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A Cross-Sectional Study of Pulmonary Function Test Using FEV_1, FVC, and FEV_1 / FVC Ratio Among Commercial Three-Wheeler Drivers Aged 18-60 Years in Guwahati

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Abstract: ***This cross-sectional study assessed pulmonary function among 150 healthy male commercial three-wheeler drivers aged 18 to 60 years in Guwahati to examine the relationship between occupational exposure to vehicular air pollution and respiratory health. Commercial three-wheeler drivers represent a vulnerable occupational group due to prolonged exposure to traffic-related pollutants in semi-open vehicles. Pulmonary function was evaluated using spirometry, with key parameters including forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and FEV1/FVC ratio. Participants were grouped according to duration of occupational exposure, less than 10 years and more than 10 years. Statistical analysis showed significantly lower pulmonary function values among drivers with longer exposure duration. FEV1, FVC, and FEV1/FVC ratio declined progressively across increasing age groups, with strong negative correlations observed between pulmonary function measures and both age and driving experience. Daily driving hours also showed a weak negative association with selected lung function parameters. Type of vehicle and alcohol use did not show significant associations with exposure duration. The findings indicate that prolonged occupational exposure to vehicular pollution may contribute to declining respiratory function among commercial three-wheeler drivers, highlighting the need for occupational health monitoring and preventive measures in this population.***

Keywords: air pollution, pulmonary function, three-wheeler drivers, occupational exposure, respiratory health.

1. Introduction

- Air pollution is the contamination of the internal or external surroundings by any biological substance which modifies the natural and chemical composition and physical characteristics of the atmosphere1. Air pollution is a major environmental health concern and a significant contributor to respiratory morbidity worldwide, accounting for approximately 5.4% of total deaths annually. rapid urbanization and increased vehicular emissions have led to rising levels of particulate matter ($PM_{2.5}$, PM_{10}), carbon monoxide, and other toxic pollutants.
- Commercial three-wheeler drivers form a high-risk occupational group due to prolonged exposure to vehicular exhaust and urban pollutants. They typically work for extended hours in semi-open vehicles, resulting in continuous inhalation of polluted air. This chronic exposure leads to airway inflammation, oxidative stress, and progressive decline in pulmonary function.
- Pulmonary function tests (PFT) including **FEV_1, FVC, AND FEV_1/FVC** ratio are reliable indicators of respiratory health. Several studies have demonstrated a significant reduction in these parameters among individuals exposed to traffic-related air pollution.
- Despite increasing pollution levels in **GUWAHATI**, limited data are available on pulmonary function among commercial three-wheeler drivers. Hence, this study is undertaken to evaluate their respiratory health.

2. Aims and Objective

Aims

To assess **FEV_1, FVC, FEV_1/FVC** ratio among commercial three-wheeler drivers aged 18–60 years in GUWAHATI.

Objective

To evaluate the association between duration of occupational exposure and pulmonary function.

3. Methods

- Cross-sectional study was conducted among 150 healthy commercial three-wheeler driver.
- Ethical approval was obtained from the institutional ethics committee.
- Informed consent was taken from all participants prior to the study.
- Simple random sampling was used to select the participants

Inclusion Criteria

- Subjects who were willing to participate.
- Healthy male commercial three-wheeler drivers in the age group 18-60 years.
- Male commercial three-wheeler drivers residing in Guwahati city during the study period.
- Only commercial three-wheeler drivers of Indian ethnicity were included.

Exclusion Criteria

- Subjects who were not willing to participate.

- Female commercial three-wheeler drivers were excluded in this study
- Male commercial three-wheeler drivers below 18 years and above 60 years.
- Subjects with a known respiratory diseases like bronchial asthma, bronchitis, tuberculosis, emphysema etc.
- Individuals presenting with structural abnormalities of the vertebral column or thoracic cage, diabetes mellitus, substance abuse, or a history of smoking were excluded.

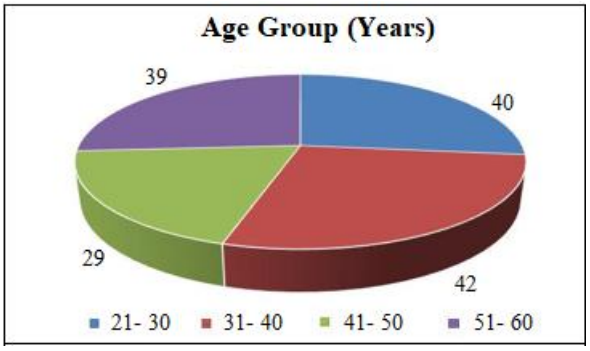
Collection of Data

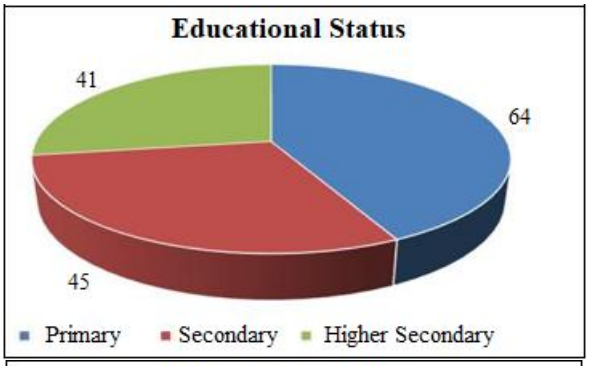
- Body mass index (**BMI; kg/m²**) was calculated as body weight (kg) divided by the square of height (m). Weight and height were measured using digital scales.
- Data were collected using an interview technique with a predesigned and pretested proforma. Information regarding demographic characteristics, smoking status, duration of work, respiratory symptoms, and awareness about health hazards and their prevention was obtained.
- Vital parameters including pulse rate, blood pressure, and respiratory rate were recorded. A comprehensive clinical examination of the respiratory, cardiovascular, and central nervous systems was carried out as per the proforma.
- Pulmonary function testing was conducted by using the Helios computer-based digital spirometer, between 8:00 A.M. And 12:00 noon to minimize the effect of diurnal variation on lung function.

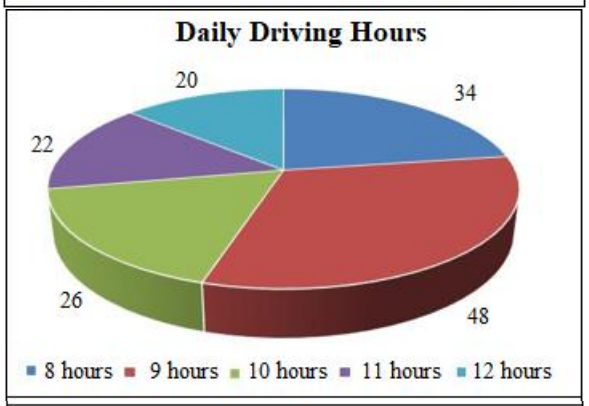
4. Results and Analysis

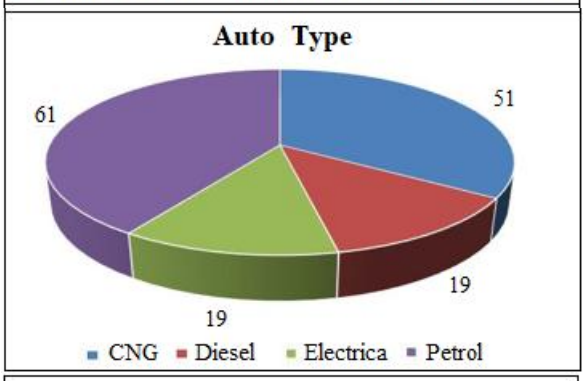
- Data were inserted into Microsoft excel and analyzed using the statistical package for social sciences (SPSS), version 20.
- Results were expressed as mean ± standard deviation (SD).
- An independent sample t-test was applied to evaluate differences in various lung volumes.
- One-way analysis of variance (ANOVA) was used for comparisons among multiple groups." Pearson's correlation coefficient was employed to determine the relationship between different lung volumes and duration of exposure.

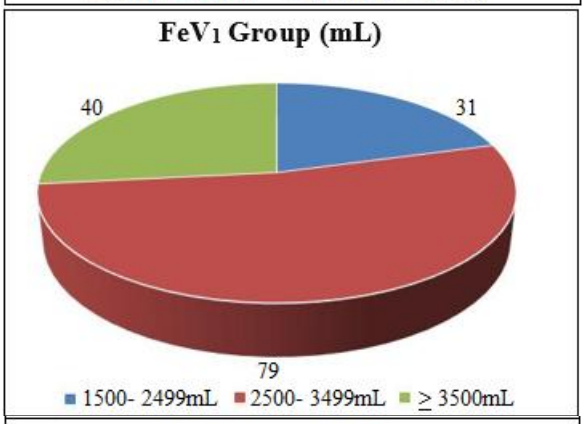
4.1 Results











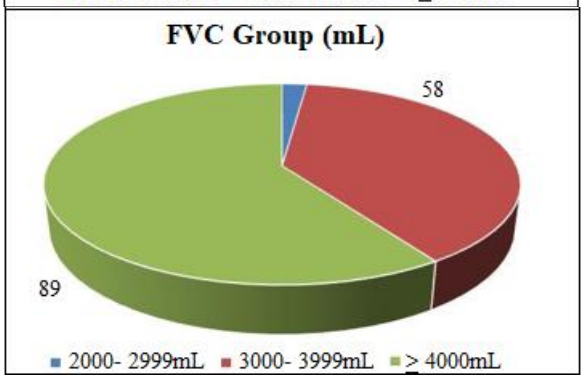


Table: Association between Age Group and Duration of Exposure Among Three-wheeler Commercial Drivers

Age Group (Years)	< 10 Years Exposure n (%)	> 10 Years Exposure n (%)	Total n (%)	Chi-square (χ^2)	df	p-value
21–30	37 (92.5)	3 (7.5)	40 (26.7)	49.592	3	< 0.001
31–40	19 (45.2)	23 (54.8)	42 (28.0)			
41–50	11 (37.9)	18 (62.1)	29 (19.3)			
51–60	6 (15.4)	33 (84.6)	39 (26.0)			
Total	73 (48.7)	77 (51.3)	150 (100)			

Table: Association Between Type of Three-wheeler Commercial Drivers and Duration of Exposure among Drivers

Type	< 10 Years Exposure n (%)	> 10 Years Exposure n (%)	Total n (%)	Chi-square (χ^2)	df	p-value
CNG	21 (41.2)	30 (58.8)	51 (34.0)	2.868	3	0.412
Diesel	10 (52.6)	9 (47.4)	19 (12.7)			
Electric	12 (63.2)	7 (36.8)	19 (12.7)			
Petrol	30 (49.2)	31 (50.8)	61 (40.7)			
Total	73 (48.7)	77 (51.3)	150 (100)			

Table: Association between Alcohol Use and Duration of Exposure among Three-wheeler Commercial Drivers

Alcohol Use	< 10 Years Exposure n (%)	> 10 Years Exposure n (%)	Total n (%)	Chi-square (χ^2)	df	p-value
Yes	36 (49.3)	37 (50.7)	73 (48.7)	0.024	1	0.877
No	37 (48.1)	40 (51.9)	77 (51.3)			
Total	73 (48.7)	77 (51.3)	150 (100)			

Table: Comparison of Demographic and Occupational Variables Between Exposure Groups (<10 Years Vs >10 Years) among Three-wheeler Commercial Drivers

Variable	Exposure Group	N	Mean ± SD	t-value	df	Effect Size (Cohen's d)	p-value
Age (years)	<10 Years	73	33.64 ± 9.28	-8.05	148	-1.315	< 0.001
	> 10 Years	77	46.45 ± 10.16				
Height (cm)	< 10 Years	73	168.81 ± 5.90	-0.129	148	-0.021	0.898
	> 10 Years	77	168.94 ± 6.15				
Weight (kg)	< 10 Years	73	66.89 ± 9.27	-0.347	148	-0.057	0.729
	> 10 Years	77	67.44 ± 10.11				
BMI (kg/m²)	< 10 Years	73	23.04 ± 3.76	-0.344	148	-0.056	0.732
	> 10 Years	77	23.26 ± 4.02				
Daily Driving Hours	< 10 Years	73	9.55 ± 1.34	-0.82	148	-0.134	0.414
	> 10 Years	77	9.73 ± 1.33				

Table: Comparison of Pulmonary Function Parameters across Age Groups (One-Way Anova)

Variable	21–30 (Mean ± SD)	31–40 (Mean ± SD)	41–50 (Mean ± SD)	51–60 (Mean ± SD)	F (df=3,146)	Eta²	p-value
FEV_1 (ml)	3750.98 ± 262.49	3203.21 ± 267.24	2799.97 ± 403.28	2506.54 ± 303.99	119.989	0.711	<0.001
FVC (ml)	4774.20 ± 367.38	4240.69 ± 384.05	3840.93 ± 433.58	3511.79 ± 445.92	69.406	0.588	<0.001
FEV_1/FVC (%)	78.20 ± 3.23	75.17 ± 4.03	72.28 ± 4.86	71.00 ± 4.10	24.278	0.333	<0.001

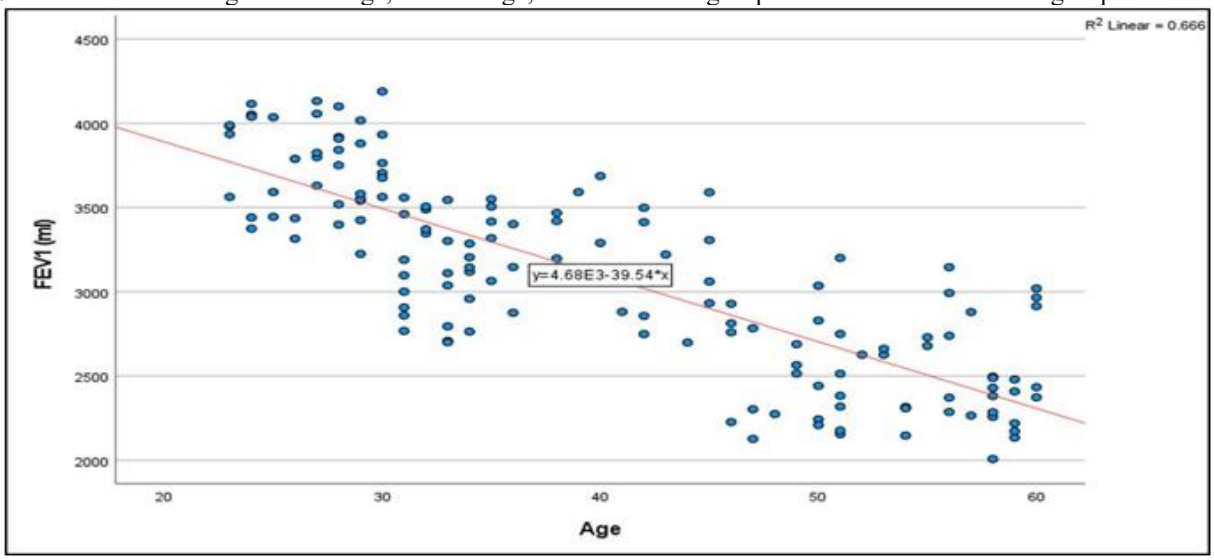
Table: Comparison of Pulmonary Function Parameters between Exposure Groups (<10 Years Vs >10 Years) among Three-wheeler Commercial Drivers

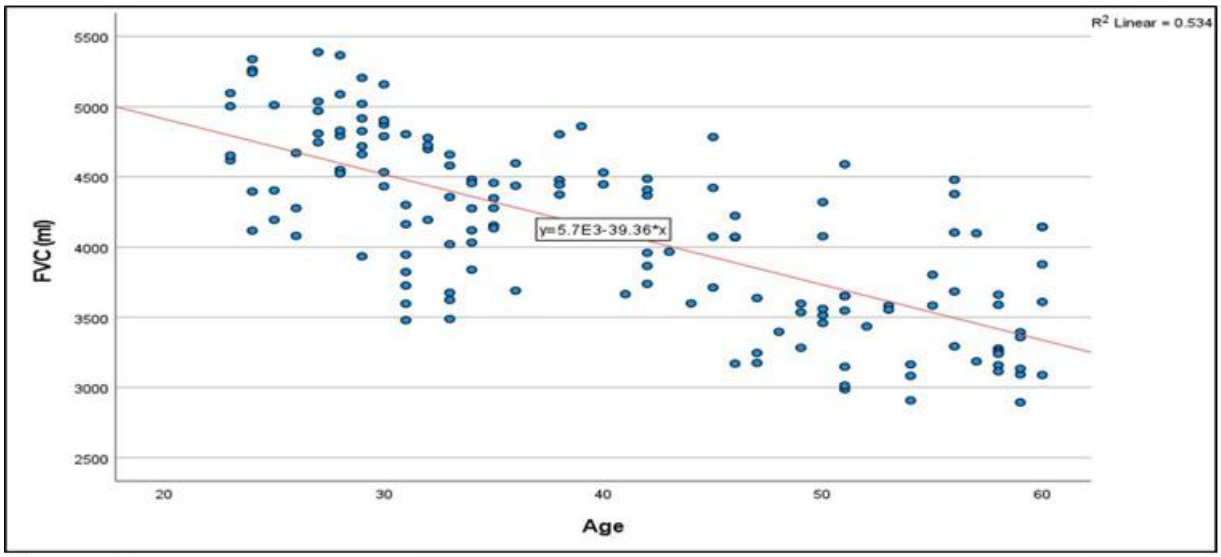
Parameter	Exposure Group	N	Mean ± SD	T-Value	DF	Effect Size (COHEN'S D)	P-Value
FEV_1 (ML)	< 10 Years	73	3407.22 ± 472.96	7.992	148	1.306	< 0.001
	> 10 Years	77	2789.62 ± 473.12				
FVC (ML)	< 10 Years	73	4439.33 ± 534.41	7.093	148	1.159	< 0.001
	> 10 Years	77	3809.78 ± 551.67				
FEV_1/FVC (%)	< 10 Years	73	76.21 ± 4.24	4.912	148	0.802	< 0.001
	> 10 Years	77	72.56 ± 4.82				

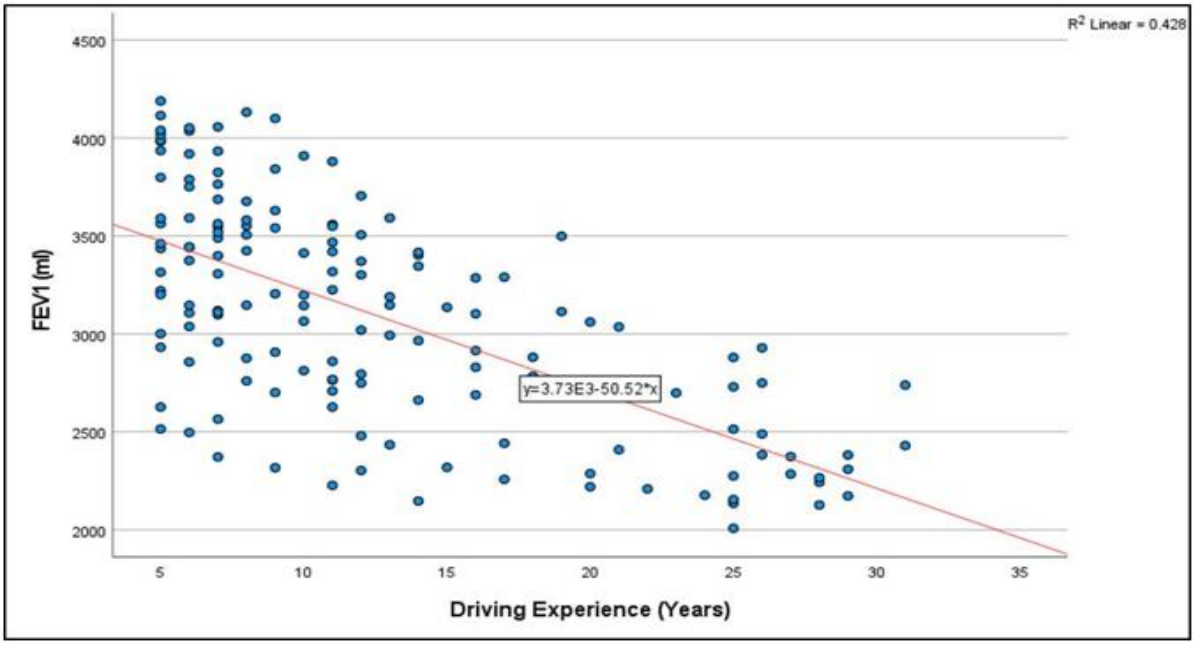
Table: Pearson Correlation Between Pulmonary Function and Clinical Variables

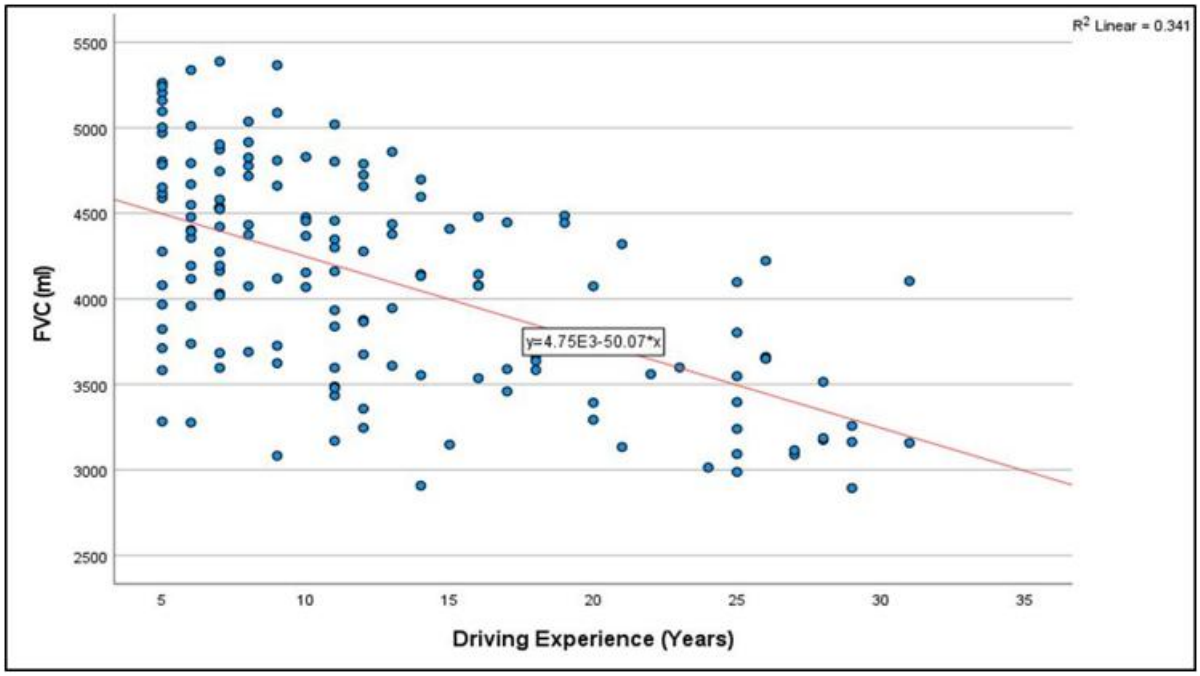
Variable 1	Variable 2	Pearson r	p-value
FEV_1	FVC	0.943	<0.001
FEV_1	FEV_1/FVC	0.619	<0.001
FEV_1	Three-wheeler	0.119	0.175
FEV_1	Driving Experience	-0.655	<0.001
FEV_1	Daily Driving Hours	-0.164	0.045
FEV_1	Alcohol	-0.052	0.525
FEV_1	Mask	-0.086	0.298
FEV_1	Age	-0.816	<0.001
FEV_1	FEV_1/FVC	0.327	<0.001
FVC	Three-wheeler	0.096	0.275
FVC	Driving Experience	-0.584	.<001
FVC	Daily Driving Hours	-0.172	0.035
FVC	Alcohol	-0.088	0.284
FVC	Mask	-0.066	0.423
FVC	Age	-0.731	<0.001
FEV_1/FVC	Three-wheeler	0.109	0.214
FEV_1/FVC	Driving Experience	-0.503	<0.001
FEV_1/FVC	Daily Driving Hours	-0.061	0.461
FEV_1/FVC	Alcohol	0.04	0.625
FEV_1/FVC	Mask	-0.085	0.299
FEV_1/FVC	Age	-0.596	<0.001
THREE-WHEELER	Driving Experience	-0.075	0.394
THREE-WHEELER	Daily Driving Hours	-0.019	0.828
THREE-WHEELER	Alcohol	-0.025	0.776
THREE-WHEELER	Mask	-0.18	0.04
THREE-WHEELER	Age	-0.176	0.044
Driving Experience	Alcohol	0.065	0.433
Driving Experience	Mask	0.137	0.093
Driving Experience	Age	0.666	<0.001
Daily Driving Hours	Alcohol	0.063	0.445
Daily Driving Hours	Mask	-0.098	0.231
Daily Driving Hours	Age	0.014	0.867
Alcohol	Mask	0.022	0.786
Alcohol	Age	0.122	0.138
Mask	Age	0.135	0.101

Table: Scatter Plot Showing Fev1 Vs Age, Fvc Vs Age, Fev1 Vs Driving Experience and Fvc Vs Driving Experience




R² Linear = 0.534
FVC (ml)
y=5.7E3-39.36*x
Age


R² Linear = 0.428
FEV1 (ml)
y=3.73E3-50.52*x
Driving Experience (Years)


R² Linear = 0.341
FVC (ml)
y=4.75E3-50.07*x
Driving Experience (Years)

5. Discussion

- The present study was conducted during the period from June 2024 to July 2025.
- A total of 150 male non-smoker three-wheeler commercial drivers in the age group of 18-60 years were included in the study of which 73 three-wheelers commercial drivers with less than 10 years of exposure and 77 three-wheeler commercial drivers with more than 10 years of exposure.
- Drivers with more than 10 years of occupational exposure showed significantly reduced mean values of forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and FEV_1/FVC ratio when compared with drivers who had less than 10 years of driving experience.
- Driving experience also showed a very highly significant negative correlation with FEV_1, FVC, and FEV_1/FVC ($p < 0.001$), suggesting adverse effects of prolonged occupational exposure.
- Daily driving hours demonstrated a weak but significant negative correlation with fev_1 and fvc.

6. Conclusion

- This study demonstrates that pulmonary function, as assessed by FEV_1, FVC, and the FEV_1/FVC ratio, is reduced among commercial three-wheeler drivers.
- These findings suggest that chronic exposure to vehicular pollution may adversely affect the health of commercial three-wheeler drivers.

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