Original Research Paper

Volume-9 | Issue-10 | October - 2019 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Physiology

EXERCISE INDUCED BRONCHOCONSTRICTION IN MEDICAL STUDENTS

Dr Mahesh Kisan Suryawanshi	Associate Professor, Department of Physiology, Government Medical College, Miraj
Dr Shrihari Bharsakle	Assistant Professor, Department of Physiology, Government Medical College, Miraj
Dr Sachin Patankar	Associate Professor, Department of General Medicine, Government Medical College, Miraj
Mr. C. G. Patil	Asst. Professor, Medical record section, Government Medical College, Miraj
Dr Sayali Raut*	Associate Professor, Department Of Physiology, Government Medical College, Miraj * Corresponding Authour

ABSTRACT

INTRODUCTION: Exercise induced bronchoconstriction (EIB) is transient narrowing of lower respiratory tract airways after exercise. It affects about 5 to 20 % of healthy individuals and 80% of Asthmatics. Obesity has been considered as one of the risk factor to the development of EIB. Symptoms of EIB are nonspecific and can be seen in a variety of disorders and studies have shown a lack of diagnosis specificity and sensitivity based on symptoms.

AIM: The aim of this study was to evaluate frequency of EIB in Medical students of Govt. Medical College Miraj. We also tried to find out association of body mass index (BMI) with EIB. We also tried to find out correlation of subjective feeling of breathlessness (symptom of EIB) with actual findings of spirometry tests used to asses EIB.

METHOD: This cross-sectional observational study was conducted on 80 male medical students. Exercise challenge test was conducted for participants. Pre and post-test values of Forced expiratory volume in one second (FEV1) and Peak expiratory flow rate (PEFR) were compared and students with ≥ 10% decrease in post-test FEV1 & PEFR were considered positive cases of exercise induced bronchoconstriction. Statistical analysis was done by using software, IBM-SPSS VER 20.

RESULT: In our study frequency of EIB in medical students was 6.4%.

Decrease in post-test FEV1 and PEFR values were statistically significant with P value < 0.001. Our findings show that there was no association between BMI and EIB. Our study results also reveal strong correlation between subjective feeling of breathlessness measured in terms of visual analogue scale (VAS) and objective spirometry tests used to assess EIB.

CONCLUSION: EIB is one of the major problems to be addressed as increasing frequency of EIB in healthy population could pose a threat when people attempt exercise training for their health benefits. Proper care with physician's consultation can minimize undue risks associated with EIB in healthy people.

KEYWORDS : Body Mass Index, Visual Analogue Scale, Forced Expiratory Volume, Peak Expiratory Flow Rate.

INTRODUCTION:

Exercise induced broncho constriction is due to temporary narrowing of lower airways after exercise. Pathophysiology of EIB is very complex. Sequence of events occurring after exercise leading to bronchoconstriction are, hyperventilation, entry of dry air in airways, water loss from airway surfaces and dehydration of airway surfaces [1]. Hyperventilation also creates hyperosmolar environment at airway surfaces leading to activation of mast cells and eosinophils. Mast cells and eosinophils release prostaglandins (prostaglandin D_2), leukotrienes, histamine, eosinophil cationic protein and neutrophil chemotactic factor [2, 3]. These molecules cause airway smooth muscle contraction.

EIB has nonspecific symptoms such as wheeze, shortness of breath, chest tightness & chest pain (children), cough (after exercise) and early fatigue. These symptoms are also seen in many disorders.

Other risk factors for EIB include allergens, high pollen counts, pollution, and dry air. Chemicals, insecticides, pesticides, and fertilizers also can trigger EIB.

Typical EIB attack occurs 5 – 15 minutes after physical exertion & peaks within 6 – 8 minutes. Symptoms gradually resolve within 30 – 60 minutes [4-7]. EIB prevalence in healthy individuals is 5 to 20 % [8-11].

Asthma is one of the factor associated with EIB. EIB occurs in 80 to 90 % of asthmatic patients [9, 12 and 13]

Prevalence of EIB in children is higher than in healthy individuals. It's about 3 to 35 % [14-22].

The prevalence of EIB is greater in high-performance athletes than in the healthy individuals due to prolonged inhalation of cold and dry air [10, 23, and 24].

Exercise induced bronchoconstriction is one of the major problems affecting optimal performance in sports. It is hindrance to achieve top athletic performance. It is reversible condition in which smooth muscle in the airways constricts in response to physical activity. Due to various attack triggers breathing becomes so difficult that athletic performance declines significantly.

EIB restricts ability to exercise and can affect quality of life. Hence there is need of improvement in management of EIB so that people with EIB remain physically active.

As health benefits of exercise cannot be ignored by people, effective management of EIB becomes prime need.

EIB is clinically diagnosed with bronchial provocation test using eucapnic voluntary hyperpnoea, methacholine aerosol challenge, mannitol inhalation, hypertonic saline aerosol challenge, exercise challenge (field or laboratory), and histamine challenge.

Many symptoms of EIB are nonspecific and can be seen in a variety of disorders. Diagnosis and treatment of EIB only on the basis of symptoms lacks diagnostic specificity [25]. People with symptoms of EIB may not have EIB with objective testing and people fulfilling EIB criteria with objective tests may not have EIB symptoms. Hence objective testing in athletes is very important and instead of on the basis of only symptoms, EIB diagnosis is confirmed with lung function tests [23, 26]. Thus symptoms & history without objective lung

Submitted : 23rd July,2019 | Accepted : 2nd September,2019 | Publication : 01st October, 2019

function tests are not adequate to make a definitive diagnosis of EIB.

Very limited work has been done till now on EIB in relation with body mass index (BMI). Obesity (increased BMI) is considered as one of the contributing factor to the development of EIB [27-31].

The purpose of this study was to evaluate frequency of EIB in Medical students of Govt. Medical College Miraj. We also wanted to assess whether there was any association of BMI with EIB. We also wished to correlate subjective feeling of breathlessness (symptom of EIB) with actual findings of tests (spirometry tests) used to asses EIB.

MATERIAL AND METHOD

This cross-sectional observational study was initially planned to be conducted in both male and female healthy medical students with age group of 20-25 years. Because of noncompliance of female students study was conducted in 100 male medical students. Amongst these 10 students were excluded due to various reasons like diagnosed asthma, allergic rhinitis, respiratory tract infection, smoking and other illnesses like diabetes and hypertension. Another 10 students who were enrolled for study did not participate in the study. Finally 80 male students were enrolled after explaining nature of the study and obtaining written informed consent from each one of them. Study was approved by ethical committee (Ref No. GMC/EC/24-C/17. dt.20/05/2017) of Govt. Medical College, Miraj. For all participants thorough history of EIB was taken and physical examination was done by physician. Study was conducted in Dept. of Physiology, Govt. Medical College, Miraj, and PVP Government Hospital, Sangli.

Height & weight was measured to calculate BMI. Students with BMI 18 to 25 Kg/m^2 were considered normal, BMI 25 to 30 Kg/m^2 were considered overweight and above $\geq$ 30 Kg/m^2 were considered obese. BMI values were used to find out association of BMI with EIB.

Exercise challenge test for exercise induced bronchoconstriction was conducted in ICU side room of PVP Government Hospital Sangli under continuous supervision of physician.

Participants were asked to walk on treadmill for 6 – 9 mins. Students were allowed to reach 80% of maximum heart rate at 2 minutes and maintain this level for another 6 minutes. Spirometry was initially done at rest, and then 8 mins after exercise bout. As literature reveals that EIB peaks at 6 – 8 mins after exercise bout, these parameters were measured 8 mins after exercise bout [4-7]. The response to the exercise challenge was considered positive when there was a decrease in FEV_1 and PEFR of 10% or more compared to baseline. The American Thoracic Society (ATS) Clinical Practice Guidelines outline a decline in FEV_1 of $\geq$10% from baseline after exercise or hyperpnoea challenge as confirmation of a positive EIB diagnosis [27].

Subjective feeling of breathlessness (EIB symptom) was assessed with visual analogue scale and was tested for its correlation with spirometry tests.

STATISTICAL ANALYSIS:

Sample size calculation was done using Rao's sample size calculator. **Statistical analysis** was done by using software, IBM-SPSS VER 20. Statistical tests used were paired t test which shows post exercise test values statistically highly significant, and Pearson correlation test to find out correlation of EIB with BMI & breathlessness a symptom of EIB assessed using VAS with spirometry tests used to assess EIB.

RESULTS

Aim of study was to determine frequency of EIB in medical students. As shown in Table No.1, in our study frequency of EIB in medical students was 6.4% as exercise challenge test was found positive in 6.4% students for both FEV_1 and PEFR tests.

As revealed in Table No. 2 paired t test was applied to compare Pre & Post FEV_1 & PEFR values. Pretest FEV_1 values were, Mean 3.36 SD 0.48 compared to post-test FEV_1 values, Mean 3.21 SD 0.39. Thus difference in pre & post-test values after exercise challenge test was statistically significant with P value < 0.001. Pretest PEFR values were, Mean 7.23 SD 1.34 compared to post-test PEFR values, Mean 6.87 SD 1.21. Thus difference in pre & post-test values after exercise challenge test was statistically significant with P value < 0.001.

Table No. 3 displays correlation of EIB i.e % fall in FEV_1 & PEFR with BMI and VAS. Pearson correlation of % fall of PEFR & FEV_1 with BMI is respectively 0.109 (P value – 0.375) & 0.193 (P value – 0.087) showing no association of BMI with EIB.

Pearson correlation of % fall of PEFR & FEV_1 with VAS used to assess breathlessness is respectively 00.464 (P value – 0.001) & 0.449 (P value – 0.001) showing strong correlation of breathlessness (symptom of EIB measured in terms of VAS) with spirometry tests.

DISCUSSION:

Prevalence of EIB varies approximately 5 to 20% of general population. Estimated EIB in our study population is 6.4%. This is consistent with several study authors like [8-11] and Sonna LD – 7% [32], Ng'ang'a LW -22%2 in urban children & 13%rural children [33], Kukafka DS – 9% [34], Johansson H – 19.2% [35]. Our study result of prevalence of EIB is on little lower side of range 5 to 20% noted by many authors. Our result might have been influenced by low number of participants in our study.

Very wide range of prevalence (5 – 20%) of EIB in general population is noted by different authors. This variability could be because of intensity & duration of exercise, population studied (age, urben-rural and sex), methods of diagnosis, environmental factors (temperature, humidity in the air, pollutants, and allergens) and the time of post-exercise spirometry test.

Peter A [27], Vlad I [28], Wright A [29], Calvert J [30] and Emily Concepcion [31] have revealed association of BMI with EIB. Individuals with higher BMIs report exercise as an EIB trigger more often than those with a lower BMI [27-31]. Our study findings show that there is no correlation between BMI and EIB. This is contradictory to above mentioned research studies which have shown positive association of BMI with EIB. This negative correlation shows that many risk factors other than BMI contribute to EIB. It also could be because of low study sample size as mentioned above.

Subjective feeling of breathlessness (a symptom of EIB), measured in terms of VAS strongly correlates with objective spirometry tests used to assess EIB. Even though many research studies have revealed negative correlation of symptoms of EIB with objective tests done to confirm diagnosis, our results show strong correlation of breathlessness with spirometry tests.

As mentioned above low sample size is the limitation of our study. We also could not involve female participants in study due to noncompliance from them. So further studies on EIB with large sample size including both male and female participants are needed to be carried out to find out gender variation in EIB prevalence and to bring more clarity in assessment of association of EIB with BMI and association of breathlessness (a symptom of EIB) with spirometry tests.

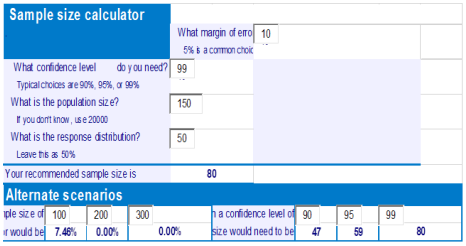
CONCLUSION:

From the results and discussion of our study we conclude that increasing frequency of EIB in healthy population highlights need for health care workers to start training programs of EIB to healthy people going for exercise which will help to minimize undue risks associated with EIB to healthy people.

EIB may lead to a substantial emotional burden on people, and restrict exercise and sports participation. This potentially leads to long-term physical health consequences in people with EIB. Increased awareness among people and physicians of the symptoms and risk factors for EIB and also increased use of objective diagnostic tests is key to the management of patients with EIB.

OBSERVATIONS:

Rao's sample size calculator.



Statistical analysis using IBM- SPSS Ver 20 Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Ht cm	155	186	172.86	5.980
Ht M	1.55	1.86	1.7286	.05980
Wt	48	98	66.00	10.545
BMI	16.22	31.64	22.0844	3.30303
FEV1 Pre-test	2.07	4.90	3.3676	.48018
FEV1 Post-test	2.34	4.37	3.2181	.39178
% Diff. FEV1	-51.69	29.92	3.7119	9.60942
PEFR Pre-test	3.70	9.83	7.2359	1.34896
PEFR Post-test	3.67	10.00	6.8716	1.21564
% Diff. PEFR	-17.89	22.22	4.4858	8.08542
VAS	2	7	3.59	1.110
Valid N (listwise)				

Table No. 1: Frequency of EIB

Exercise challenge test OR EIB	Participants No. (FEV1)	Participants No. (PEFR)	Percentage (both FEV1 & PEFR together)
Positive	8	12	6.4 %
Negative	72	68	93.6%
Total	80	80	100%

Exercise challenge test positive means % fall of = or > 10% in both FEV1 & PEFR.

Table No. 2: T Test: Paired samples statistics for pre & post exercise test values of FEV1 & PEFR

		Mean	Standard Deviation	Test value	P-Value
Pair 1	FEV1 Pre-test	3.3676	0.48018	4.332	0.00100
	FEV1 Post-test	*3.2181	0.39178		
Pair 2	PEFR Pre-test	7.2359	1.34896	5.841	0.00100
	PEFR Post-test	*6.8716	1.21564		

* Decrease in post-exercise test values is statistically highly significant.

Table No.3: Correlations Of Eib With Vas & Bmi

		% decrease in PEFR	% decrease in FEV1
VAS	Pearson Correlation	0.464**	0.449**
	P-Value	0.001	0.001
BMI	Pearson Correlation	0.109	0.193
	P-Value	0.335	0.087

a. **. Correlation of EIB with VAS is significant at the 0.001 level (2- tailed).

b. No correlation found between EIB & BMI

REFERENCES

1. Weiler, J. M. Exercise-induced bronchoconstriction update-2016. J. Allergy Clin. Immunol. 2016,138, 1292–1295.e36.
2. Hallstrand TS. New insights into pathogenesis of exercise-induced bronchoconstriction. Curr Opin Allergy Clin Immunol. 2012 Feb; 12(1):42-8.
3. Brannan JD, TurtonJA. The inflammatory basis of exercise-induced bronchoconstriction. Phys Sports med. 2010 Dec; 38(4):67-73. doi: 10.3810/psm.2010.12.1827.
4. Godfrey S. Problems of interpreting exercise induced asthma. J Allergy Clin Immunol 1973; 52:199-209
5. Brown R. Exercise-induced asthma. Allergy and Asthma Magazine, 1996, 5(1), http://www.healthline.com/articles/ac960102.htm.
6. Disabella V, Sherman C, DiNubile N.A. Your guide to exercising with asthma. The Physician and Sports medicine, 1998, 26(6), 85.
7. Rupp N.T. Diagnosis and management of exercise-induced asthma. The Physician and Sports medicine, 1996, 24(1), 77-87.
8. Caillaud, D. Exercise-induced bronchospasm related to different phenotypes of rhinitis without asthma in primary schoolchildren: the French Six Cities Study. Clin. Exp. Allergy.: J. Br. Soc. Allergy. Clin. Immunol. 2014, 44, 858–866.
9. Weiler, J. M. American Academy of Allergy, Asthma & Immunology Work Group report: exercise-induced asthma. J. Allergy Clin. Immunol. 2007, 119, 1349–1358.
10. Rundell, K.W. Self-reported symptoms and exercise-induced asthma in the elite athlete. Med. Sci. Sports Exerc. 2001, 33, 208–213.
11. Ng'ang'a, L. W. Prevalence of exercise induced bronchospasm in Kenyan school children: an urban-rural comparison. Thorax 1998, 53, 919–926.
12. Weiler, J. M. Pathogenesis, prevalence, diagnosis, and management of exercise-induced bronchoconstriction: a practice parameter.Annals Allergy Asthma Immunol. 2010, 105, S1–S47.
13. Correia Junior M. A. V., Costa, E. C., Sarinho, S. W. Exercise-induced bronchospasm in a hot and dry region: study of asthmatic, rhinitistic and asymptomatic adolescents. Expert Rev. Respir. Med. 2017, 11, 1013–1019.
14. Dickinson, J., McConnell, A. Whyte, G. Diagnosis of exercise-induced bronchoconstriction: eucapnic voluntary hyperpnoea challenges identify previously undiagnosed elite athletes with exercise-induced bronchoconstriction. Br. J. Sports Med. 2011, 45, 1126–1131.
15. Pnina Weiss, Kenneth W Rundell. Limitators of EIB. Allergy Asthma & Clinical Immunology 2009, 5(1):7
16. Lopes WA, Radominski PB. EIB in obese adolescents. Allergol Immunopathol 2009 July-Aug 37 (4):175-9
17. Saadeh D, Salameh P. High BMI & allergies in schoolchildren, the French six cities study. BMJ Open Respir Res 2014 Dec 24:1(1).
18. Adewumi, A. A. Association between exercise-induced asthma and parental socio-economic status among school-aged adolescents in a semiurban community in Nigeria. J. Exerc. Rehabil. 2017, 13, 292–299.
19. Anthracopoulos, M. B. Physical activity and exercise-induced bronchoconstriction in Greek schoolchildren. Pediatr. Pulmonol. 2012, 47, 1080–1087.
20. Benarab-Boucherit, Y. Prevalence rate of exercise-induced bronchoconstriction in Annaba (Algeria) schoolchildren.J. Asthma. 2011, 48, 511–516.
21. Cichalewski, L. Prevalence of exercise-induced cough in schoolchildren: a pilot study.Allergy Asthma Proc. 2015, 36, 65–69.
22. Lin, L. L. Exercise-induced bronchoconstriction in children with asthma: an observational cohort study. J. Microbiol. Immunol. Infect. pii: 2017, S1684-118, 30196-2.
23. Krafczyk, M. A., Asplund C. A. Exercise-induced bronchoconstriction: diagnosis and management. Am. Fam. Physician 2011, 84, 427–434.
24. Parsons, J. P. Prevalence of exercise-induced bronchospasm in a cohort of varsity college athletes. Med. Sci. Sports Exerc. 2007, 39, 1487–1492.
25. De Baets, F. Exercise-induced respiratory symptoms are poor predictors of bronchoconstriction. Pediatr. Pulmonol. 2005, 39, 301–305.
26. Parsons, J. P. An official American Thoracic Society clinical practice guideline: exercise-induced bronchoconstriction.Am. J. Respir. Crit. Care Med. 2013, 187, 1016–1027.
27. Peeters A, Barendregt JJ, Willekens F. Obesity in adulthood and its consequences for life expectancy: a life-table analysis. Ann Intern Med 2003; 138:24.
28. Vlad I. Obesity costs UK economy 2bn pounds sterling a year. BMJ 2003; 327:1308.
29. Wright A, Lavoie KL, Jacob A. Effect of body mass index on self-reported exercise-triggered asthma. Phys Sportsmed. 2010 Dec; 38(4):61-6. doi: 10.3810/psm.2010.12.1826.
30. Calvert J, Burney P. Effect of body mass on exercise-induced bronchospasm and atopy in African children. J Allergy Clin Immunol. 2005 Oct; 116(4):773-9.
31. Emily Concepcion, Suzanne Burke-McGovern, K.D. Graw-Panzer.Induced Bronchospasm In Asthmatic And Non-Asthmatic Obese Children. American Journal of Respiratory and Critical Care Medicine 2012; 185:A1767
32. Sonna LA, Angel KC, Sharp MA, Knapik JJ, Patton JF, Lilly CM et al. The prevalence of exercise-induced bronchospasm among US Army recruits and its effects on physical performance. Chest. 2001; 119(6):1676.
33. Ng'ang'a LW, Odhiambo JA, Mungai MW, Gicheha CM, Nderitu P, Maingi B et al Prevalence of exercise induced bronchospasm in Kenyan school children: an urban-rural comparison. Thorax. 1998; 53(11):919.
34. Kukafka DS, Lang DM, Porter S, Rogers J, Ciccolella D, Polansky M et al. Exercise-induced bronchospasm in high school athletes via a free running test: incidence and epidemiology. Chest. 1998; 114(6):1613.
35. H Johansson, K Norlander, L Berglund, C Janson, A Malinovschi, L Nordvall et al. Prevalence of exercise-induced bronchoconstriction and exercise-induced laryngeal obstruction in a general adolescent population. Thorax.2015, 70 (1), 57-63