Scholars Journal of Applied Medical Sciences (SJAMS) ISSN 2320-6691 (Online)
Sch. J. App. Med. Sci., 2014; 2(1A):80-84 ISSN 2347-954X (Print)

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

Comparative Study of Change in Physical Activity on Cardio-respiratory Efficiency and Exercise Performance in Sedentary Females

Jaman M Harsoda[1], Geetanjali Purohit[2]*

[1]Prof & Head Department of Physiology, Smt. B K Shah Medican Institute & Research Center, Dhiraj Hospital, Sumandeep Vidyapeeth, Piparia,Vadodara-391760, Gujarat, India
[2]Tutor &PhD student in Department of Physiology, Smt. B K Shah Medican Institute & Research Center, Dhiraj Hospital, Sumandeep Vidyapeeth, Piparia, Vadodara-391760, Gujarat, India

***Corresponding author**
Ms Geetanjali Purohit
Email: purohit85geet@gmail.com

Abstract: Few data are available regarding the outcome of women in cardiac rehabilitation. To determine whether women are differing in physical profile and outcome, 45 sedentary females were prospectively studied for post exercise cardio-respiratory changes and exercise efficiency. Females were divided into five groups, 9 in each. Each group performed different exercise (whole body, walking, upper limb, lower limb and combined exercise) for 12 weeks under the supervision of physical trainer. Interventions included respiratory rate, resting pulse rate, blood pressure, forced expiratory volume in one second (FEV1), peak expiratory flow rate (PEFR), 6 minute maximum walking distance (6 MWD), 12 minute maximum walking distance (12 MWD), 6 minute maximum bicycle ergo meter (6 MBE) test and 6 minute maximum arm ergo meter (6MAE) test. Parameters were studied twice before and after exercise training. Students paired t test was applied for pre and post data analysis. Cardio- respiratory efficiency found to be significantly higher in response to whole body, combined and walking exercises. The other modes like only upper limb or only lower limb exercise are not as beneficial. Exercise performance showed non-significant results except 6MBE distance. In conclusion cardio respiratory efficiency was improved by regular exercise training and whole body, walking and combined exercises are better than upper and lower limb exercises.
Keywords: 6MWD, 12 MWD, 6MBE, 6MAE, FEV1

INTRODUCTION

Exercise has been a means of testing the physical capabilities, form the basis of good health and well-being and it develops the ability to tolerate, withstand stress and carry on in circumstances where an unfit person cannot continue. The American College of Sports Medicine (ACSM)defines aerobic exercise as "Any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature", as walking, jogging, running, skipping, dancing, swimming, bicycling, etc [1]. There are many evidences confirming that regular physical work not only increase the functional capacity of organism but also decrease the risk of various diseases in women [2]. Exercise training is important for the improvement of cardio-respiratory efficiency, work performance and the functioning of other systems and known to reduce morbidity and mortality from numerous chronic ailments [3]. A regular participation in aerobics exercise program, as in other endurance exercises, increases the capacity of cardiovascular system [4-5].

There are few studies reported on aerobic exercise and its impact on pulmonary function in general population. As far as the respiratory efficiency concern exercise physiology have shown significantly positive improvements, however non-significant associations have also been reported [6-8]. Exercise training influence a number of factors which affect exercise performance. It may cause increase muscle strength, maximal oxygen uptake, structural and functional changes in a number of organ systems.

Exercise physiology has become a separate study, having different specialization like sportsphysiology, exercise for bronchial asthma and other respiratory diseases, exercise for neurological and cardiovascular diseases and so on. Few studies reported in females. With this idea 45 sedentary females were trained in different forms of exercise for 12 weeks. Their cardio-respiratory efficiency and exercise performance were evaluated and compared before and after exercise training. Authors were keen to know the role of physical activity in the modification of cardiovascular functions, lung functions; positive results, if derived, could be communicated for fitness and well-being of other population and clinical rehabilitations.

MATERIAL AND METHODS

Participants

Longitudinal experimental study was conducted in 45 healthy female participants. This study was conducted in Department of Physiology, PSMC, Karamsad. After taking informed consent, a detailed history was noted. Those with a past medical history suggestive of asthma and exercise-induced asthma, smoking, chronic cough, recurrent respiratory tract infection, history of chest or spinal deformity, obesity, and chronic obstructive lung diseases were excluded from the study. Only healthy, non-smoker and non addict females were selected for the study. The aim of the study and procedure of the tests were explained to all females and only those who volunteer included in the study.

Exercise training

Participants were divided in to 5 different groups, 9 in each. All participants underwent the 12 week exercise training for half an hour daily, five times in a week. Five different modes of exercise were used. The training protocol was as follows

Table 1: Exercise training protocol

Exercise training	Instrument used	Type of exercise	Speed	Tension
Whole body Group A (N=9)	Hero allegro Exer bike	Rowing+ pedalling+ walking	20 times/ min 20 kms/hr 10 kms/hr	Moderate 30kg.m/sec
Combined limb Group B (N=9)	Hero allegro Exer bike	Rowing+ pedalling	20 times/min 20kms/hr	Moderate 30kg.m/sec
Walking Group C (N=9)	-	walking	10 km/ hr	-
Upper limb Group D (N=9)	Hero allegro Exer bike	Rowing	20times/min	Moderate 30kg.m/sec
Lower limb Group E(N=9)	Hero allegro Exer bike	Pedalling	20kms/hr	Moderate 30kg.m/sec

Material and Interventions

All the participants were studied for cardio respiratory efficiency and exercise performance. Interventions were performed twice, before and after the 12 week of physical training. The following interventions were taken.

A. Cardiorespiratory efficiency tests
    - Measurement of resting pulse rate and blood pressure.
    - Respiratory rate: Resting respiratory rate was taken before the study and after the exercise training.
    - Forced expiratory volume in one second(FEV1): For the measurement of FEV1 digital spirometer SP-1A was used. Participants were asked to breathe in deeply in upright position, then to take mouthpiece firmly between their lips and breathe out as strongly as possible for more than two seconds.
    - Peak expiratory flow rate (PEFR): To measure the PEFR the mini Wright's peak flow meter was used. The Participants were asked to take a full and deep inspiration and then to blow out fast and forcefully in to the mouth piece of peak flow meter.

B. Exercise performance test
    - Walking tests: 6 minute (6MWT) and 12 minute walk tests (12MWT) were performed. Both the teats were carried out on a level enclosed passage. Each participant was instructed to walk as much as distance as he could in 6 and 12 minutes and instructed to walk continuously as fast as possible without any stoppage or slowing down in speed. Participants should put his maximum efforts to cover maximum distance. A physical instructor accompanied, acting as time keeper and giving the necessary encouragement. Distance was measured in meters.
    - Bicycle Ergometer test: Six minute ergometer distance (6 MED) was performed on Hero allegro Exer bike. The participants were instructed to pedal (at moderate tension of 30 kg/sec) as fast as possible for a period of six minutes. During the test they were continuously encouraged to reach a maximal pedalling. The result was expressed as distance covered in kilometres. Six min maximum arm ergometer test (6 MAE) was also performed by setting a moderate tension 30 kg / sec on handle bars of hero allegro exer bike.Participants were instructed to row the pedals as maximally as possible for a period of six minutes. During the test they were continuously encouraged to reach a maximally rowing speed.

Statistical analysis

Students paired t test was applied to compare the pre and post training values. Statistics were tested at the p<0.05 level of significance and data were reported as mean standard deviation.

RESULTS

There were 45 sedentary female subjects aged between 15-25 years were studied. Besides cardio-respiratory efficiency tests, exercise performance tests were also studied.

Table 2 showed the anthropometric data of subjects for each group which include age, weight and height and body surface area. Table 3 showed the values of pre and post exercise changes in cardio-respiratory efficiency. Pulse rate and SBP decreased after all exercise modes, while DBP has shown variable values. Respiratory rate is not affected by exercise while FEV1 improved after whole body, combined and walking exercise. PEFR improved only after whole body and walking exercise.

Table 4 showed the improvement in exercise performance as 6 MWD, 12 MWD both increased after exercise training. Results showing that whole body exercise showed significant changes in 6MBE. It consisted of rowing, pedalling on hero allegro exer bike and walking. Other modes of aerobic exercises improve the exercise efficiency but statistically non significant.

Table 2: Anthropometric Measurements for Each Group

Data	Whole body	Combined limbs	Walking	Upper limbs	Lower limb
N	(N=9)	(N=9)	(N=9)	(N=9)	(N=9)
Age (Yrs)	17.83±0.7	17.78±0.97	18.22±0.67	17.44±0.53	17.89±0.33
Weight (kg)	48.97±6.98	48.67±1.41	47.22±6.48	48.78±9.36	51.22±8.48
Height (cms)	154.17±5.14	153.89±2.12	150.89±5.49	156.11±5.93	155.78±5.07
BSA m^2	1.44±0.10	1.44±0.02	1.40±0.09	1.44±0.12	1.47±0.13

Table 3: Comparison of Effect Different Modes of Exercise on Cardiorespiratory Parameters

Parameter	Whole body		Combined limbs		Walking		Upper limbs		Lower limb	
	Before	After	Before	After	Before	After	Before	After	Before	After
RR (/min)	14.4± 2.07	15.8± 2.10	14.9± 1.76	16.2± 2.11	14.0± 2.24	15.8± 1.56	14.5± 2.40	15.6± 2.60	14.2± 2.11	15.8± 2.33
PR (/min)	80.3± 4.36	74.4± 3.48***	80.4± 4.88	73.8± 4.06*	79.8± 5.04	75.1± 4.26*	78.0± 3.32	72.9± 2.67**	82.9± 3.02	76± 2.24***
SBP (mm/Hg)	117.7± 8.16	107.9± 6.42***	118.4± 6.46	104.67± 4.24***	119.1± 7.69	110.7± 7.07*	114.7± 10.3	105.8± 5.14*	118.4± 8.41	110.7± 7.21*
DBP (mm/Hg)	82.0± 5.22	77.8± 3.32***	83.1± 4.01	76.2± 4.29**	84.2± 4.41	77.8± 3.23**	80± 6.16	78.7± 1.41	80.9± 5.66	76.4± 3.57
FEV1 (L)	2.43± 0.4	2.97± 0.53*	2.32± .22	2.85± .18**	2.31± .26	2.78± .33**	2.60± .61	2.72± .54	2.50± .37	2.59± .34
PEFR (L/min)	408.19 ±45.8	436.81± 42.3*	408.89± 50.6	435.0±6 43.9	406.67± 51.8	455.56± 39.4*	402.78± 42.2	422.78± 40.4	414.44± 46.13	433.89 ±45.81

RR= Respiratory rate, PR= pulse rate, SBP= systolic blood pressure, DBP= diastolic blood pressure, FEV1= forced expiratory volume in first one second, PEFR= peak expiratory flow rate, * P <0.05, ** P<0.005, *** p<0.001

Table4: Comparison of Effect Different Modes of Exercise on Exercise Performance Test

Test	Whole body		Combined limbs		Walking		Upper limbs		Lower limb	
	Before	After	Before	After	Before	After	Before	After	Before	After
6 MWD (Mtr)	563.88± 64.81	589.89± 64.12	559.28± 58.5	577.99± 64.39	655.42± 58.7	592.43± 56.22	562.64± 68.08	575.96± 61.36	578.17± 90.34	613.18± 76.95
12 MWD (Mtr)	1115.2± 121.14	1149.85 ±119.8	1103.93 ±111.06	1161.46 ±101.35	1086.27 ±95.51	1128.87 ±95.44	1125.85 ±125.08	1138.23 ±122.28	1144.74 ±157.8	1170.8± 164.83
6MBE (Km)	2.52± 0.50	2.81± 0.41*	2.33± 0.36	2.90± 0.21**	2.50± 0.33	2.69± 0.31	2.76± 0.71	2.90± 0.59	2.44± 0.51	2.73± 0.47
6MAE (Mtr)	251.0± 53.9	276.39± 54.9	251.44± 46.66	291.89± 51.86	267.22.± 35	284.78± 34.67	238.11± 76.54	271.44± 68.35	249.3± 62.6	257.44± 62.3

6MWD= 6 minute walk distance, 12MWD= 12 minute walk distance, 6MBE= 6 minute bicycle ergometer test, 6MAE= 6 minute arm ergometer test, * P <0.05, ** P<0.005, *** p<0.001

DISSCUSSION

Earlier research suggests that regular physical training leads to improved physical fitness and cardio-respiratory efficiency of normal healthy persons and clinical practice such as, diagnosis and evaluation of cardiovascular disease, assessment of treatment effect, ascertainment of pathophysiology and exercise prescription for rehabilitation [9-12]; few data are available regarding the outcome of women in cardiac rehabilitation. Whole body, walking and combined limb exercise training maximum benefits in cardio-respiratory efficiency, while lower limb and upper limb exercise training has variable effects [13].

Blood pressure depends upon central and peripheral mechanism of regulation, peripheral vascular resistance, mechanical efficiency of heart and cardiac output [14]Pulse decreases significantly in all kind of exercises. Aerobic exercise increases the vagal tone and also increases the concentration of circulatory catecholamine. Reflex activation of heart rate due to cardiovascular and pulmonary reflexes is reduced and the effect of stretch receptor of muscle and joints on heart rate also reduced [15].

Forceful inhalation and deflation of the lungs for prolonged period leads to strengthening of respiratory muscles and an increase in the maximal shortening of the inspiratory muscles, possible explanation for improved lung functions after exercise [16-17]. FEV1 depends upon airway resistance, lung compliance and contraction power of respiratory muscle. In present study FEV1 increase significantly in whole body, combined and walking exercise in females. This may be due to increased elasticity of joints concern with respiratory movements leading to greater expansion and recoil of thoracic cage. FEV1 is also improved after exercise in asthmatic persons but the rise was statistically insignificant maybe due to respiratory muscle weakness [18]. It is studied that improvement in FEV1 after an 12-week exercise course is comparable to a study in which significant augmentation in FEV1 and FVC were observed after physical training in healthy male welders [19-20]. Our study found that PEFR improved only after whole body and walking exercise. It is reported that 16 weeks aerobic exercise plan (five 20 minute sessions of jogging in a week) can improve the PEFR up to 17% significantly [21]. As far as airways are concerned, activity-induced bronchodilatation reduces airway resistance and improves pulmonary ventilation. The normal pattern and volume of ventilation is influenced by input from chemoreceptors, proprioceptors in muscles, tendons and joints and impulses sent by nerves to the intercostal and diaphragmatic muscles. Our resultscorrelate with study, showed that physical activity improved pulmonary function in healthy sedentary people [22].

Studies found that exercise training not only improve the cardiorespiratory capacity but also increase the exercise efficiency in male participants [23]. In our study Exercise training improve the performance but not statistically significant. This might be because of less cooperation from females. It would give significant improvement if continue for longer time.

CONCLUSION

In conclusion the longitudinal purposeful physical exercises significantly improve the cardio-respiratory efficiency in sedentary females. Amongst different modes of aerobic exercises the whole body and combined limb exercise is best. It is confirmed above mentioned aerobic exercise improves the physical health component of quality of life and endurance in persons. It should be included as a part of a comprehensive health promotion strategy and cardiac rehabilitations.

Results of blood pressure enlightened the further way of hypertension management. Our study suggests that the moderate aerobic exercise can improve airway functions in healthy people and thus provides further support for the aerobic exercise as an important component of pulmonary rehabilitation. This will lead to better and improved treatments of COPD. Repeated periodic exercise helped in improving lung functions, especially FEV1. Periodic measurement of FEV1 with regular exercise can help in generating awareness regarding lifestyle modifications, and acquiring a healthy habit of being active.

REFERENCES

1. Resource Manual for Guidelines for Exercise Testing and Prescription. American College of Sports Medicine, Lea & Febiger Philadelphia, 1988:168-169.
2. Halm MA, Denker J; Primary prevention programs to reduce heart disease risk in women. Clin Nurse Spec., 2003;17(2):101-109.
3. Garrick JG, Regua RK; Aerobic dance: a review. Sports Med., 1998;6:169-179.
4. Poderys J; Asmens sveikatos ugdymas (Personal health promotion.) Kaunas: Kauno medicines universitetas, 2000.
5. Shephard RJ, Balady GJ; Exercise as cardiovascular therapy. Circulation, 1999; 99: 963-972.
6. Twisk JW, Staal BJ, Brinkman MN, Kemper HC, van Mechelen W; Tracking of Lung Function Parameters and the Longitudinal Relationship with Lifestyle. Eur Respir J., 1998; 12(3): 627-634.
7. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM *et al*.; American College of Sports medicine. Quantity and quality of exercise for developing and maintaining cardio respiratory and muscular fitness and flexibility in health adults. Med Sci Sports Exerc., 1998; 30(6): 975-991.
8. Nourry C, Desuelle F, Guinhouya C, Baquet G, Babic C, Bait F *et al*.; High intensity intermittent running training improves pulmonary function and alters exercise breathing pattern in children. Eur J Appl Physiol., 2005; 94(4): 415-423.

9. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM *et al*.; American College of Sports Medicine. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc., 2011; 43(7):1334–1359.
10. Fletcher GF, Balady GJ, Amsterdam EA, Chaitman B, Eckel R, Fleg J *et al*.; Exercise standards for testing and training: An statement for healthcare professionals from the American Heart Association. Circulation, 2001; 104(14):1694–1740.
11. Mezzani A, Agostoni P, Cohen-Solal A, Corra U, Jegier A, Kouidi E *et al*.; Standards for the use of cardiopulmonary exercise testing for the functional evaluation of cardiac patients: a report from the Exercise Physiology Section of the European Association for Cardiovascular Prevention and Rehabilitation. Eur J Cardiovasc Prev Rehabil., 2009; 16(3): 249–267.
12. Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE *et al*.; Exercise capacity and mortality among men referred for exercise testing. N Engl J Med., 2002; 346(11): 793–801.
13. Lake F R, Henderson K, Briffa, Openshow J, Musk W;Upper limb and lower limb exercise training in patients with chronic air flow obstruction. Chest, 1990; 7(5):1077-1081
14. Jone DR, Speier J, Canine K, Owen R, Stull A; Cardiorespiratory responce to aerobic training by patients with poliomyelitis sequelae. JAMA, 1989; 261(22): 3255-3258.
15. De Meersman RE; Heart rate variability and aerobic exercise. Am Heart J., 1993;725:26.
16. Thaman R G, Arora A, Bachhel R; Effect of Physical Training on Pulmonary Function Tests in Border Security Force Trainees of India. Jn Life Sci., 2010; 2(1):11-15.
17. Hamilton P, Andrew GM; Influence of growth and athletic training on heart and lung functions. Eur J Appl Physiol Occup Physiol., 1976; 36(1): 27-38.
18. Gimenez M, Predine E, Marchand M, Servera E, Ponz JL, Polu JM; Implication of upper and lower limbs training in patients with chronic airway obstruction. Chest, 1992; 101(5): 279-288.
19. El-Batanouny MM, Amin Abdou NM, Salem EY, El-Nahas HE; Effect of exercise on ventilatory function in welders. Egyp J Bronchol., 2009; 3(1):67-73.
20. Ali AT, Badr NM, Batanony MM, Seri ZMH;Ventilatory functions response to respiratory exercise program in workers of Tourah Cement Factory. A doctoral thesis, Faculty of physical therapy, Cairo University, 2002: 168.
21. Chaitra B, Vijay Maitri; Effect of Aerobic Exercise Training on Peak Expiratory Flow Rate: a Pragmatic Randomized Controlled Trial.Int J Biol Med Res., 2011; 2(3): 789-792.
22. Cheng YJ, Macera CA, Addy C, Sy F, Wieland D, Blair S; Effects of Physical Activity on exercise tests andrespiratory function. Br J Sports Med., 2003; 37(6): 521-528.
23. Harsoda JM, Purohit G; Effect of different modes of aerobic exercise on cardiorepiratory efficiency and exercise performance in sedentary males. IJBAP, 2013;2(1): 72-78.