Monthly income	<10 thousand/s	51	109 (31%)	16.826	**<0.001**
	>=10 thousands	27	12 (69%)		
Usual Cough	No	45	78	0.656	0.417
	Yes	33	43		
Usual Phlegm	No	48	81	0.393	0.530
	Yes	30	40		
Wheezing	No	57	93	0.190	0.662
	Yes	21	28		
Breathlessness	No	40	80 (33%)	3.761	**0.052**
	Yes	38	41 (48%)		
History of lungs disease	No	67	114 (37%)	3.041	**0.081**
	Yes	11	7 (61%)		
Years of Working as Garage Worker	<10	35	76 (31%)	5.481	**0.019**
	>=10	43	45 (49%)		
Ever smoked	No	46	76	0.154	0.694
	Yes	32	45		
Duration of smoking	<=5	9	12 (47%)	0.314	0.854
	>5	23	33 (41%)		
	0	46	76 (37%)		
Family member	Nuclear family	25	58 (30%)	4.289	0.038
	Joint family	53	63 (45%)		

Multivariable Logistic Regression

A multivariable logistic regression analysis identified key factors significantly associated with affected breathing displays in Table 2 results of the adjusted logistic regression analysis, highlighting the association between various covariates and the likelihood of affected breathing among diesel automotive garage workers.

- Age was found to be a significant factor ($p = 0.020$), with each additional year increasing the odds of affected breathing by 12% (OR = 1.128; 95% CI: 1.021–1.257).
- Monthly income showed a strong association ($p = 0.0004$), where workers earning ≥10,000 BDT were over five times more likely to have affected breathing compared to those earning less (OR = 5.189; 95% CI: 2.13–13.450).
- Family size was another significant variable ($p = 0.014$); workers from nuclear families were approximately 2.3 times more likely to experience affected breathing compared to those from joint families (OR = 2.289; 95% CI: 1.190–4.535).

While not statistically significant, variables such as marital status (OR = 2.11; $p = 0.143$), educational level (OR = 1.62; $p = 0.147$), and history of lung disease (OR = 2.719; $p = 0.076$) suggested potential trends that warrant further investigation. Additionally, factors like years of working ($p = 0.431$) and smoking habits ($p > 0.3$) did not show significant associations in this analysis.

This table provides a comprehensive overview of the significant and near-significant predictors, emphasizing the impact of socio-demographic and occupational factors on respiratory health.

Table 2: Adjusted Association Between Each of Covariates and Breathing

Variables	References	Estimate	OR	LCL	UCL	P- value
Age	---	0.120	1.128	1.021	1.257	**0.020**
Marital status (Unmarried)	Married	0.748	2.11	0.791	5.954	0.143
Educational level (Primary and below)	Above primary	0.487	1.62	0.848	3.194	0.147
Monthly income>=10	< 10000	1.646	5.189	2.13	13.450	**0.0004**
History of lungs disease (Yes)	No	1.000	2.719	0.907	8.58	**0.076**
Years of working	---	-0.040	0.960	0.865	1.061	0.431
Duration of smoking habit ≤5yrs	>5yrs	0.380	1.462	0.528	3.949	0.454
Duration of smoking habit >5yrs	≤5yrs	-0.443	0.641	0.269	1.459	0.300
Family member (Joint family)	Nuclear family	0.828	2.289	1.190	4.535	0.014

Stepwise Regression Findings

Stepwise regression confirmed monthly income, age, and family size as consistent predictors of affected breathing showing in Table 3, which represents the findings from the stepwise logistic regression analysis, which identified consistent predictors of affected breathing among diesel automotive garage workers.

- Monthly income remained a highly significant factor, with workers earning ≥10,000 BDT having 4.43 times higher odds of affected breathing compared to those earning less (OR = 4.425; 95% CI: 1.890–10.905; p = 0.0008).
- Age also emerged as a significant predictor, with each additional year increasing the odds of affected breathing by 8.6% (OR = 1.086; 95% CI: 1.025–1.155; p = 0.006).
- Family size was another significant factor, as workers from nuclear families were 2.34 times more likely to experience affected breathing compared to those from joint families (OR = 2.343; 95% CI: 1.225–4.610; p = 0.011).

Additionally, marital status (OR = 2.516; p = 0.060), history of lung disease (OR = 2.873; p = 0.059), and educational level (OR = 1.674; p = 0.122) were not statistically significant but showed trends suggesting potential associations.

This analysis underscores the critical role of sociodemographic and occupational factors, particularly income, age, and family size, in predicting respiratory health risks among workers.

Table 3: Stepwise Regression with Breathing After Adjusting Covariance

Variables	References	Estimate	OR	LCL	UCL	P-value
Age		0.082	1.086	1.025	1.155	**0.006**
Marital status (Unmarried)	Married	0.922	2.516	0.987	6.856	0.060
Educational level (Primary and below)	Above primary	0.515	1.674	0.878	3.266	0.122
Monthly income>=10000	< 10000	1.487	4.425	1.890	10.905	**0.0008**
History of lungs disease (Yes)	No	1.055	2.873	0.971	8.987	**0.059**
Family member (Joint family)	Nuclear family	0.851	2.343	1.225	4.61	0.011

DISCUSSION

This study, conducted among male diesel automotive garage workers in Bogra district town, assessed respiratory health using a Peak Flow Meter (Rossmax) to measure the Peak Expiratory Flow Rate (PEFR). Participants were instructed to inhale deeply and exhale forcefully, with the meter recording a range between 0 and 800 L/min. Each participant performed the test three times, and the highest reading was recorded. PEFR reference values, adjusted for age and height, were calculated using a standardized PEFR calculator [9]. Exposure to diesel fumes in significant concentrations is known to impair ventilatory capacity. Chronic inhalation of such fumes has also been linked to conditions like chronic bronchitis, marked by persistent cough and sputum production [10]. The prevalence of affected breathing among the participants in this study was 39%, aligning closely with findings from a similar study in India, where 30.19% of engine mechanics exhibited obstructive impairments. That study was conducted by the Institute of Hygiene & Public Health, Urban Health Centre [11,12].

Analysis of income levels revealed that participants with higher monthly incomes were more likely to have affected breathing. This association likely reflects increased work hours and, consequently, greater exposure to diesel fumes among higher-income workers (Tables 2 and 3). Age also emerged as a significant predictor. Multivariable analysis indicated that with each

additional year, the likelihood of affected breathing increased by 12%. This finding corroborates results from similar research conducted in India, which also highlighted the cumulative effects of age on respiratory health [13]. Family size was another significant factor identified in both stepwise and multivariable regression analyses. Workers from larger families may experience higher exposure to respiratory infections due to overcrowding and poor ventilation in confined living spaces, which exacerbates breathing difficulties.

A history of lung disease was found to be nearly significant, emphasizing that pre-existing respiratory conditions could increase susceptibility to impaired breathing. Including this variable provided insight into the magnitude of the problem among this subgroup, even though further investigation is warranted [14].

Education level was also found to be near-significant in association with affected breathing. Most workers had only attained primary-level education, and this limited awareness may contribute to occupational hazards. Providing at least high school-level education, along with technical or occupational safety training, could potentially mitigate these risks. Further research is needed to explore this relationship in greater depth.

CONCLUSION

This study identified significant factors associated with affected breathing among diesel automotive garage workers in Bogra district town, with a prevalence rate of 39%. Key predictors included monthly income, age, family size, and education level. Workers earning higher incomes were at greater risk due to increased work exposure, while older workers were more susceptible to respiratory issues. Those from nuclear families faced additional risks, likely due to poor ventilation in smaller living spaces. Most workers had only primary-level education, highlighting the need for enhanced occupational safety training and access to higher education.

To mitigate these risks, the following measures are recommended:

- Implement regular health screenings, prioritizing workers with higher incomes and prolonged exposure.
- Provide age-specific health interventions to address the increased vulnerability of older workers.
- Promote improved ventilation and reduced overcrowding in living spaces for workers from nuclear families.
- Facilitate access to high school education and occupational safety training to raise awareness and reduce exposure.

Further research on larger scales and other occupational health risks is essential to enhance the quality of life for these workers.

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