ORIGINAL ARTICLE

Comparison of Asthma Gymnastic and Static Ergocycle Exercise in Improving VO_2max and Quality of Life in Adult Asthmatic Patient

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ABSTRACT

Objective: To compare two aerobic exercise training program, asthma gymnastic and static ergocycle exercise, in improving VO_2max and QoL based on St. George's Respiratory Questionaire (SGRQ) for partially-controlled asthmatic patients.

Methods: This study analysed 36 of partially-controlled asthmatic adult patients (aged 21-50 years old) which were divided into two groups, asthma gymnastic (A, n=18) and ergocycle exercise (B, n=18) each for 3x/week for 6 weeks. Before and after treatment, VO_2max was measured using Astrand ergocycle method and QoL using SGRQ.

Results: Significant increase of mean VO_2max in both groups (A 3.78 ml/kg/minute vs B 7.13 ml/kg/minute in group B; p 0.00). Significant improvements were also found in all component of SGRQ (p=0.00) in both groups, with higher total score found in group B (A 271.11 vs B 384.86, p=0.00).

Conclusion: Static ergocycle exercise increased the level of VO_2 max and QoL in partially-controlled asthmatic adult patients better than asthma gymnastic.

Keywords: *Asthma gymnastic, static ergocycle exercise, partially-controlled asthma, quality of life, VO_2max*

INTRODUCTION

Asthma as a chronic airway inflammation disease is characterized with episodic wheezing, cough and chest tightness due to airway obstruction especially at night or early in the morning. The mechanism is considered reversible spontaneously or with medication.[1] Asthma is one of the common airway disease that affects at least 300 milion individuals in the world and its prevalence increases in the last 20 years.2 If it is not well-treated and prevented, higher prevalence is predicted to happen in the future.[3]

Adult sufferers of asthma usually have constant symptoms of impaired function in daily activities and sleep disturbance due to shortness of breath. These things keep the patient worried about being sick and force them to limit their physical activities in the impact of reducing quality of life (QoL). This is proven by Listyanti (2003) that showed lower maximum oxygen

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uptake (VO_2max) in persistent asthma patients' fitness to non asthmatic patient. Therefore, symptoms relieving and improved QoL are the main goals in treating this disease.[4,5,6,7]

Asthma is treated with medication and non-medication methods with pulmonary rehabilitation. Medications are given to control and reduce symptoms, yet this is proven inadequate.[1,8] Preventing the event of exacerbation, increasing lung function and reducing the event of medication's side effects should be aimed in the whole treatment.[1] Thus, pulmonary rehabilitation should be considered completed in every patient in which even after optimal medication they still feel respiratory symptoms and the finding of decreased exercise tolerance, limited activity or impaired health state.[7]

Pulmonary rehabilitation consists of many components, such as physical exercise which is considered as the basic principle, education, nutrition, psychological support and behavioural change.[8] A systemic review in 2005 conducted by Ram et al. recommended 20-30 minutes of regular aerobic exercise (2-3 times per week for a minimal of 4 weeks) in improving fitness (increasing VO_2max) in asthmatic patient.[9]

Psychosocial morbidity and symptoms' points of view in moderate and severe persistent asthma patient was reviewed in a study by Mendes et al. that captured increased VO_2max, improved asthma symptoms and QoL, reduced anxiety and depression by giving education, breathing exercise and aerobic exercise (twice per week for 3 months) compared to giving only education and breathing exercises.[10]

Aerobic exercise in asthmatic cases can be done by walking or running with treadmill, swimming, gymnastics, or static ergocycle.[9,11] Indonesia asthmatic gymnastics routine as standardized by Indonesian Asthmatic Foundation (*Yayasan Asma Indonesia* – IAF) consists of aerobic exercise and breathing exercise. Anwar et al. in 1998 obtained decreased clinical symptoms event and usage of bronchodilator inhaler with significant increase of VO_2max by giving asthma gymnastics routine (mean of 2.67 times per week for 18 weeks).[12]

Another recommended exercise as stated in the American College of Sport Medicine (ACSM) for asthma patient is static ergocycle exercise. This exercise is considered relatively easy to perform, safe and comfortable. Blood pressure and heart rate monitoring are two things to be evaluated as the safety parameters while cycling. Dosage in this type of exercise is customized individually.[11] Alamsyah (2005) adopted three times per week for 6 weeks of static ergocycle exercise in moderate persistent asthma subjects and acquired higher significant increase of VO_2 max.[13]

While QoL in chronic lung diseases is measured by St. George's Respiratory Questionnaire (SGRQ), the British Thoracic Society (BTS) also recommends the usage of this tool in asthma patients since it is more sensitive in detecting clinical changes. Furthermore, validity of this tool in different languages has been advised as high.[14]

Both pulmonary programs mentioned above has been proven to increase VO_2max, reduce clinical symptoms and increase QoL, yet the comparison between static ergocyle exercise and Indonesian standard asthma gymnastic routine has never been conducted before. This is due to the difference in exercise intensity, for instance, asthma gymnastics is more on recreational purpose because it is performed in a group with the same dosage for all the participants, whereas static ergocycle dosage is individualized.[11-13] Hence, the purpose of this study is to compare the effect of asthma gymnastics and static ergocyle exercise in improving VO_2max and SGRW based of QoL in adult asthma patients.

METHODS

This study employed experimental method with controlled random design before and after intervention conducted in the Physical Medicine and Rehabilitation Department of Hasan Sadikin Hospital, Bandung, Indonesia in October – December 2012. Subjects were chosen from partially controlled asthmatic patients who visited Pulmonology outpatient clinic of Hasan Sadikin Hospital and Cibadak Hospital. We included subjects aged 21-50 years; sedentary

lifestyle; able to apprehend verbal, non-verbal and sign language (mini mental state examination – MMSE of 24-30), understand and signed informed consent. Subjects were excluded when the following clinical manifestation present: hearing impairment, other lung diseases, history of cardiovascular disease, diabetes mellitus, neuromuscular and musculoskeletal disorder that evading the procedures, oxygen saturation <90%, and pregnancy. If one was found with total more than three times inattendance then the subject would be dropped out.

Each subjects underwent spirometry tests (with and without bronchodilators) and electrocardiography in the beginning of the study, while QoL evaluation with SGRQ and static ergocycle stress test with Astrand method were done before and after intervention. Forty subjects were divided into two groups, a group with asthma gymnastics (group A) and another with static ergocycle exercise (group B). Each groups received 3 times per week for 6 weeks of exercises.

Group A received standardized asthma gymnastic exerises, a revised version of 2003 with an hour duration. This routine consisted of core A and B with aerobic exercise type 1, 2, and 3. Group B underwwnt modified Cooper Clinic method of static ergocycle exercise with 10 minutes in duration in the beginning and increased 5 minutes every week until 35 minutes at week 6. The intensity given was 80% of VO_2max, obtained from stress test and also increased by 5% each week if subjects were able to complete 3 sessions of exercise without any symptoms of shortness of breath.

Data were analyzed using normality, descriptive and hypothesis tests. When normal distribution were found among data, hypothesis would be tested in t-test for differences in two independent mean data, otherwise a non parametric test was conducted with either Mann Whitney or Wilcoxon Match Pairs test. Each analysis were using SPSS version 13.0 with p value <0.05. Ethical clearance were gained from ethic committee of Hasan Sadikin Hospital, Bandung.

RESULTS

Each groups have 20 subjects in the beginning and 4 of them dropped out in the way (2 from each group). Subjects characteristics were found no significant difference (table 1).

Table 1. Subjects Characteristics

Variables	Group A (n=18)	Group B (n=18)	p value
	Mean (SD)	Mean (SD)	
Age (year old)	42.83 (6.61)	42.56 (9.28)	0.46*)
BW	55.22 (11.07)	56.83 (5.68)	0.26*)
BH	152.72 (7.12)	152.28 (6.17)	0.84**)
BMI	23.53 (3.31)	24.61 (3.07)	0.33**)

Note: *) Mann Whitney U test; **) t-test; BW: body weight (kg); BH: body height (cm); BMI: body mass index (kg/m2)

After 6 weeks of intervention, significant difference in VO_2max was found in both groups (p 0.00, table 2) with increased VO_2max higher in group B (table 3) after 6-week intervention.

Table 2. Changes of VO_2max Before and After 6-weeks Intervention

	VO2max	Mean	SD	p value*)
Group A	Before After	25.19 28.97	25.67 29.53	0.00
Group B	Before After	26.05 7.81	33.18 9.04	0.00

Note: *) Wilcoxon Matched Pairs test; VO2 max (ml/kg/min)

Improved QoL was shown by significant increased of all components of SGRQ (p 0.00, table 4). Furthermore, after 6 weeks of intervention higher improvement of SGRQ was significant in group B (p 0.00, Table 5).

Table 4. Changes in Quality of Life (SGRQ) Before and After 6-weeks Intervention

Variables	Group A (n=18)			Group B (n=18)		
	Mean	SD	p value	Mean	SD	p value
Symptoms 1	284.67	48.94	0.00*)	240.07	54.97	0.00*)
Symptoms 2	218.47	39.55		152.04	62.12	
Activity 1	323.48	77.82	0.00**)	296.39	127.77	0.00**)
Activity 2	228.67	70.77		184.42	97.12	
Impact 1	391.43	79.95	0.00*)	352.80	77.13	0.00*)
Impact 2	288.45	78.71		168.96	73.15	
Total 1	999.43	157.01	0.00*)	890.28	239.73	0.00*)
Total 2	728.32	170.23		505.42	212.88	

Note: *) t-test; **) Wilcoxon Matched Pairs test;
Symptoms 1: before-6-week-intervention score of symptoms component of SGRQ; Symptoms 2: after-6-week-intervention score of symptoms component of SGRQ; Activity 1: before-6-week-intervention score of activity component of SGRQ; Activity 2: after-6-week-intervention score of activity component of SGRQ; Impact 1: before-6-week-intervention score of impact component of SGRQ; Impact 2: after-6-week-intervention score of impact component of SGRQ; Total 1: before-6-weekintervention score of total component of SGRQ; Total 2: after-6-week-intervention score of total component of SGRQ

DISCUSSION

This present study showed increased mean of VO_2max after 6-week intervention between asthma gymnastics (group A) and static ergocycle (group B) groups. Significant increased from 25.19 ml/kg/min to 28.97 ml/kg/min in group A showed a mean increase of 3.78 ml/kg/min that was similar to a study by Anwar et al. (1998) whom found significant increased after a mean of 2.67 times of exercise per week for 18 weeks. Anwar used asthma gymnastics 1994 version with 45 minutes of duration which consists of core exercise A and B in addition to aerobic exercise, while different version is used in this study (revised 2003 version, 1 hour duration).[15]

In the other group, significant increase of VO_2max also happened with mean of 26.05 ml/kg/min became 33.18 ml/kg/min (increased by 7.13 ml/kg/min) after 6-week static ergocycle exercise. It was higher in comparison to another study by Ram et al. (2005) with resulted mean of 5.4 ml/kg/min. This is also found in accordance with another study by Alamsyah (2005) which gave three times per week static ergocycle for 6 weeks described mean increase of VO_2max of 5.27 ml/kg/min in adult with persistent asthma and also with Mendes et al. (2010) when increased >10% VO_2max found after 30-minute aerobic exercise twice a week for 3 months.[8,10,13] These differences among studies are explained by varieties of asthma classification, types of exercise, duration, intensity and exercise frequency.

Asthma gymnastics routine is one of physical activities included in aerobic exercise especially targeting upper and lower extremity muscles, whilst static ergocycle exercise aimed particularly at the lower extremity muscles. The affected muscle groups will influence energy demands and increase work load of cardiopulmonary system which shown in increased heart rate and ejection volume. In theory, in order to increase physical fitness, regular physical activities that contracts big muscle groups are needed to obtain cardiopulmonary responses.[11,15,16]

Alamsyah (2005) studied static ergocycle exercise to moderate persistent asthma patients using Cooper Clinic method. This method started with a 2.5-minute stage and each week increased with 2.5 minutes. Intensity was chosen 70 % heart rate.13 Mendes *et al.* (2010) conducted aerobic exercise to moderate and severe persistent asthma patients aged 20-50 years with 30 minutes duration, 2 sessions per week for 3 months. The difference was the chosen intensity, which was started with 60 % of VO_2max in the first 2 weeks and increased to 70 % VO_2max, moreover when subjects were able to do two sessions without shortness of breath symptoms the intensity is increased 5 % more.[10]

This present study used modified Cooper Clinic method which conducted as follow: 10-minutes in duration for the first week; increased duration by 5 minutes every week until reaches 35 minutes in week 6. The starting duration was chosen higher than any previous studies and also with higher preferred intensity (80%). These differences in contrast to other studies reason for higher results of increased mean of VO_2max.[10,12,17]

Pulmonary rehabilitation program which uses high intensity endurance exercise will cause significant effect in skeletal muscles. ACSM recommends above 60% intensity of aerobic exercise, yet higher recommendation by Cassaburi et al. with 70-80% of maximum work load in static ergocycle exercise.[11,17] Increased exercise capacity in group B showed physical adaptation as increased oxidative capacity of lower extremity muscle groups.[18] This study adopted 80% intensity and its 5% increase every week in group B was shown well tolerated by subjects even though with shorter duration (6 weeks). The recommended duration of 30 minutes is done differently in this study with short duration (10 minutes) in the beginning until 35 minutes in the end in order to prevent exercise-induced bronchoconstriction (EIB).[11,13]

Increased mean of VO_2max in static ergocycle group of 7.13 ml/kg/min was illustrated higher than group A (asthma gymnastics, 3.78 ml/kg/min). Theoretically better result of static ergocyle is as expected before due to specific individual measurement of intensity as each subject received the exact intensity from individualized stress test. Each dosage in duration and intensity was then increased each week with the same procedure to do 50 rpm.[10,17]

Thus far, exercise dosage in asthma gymnastics group was generalized as of duration, frequency, and standardized movements.[16] Therefore, exercise intensity can not be determined to conclude the dose. Consequently, not all movements were done perfectly as instructed since the subjects complained of lower extremity fatigue when doing jumping and running. This explains the unequal exercise intensity of the standardized routine to each aerobic capacity.

Events of shortness of breath during physical activity or fear that overwhelms during the activity in asthmatic patients will induce the symptoms itself. This will further limit the patient him/herself from any physical actions.[10] This clarifies the lower fitness degree in asthmatic patients when matched to able-bodied individuals.[6] Each asthmatic patient admitted being disturbed by asthma symptoms in daily activities.[14] Furthermore, limitation in social life and retreat of psychological well-being will destroy one's quality of life. In addition, anxiety and depression will accompany with the decreasing degree of uncontrollable asthma.[19]

Mendes et al. used athma-specific health related QoL questionnaire to evaluate three components, physical activity limitation, frequency of symptoms and psychosocial evaluation. The following study confirmed increased QoL after giving twice a week of aerobic exercise for 3 months compared to breathing exercise.[10] This present study used SGRQ in evaluating symptoms, activity, and psychosocial impacts in chronic lung disease such as asthma. Symptoms component measured frequency and degree of severity of upper airway disturbance. Activity is measured on limitation of activity due to shortness of breath and activities that causes shortness of breath. Psychosocial impacts include social function and psychologic impairment. Altogether, in total component, health related QoL is measured through the influence of theset three components.[14]

Both groups in this study have increased exercise capacity significantly that also correlates with the increased QoL (decreased score of SGRQ in all components). This is by means of statistically higher mean QoL measurements in group B (384.86) and statistically different than group A (271.11, $p < 0.05$).

Well planned and measurable pulmonary rehabilitation programs are capable of increasing ability in doing daily activities and exercise capacity; decreasing shortness of breath events, anxiety and depression episodes to better overall quality of life in asthmatic patients. The higher aerobic capacity or cardiopulmonary endurance gained is due to increased oxydative enzymes action in muscles, density and size of mitochondrias, capillary supplies in muscle fibers and exercise capacity, the better fitness profile is. Patient then will fear less in doing activities. Reduced episodes of shortness of breath were also positively correlated with patients' activity and psychosocial life. In addition, Mendes et al. pointed out inflammation profile improvement in causing asthma as the reason behind the reduced symptoms of shortness of breath after performing aerobic exercises.[10]

Small sample size and asthma medication throughout the study period is admitted as the study limitations which influenced the study result.

CONCLUSION

Pulmonary rehabilitation program of aerobic exercises was proven by this study as it is able to improve VO_2max significantly and QoL in asthmatic patients with better improvements after static ergocycle exercise compared to asthma gymnastics routine exercise.

REFERENCES

1. Global Initiative for Asthma. Global strategy for asthma management and prevention; 2011. p. 2-72.
2. Weinberger, Cockrill, Mandel. Principles of Pumonary Medicine. 5th ed. Philadelphia: Saunders Elsevier; 2008. p. 1-86.
3. Pedoman pengendalian penyakit asma. Jakarta: DepKes RI; 2008.
4. Fanelli A, Cabral ALB, Neder JA, dkk. Exercise Training on Disease Control and Quality of Life in Asthmatic Children. Med Sci Sports Exerc.; 2007. Sep;39(9):1474-80.
5. Camargo, Rowe. Asthma Exacerbations. In: Asthma and COPD management. San Diego: Elsevier Ltd; 2009. p.775-87.
6. Listyanti W. Perbandingan tingkat kebugaran pada penderita asma persisten dengan non asma di RSUPN Dr. Cipto Mangunkusumo. Jakarta: Program studi Ilmu Rehabilitasi Medik fakultas Kedokteran Universitas Indonesia; 2003.
7. Farid R, Azad FJ, Atri AE, et al. Effect of Aerobic Exercise Training on Pulmonary Function and Tolerance of Activity in Asthmatic Patients. Iran J Allergy Asthma Immunol. 2005 Sep;4(3):133-8.
8. Troosters, Janssens, Decramer. Pulmonary Rehabilitation. In: Asthma and COPD management. San Diego: Elsevier Ltd; 2009. p.713-9.
9. Ram FS, Robinson SM, Black PN, et al. Physical training for asthma. Cochrane Database Syst Rev. 2005 Oct 19;(4):CD001116.
10. Mendes FA, Goncalves RC, Nunes MP, Saraiva-Romanholo BM, Cukier A, Stelmach R, et al. Effects of Aerobic Training on Psychosocial Morbidity and Symptoms in Patients With Asthma: a randomized clinical trial. Chest. 2010 Aug;138(2):331-7.
11. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. 7th ed. Lippincott Williams & Wilkins; 2005. p. 3-229.
12. Anwar J, Yunus F, Fachrurrojdu H. Pengaruh senam asma Indonesia terhadap penderita asma. Program studi Kedokteran Universitas Indonesia. 1998.
13. Alamsyah A. Pengaruh latihan pernapasan diafragma dengan latihan sepeda static pada pasien asma persisten sedang. Jakarta : Program studi Ilmu Rehabilitasi Medik Fakultas Kedokteran Universitas Indonesia. 2005.

14. Wright, Alicia. Effects of aerobic exercise on asthma quality of life: A Pilot study. Concordia University. Kanada. 2009. p. 96. Available from http://clues.concordia.ca/search/c?SEARCH=LE%203%20C66E94M%202010%20W75
15. Yunus F. Senam asma indonesia. Revised 2003 version. Yayasan Asma Indonesia. Jakarta. 2003.
16. Prasetyo, Budi. Seputar Masalah Asma. Jogjakarta: Diva Press. 2010.
17. Cooper CB. Exercise in chronic pulmonary disease: aerobic exercise prescription. Med Sci Sport Exerc. 2001 Jul;33(7Suppl):S671-9.
18. Baiardini I, Braido F, Brandi S, Canonica GW. Allergic diseases and their impact on quality of life. Ann Allergy Asthma Immunol 2006 Oct;97(4):419–28.
19. Kullowatz A, Kanniess F, Dahme B, et al. Association of depression and anxiety with health care use and quality of life in asthma patients. Respir Med 2007 Mar;101(3):638-44.