Original Research Article

Effect of exercise on cardio respiratory function parameters

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Abstract

Background: For many ailments, exercise has become a popular therapeutic choice. Rehab through exercise is frequently utilised to improve respiratory and cardiovascular conditions. Despite the numerous benefits of regular exercise, persons with sedentary lifestyles, particularly students, do not include exercise into their daily routines. Exercise has different effects on the cardiovascular and respiratory systems depending on health and disease. Its effects vary depending on the physical fitness of the individuals, even in healthy individuals.

Aim and Objectives: The purpose of this study was to determine the effect that short-term exercise has on cardiorespiratory parameters in young healthy people who have and have not been exercising regularly.

Methods: For the purpose of the study, there were collected fifty medical students between the ages of 18 and 25 who had never participated in regular physical activity. Group I consisted of 25 students who engaged in activities such as cycling, aerobics, and yoga for a total of three months, each day for a duration of twenty-five minutes. Group II consisted of 25 students who did not take part in any form of physical activity or exercise. Before and immediately after a short-term exercise consisting of cycling for six minutes, the heart rate and blood pressure of the participants were recorded. Tests of the pulmonary function were performed in a comparable fashion both before and two minutes after the exercise.

Results: There was no discernible difference between persons who had exercise training and those who had not in terms of their HR, SBP, DBP, PP, MAP, or RPP. In trained people, the PFT metrics SVC, PEF and MVV were considerably higher (p=0.01, 0.03 and 0.03 respectively). When the effects of short-term exercise were compared, it was found that HR, SBP, PP, MAP and RPP all increased considerably after exercise in both groups (p value 0.05). This was the case regardless of whether the exercise was aerobic or anaerobic. Untrained participants showed a substantial drop in their PEF following exercise (p=0.05), whereas trained persons did not demonstrate the same trend (p=0.05).

Conclusion: Exercise performed for a shorter period of time does not have a substantial impact on the respiratory parameters of those who are not exercise trained. A training programme consisting of three months' worth of exercise can improve respiratory function with almost little effect on cardiovascular function.

Keywords: Cardiac, respiratory and short-term exercise, parameters

Introduction

Particulate matter Over three million people every year lose their lives due to the effects of air pollution, which also plays a role in the beginning stages of the development of cardiovascular and respiratory diseases. Studies of epidemiology usually focus on non-invasive outcomes such heart rate variability (HRV), retinal vessel sizes, lung function, and fractional exhaled oxygen concentration [1-3]. In recent years, physical activity has emerged as

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a leading treatment option for a wide range of conditions. Rehabilitative exercise is frequently utilised in the treatment of cardiovascular and respiratory conditions. Despite the numerous benefits that have been shown as being associated with regular exercise, people who lead sedentary lifestyles, particularly students, do not make exercise a part of their day-to-day routine [4]. The effects that exercise has on the cardiovascular and respiratory systems differ depending on whether or not the systems are healthy. Even in healthy people, their effects can be different depending on the level of physical fitness of the person experiencing them [5]. The strengthening of the respiratory muscles that results from regular, strong inspiration and expiration during exercise training is one of the ways that exercise improves respiratory function. The autonomic nerve system exerts a predominately controlling influence over the cardiovascular system. There are research that demonstrate that engaging in consistent physical activity can help to maintain a healthy autonomic nervous system. To better emphasise the role that exercise plays in the rehabilitation of cardiovascular and respiratory disorders, it is helpful to have a foundational understanding of the impact that exercise has on the cardiovascular and respiratory systems [6-8]. Physical fitness can be improved by consistent exercise training, although the consequences of shorter bouts of exercise may be different for different people depending on whether or not the individual has previously trained his or her system for activity. Few research have been done to investigate how exercise training changes the cardiovascular and pulmonary response to short-term exercise. To gain a deeper comprehension of the role that exercise plays in the cardiorespiratory rehabilitation of patients, this facet of the topic needs to be investigated more thoroughly. Therefore, in order to investigate the impact of the short term, this study was carried out. Young individuals who are both exercise trained and untrained should get regular exercise [9-11].

As early markers of cardiovascular problems, increased sympathetic tone, which is indicated by lower HRV, and responses of the vessel diameters in the retina are regarded as being important. The sympathetic and parasympathetic branches, which together make up the autonomic nervous system, function in dynamic equilibrium in persons who are healthy. Reduced heart rate variability (HRV) is caused by sympathetic dominance, which in turn causes arrhythmias, which can lead to unexpected death. In addition, microvascular narrowing, which can be evaluated using retinal image analysis, has been linked to increased blood pressure, which could potentially lead to hypertension and cardiovascular illnesses [12, 13]. More information is required to separate the short-term physiological responses, particularly in light of the fact that a large number of people engage in physical activity in an urban setting. The evaluation of subclinical alterations in healthy persons may provide information that is useful in understanding the progression of cardiovascular and respiratory disorders. The purpose of the present investigation was to assess the short-term, subclinical effects of the intervention on the cardiorespiratory systems of healthy people [14-16].

Materials and Methods

The study was carried out in Medical College, Secunderabad, Telangana State, India, department of Physiology. The study's subjects included between the ages of 18 and 25. Only male students are chosen for the study in order to rule out the impact of hormonal changes during the menstrual cycle on cardiorespiratory function. Before the study began, consent was sought from the subjects and the study's goal was communicated to them with the institutional ethical committee's approval. Each participant had a thorough medical history taken before undergoing a physical examination. The study did not include anyone who had a history of a cardiovascular, respiratory, neurological, or endocrine disease. The same rules applied to students who had a history of regular exercise and sports training. The Quetelet Index was used to measure height, weight, and body mass index. BMI = Weight in Kg / (Height in m) 2 People with BMIs between 18.5 and 24.9 were chosen, while those with BMIs above and below that range were eliminated. Out of this, 25 students were chosen at random as group I and received exercise training in the forms of cycling, aerobics, and yoga every day in the evening for a period of three months, while the remaining 25 students were placed in group II without receiving any exercise instruction.

In the Research lab of the Department of Physiology, pulmonary function tests (PFT) and blood pressure were monitored using OMRON digital BP apparatus and SCHILLER digitalized spirometer, respectively. Pulse pressure (PP), mean arterial pressure (MAP), and rate pressure product (RPP) were determined from the results after the individuals had rested for 5 minutes before the measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR). The individuals were sitting with their spines straight, and care was taken to avoid talking to them while taking the measurements. PFT was carried out on the individuals while they were seated after the cardiovascular parameters were measured. The computerised spirometer and associated software were used for PFT. The subjects were given instructions on how to carry out FVC-acceptable manoeuvres. The individual was instructed to inhale deeply before blowing firmly into the spirometer's turbine. For the study, the best reading out of the three was chosen.

The participants were told to ride for 6 minutes while carrying a 2 kg burden at a speed of 16 to 20 RPM on a bicycle ergometer. Cardiovascular parameters were assessed immediately following exercise, and PFT values were obtained two minutes later.

Statistical analysis

The statistical analysis was performed using SPSS version 21, and the data were entered into a spreadsheet created in MS Excel. In order to compare the mean and standard deviation of the cardiovascular and respiratory parameters before and after exercise in both groups, a paired t test was carried out. A test called an unpaired t test was carried out in order to examine the difference between the two groups in terms of their cardiovascular and pulmonary baseline parameters before exercise. We considered the data to be statistically significant if the p value was less than 0.05.

Results

Results In our research, when we compared the baseline cardiovascular parameters of groups I and II prior to exercise, we discovered that there was not a significant difference between the groups in HR, SBP, DBP, PP, MAP, or RPP ($p>0.05$). This was the finding that we came to when we compared the two groups' baseline cardiovascular parameters. [Table 1]. Figure 1 presents a comparison of the rate pressure product in people who have exercised regularly (Group I) and people who have not exercised regularly (Group II).

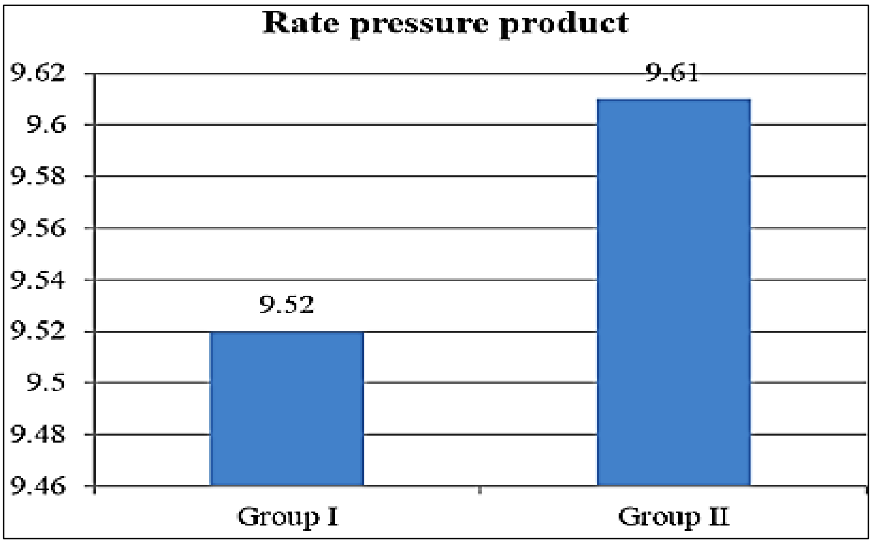

Fig 1: Comparison of Rate pressure product between exercise trained (Group I) and untrained (Group II) individuals

Table 1: Comparison of cardiovascular parameters between exercise trained and untrained individuals

S. No	Parameters	Group I Mean ± SD	Group II Mean ± SD	P value
1.	HR	78.08±9.77	80.65±8.52	0.45
2.	SBP	121.85±10.21	119.06±10.39	0.47
3.	DBP	70.92±8.91	76.18±8.93	0.12
4.	PP	45.92±9.78	42.88±10.66	0.09
5.	MAP	88±8.12	90.47±7.94	0.41
6.	RPP	9.52±1.46	9.61±1.42	0.85

SVC, PEF, and MVV were substantially higher in group I than group II (p = 0.01, 0.03 and 0.03 respectively) when the baseline pulmonary function parameters were compared. On the other hand, FVC, FEF25-75%, FIVC, FIV1 and FIV1/FIVC revealed no significant difference between the groups. [Table 2]. The graph 2 presents a comparison of MVV between individuals who are exercise trained and individuals who are not exercise trained.

Table 2: Comparison of respiratory parameters between exercise trained and untrained individuals

Sr. No.	Parameters	Group I Mean ± SD	Group II Mean ± SD	P value
1.	SVC	4.06±0.84	3.26±0.82	0.01*
2.	FVC	3.15±0.82	2.94±0.63	0.44
3.	FEF25-75%	5.2±1.92	4.99±1.59	0.74
4.	PEF	501.15±67.09	442.12±76.76	0.03*
5.	FIVC	2.82±1.08	2.38±0.77	0.21
6.	FIV1	2.59±1.11	2.25±0.74	0.33
7.	FIV1/FIVC	90.45±11.35	94.97±5.45	0.16
8.	MVV	122.95±31.24	98.42±27.61	0.03*

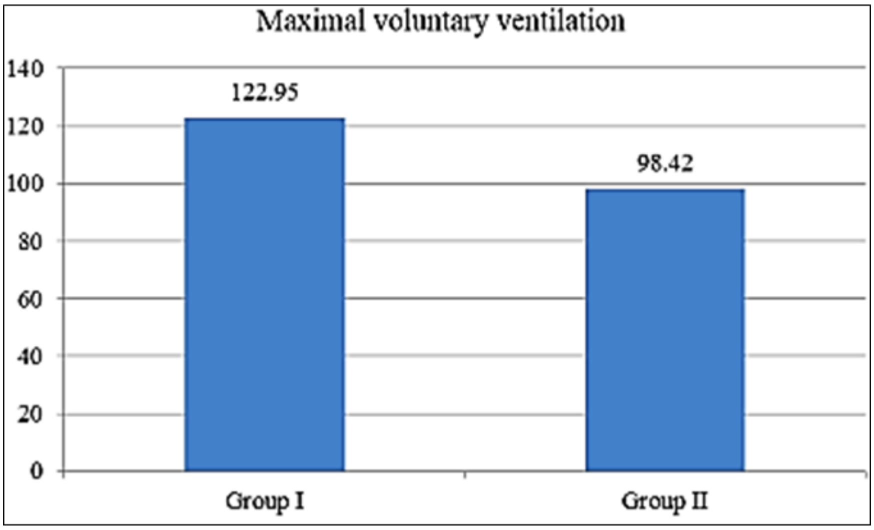

Fig 2: Comparison of Minute volume ventilation between exercise trained and untrained individuals

Exercise had a highly significant impact on both groups' cardiovascular measures, increasing HR, SBP, PP, MAP and RPP (p = 0.000), although DBP did not differ significantly between the group. This result suggests that physical activity is good for cardiovascular health. Figure 3 compares the mean arterial pressure in groups I and II before and after exercise.

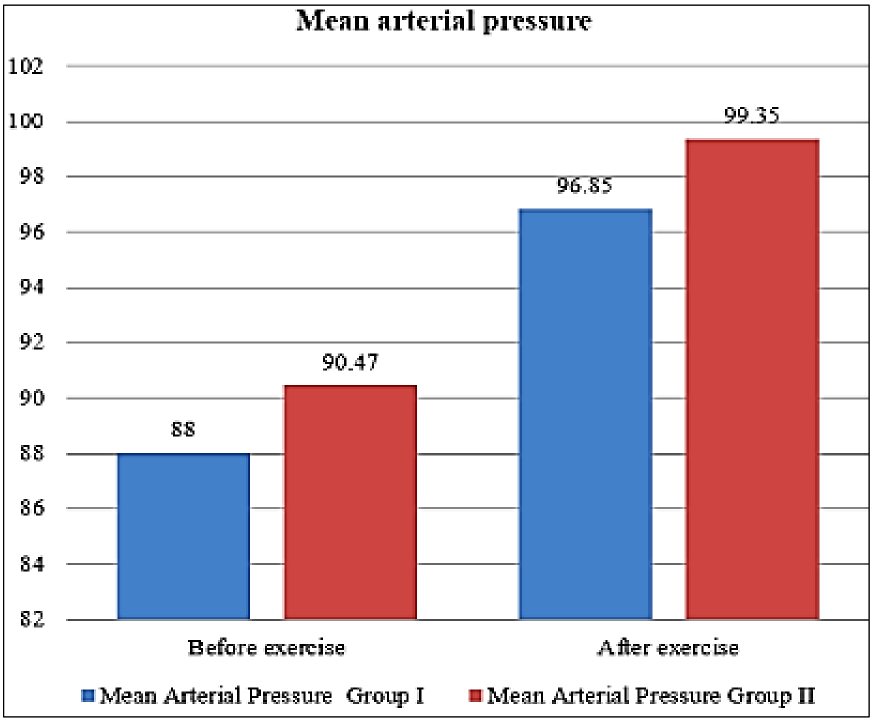

Fig 3: Comparison of Mean arterial pressure before and after exercise in group I and group II

SVC, FVC, FEF25-75%, FIV1, FIVC, FIV1/FIVC, and MVV were not significantly different between the two groups' PFT parameters before and after exercise (p>0.05), while PEF was significantly lower in group II alone (p = 0.05). Peak expiratory flow in groups I and II before and after exercise is compared in Fig. 4.

Discussion

The autonomic nerve system is crucial in the adaptation of the cardiorespiratory system to exercise. In our investigation, we discovered that there was no discernible difference in the baseline cardiovascular parameters between exercise-trained and untrained people [Table/Fig. 1]. Contrary to what was reported in the study by Davy *et al*., exercise-trained subjects' baroreceptor reflex function was comparable to that of subjects who were moderately active. Numerous studies have demonstrated that as compared to untrained subjects, exercise-trained individuals had improved heart rate variability [17]. The shorter length of exercise training in our study may be responsible for the lack of changes in baseline cardiovascular measures (3 months). After six months of aerobic exercise, ambulatory blood pressure did not significantly alter, but after 12 months of aerobic exercise, there was a considerable decline in ambulatory blood pressure levels, according to a study by Seals and Reiling. Only SVC, PEF, and MVV revealed substantially higher values in exercise-trained people than in untrained ones among the baseline PFT parameters [18]. This is in line with recent studies that discovered exercise training enhanced MVV, which was connected to increased contracted lung volumes and diaphragm thickness. According to a research by Thaman *et al*., exercise-trained subjects had PEF that was considerably higher than that of untrained medical students. It was shown that athletes had higher vital capacities than non-athletes, which could be attributable to their respiratory muscles' greater strength from training that involved frequent maximal expansion and deflation. As a result, in our study, 3 months of exercise training did not significantly change the cardiovascular measures, however certain respiratory function did improve. This is consistent with past research where an 8-month exercise programme was found to be necessary to enhance cardiopulmonary function. In contrast, it was discovered that even one month of exercise training increased PFT. We discovered that there was a highly significant increase in HR, SBP, PP, DBP, MAP, and RPP after exercise whereas the increase in DBP was not significant in either group when comparing the effects of short-term exercise on the cardiovascular system. In young, healthy people, the rate pressure product and myocardial oxygen consumption are closely connected. Exercise increases blood pressure and heart rate right away, which raises RPP. Exercise stimulates the sympathetic nervous system, which raises the heart rate and blood pressure. This has a physiological basis. SVC, FVC, FIV1, FIVC, FIV1/FIVC, FEF25-75% and MVV were PFT parameters that did not substantially change after exercise. In our investigation, it was discovered that short-term exercise had no impact on respiratory function in both exercise-trained and untrained people [18-20]. This finding is consistent with earlier research that also discovered that light to moderate exercise has no appreciable impact on PFT. Contrary to our findings, several investigations discovered an increase in dynamic lung volume and capacity, which they attributed to the catecholamine's released during exercise. Peak expiratory flow dramatically decreased in non-exercisers immediately after exercise, but not in trained exercisers. Peak expiratory flow rate (PEFR) primarily reflects the quality of big airways and is almost completely independent of lung size [21]. It is an effective criterion for evaluating individuals with obstructive airway problems and is reliant on expiratory effort. Exercise-induced asthma (EIA) and exercise-induced bronchospasm (EIB) are terms used to describe a temporary increase in airway resistance that manifests as a decrease in FEV1 and PEFR of more than 10% or a fall in FEF 25-75% of more than 35%. EIB is a sign of exercise-induced bronchial lability. Asthma clinical symptoms are more likely to occur in patients with hyperresponsiveness to exercise than in those with a normal bronchial response. It is most likely a sign of a subclinical asthmatic condition. Sager F. also shows a decrease in PEF following brief exercise. PEF rises in exercise-trained individuals after brief exercise, albeit this increase was not statistically significant. This could be caused by an increase in expiratory muscular endurance brought on by consistent training.

Conclusion

The growing awareness of the health advantages of exercise is further accentuated by a comprehension of the role that exercise plays in the operation of the cardiovascular and respiratory systems. It is important to encourage people who lead sedentary lifestyles to participate in regular physical activity. According to the results of our research, a brief bout of exercise had no discernible impact on the respiratory parameters of either exercise-trained or untrained persons. A training programme consisting of three months' worth of exercise can improve respiratory function with almost little effect on cardiovascular function. To properly evaluate the impact that sustained physical activity has on the cardiorespiratory system, additional research is required.

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References

1. Do Amaral VT, Viana AA, Heubel AD, Linares SN, Martinelli B, Witzler PHC, *et al*. Cardiovascular, respiratory and functional effects of tele-supervised home-based exercise training in individuals recovering from COVID-19 hospitalization: A randomized clinical trial, 2022. medRxiv.
2. Maxwell JD, Bannell DJ, Brislane A, Carter SE, Miller GD, Roberts KA, *et al*. The impact of age, sex, cardio-respiratory fitness and cardiovascular disease risk on dynamic cerebral autoregulation and baroreflex sensitivity. European Journal of Applied Physiology, 2022, 1-11.
3. Olivo CR, Castro TBP, Riane A, Regonha T, Rivero DHRF, Vieira RP, *et al*. The effects of exercise training on the lungs and cardiovascular function of animals exposed to diesel exhaust particles and gases. Environmental research. 2022;203:111-768.
4. Wu X, Zhang Y, Wang F, Xiang J. Cardiopulmonary exercise testing to observe subclinical abnormalities in cardiopulmonary function in patients undergoing peritoneal dialysis. Clinical Physiology and Functional Imaging, 2022.
5. Zhao Q, Mao F. Effects of Aerobic Training on Cardiopulmonary Function Based on

Multiple Linear Regression Analysis. Journal of Healthcare Engineering, 2022.

6. Fereydounnia S, Shadmehr A, Tahmasbi A, Salehi RS. The Comparison of the Effectiveness of Respiratory Physiotherapy Plus Myofascial Release Therapy Versus Respiratory Physiotherapy Alone on Cardiorespiratory Parameters in Patients With COVID-19. International Journal of Therapeutic Massage & Bodywork. 2022;15(1):4.
7. Bhutkar PM, Bhutkar MV, Taware GB, Doijad V, Doddamani BR. Effect of suryanamaskar practice on cardio-respiratory fitness parameters: A pilot study. Al Ameen J Med Sci. 2008;1(2):126-129.
8. Pechter Ü, Maaroos J, Mesikepp S, Veraksits A, Ots M. Regular low- intensity aquatic exercise improves cardio- respiratory functional capacity and reduces proteinuria in chronic renal failure patients. Nephrology Dialysis Transplantation. 2003;18(3):624-625.
9. Giles LV, Carlsten C, Koehle MS. The effect of pre-exercise diesel exhaust exposure on cycling performance and cardio-respiratory variables. Inhalation toxicology. 2012;24(12):783-789.
10. Do Amaral VT, Viana AA, Heubel AD, Linares SN, Martinelli B, Witzler PHC, *et al*. Cardiovascular, respiratory and functional effects of tele-supervised home-based exercise training in individuals recovering from COVID-19 hospitalization: A randomized clinical trial., 2022. medRxiv.
11. Amin RA, Kulkarni SD, Pathak NR, Joshi S. Comparative study of effects of exercise and yoga on cardio-respiratory parameters. Indian Journal of Applied Basic Medical Sciences, 2010, 12(15).
12. George JM, Sen K, Raveendran C. Evaluation of the effect of exercise on pulmonary function in young healthy adults. International Journal of Biomedical and Advance Research. 2014;5(6):308-312.
13. Gustin P, Dhem AR, Lomba F, Lekeux P. Cardio-pulmonary function values in double-muscled cattle during muscular exercise. Veterinary Research Communications. 1988;12(4):407-416.
14. Sakhaei S, Sadagheyani HE, Zinalpoor S, Markani AK, Motaarefi H. The impact of pursed-lips breathing maneuver on cardiac, respiratory, and oxygenation parameters in COPD patients. Open access Macedonian journal of medical sciences. 2018;6(10):18-51.
15. Singh S, Gaurav V, Parkash V. Effects of a 6-week nadi-shodhana pranayama training on cardio-pulmonary parameters. Journal of Physical Education and Sports Management. 2011;2(4):44-47.
16. Choudhary S, Choudhary R, Chawla VK, Soni ND, Kumar J, Choudhary K. Effects of Yoga and Physical Exercise on Cardio-Respiratory Parameters. National Journal of Integrated Research in Medicine, 2013, 4(3).
17. Nelson D, Stieglitz JD, Cox GK, Heuer RM, Benetti DD, Grosell M, *et al*. Cardio-respiratory function during exercise in the cobia, Rachycentron canadum: The impact of crude oil exposure. Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology. 2017;201:58-65.
18. Sperlich B, Haegele M, Krueger M, Schiffer T, Holmberg HC, Mester J. Cardio-respiratory and metabolic responses to different levels of compression during submaximal exercise. Phlebology. 2011;26(3):102-106.
19. Art T, Votion D, McEntee K, Amory H, Linden A, Close R, *et al*. Cardio-respiratory, haematological and biochemical parameter adjustments to exercise: effect of a probiotic in horses during training. Veterinary research, 1994, 25(4).
20. Smith TB, Stonell C, Purkayastha S, Paraskevas P. Cardiopulmonary exercise testing as a risk assessment method in non-cardio- pulmonary surgery: a systematic review. Anaesthesia. 2009;64(8):883-893.
21. Shakouri SK, Salekzamani Y, Taghizadieh A, Sabbagh-Jadid H, Soleymani J, Sahebi L, *et al*. Effect of respiratory rehabilitation before open cardiac surgery on respiratory function: a randomized clinical trial. Journal of cardiovascular and thoracic research. 2015;7(1):13.