Original Article

Cross-Sectional Analysis of Chronic Obstructive Pulmonary Disease (COPD) Prevalence Among Auto Rickshaw Drivers In Gwalior Urban Area

Anil K Agarwal[1], Harnoor Baweja[2], Aparna Thamman[3], Ram Niwas Mahore[4], Bishwajit Thakur[5]

[1]Professor, Department of Community Medicine, G R Medical College Gwalior (MP)
[2,3,5] PG (MD) Std Department of Community Medicine, G R Medical College Gwalior (MP)
[4]Associate Professor ,Department of Community Medicine, G R Medical College Gwalior (MP)

Corresponding Author
Ram Niwas Mahore
B20 Kailash Nagar, New Collectoate Road Gwalior 474011 MPdrmahore@ gmail.comMo 9425334365
Orcid ID: 0000-0001-9585-2852

Received: 19 November, 2023 Accepted:29 December, 2023

ABSTRACT
Background: The recent surge in industrialization and urbanization, coupled with the widespread use of fossil fuel-driven vehicles, has resulted in escalated pollution levels, particularly in major cities. This environmental deterioration has given rise to various health issues, including both acute and chronic diseases such as Chronic Obstructive Pulmonary Disease (COPD), Cardiovascular Diseases, Cerebrovascular Diseases, among others, leading to substantial mortality and morbidity. Auto rickshaw drivers, operating in environments abundant with pollutants, are particularly susceptible to the adverse effects of these environmental stressors. **Objectives:** The current study aimed to assess the prevalence of COPD among auto rickshaw drivers. **Methods**: A community-based cross-sectional study was conducted in 2023 in the four major areas of Gwalior city, encompassing 500 auto rickshaw drivers selected from ten Three-Seater Rickshaw (TSR) stands through simple random sampling. Consecutive drivers were enrolled from each stand. Data collection involved a structured questionnaire, and spirometry was performed using a handheld portable spirometer with adjusted values according to S K Chhabra's formula for Indian Males. Statistical analysis was conducted using SPSS, applying chi-square tests. **Results:** The mean age of the study subjects was 40.2±7.9 years, falling within the age group of 21 to 60 years. COPD prevalence was determined to be 15.2% based on spirometry according to GOLD criteria. Statistically significant associations were identified with the age of the study subjects and the cumulative driving hours. However, no significant association was found with smoking status. **Conclusion:** The study revealed a higher prevalence of COPD among the auto rickshaw drivers. Given their status in the unorganized sector, there is a pressing need for pertinent policies to enhance their health status and overall well-being.
KEY WORDS: Breathing difficulty, COPD, Auto rickshaw drivers, Smoking

INTRODUCTION

In the realm of human development, significant strides have been made across various sectors such as industrialization, transportation, and medical facilities over the years. This progress has notably fuelled the trend of urbanization, with a considerable portion of this urban growth occurring haphazardly, giving rise to a myriad of health-related challenges. Unplanned urbanization has, in turn, contributed to heightened air pollution due to increased industrial and transport activities, thereby adversely affecting human health and the environment. The escalating prevalence of respiratory ailments linked to air pollution underscores the urgent need for comprehensive understanding and mitigation. Respiratory morbidities attributed to air pollution are on the rise and it has also played an important role in the development of other noncommunicable diseases such as hypertension, myocardial infarction, and stroke among others. Chronic obstructive pulmonary disease (COPD) is considered to be the fourth leading cause of death. [1] The disease is characterized by persistent and usually progressive airflow limitation, which is not fully reversible, characterized by over responsiveness of the airway to pollutants and other noxious particles. It includes three conditions namely emphysema, chronic

bronchitis, and small airway disease. [2] The common symptoms of COPD are breathlessness, cough with moderate to excessive sputum production, and the complaints of chronic duration. The main risk factors of COPD are (i) tobacco smoking which accounts for a majority of cases; (ii) indoor as well as outdoor air pollution; and (iii) occupational exposure to the dust, vapors, and fumes. According to the WHO, COPD has been accounting for 5% of total deaths worldwide and is estimated to become the third leading cause or 8.6% of deaths worldwide by 2030. [1,2] Besides causing morbidity, COPD causes a major economic burden on patients as well as the healthcare infrastructure of the country. India is a developing country with a major burden of COPD having a prevalence of 4.3% in 2016 and with 75.6% of disability adjusted life years (DALYs) among those due to chronic respiratory illnesses.[1,3] Along with China, India contributes to 66% of the total COPD mortality, which can be attributed to environmental pollution in the major cities of these 2 countries.[3] Furthermore, the risk factors vary across the country because of variations in socio demographic characteristics, cultural practices, behavioral habits, and ethnicities. The World Health Organization (WHO) reports that COPD presently accounts for 5% of global deaths, with an anticipated rise to 8.6% by 2030. This not only poses a significant health burden but also places substantial economic strain on both affected individuals and healthcare systems worldwide. In the context of India, a developing nation grappling with a COPD prevalence of 4.3% in 2016, the impact is substantial, constituting 75.6% of Disability Adjusted Life Years (DALYs) attributed to chronic respiratory illnesses. India, alongside China, bears the brunt of 66% of total COPD mortality, primarily linked to environmental pollution in major urban centers. [4]Gwalior, notorious for elevated air pollution levels, faces unique challenges, with certain occupational groups at heightened risk. Notably, auto rickshaw drivers, integral to the public transport system in low and middle-income countries, stand out as a vulnerable group due to constant exposure to environmental pollutants in their open cabins. Moreover, studies reveal a high prevalence of tobacco smoking among this group.This study aims to address a critical research gap by focusing on COPD prevalence among auto rickshaw drivers in Gwalior city. As of our knowledge cut-off date, there is a lack of major studies in this specific demographic, emphasizing the significance of this investigation. The primary objectives include determining the prevalence of COPD among auto rickshaw drivers in Gwalior, a city in the central Indian state of Madhya Pradesh, and identifying the associated risk factors. This study endeavors to contribute valuable insights into the burden of COPD within this occupational group, shedding light on a critical public health issue that has implications for both individual well-being and broader societa

MATERIAL AND METHOD

Gwalior city is divided into four major areas, namely Lashkar, Gwalior, Morar, and Hazira, with a total population exceeding 20 lakhs. This cross-sectional study was conducted across the entire Gwalior district, spanning from January to July 2023, with data collection taking place at Three Seater Rickshaw (TSR) stands. The sample size determination was based on a study by Stephen et al. [5], which reported a 24% prevalence of reduced peak expiratory flow rate (PEFR). Using the formula $N = (Z1- \alpha/2)\ 2 \times p \times (1 - p)/E2$, where $Z1\ \alpha/2 = 1.96$ (95% confidence interval), $P = 0.24$, $SE = 0.036$ (Relative error = 20% of p), the initial sample size was calculated as 332. After applying a design effect of 1.5, the final sample size was rounded up to 500.Gwalior city, encompassing all four regions with 18 TSR stands, was selected as the study area. Out of these, 10 TSR stands were randomly chosen, and 50 consecutive rickshaw drivers were selected from each stand. A total of 500 auto rickshaw drivers aged 21–60 years, with a minimum of 1 year of driving experience, were included in the study. Exclusion criteria comprised individuals with known heart diseases or chest deformities and those not providing consent.Written consent was obtained, and study details were explained to participants through a self-designed, pretested, semi-structured interview schedule, including the Indian Study on Epidemiology of Asthma, Respiratory symptoms, and Chronic Bronchitis questionnaire. This covered general demographic data, driving habits, behavioral habits, and questions related to chronic respiratory complaints. A comprehensive physical examination, incorporating anthropometry, blood pressure, pulse, SpO2, and other vital signs, was conducted. Measurements, including height, weight, SpO2, chest circumference, and chest expansion, were taken using appropriate tools. Respiratory system examination and spirometry were conducted in a field setup using a turbine-based spirometer from Uni Med India, following two weeks of training at a tertiary care hospital. Predicted spirometry values were based on Chhabra's predicted values for North Indian males [6]. Spirometry parameters measured included forced expiratory volume at first second (FEV1), forced vital capacity (FVC), PEFR, and FEV1/FVC ratio. The spirometer software was pre-set to Indian standards for predicted values. Individuals were classified based on the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, using FEV1/FVC ratios [7]. Institutional ethical committee approval was obtained before commencing the study. Data were entered and analyzed using Statistical Package of Social Sciences (SPSS) Version 22. After data cleaning, mean and

standard deviation were calculated for quantitative data, and proportions were determined for qualitative data. Statistical tests, including the chi-square test, binary logistic regression, multinomial logistic regression, and analysis of variance, were applied as appropriate, with significance set at $P < 0.05$.

RESULTS

The study comprised 500 auto rickshaw drivers aged between 21 and 60 years who met the specified inclusion and exclusion criteria. Out of the 536 drivers initially approached, four were excluded due to pre-existing ischemic heart disease, and 32 individuals declined to participate, resulting in a non-response rate of 6%. The majority of the study subjects fell within the age group of 31–40 years (41.0%), followed closely by the 41–50 age group (39.6%). All participants were male, with a mean age of 40.2 and a standard deviation of 7.9 years. The age range spanned from 21 to 60 years.Among the 500 auto rickshaw drivers, 52.8% had been driving auto rickshaws for more than 10 years, with a mean duration of 14.2 years and a standard deviation of 7.2 years, ranging from 3 to 34 years. Exposure measurement was assessed using "hour-years of driving," calculated as the product of hours of driving per day and the total years of driving. Approximately 49.6% of the auto drivers had accumulated more than 1000 hours of driving, and 39.4% were found to have a reduced FEV1/FVC ratio without the use of a bronchodilator.Eighty-eight subjects (86.3%) from the initial cohort underwent post bronchodilator spirometry evaluation during the follow-up. Among these, 32 individuals exhibited reversibility, marked by a more than 12% increase in the percentage predicted of FEV1. The diagnosis of COPD was established when the post bronchodilator value of the FEV1/FVC ratio remained below 0.7. Among those with COPD, 14.5% had mild COPD, 63.1% had moderate COPD, and 22.4% had severe COPD, with diagnoses based on Chhabra's lower limit of normal criteria for North Indian males [5]. Severity classification followed the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria [6]. Significant associations were observed between COPD prevalence and various risk factors, including the age of study subjects ($P = 0.013$), years of driving ($P = 0.006$), and hours per day of driving ($P = 0.028$) [Table 2]. Additionally, a noteworthy association was found with smoking in the current study ($P = 0.053$) [Table 3]. Binary logistic regression analysis revealed that night-time driving, the presence of obstructive and restrictive patterns on spirometry were significantly associated with the prevalence of COPD.Further analysis using binary logistic regression and multinomial logistic regression indicated that higher age, increased hour-years of driving, and the presence of breathlessness were significantly associated with the prevalence of COPD [Table 4].

Table :1. Prevalence and grading of chronic obstructive pulmonary disease (COPD) among the study subjects (*n*=500)

COPD Status		No (%)
Prevalence of COPD	Present	76 (15.2)
	Absent	424 (84.8)
Grading of COPD (n=76)	Mild	11 (14.5)
	Moderate	48 (63.1)
	Severe	17 (22.4)

Table :2. Prevalence of chronic obstructive pulmonary disease with different demographic variables among the study subjects (*n*=500)

Socio-Demographic Variables		COPD		Total (500) n(%)	*p* Value
		Present (N=76) n(%)	Absent (424) n(%)		
Age Group (Mean = 40.2±7.9)	21-30	2 (4.5)	42 (95.5)	44 (8.8)	0.013*
	31-40	24 (11.7)	181(88.3)	205 (41.0)	
	41-50	38 (19.1)	101(80.9)	198 (39.6)	
	>50	12 (23.1)	40 (76.9)	52 (10.4)	
Year of Driving	≤10 years	25(10.6)	211 (89.4)	236 (47.2)	0.006*
	≥10 years	51 (19.3)	213 (80.7)	264 (52.8)	
Hours of driving per day	≤8 hours	24(10.2)	211(79.8)	235 (47.0)	0.028*
	>8hours	45 (17.0)	220 (83.0)	265 (53.0)	
Day per week of driving	≤5	7 (6.5)	101 (93.5)	108 (21.6)	0.275
	≥5	69 (17.6)	323 (82.4)	392(78.4)	
*Statistically Significant COPD=Chronic Obstructive Pulmonary Disease					

Table: 3. Association of prevalence of chronic obstructive pulmonary disease with smoking habits of study subjects (*n*=500)

Smoking Determinants		COPD				*p* value
		Present n (%) N=76	Absent n (%) N=424	Total	OR (95%CI)	
Tobacco Smoking (Cigarette, Bidi)	Present	57 (17.5)	269 (82.5)	326	1.72(0.9;3.0)	0.053*
	Absent	19(10.9)	155(89.1)	174	Reference	
Duration of Smoking	Never	11 (7.5)	135 (92.5)	146	Reference	
	Mild (≤5 year)	22 (11.2)	117 (88.8)	196	2.3(1.1;4.9)	0.032*
	Moderate (≥5 years)	34 (21.5)	172 (88.5)	206	2.4(1.1;4.9)	0.015*
Smoking status per day	≤5 per day	12 (12.4)	85 (87.6)	97	2.9(1.5;5.6)	0.002*
	≥6 per day	66 (28.8)	163 (71.2)	229		
*Statistically Significant COPD=Chronic Obstructive Pulmonary Disease						

Table :4. Logistic regression of prevalence of chronic obstructive pulmonary disease with various risk factors (*n*=500)

Risk Factors		OR (95% CI)	*p* value
Binary Logistic Regression			
Overcrowding	Absent	Reference	
	Present	0.94 (0.5;1.5	0.49
Night time driving	Yes	Reference	
	No	1.9 (0.8;2.5	0.084
Respiratory complaint	Present	Reference	
	Absent	2.3 (0.8;3.8)	0.032*
Allergic complaint	Present	Reference	
	Absent	2.9 (0.7;4.1)	0.056*
Smoking	Absent	Reference	
	Present	3.4 (1.2;5.2)	0.014*
Obstruction	Absent	Reference	
	Present	2.2 (1.8;2.6)	0.00
Restriction	Absent	Reference	
	Present	2.9 (1.7;5.9)	0.024*
	Multinominal Logistic Regression		
Age Group	21-30	Reference	
	31-40	1.9 (0.8;5.1)	0.001*
	41-50	3.9 (1.1;4.7)	0.023*
	>50	4.3 (1.5;8.7)	0.001*
Hours per year driving	≤500	Reference	
	500-700	1.7 (0.8;3.3)	0.09
	700-1000	3.7 (1.0;9.8)	0.032*
	>1000	4.3 (1.8;10.8)	0.01*
Education of the study subjects	Up to Senior Secondary & above	Reference	
	Up to Middle	1.4 (0.7;5.3)	0.08
	Up to Primary	2.8 (1.0;7.8)	0.046*
	illiterate	4.3 (1.7;10.6)	0.013*
Breathing difficulty	No shortness of breath	Reference	
	Breathlessness (self-resolving)	3.1 (1.2;6.3)	0.013
OR= Odds Ratio CI: Confidence Interval * Statistically Significant			

DISCUSSION

COPD inflicts irreversible damage on the lung parenchyma by eroding elastic tissues, disrupting the natural recoil of the lungs during expiration. Consequently, this phenomenon leads to "air trapping," a condition where expiration is incomplete, culminating in an observable increase in lung size on radiological imaging [7]. The repercussions of COPD extend to a substantial reduction in lung capacities, impinging on the affected individual's ability to engage in daily activities. This condition not only causes significant mortality and morbidity but also contributes to the loss of Disability Adjusted Life Years (DALYs). Over the past few years, pollution levels in Gwalior city have steadily risen, intensifying the risk of exposure, particularly during the winter season. This study specifically concentrates on assessing the prevalence of COPD among auto rickshaw drivers in Gwalior city. These drivers are consistently exposed to environmental pollutants and tobacco smoke due to the nature of their occupational environment. Additionally, the design feature of open cabins in auto rickshaws, coupled with their smaller size compared to most other vehicles, accentuates the extent of exposure in comparison to larger or enclosed vehicles. The primary focus of this study is on uncovering the prevalence of COPD among auto rickshaw drivers, grading the severity of the condition, and establishing associations with known risk factors. Among the 500 study subjects included in the research, all were male, and the mean age of the participants was 40.2 years (40.2±7.9 years). This aligns with the findings of Stephen P et al., where the mean age was 40 ± 8.7 years, and a study by Farooque and Jayachandra reported a mean age of 36.5 ± 4.10 years [8]. This gender distribution suggests that the occupation is predominantly undertaken by males, even though female auto rickshaw drivers typically operate electrical rickshaws. The mean duration of driving in the current study was 14.2 ± 7.2 years, ranging from 3 to 34 years, similar to the study by Stephen et al. (16 ± 8.3 years). Over half of the auto drivers (52.8%) in the current study had a driving experience of 10 years or more, while the remaining 47.2% had less than 10 years of experience.Hour years of driving, a measure of exposure to environmental pollutants calculated as the product of hours of driving and years of driving, were employed in the study. The amount of exposure showed a direct correlation with hour years of driving, a more sensitive metric compared to years of driving. In this study, 34.0% of drivers were exposed to ≤500 hours of driving, while the majority (49.6%) had >1000 hours of exposure. Notably, other reviewed studies did not use hour years of driving as a measurement of exposure.Considering the constant exposure of auto drivers to environmental pollutants due to the open driver cabin, proper mask usage is crucial for their protection. N95 masks with a snug fit and a respirator valve, certified by NIOSH, are recommended to guard against particulate matter. However, only 6.8% of rickshaw drivers in this study were using face masks, mostly cloth masks, and even then, the masks were worn only occasionally, providing limited protection against environmental pollutants. The diagnosis of COPD in this study relied solely on a turbine-based spirometer. The overall prevalence of COPD was determined to be 15.2%, with 76 out of 500 respondents being diagnosed with the condition. The diagnosis was established by administering an inhalational bronchodilator and repeating the test after 15 minutes. In the current study, various risk factors were considered, encompassing those extensively documented in literature and those that are infrequently explored or predicted to yield better outcomes in terms of respiratory health. Evaluated known risk factors included smoking, exposure to environmental smoke, age, and the presence of respiratory complaints. The genetic component, specifically alpha-1 antitrypsin deficiency, was not assessed as it falls outside the scope of this community-based study. A statistically significant association was observed between the prevalence of COPD and the age groups of the study subjects (P = 0.01). Although other studies in our review did not focus on COPD diagnosis, statistically significant associations between Spiro metric patterns and age were found in studies by Babu and Damodar, McKay et al., and Nag et al. [9,10,11]. This association can be attributed to the increased risk of developing COPD with advancing age, a progression associated with decreased lung elasticity [12-14].Regarding the driving habits of the study subjects, a statistically significant association (P = 0.02) was noted in terms of hour years of driving, considered a more accurate indicator of exposure to environmental pollutants [12]. An increase in hour years of driving correspondingly amplified the risk of developing COPD by augmenting pollutant exposure. Further assessment is warranted to explore the potential impact of increased hours of driving during winter, when pollution levels are elevated [15-18].In the binary logistic regression analysis, a statistically significant association was identified between the prevalence of COPD and the respiratory complaint (0.056), allergic complaint with pollution (0.032) and have smoking habits (0.056) This finding aligns with existing knowledge that attributes the oxidative damage caused by pollutants and cigarette smoke [14,19,20]. Additionally, the presence of obstruction in spirometry exhibited a highly statistically significant association (P = 0.001), underlining its role as a precursor to the development of COPD [12,20,21]. Moreover, there was a significant association between the prevalence of COPD and a restrictive pattern on spirometry (P = 0.024).In multinomial logistic

regression, the prevalence of COPD showed a statistically highly significant association with the age group of 31–40 years (P = 0.001), 41–50 years (P = 0.023) and a statistically significant association with the age group of 51–60 (>50) years (P = 0.001). The increasing odds of developing COPD with advancing age reinforce the recognized risk factor of age in COPD development, as supported by various reviews and studies [13,22,23]. A statistically significant association was also found with higher hour years of driving, specifically more than 1000h years of driving (P = 0.001) and more than 700 h years of driving (P = 0.032), as well as the presence of breathlessness (P = 0.013). Numerous studies have established that higher pollutant exposure, reflected in increased hour years of driving, is linked to a heightened prevalence of COPD [14,17,19,24,25].Therefore, our study demonstrates a higher prevalence of COPD among auto rickshaw drivers compared to the general population within the same age groups. This heightened prevalence can be attributed to the cumulative years of driving and, consequently, the increased exposure to pollutants. It underscores the impact of air pollution on the health of specific occupational groups, including auto rickshaw drivers.

Conclusion and Recommendation: The prevalence of COPD in our current study was found to be 15.2%, surpassing that of the general population. This highlights the significance of auto rickshaw drivers as an occupational group deserving attention in terms of respiratory health. The prevalence was notably higher in older age groups, with a majority presenting with moderate COPD (63.1%), followed by severe and mild COPD (22.4% and 14.5%, respectively). The prevalence consistently increased with advancing age and longer years of driving. Considering the substantial impact this sector has on public transport, it is imperative to prioritize respiratory health concerns within this cohort. Adequate policy design should address aspects such as cabin design, work hours, and the use of masks in this unorganized sector. Additionally, implementing measures to reduce air pollution would benefit various sectors, especially the transport sector, where individuals face constant exposure to ambient air.

REFERENCES

1. Global Health estimates: Deaths, disability-adjusted life year (DALYs), years of life lost (YLL) and years lost due to disability (YLD), by cause, age, sex and member country 2000-2016. Geneva: World Health Organisation (WHO) http://www.who.int/healthinfo/global_burden_ disease/estimates/en/.[last assessed on 13th Oct23]
2. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J. Harrison's principles of internal medicine, 19th edition. New York; McGraw Hill,2015.
3. Chronic Respiratory diseases: Chronic obstructive pulmonary disease (COPD). Geneva: WHO http://www.who.int/respiratory/copd/en/. [last assessed on 09 September 2018 at 1500 hrs].
4. World Health Organization (WHO). Chronic Obstructive Pulmonary disease (COPD); Key Facts. Available on https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd). [Last access on 26th Nov 2023]
5. Stephen P, Mahalakshmy T, Manju R, Laksham KB, Subramani S, Panda K, et al. High prevalence of chronic respiratory symptoms among autorickshaw drivers of urban Puducherry, South India. Indian J Occup Environ Med 2018; 22:40 4.
6. Chhabra SK. Interpretation of spirometry: Selection of predicted values and defining abnormality. Indian J Chest Dis Allied Sci 2015; 57:91 105.
7. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Pocket Guide for COPD Diagnosis, Management and Prevention; 2017. Available from: https://goldcopd.org/wp content/uploads/2016/12/ wms GOLD 2017 Pocket Guide.pdf. [Last accessed on 2020 Jun 15, at 1400 hrs].
8. Farooque I, Jayachandra S. Pulmonary function tests in nonsmoking auto rickshaw drivers. Al Ameen Journal of medical sciences. 2014; 7(3):240-243.
9. Babu VK, Damodar KS. Effect of outdoor air pollution on pulmonary function of non-smoking auto-rickshaw drivers in Bangalore. Int J ClinExpPhysiol [serial online] 2017 [Last accessed on 2018 Sep 9]; 4:30-3. Available at: https://go.gale.com/ps/ i.do?p=AONE&u =googlescholar&id=GALE%7C A485630011 &v=2.1& it=r&sid=googleScholar&asid=f361b260.
10. McKay AJ, Mahesh PA, Fordham JZ, Majeed A. Prevalence of COPD in India: A systematic review. Prim Care Respir J 2012; 21:313 21.
11. Nag A, Vyas H, Nag P. Occupational health scenario of Indian informal sector. Ind Health 2016; 54:377 85.
12. Koul PA. Chronic obstructive pulmonary disease: Indian guidelines and the road ahead. Lung India 2013; 30:175 7.
13. Gao W., Sanna M., Hefler M., Wen CP. Air pollution is not "the new smoking": comparing the disease burden of air pollution and smoking across the globe, 1990–2017. British Medical Journal. 2020; 29: 715- 18. Assessed from doi:10.1136/tobaccocontrol-2019-055181. (Last assessed on 20 June 2020 at 1730 hrs)
14. Jindal SK. Indian Study on Epidemiology of Asthma, Respiratory symptoms and Chronic Bronchitis (INSEARCH): A Multi-centre study (2006-2009). Indian Council of Medical Research (ICMR). New Delhi. 2013.
15. Wani RT. Socioeconomic status scales modified Kuppuswamy and UdaiPareekh's scale updated for 2019. J Family Med Prim Care 2019; 8:1846 9.
16. Ajay KT, Vatsala AR, Prabhuraj, Sangam. Comparative Study of PEFR between Auto Drivers with the Residents of Urban Davangere. India Journal of Pharmaceutical sciences and Research 2014; 6(5); 226-228.
17. Pramanik P, Ganguly NI, Chowdhury A, Ghosh B. A study to assess the respiratory impairments among three wheeler auto taxi drivers. Int J Life Sci Pharma Res 2013; 3:94 9.

18. Gavali S, Singh R, Kharche JS, Pranita A. Prevalence of Restrictive Lung Disorders in Auto Rickshaw Drivers. Available from: http:// themedicalacademy.in/fxconsult1/userfiles/ 5%20PREVALENCE%20 OF%20RESTRICTIVE%20LUNG%20DISORDERS%2 0IN%20 AUTO%20RICKSHAW%20.pdf. [Last accessed on 2018 Sep 09, at 1530 hrs].
19. Afroz A, Veeresh BS, Manjushree S, Amrutha SI. A comparative study among the three wheeler automobile drivers on pulmonary function tests in adult males of Gulbarga city. Int J Med Res Health Sci 2013; 2:35 9.
20. Bhome AB. COPD in India: Iceberg or volcano? J Thorac Dis 2012; 4:298 309.
21. Kotaki K, Ikeda H, Fukuda T, Yuhei K, Yuki F, Kawasaki M, et al. Trends in the prevalence of COPD in elderly individuals in an air polluted city in Japan: A cross sectional study. Int J Chron Obstruct Pulmon Dis 2019; 14:791 8.
22. Wang M, Aaron CP, Madrigano J, Hoffman EA, Angelini E, Yang J, et al. Association between long term exposure to ambient air pollution and change in quantitatively assessed emphysema and lung function. JAMA 2019; 322:546 56.
23. Yan P, Liu P, Lin R, Xiao K, Xie S, Wang K, et al. Effect of ambient air quality on exacerbation of COPD in patients and its potential mechanism. Int J Chron Obstruct Pulmon Dis 2019; 14:1517 26.
24. Doiron D, de Hoogh K, Probst Hensch N, Fortier I, Cai Y, De Matteis S, et al. Air pollution, lung function and COPD: Results from the population based UK Biobank study. EurRespir J 2019; 54:1802140.
25. Dragonieri S, Lacedonia D, Scioscia G, Palladino GP, Quaranta VN, Carratù P, et al. Assessment of induced sputum cellularity in COPD patients belonging to two different classes of air pollution exposure. Arch Bronconeumol (Engl Ed) 2020; 56:214 7