Research Paper

Volume : 3 | Issue : 3 | March 2014 • ISSN No 2277 - 8179

Cardiopulmonary Assessment of Middle Aged Males at High Altitude and its Correlation with Exercise

Medical Science

KEYWORDS : Oxygen Saturation, PEFR, Exercise, Pulse oximetry

Dr. M. Bhima Bhat — Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore, 575018. Karnataka, India.

*** Dr.Aswini Dutt.R** — Associate Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore, 575018. Karnataka, India. * Corresponding author

Dr. Siddharuda Shivalli — Assistant Professor, Department of Community Medicine, Yenepoya Medical College, Deralakatte, Mangalore, 575018. Karnataka, India.

ABSTRACT

Regular physical exercise protects the lung function and has a beneficial impact on cardio respiratory health. Measurement of Pulmonary function and oxygen saturation (PO2) levels can form a simple assessment tool for determining cardio respiratory well being. To assess PEFR and Oxygen saturation (PO2) at increasing altitudes and study the effects of regular exercise on PEFR, O2 saturation in middle aged individuals, the present study was carried out. 50 subjects of 40-55 year age group were divided into two groups based on their exercise pattern. Their age, Heart rate, basal PEFR and oxygen saturation were recorded at 7000ft, 11,000ft and 15,000 ft en route to Himalayas.

PEFR and PO2 levels decline and HR increase as the altitude increases. Regular exercise had a significantly better PEFR, lower Heart rate and PO2 compared to non exercisers at higher altitudes. Regular exercise improves blood oxygenation, strengthens the respiratory muscles during air hunger.

INTRODUCTION:

There is a rapid emergence of cardiac and respiratory diseases worldwide. Various factors influence the morbidity and mortality in these cases. One of the principle causative agents is individual present lifestyle. Sedentary lifestyle, lack of exrcise regimes in day to day life ignites the derangement of body systems resulting in initiation of disease process.[1]

Pulmonary function tests check how well our lungs are working. They determine how much air lungs can hold, how quickly oxygen and carbon dioxide are transported in blood and out of lungs. They can diagnose lung diseases, measure the severity of lung problems, and pulmonary disease prognosis. Spirometry is a simple lung function test. Many lung function volumes can be measured with this technique. One such measurement is Peak Expiratory Flow Rate (PEFR).

This a simple test that measures how fast a person can exhale. It is the highest flow achieved during a forced expiration after maximum inspiration.[2,3] It is one of the many tests that measure how well our airways work. This test is effort dependent and checks lung functioning mainly large airway function.[4] It can be used as a screening test in epidemiological studies.[5]

Various factors affect PEFR like anthropometric factors such as age, gender, height, weight, altitudes, chest circumference and body surface area.[6] The physiological factors which affect are the dimensions of the large intra-and extra thoracic airways, the force generated by the expiratory muscles, the speed with which maximal alveolar pressure is reached, which depends on the force-velocity properties of the expiratory muscles. Those with good chest expansibility, stronger respiratory muscles and large intra and extra thoracic airways have better pulmonary function.[7,8,9,]

Exercise, cardiac health and high altitudes also alter PEFR. Regular exercise and yoga have an effect on respiratory muscle strength which increases chest expansion and breathing capacity.[10] Exercise increases respiratory muscle strength and lung capacity.

PEFR can be measured by a simplified device, mini-Wright peak flow meter, which is cheap, easily portable, available and clinically reproducible.[11] In men, readings up to 100 L/min lower than predicted are within normal limits. For women, the equivalent figure is 85 L/min. PEFR (L/min) = [Height (cm) - 80] x 5 Pulse oximetry is a simple, noninvasive measurement method to monitor oxygenation, changes in blood volume in the skin and also to detect abnormalities in ventilation. It displays the percentage of arterial hemoglobin in the oxyhemoglobin configuration.[12] Its normal value ranges from 95 to 99 percent in healthy individuals. It is useful for patients with respiratory or cardiac problems, for mountain climbers and athletes whose oxygen levels may decrease at high altitudes or with exercise, for pilots operating in a non-pressurized aircraft.[13]

Portable battery-operated pulse oximeters can also detect pulse rate. Portable pulse oximeters are also useful for mountain climbers and athletes whose oxygen levels may decrease at high altitudes or with exercise. At high altitude, oxygen saturation falls resulting in hypoxia. Deep breathing exercises and yoga have got significant improvement in oxygen saturation in high altitudes.[14]

AIMS AND OBJECTIVES:

1. To assess PEFR and Oxygen saturation (PO_2) at increasing altitudes in middle aged individuals.
2. To study the effects of regular exercise on PEFR, O_2 saturation.

MATERIALS AND METHODS:

The present study was carried out on 45-55 year old males, residents of in and around Mangalore, South India who took pilgrimage to Manasa sarovara at Himalayas. Ethical clearance was obtained from the Institutional Ethics committee. Healthy, non exercising subjects form the controls. Healthy, exercising subjects form the test group. Those with history of smoking, alcohol consumption, neurological disorders and any systemic illness were excluded from the study.

They were divided into two groups based on their exercise pattern. Control group (Non exercising) and test/experimental group (Exercising). Exercising group consisted of those who did stretching, jogging, yoga and pranayama for minimum 45 min/day for at least 4 days in a week for a minimum 2 years.

Their age, Heart Rate (HR), basal PEFR using Wright flow meter and oxygen saturation using Pulse oximeter were recorded. General physical examination, vital signs, complete systemic examinations were done. A detailed history which included the work history, diet history, family and drug history were taken.

PEFR was measured by Wright flow meter. Subjects were properly instructed and demonstrated to record the correct readings. First, the cursor was set to zero. They should not touch the

cursor when breathing out. They should stand up and hold the peak flow meter horizontally in front of the mouth. After taking a deep breath in and close the lips firmly around the mouthpiece, making sure there is no air leak around the lips, they was advised to breathe out as hard and as fast as possible. Number indicated by the cursor was noted. Cursor was returned to zero and this sequence was repeated twice more, thus obtaining three readings. The highest or best reading of all three measurements was the peak flow at that time.

The oxygen saturation of the blood was determined by Pulse Oximetry. The oximeter probe has two light-emitting diodes (LEDs), one red and one infrared, located on one side of the probe. The probe is placed on a suitable part of the body; usually a fingertip and the LEDs transmit light wavelengths through pulsating arterial blood to a photo detector on the other side of the probe. The oxygen saturation of the blood determines the degree of light absorption. The result is processed into a digital display of oxygen saturation on the oximeter screen, which is symbolized as SpO2. Heart rate, PEFR, PO2 were assessed at 7000ft-Nepal Tibet border, 11,000ft-Nyalam and 15,000 ft -Manasa Sarovar (Stage 1, 2 and 3 respectively) en route to a pilgrimage to Himalayas.

Statistical Analysis:
Data was analyzed for normal distribution. Age, BP, PEFR and Oxygen saturation (PO_2) among exercising and non exercising middle aged subjects were analyzed statistically by using the statistical software SPSS & MS Excel. All tests were two-tailed and $p< 0.05$ is considered as significant.(Unpaired t test)

RESULTS:
50 Male subjects of 40-55 year age group were included in the study. 29 were doing regular exercise and yoga for a minimum 2 years, 21 non exercisers. Mean age of the study group was 51.12±9.60 years.

Pulse rate was significantly better at 1st stage (7,000 ft) and 2nd stage (11,000ft) among the exercising group. (Table1) There was no significant change in PO2 levels at stage 1 and stage 2 but at 15,000ft exercising group had better PO2 levels. The study revealed that regular exercise regime had a significantly better PEFR and PO_2 in compared to non exercisers even at higher altitudes. (Table 2, 3)

Table 1: Pulse Rate at different heights.

	Exercise	MEAN	SD	N	P
PR_1 /min	YES	83.00	8.11	21	0.03*
	NO	87.62	7.04	29	
	TOTAL	85.58	7.78	50	
PR_2 /min	YES	88.38	6.43	21	0.029*
	NO	90.24	4.65	29	
	TOTAL	89.46	5.49	50	
PR_3 /min	YES	95.19	4.62	21	0.51
	NO	96.00	4.30	29	
	TOTAL	95.66	4.11	50	

- **Significant**

Table 2: PEFR levels at different heights.

	Exercise	MEAN	SD	N	P
PEFR_1 L/min	YES	473	0.93	21	0.22
	NO	438	1.04	29	
	TOTAL	453	1.00	50	
PEFR_2 L/min	YES	452	0.90	21	0.28
	NO	423	0.98	29	
	TOTAL	435	0.95	50	
PEFR_3 L/min	YES	425	0.88	21	0.03*
	NO	402	0.92	29	
	TOTAL	412	0.90	50	

- **Significant**

Table 3: PO2 levels at different heights.

	Exercise	MEAN	SD	N	P
PO2_1 (%)	YES	97.2857	1.70	21	0.39
	NO	97.5862	0.68	29	
	TOTAL	97.4600	1.21	50	
PO2_2 (%)	YES	89.8571	2.86	21	0.29
	NO	90.6552	2.43	29	
	TOTAL	90.3200	2.62	50	
PO2_3 (%)	YES	86.0952	5.34	21	0.049*
	NO	78.7931	3.67	29	
	TOTAL	80.9200	4.40	50	

- **Significant**

DISCUSSION:
This study was designed to find out the cardio- respiratory and hemodynamic effects of exercise on healthy lowlanders who were exposed to high altitude. The results revealed that exercise has a beneficial effect on oxygen saturation, pulse rate and Pulmonary function like PEFR.

Sedentary life style, lack of exercise will have detrimental effect on health of an individual. There are many beneficial effects of regular exercise practice in day to day life. It has been shown from the previous studies that Cardio respiratory benefits are predominantly observed in those who do regular exercises. They are well protected from cardio respiratory morbidity and mortality.[15,16] It has been observed that physical exercise has a positive effect on the growth of cardiomyocyte, neoangiogenesis and even the activation of cardiac tissue specific progenitor cells.[17]

Even in the experimental animals it was seen that rats that had treadmill exercise for a specific period of 3 months showed increase in cardiac index and stroke volume and a concomitant decrease in systemic vascular resistance compared with both age-matched and body weight-matched sedentary controls in the conscious state at rest.[18]

Well trained and strengthened respiratory system protects from multiple lung diseases. Defective respiratory function can enhance morbidity and mortality.[19] Efficiency of ventilation for oxygen may be improved by changing the respiratory pattern. Slow deep breathing exercises, pranayama improves blood oxygenation and affects hemodynamic in hypoxic condition like higher altitudes.[20] This also builds up the respiratory muscles and helps in ventilation during air hunger. Breathing exercises like pranayama may also improve arterial oxygenation by increasing alveolar volume and gas exchange at the alveolar capillary membrane level.[21]

Regular exercise, Yoga practice hence improves cardio respiratory fitness. This beneficial effect is observed even in higher altitudes. Hence such healthy practices need to be advocated to all individuals, all groups for healthy future.

Volume : 3 | Issue : 3 | March 2014 • ISSN No 2277 - 8179

REFERENCE

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol. 2012;2(2):1143-211. | 2. Njoku CH, Anah CO. Reference values for peak expiratory flow rate in adults of African descent. Tropical Doctor. 2004;34(3):135–140. | 3. Marciniuk DD. ACCP Pulmonary Board Review. 25th Edition. Northbrook, Il: American College of Chest Physicians; 2009. Pulmonary Function Testing; pp. 187–204. | 4. Mueller GA, Eighen H. Paediatric pulmonary function testing in asthma. Pediatr Clin North Am. 1992 Dec;39(6):1243-58. | 5. Quanjer PH, Lebowitz MD, Gregg I, Miller MR, Pedersen OF. Peak expiratory flow: conclusions and recommendations of a Working Party of the European Respiratory Society. Eur Respir J Suppl. 1997 Feb;24:2S–8S. | 6. Okoroma CN, Oviawe O. Peak expiratory flow rate in Children living in Enugu urban area, Nigeria. Nig Qt J Hosp Med. 2000;10:171–174. | 7. Black LF, Hyatt RE. Maximal respiratory pressures: normal values and relationship to age and sex. Am Rev Respir Dis 1969; 99: 696–702. | 8. Mellissnos CG, Mead J. Maximal expiratory flow changes induced by longitudinal tension on trachea in normal subjects. Journal of Applied Physiology: Respiratory Environmental Exercise Physiology 1977;43:537-544. | 9. Potter WA, Olafsson S, Hyatt RE. Ventilatory mechanics and expiratory flow limitation during exercise in patients with obstructive lung disease. Journal of Clinical Investigations 1971;50:910-918. | 10. Mandanmohan, Jatiya L, Udupa K, Bhavanani AB. effect of yoga training on handgrip, respiratory pressures and pulmonary function. Indian J Physiol Pharmacol 2003; 47 (4) : 387–392. | 11. Cross D, Nelson HS. The role of the peak flow meter in the diagnosis and management of asthma. J Allergy Clin. Immunol 1991; 87(1): 120-128. | 12. Sinex J. Pulse oximetry: principles and limitations. Am J Emerg Med. 1999;17(1):59–67. | 13. Roberts CM, Franklin J, O'Neill A, et al. Screening patients in general practice with COPD for longterm domicillary oxygen requirement using pulse oximetry. Resp Med 1998;92:1265–1268. | 14. Nepal O, Pokharel BR, Khanal K, Mallik SL, Kapoor BK, Koju R. Relationship between arterial oxygen saturation and hematocrit, and effect of slow deep breathing on oxygen saturation in Himalayan high altitude populations. Kathmandu Univ Med J (KUMJ). 2012 Jul-Sep;10(39):30-4. | 15. Jones AM, Carter H. The effect of endurance training on parameters of aerobic fitness. Sports Med. 2000;29(6):373-386. | 16. Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise capacity and mortality among men referred for exercise testing. N Engl J Med. 2002;346(11):793-801. | 17. Ellison GM, Waring CD, Vicinanza C, Torella D. Physiological cardiac remodelling in response to endurance exercise training: cellular and molecular mechanisms. Heart. 2012;98(1):5-10. | 18. Jin H, Yang R, Li W, Lu H, Ryan AM, Ogasawara AK,et al. Effects of exercise training on cardiac function, gene expression, and apoptosis in rats. Am J Physiol Heart Circ Physiol. 2000;279(6):2994-3002. | 19. E Neas LM, Schwartz J. Pulmonary Function Levels as Predictor of Mortality in a National Sample of US Adults, 2009. | 20. Spicuzza L, Gabutti A, Porta C, Montano N, Bernardi L. Yoga and chemoreflex response to hypoxia and hypercapnia. Lancet 2000;356:1495–1496. | 21. Bernardi L, Sleight P, Bandinelli G, Cencetti S, Fattorini L, et al. Effect of rosary prayer and yoga mantras on autonomic cardiovascular rhythms:comparative study. BMJ 2001;323:1446–1449. |