

ORIGINAL RESEARCH

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SUSCEPTIBILITY OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE AMONG BIKE RIDERS IN BANGALORE USING BODE INDEX

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ABSTRACT

Background: Air pollution as a trigger for exacerbation of COPD has been recognized for more than 50 years. Nowadays, in the cities like Bangalore, most of the people need to ride the bike for their occupational demand and move around. The purpose of this study is to find out the prediction of COPD using the BODE index in motor bike riders in Bangalore.

Methods: An exploratory cross sectional study has been done on 100 subjects who uses motor bike as their mode of transport for their occupational demand, to study the hours of bike riding with the chances of COPD based on BODE index.

Results: Analysis using spearman rank correlation found that there is statistically significant correlation ($p < 0.05$) between hours of bike riding and the BODE index. Chi square test found that more than 4 hours of bike riding was associated with the chances of COPD.

Conclusion: Based on the result, it is concluded that more than 4 hours of bike riding is associated with the chances of developing COPD even in non-smokers. Therefore there is significant susceptibility of COPD among bike riders in Bangalore.

Key words: COPD, BODE Index, Air pollution, BMI, Bike riders, Exercise Capacity.

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INTRODUCTION

Chronic obstructive pulmonary disease is defined as a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases.¹ Some of the risk factors for COPD are well known and include smoking, occupational exposure, air pollution.² Tobacco smoking is established as a risk factor, but emerging evidence suggest other risk factors that are associated with COPD in non smokers.³ Studies have shown that even non smokers are prone for the development of COPD. Mild, moderate, severe COPD is possible in non smokers. Although the majority of COPD occurs in current or former smokers the disease also occurs in persons who have never smoked.⁴

Air pollution as a trigger for exacerbation of COPD has been recognized for >50 years. The recent dramatic increase in motor vehicle traffic has produced a relative increase in the levels of newer pollutants such as ozone and fine particulate air pollution <10 micro meter in diameter. Numerous epidemiological studies has shown association between the level of these air pollutants and adverse health effects such as exacerbation of airway disease and even death from respiratory and cardiovascular cause.⁵ The minute particles in the air pollution leads to various pathological changes in the lung. COPD comprises pathological changes in four different compartment of the lungs, central airways, peripheral airways, lung parenchyma and pulmonary vasculature, which are variably present in the individual with the disease.^{6,7,8} The different pathogenic mechanism produces the pathological changes which in turn give rise to the following changes: mucus hypersecretion and ciliary dysfunction, airflow limitation and hyperinflation, gas exchange abnormalities, pulmonary hypertension and systemic effects.⁹

Nowadays in Bangalore most of the profession requires riding bike for their occupation. Too much of exposure to the pollution gives rise to various respiratory ailments. All the pathological changes in the lungs may later after some years lead to the development of COPD. The risk of death in patients with COPD is often graded with the use of a single pathological variable the forced expiratory volume in one second (FEV1)^{1,10,11,12}. However other risk factors such as presence of hypoxaemia or hypercapnia, a short distance walked in a fixed time, a high degree of functional breathlessness and a low BMI are also associated with an increased risk of death¹²

Recently BODE (body mass index, airflow obstruction, dyspnea and exercise capacity) index a multidimensional grading system was shown to be a better predictor than FEV1 in predicting the risk of death among patient with COPD.^{12,13} BODE index is a multidimensional grading system to assess severity in COPD, that incorporates four factors known to be the independent predictor of survival in this disease: the body mass index(B), the degree of airflow obstruction(O), functional dyspnea (D) and exercise capacity(E)¹³ The BODE index has being used as it is a better predictor of the risk of death from any cause and respiratory cause than GOLD (Global initiative for Obstructive Lung Disease) alone.¹² Also due to larger inter individual variability FEV1 does not seem to be adequate as a basis for individual management plan in rehabilitation.¹⁴ GOLD is unidimensional but BODE is multidimensional.¹⁵

There are no studies done till now to find the influence of air pollution in bike riders who are non smokers but are susceptible to COPD due to their exposure to air pollution for occupational demand. Therefore the purpose of this study is to find the prediction of COPD based on BODE index in bike riders who uses it for their occupational demand.

METHODOLOGY

An exploratory cross sectional study done on 100 subjects who uses bike as their mode of transport for their occupational demand. The ethical clearance was obtained from ethical committee of Padmashree institute of Physiotherapy, Bangalore. Subjects were recruited from Bangalore Urban Community and study measurements procedure was conducted at Padmashree Clinic, Bangalore. Subjects included were non smoker bike riders for more than 5 years with minimum of 1 hour riding per day in Bangalore, between ages 25-40 years. Subjects were excluded with hypertension, joint pain, asthma.

Procedure:

Subjects who joined companies where workers had to travel more in bikes for their occupational demand were approached. 100 subjects were selected based on inclusion criteria once the subject agrees to participate in the study, an informed written consent was taken from the subjects. A questionnaire was distributed to all the people who used bike as their mode of transport. The questionnaire included person's name age, occupation, smoker/non smoker, reason for using bike, duration of using bike, routine areas and places covered in Bangalore, approximate distance and time covered each day. Contact information

was included including address and phone number.

OUTCOME MEASURES

Measurements were taken for all the subjects. To calculate BODE index measurements such as BMI, FEV1, Exercise capacity and Dyspnea were measured.

- BMI:** According to WHO Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in metres (kg/m²). For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 22.9. $BMI = 70 \text{ kg} / (1.75 \text{ m}^2) = 70 / 3.06 = 22.9$. Subjects height and weight were calculated. Weight was measured using the weighing machine. Height was measured using the stadiometer. Calculation: $BMI = \text{weight in kg} / \text{height in m}^2$
- FEV1:** FEV1 predicted value was measured using the PFT as per the American thoracic society are 0 = >65%; 1 = 50-64; 2 = 36-49%; 3 = <35%.
- Exercise Capacity:** Distance walked was measured by the 6 min walk test as per the standards outlined by the American thoracic society. Interpretation: 0 = >350m; 1 = 250-349m; 2 = 150-249m; 3 = <149m.
- Dyspnea:** Dyspnea was graded by MMRC.

MMRC Dyspnea Scale	
1	Breathless only with strenuous exercise.
2	Short of breath when hurrying on the level or up a slight hill
3	Slower than most people of the same age on a level surface or have to stop when walking at own pace on the level
4	Stop for breath walking 100 meters or after walking a few minutes at own pace on the level
5	Too breathless to leave the house

- BODE INDEX:** Stage 1: BODE index 0-2; Stage 2: BODE index 3-4; Stage 3: BODE index 5-7; Stage 4: BODE index 8-10.

	0	1	2	3	score
BMI	> 21	< 21			
FEV₁	>65%	50-64%	36-49%	<35%	
MMRC	1-2	3	4	5	
6MWD	>350m	250-349m	150-249m	<149m	
				TOTAL	

Based on the above quartile the subjects susceptible for COPD were calculated. The higher

the score the more susceptible are the subjects for COPD.

Statistical Methods

Descriptive statistical analysis presented as mean \pm SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 (1tailed Hypothesis). Chi square test has been used to find out the association between the hours of bike riding and COPD. Spearman rank correlation has been used to find out the relationship between the hours of bike riding with BODE index. Linear regression analysis was done to predict BODE index score from hours of bike riding. The statistical analysis was performed by using SPSS version 17. Alpha value was set at 0.05. Microsoft word and excel has been used to generate graphs, tables.

RESULTS

The correlation between the hours of bike riding and COPD showed that there is significant association of COPD with hours of bike riding. As the hours of bike riding increases the BODE index also increases. Chi square test shows that more than 4 hours of bike riding is prone for developing COPD. The scatterd graph shows an upward trend which means there is significant positive correlation between the hours of bike riding and BODE index.

Table 1: Basic Variables of the Bike Riders under Study

Variable	Range	Mean	SD
Age	25-40	32.51	4.44
BMI	13.82-39.62	24.75	4.47
FEV1	50.0-100	89.70	11.16
6MWD	115-368	272.82	52.79
MMRC	1-4	1.95	0.744
BODE	0-7	1.64	1.40
Hours of bike riding	2-10	4.32	1.74

Table 2: Correlation between the basic variables in the study.

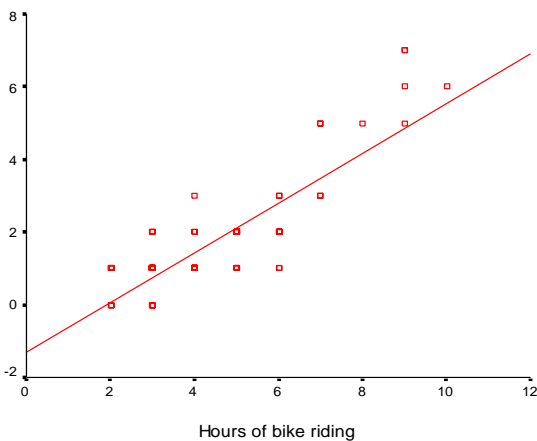
Variable	BMI	FEV1	6MWD	MMRC	BODE
Hours of bike riding	-0.177 NS	-0.626**	-0.729**	-0.432**	0.745**

**Correlation significant at 0.05 level; NS: Not significant

Table 3: Association between the hours of bike riding and stages of COPD.

Hours of bike riding	Stages of COPD						Total	Chi square value, df & p value
	Stage 1		Stage 2		Stage 3			
	n	%	n	%	n	%		
2 hrs and below	8	9.2	0	0	0	0	8	X ² = 47.192, df = 8 P < 0.05 Significant. So, more than 4 hours of bike riding may be prone for COPD.
3hrs	32	36.8	0	0	0	0	32	
4hrs	22	25.3	1	14.3	0	0	23	
5 hrs	13	18.4	2	28.6	1	11.1	16	
6 hrs and above	9	10.3	4	57.1	8	88.9	21	
Total	84	87.0	7	4.0	9	8.0	100	

Figure 1: Scattered graph



Graph shows a significant positive correlation between hours of bike riding and the BODE index.

Table 6: Regression equation of scores of BODE on hours of bike riding

BODE = 0.909 + 0.571 × Hours of bike riding
Eg. If hours of riding = 5, then
BODE = 0.909 + 0.571 × 5 = 3.764 = 4

Figure 2: BODE index according to stages

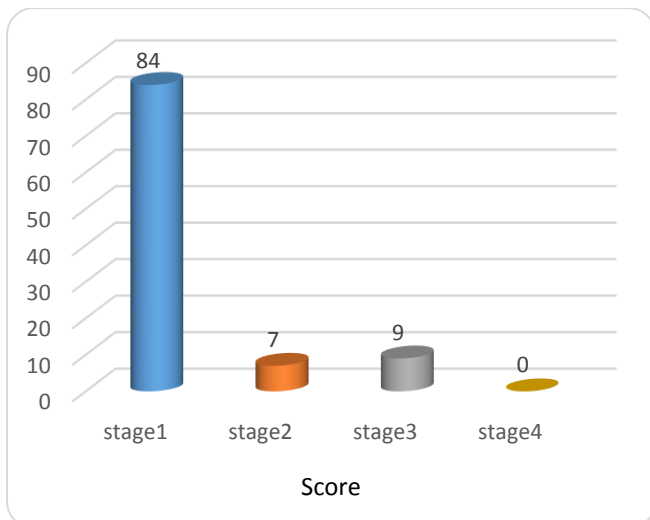
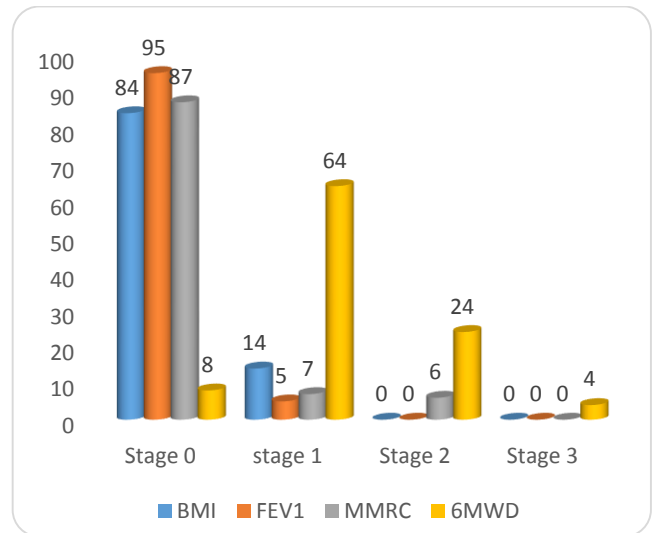


Figure 3: BODE index distribution



DISCUSSION

The purpose of this study was to find out with the help of BODE index the number of bike riders who are non smokers, but are susceptible to COPD due to exposure to air pollution for their occupational demand. The main objective of the study was to find out the association between bike riders and BODE index, relationship between hours of bike riding and BODE index and how many hours of bike riding can be prone for COPD.

Majority of the subjects that is 84 fell in stage 1. However in stage 2 and stage 3 the number of subjects were 7 and 9 respectively and stage 4 being 0. Majority of the subjects that is 32 rode bike for 3 hours. 22 subjects for 4 hours, 16 for 5 hours and 21 for more than 6 hours.

Analysis about relationship between hours of bike riding and BODE index shows that as hours of bike riding increases the BODE index also increases. Results shows that more than 4 hrs of bike riding is prone for COPD.

Result has shown statistically significant positive correlation of MMRC of dyspnea with hours of bike riding. It may have increased due to decreased exercise tolerance or susceptibility of the subjects with COPD. Study done by Loredana Stendardi et., al shows that Respiratory muscle function and its relationship to metabolic and cardiopulmonary variables during exercise identify some of the factors that limit exercise performance in patients with COPD¹⁶.

Result shows statistically significant negative correlation of 6MWD with hours of bike riding. Since all were non smokers, this may be due to pollution. Factors like BMI may influence 6MWD but it can be ruled out as BMI was generalized. So decreased distance walked can be due to their susceptibility to COPD. The 6MWD used in this study is limited to 350 meter instead of the usual

500 to 600 meters. It could be due to the susceptibility of the cases with COPD. Previous study has shown that the distance walked by COPD patients is limited approximately to 350 meter. Study done by Hatem F S Al Ameri shows that overall the average 6MWD for 129 patients with respiratory disease was 341 ± 70 m. The mean distance walked for men was 390 ± 75 m, which was significant at ($p < 0.001$) more than distance walked by women (mean 305 ± 57 m).¹⁷

Result has shown statistically significant negative correlation of FEV1 with hours of bike riding. Since subjects were non smokers it can be due to their exposure to air pollution for their occupational demand. Study done by Bijendra Kumar Binawara et.al shows that the FEV1 were decreased in study group both in smokers and non-smokers which were statistically highly significant in age group of up to 40 years in non-smokers¹⁸. But due to larger inter individual variability FEV1 does not seem to be adequate as a basis for individual management plan in rehabilitation.¹⁴ So BODE index has been used in this study and it has shown statistically significant positive correlation with hours of bike riding. Result also has shown significant association of bike riding with BODE index. Since all the subjects were healthy non smokers, the association can be due to their susceptibility to COPD in future.

Based on the findings it signifies that there is susceptibility of COPD among the bike riders in Bangalore and more than 4 hours of bike riding is prone to develop COPD in future.

Limitation of the study are that the data taken was completely subjective which may influence the study. Covering areas always may not be always polluted. So hours of bike riding and COPD may vary. 6MWD was done only 1 time, so less distance covered may give high BODE index. No data about hip, knee or ankle pain was taken as it was completely subjective. Alpha trypsin deficiency was not ruled out which is a genetic factor associated with COPD. Wearing helmet with front glass on was not taken into consideration which may influence the study.

Further Research Recommendation: Incidence of COPD in bike riders, a cohort study can be done. 6MWD should be done with practice. Can be done in auto drivers, traffic police to know their chances of developing COPD due to their exposure to air pollution for their occupational demand.

CONCLUSION

Based on the statistical analysis performed, it is concluded that there is significant effect of bike riding and COPD in Bangalore. The higher BODE index suggests that even non smokers who are exposed to pollution mostly due to their occupational demand are susceptible of getting COPD.

Based on this outcome it can be concluded that "There will be significant susceptibility of COPD among bike riders in Bangalore who are exposed to more than 4 hours of bike riding for their occupational demand."

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