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Exercise to Improve Asthma Control and Lung Function in Stable Asthma: An Evidence-based Case Report

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Abstract

Asthma is a heterogeneous disease with respiratory symptoms that vary over time and intensity. Exercise-induced asthma patients are advised to avoid strenuous physical activity, which can trigger bronchospasm. However, appropriate exercise can improve asthma control and lung function in stable asthma patients. A literature search was conducted on PubMed, COCHRANE, and EMBASE databases using Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines according to the specified eligibility criteria. Those studies were critically appraised using the Oxford Critical Appraisal Tool 4.0. Four articles were selected based on the PRISMA search strategy flowchart to assess their validity, importance, and applicability. There was a significant effect of aerobic exercise on lung function (p-value = 0.05) and asthma control (p-value = 0.004). There was a significant effect of breathing exercise on the quality-of-life outcome group (p-value <0.05) and Forced Expiratory Volume in 1 second (FEV_1)% predicted (p-value <0.001). Physical exercise for 30 minutes two to three times per week or yoga exercise for 60 minutes per day for 3-5 days improves lung function and asthma control in stable asthma patients.

Keywords: aerobic exercise, asthma, asthma control, breathing exercise, lung function

Introduction

Asthma is a heterogeneous disease characterized by chronic inflammation of the respiratory tract.[1] Asthma has respiratory tract symptoms, such as coughing, wheezing, shortness of breath, and chest tightness that vary over time and in intensity. Asthma can be accompanied by variable expiratory airflow limitations.[1] Asthma cannot be cured but can be controlled by administering the right medication to optimize the patient's quality of life.[1] The World Health Organization (WHO) states that 235–250 million people globally are affected by asthma, with at least 4.3% coming from the adult population.[2]

Patients with exercise-induced asthma (EIA) are advised to avoid strenuous physical activity because it can trigger bronchospasm.[3] However, exercise such as aerobics can be beneficial for stable asthma, improve quality of life, and reduce the rate of asthma recurrence. Warm-up exercises are needed before doing exercises.[4,5] The Global Initiative for Asthma (GINA) also recommends physical exercise as a non-pharmacologic add-on therapy, in addition to a healthy diet, weight reduction, allergen avoidance, and smoking cessation.[1] Therefore, this study aimed to analyze types of exercise that could improve asthma control and lung function so that it can be a recommendation for stable asthma patients.

Clinical Question

A 45-year-old woman came to the pulmonary clinic with a record of previous hospitalization for moderate asthma exacerbation. She had a record of asthma since childhood and started using the salbutamol inhaler for shortness of breath without a doctor's prescription in 1998. She had a family record of asthma from her father's side. The patient had no record of smoking or allergies. Her shortness of breath is triggered by fatigue, dry air, coughs, and air pollution. The patient had had several visits to the Emergency Room due to asthma attacks since the beginning of 2023 and had been hospitalized once. She complained of shortness of breath almost every day and sometimes woke up at night due to shortness of breath.

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She was diagnosed with moderate persistent asthma. She received long-acting beta-agonists and medium-dose inhaled corticosteroids. She had used the medication regularly as recommended by the doctor but still complained of shortness of breath often. The patient temporarily did not want additional types of medication; thus, the doctor planned to provide add-on treatment in the form of exercise. Therefore, it is necessary to critically appraise the effect of exercise on improving asthma control and lung function. Can physical exercise improve asthma control and lung function in stable asthma patients?

Method

Search Strategy

A literature search was conducted on October 11, 2023, using PubMed, COCHRANE, and EMBASE databases, which offer access to either synthesized publication types or critically appraised and carefully selected references. The keywords used for the searching strategy were asthma, physical exercise, breathing exercise, asthma control, and lung function using boolean operators. All the articles in English were included. The search results were filtered to limit the literature to randomized control trials (RCTs) and systematic reviews published from 2018 to 2023.

The inclusion criteria for the literature search were systematic review and randomized control trial articles and asthma control and/or lung function test as the outcome. Meanwhile, for the exclusion criteria were exercise Induced Asthma (EIA), ≤15 years old population, asthma with other comorbids, and acute asthma. The article search strategy can be seen in Table 1 and Figure 1 in the Results section.

The search literature obtained 224 studies to be screened based on abstract titles. The screening aimed to assess duplications and appropriate the study design according to this study's Population–Intervention–Comparison-Outcome (PICO) framework. Full-text literature was assessed according to the eligibility criteria, resulting in four studies to be analyzed for validity, importance, and applicability. Lung function and asthma control questionnaires were measured to assess the impact of exercise. Forced expiratory volume at 1 second (FEV_1) and peak expiratory flow (PEF) were parameters of lung function measuring the obstructive degree of the airway.

Asthma control is a condition of a subject that can fluctuate over time, varying from normal conditions to exacerbation or worsening of symptoms. Asthma patients with poor asthma control had more frequent exacerbations that might impact their quality of life. The questionnaires used to assess asthma control were the Asthma Control Questionnaire (ACQ), Asthma Control Test (ACT), or Asthma Quality of Life Questionnaire (AQLQ).

Critical Appraisal Methods

Four studies were critically appraised. Critical appraisal used validity, importance, and applicability criteria based on the Oxford Critical Appraisal for three systematic review studies and one randomized control trial study. Those articles were critically appraised for assessment of the level of evidence on treatment benefits based on the 2011 Oxford Center for Evidence-Based Medicine (OCEBM) Level of Evidence.

Results

Four articles obtained from literature searching were: (1) A Systematic Review of the Effect of Physical Activity on Asthma Outcomes[6], (2) Effect of Aerobic Exercise Training on Asthma in Adults: A Systematic Review and Meta-Analysis[7], (3) Regular Exercise Improves Asthma Control in Adults: A Randomised Controlled Trial[8], (4) Breathing Exercise for Adults with Asthma.[9] The studies mentioned that physical exercise improves asthma control (using ACT, ACQ, AQLQ) and lung function tests (based on FEV_1). The physical exercises there were walking, running, jogging, spinning, treadmill running, muscle training, stretching, and breathing exercises such as yoga. They recommend that physical exercise be done in proper and gradual time, once to twice a week at minimum, with a 30-minute duration.

Kuder *et al*. (2021)[6] revealed that 10 studies using treadmill, swimming, cycling, walking and aerobic training significantly improved the ACQ score between groups. Hansen *et al*. (2020)[7] showed that 10 studies stated that using aerobic exercise reported significant improvement in FEV_1. Jaakkola *et al.* (2019)[8] showed that aerobic exercise, muscle training, and stretching on 105 subjects gave improvement in PEF and ACT. Stantino *et al.* (2020)[9] showed that breathing exercises included 22 studies that used yoga to improve ACT, ACQ, and FEV_1.

Table 2 shows the PICO characteristics and level of evidence from each study based on the 2011 OCEBM. Level 1 for RCT meta-analysis and level 2 for RCTs. Tables 3 to 5 show the critical appraisal results of three systematic review studies and one randomized control trial study using worksheets from the Oxford Critical Appraisal.

Table 1. Article Search Strategy

Database	Search Strategy	Finding	The Total of Article Used
PubMed	((asthma[MeSH Terms]) OR (asthma[Title/Abstract])) AND (((((((aerobic exercise[MeSH Terms]) OR (aerobic exercise[Title/Abstract])) OR (physical exercise[MeSH Terms])) OR (physical exercise[Title/Abstract])) OR (breathing exercises[MeSH Terms])) OR (breathing exercises[Title/Abstract])) OR (regular exercise[MeSH Terms])) OR (regular exercise[Title/Abstract])) AND ((y_5[Filter]) AND (randomizedcontrolledtrial[Filter] OR systematicreview[Filter]))	87	3
COCHRANE	ID Search Hits #1 MeSH descriptor: [Asthma] explode all trees 15046 #2 MeSH descriptor: [Exercise] explode all trees 38609 #3 MeSH descriptor: [Breathing Exercises] explode all trees 1190 #4 #2 OR #3 39596 #5 #1 AND #4 with Cochrane Library publication date Between Oct 2018 and Oct 2023 59	59	1
EMBASE	'asthma'/exp AND ('exercise'/exp OR 'breathing exercise'/exp OR 'aerobic exercise'/exp OR 'regular exercise'/exp OR 'physical exercise':ti,ab OR 'breathing exercise':ti, ab OR 'aerobic exer':ti,ab) AND ('lung function'/exp OR 'asthma control'/exp) AND ('systematic review'/exp OR 'randomized controlled trial'/exp) AND [2018-2023] /py	78	0

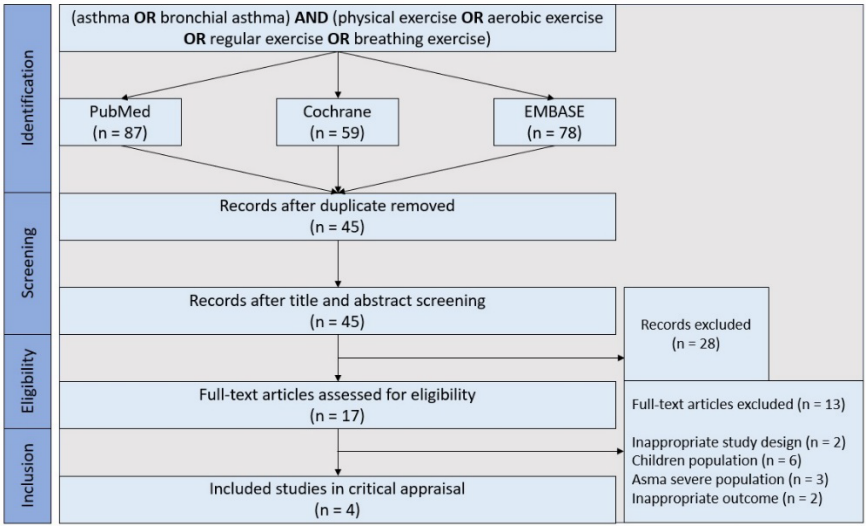

Figure 1. Search Strategy Flow According to PRISMA Guidelines

Table 4 shows the importance of each study. All studies found that exercise affected asthma control, which was measured by AQLQ, ACT, or ACQ. Three systematic review studies showed that exercise affected lung function, as measured by the FEV_1 parameter. The randomized control trial study by Jaakkola *et al.*[8] showed that exercise did not affect lung function as seen on PEF parameters. Jaakola *et al.*[8] measured the PEF of the control and intervention groups at three measurement points: baseline, three-month interval, and six-month interval. It did not show a significant mean difference (p-value = 0.35 in the morning and p-value = 1.47 in the afternoon).

Table 2. PICO Characteristics and Level of Evidence from the Literature

Authors	Study Design	P	I	C	O	Level of Evidence
Kuder *et al.* (2021)[6]	Systematic Review	Asthma in the population aged ≥18 years	Walking/running, aerobics. Frequency: 1-2x/week. Duration: 6 weeks–1 year	Control group (without exercise)	Physical exercise improves asthma control (ACQ), lung function (FEV_1), quality of life (AQLQ)	1
Hansen *et al.* (2020)[7]	Systematic Review	Asthma in the population aged 22-54 years with BMI 23.2-38.1 kg/m ^{2}	Aerobic exercise (walking, jogging, spinning, treadmill running). Duration: 8-12 weeks	Control group (without exercise)	Exercise improved ACQ and FEV_1	1
Jaakkola *et al.* (2019)[8]	Randomized Control Trial	Mild/moderate asthma in the population aged 16-65 years	Aerobic exercise, muscle training, stretching at least 3x/week, for ≥30 minutes	Control group (without exercise)	ACT increased; lung function (PEF) did not significantly increase	2
Santino *et al.* (2020)[9]	Systematic Reviews	Asthma in the population >18 years	Breathing exercise	Control group (without exercise)	ACT, ACQ, and FEV_1 improved	1

Notes: PICO = Population, Intervention, Comparison, and Outcomes, P = population, I = intervention, C = comparison, O = outcomes

Table 3. Critical Appraisal for Validity

Systematic Review Studies	Clearly implied research question	Missed relevant studies	Appropriate inclusion criteria	Valid included studies	Similar results between studies
Kuder *et al*. (2021)[6]	+	+	+	+	?
Hansen *et al*. (2020)[7]	+	+	+	+/-	-
Santino *et al*. (2020)[9]	+	+	+	+	+
Randomized Control Trial Study	**Randomized assignment of subjects**	**Similar baseline characteristics**	**Groups treated equally**	**All patients accounted for and analyzed**	**Blinding process**
Jaakkola *et al*. (2019)[8]	+	+	+	+	-

Table 4. Critical Appraisal for Importance

Literature	Treatment Effect size	Treatment Effect Precision
Kuder *et al*. (2021)[6]	20 included studies on lung function outcomes: – 5 studies had a significant effect – A study showed a positive but not significant effect – 14 studies had no significant effect 12 included studies on asthma control outcomes: – 7 studies had a significant effect – 5 studies had no significant effect	The confidence interval is not clearly stated Forest plots are not displayed
Hansen *et al.* (2020)[7]	There is a significant effect of aerobic exercise on asthma control and lung function, but not significant on airway inflammation – ACQ outcome group **Mean difference** -0.48 (-0.81 to -0.16) with P 0.004 – FEV_1 outcome group **Mean difference** -0.36 (-0.72 to 0.00) with P 0.05	A forest plot with 3 outcome groups is displayed. Two outcome groups had significant effects on asthma control and lung function – Asthma control outcome group CI -0.81 to -0.16 (narrow) – Pulmonary function outcome group CI -0.72 to 0.00 (narrow) – Airway inflammation outcome group CI -0.41 to 0.36 (narrow) A narrow Confidence Interval shows precision
Santino *et al*. (2020)[9]	– There is a significant effect of breathing exercise on AQLQ (up to 3 months) **Mean difference** 0.42 (CI 0.17 – 0.68) – There is a significant effect of breathing exercise on predicted FEV_1% **Mean difference** 6.88 (5.03 – 8.73) with P <0.0001	A forest plot is displayed, showing the CI for each outcome group The CI used is 95%, with a narrow CI range.
Jaakkola *et al*. (2019)[8]	– There is a significant effect of 6 months of exercise on ACT **Risk Difference (RD)** 0.233 (CI 0.027 – 0.438) with P 0.032 – There is no significant effect of 6 months of exercise on PEF (morning and evening) **Mean difference** 0.50 (-0.88 to 1.88) morning **Mean difference** 1.26 (-0.53 to 3.05) evening	The CI used is 95%, with a narrow CI range.

Table 5. Critical Appraisal for Applicability

Studies	Different patient characteristics compared to the study	Feasible treatment
Kuder *et al.* (2021)[6]	**No.** The research population in the study is in accordance with the age predilection of asthma patients in Indonesia, which starts in young adults. No comorbidities other than asthma.	– Swimming 2x/week for 6 months – Aerobic exercise (walking, running, stretching) at least 30 minutes per week for 8 weeks – Cycling, treadmill, 3x/week for 12 weeks
Hansen *et al*. (2020)[7]	**No.** The research population in the study is in accordance with the age predilection of asthma patients in Indonesia which starts in young adults. No comorbidities other than asthma	– Treadmill, breathing exercise 2x/week for 12 weeks – Indoor cycling 3x/week for 8 weeks – Aerobic exercise (walking, running, stretching) 2x/week for 3 months
Santino *et al*. (2020)[9]	**No.** In this review study, the research samples in each included study are explained. Of the 14 included studies, 8 included Indian (Asian) populations so they could be adapted to Indonesian characteristics. Research sample in each study > 18 years (starting from young adults)	– Yoga at least 60 minutes/day for 3-5 days
Jaakkola *et al*. (2019)[8]	**No.** In this study, the sample age was stated to be 16-65 years. Diagnosed with asthma without other comorbidities. Do not do other physical activities at least 3x/week	– Aerobic exercise (rapid walking, jogging, running, cycling) for at least 30 minutes 3x/week

Discussion

Four articles were obtained to conduct validity, importance, and applicability appraisal. The studies had lung function outcomes measured by FEV_1 and PEF. In contrast, asthma control was measured by the AQLQ, ACT, and ACQ questionnaires. The subjects had fulfilled the specified eligibility criteria. The intervention was physical exercise in the form of aerobic exercise (running, walking, cycling, swimming, treadmill) and breathing exercise (yoga).

The FEV_1 is the volume of air that can be exhaled from the lungs during maximum expiration in one second.[10] The FEV_1 value is measured for one second from the start of maximal exhalation after maximal inhalation. PEF is the maximal measure of the airflow rate that can be exhaled from the lungs with maximum expiration.[10] FEV_1 and PEF are not equivalent in determining the degree of airway obstruction, whether in COPD or asthma, so it is still necessary to measure those two parameters.[10] This causes routine physical exercise in Jaakola *et al.*[8] to have no significant effect on PEF. Another systematic review study stated that physical exercise affected FEV_1.[11]

A systematic review by Wu *et al.*[11] was excluded from this study because it involved a pediatric population (age ≤15 years). The study showed a significant effect of aerobic exercise on PEF (p-value = 0.000). The study analyzed the pool effect of six studies, four involving the pediatric population and two involving the adult population. The study showed that PEF would have a significant and dominant effect on the child population compared to the adult population.[11]

Based on the critical appraisal of the four studies, Kuder *et al.*[6] did not show a pooled effect analysis in the forest plot. The importance of the study could not be measured due to the absence of a forest plot. The study by Jaakkola *et al.*[8] was not excluded because it met the eligibility criteria and was not included in the three systematic reviews. The study showed that not all lung function parameters were affected by physical exercise. Hansen *et al.*[7] and Santino TA *et al.*[9] showed pooled effect analysis in forest plots for each outcome group so that the importance of these two studies could be measured significantly. Thus, three studies (Hansen *et al.,*[7] Jaakkola *et al.,*[8] and Santino *et al.*[9]) are recommended to be applied in clinical practice.

The recommendation is having physical exercise (by warming up first) in the form of aerobic exercise (running, walking, cycling, or swimming) for a minimum of 30 minutes two to three times per week 7.8 or yoga exercise for a minimum of 60 minutes per day for 3-5 days to improve lung function based on FEV_1 and asthma control based on ACT, ACQ, or AQLQ scores.

Conclusion

Physical exercise has a significant effect on lung function (FEV_1) and asthma control (ACQ, ACT, and AQLQ). The recommended physical exercise is aerobic exercise for at least 30 minutes two to three times a week or yoga exercise for at least 60 minutes per day for 3-5 days. The results of these three studies are feasible to apply in clinical practice scenarios.

Abbreviations

Embase: Excerpta Medica Database; OCEBM: Oxford Center for Evidence Based Medicine; EBCR: Evidence Based Case Report; RCT: Randomized Control Trial; EIR: Exercise Induced Asthma; ACQ: Asthma Control Questionnaire; AQLQ: Asthma Quality of Life Questionnaire; ACT: Asthma Control Test; FEV_1: Forced Expiratory Volume in 1 second; PEF: Peak Expiratory Flow

Ethics Approval and Consent to Participate

Not applicable

Competing Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The data supporting this study's findings are openly available in public repositories (PubMed, Cochrane, Embase) that issue datasets with DOIs (see the references).

Authors' Contribution

ARR and ATA conducted the data collection, wrote the manuscript, and reviewed each study for critical appraisal. TD commented on the manuscript, supervised the conducted data collection, and wrote the manuscript. All authors have read and approved the final version of the manuscript.

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References

1. Global Initiative for Asthma (GINA). 2023 GINA Main Report: Global strategy for asthma management and prevention. Fontana, WA: Global Initiative for Asthma (GINA); 2023.
2. World Health Organization. Fact sheet no 307: Asthma. Geneva: World Health Organization; 2024.
3. Jayasinghe H, Kopsaftis Z, Carson K. Asthma bronchiale dan exercise-induced bronchoconstriction. Respiration. 2015; 89 (6): 505-512. DOI: 10.1159/000433559.
4. Lang JE. The impact of exercise on asthma. Curr Open Allergy Clin Immunol. 2019; 19 (2): 118-125. DOI: 10.1097/ACI.0000000000000510.
5. Kippelen P, Anderson SD, Hallstrand TS. Mechanisms and biomarkers of exercise-induced bronchoconstriction. Immunol Allergy Clin North Am. 2018; 38 (2): 165-182. DOI: 10.1016/j.iac.2018.01.008.
6. Kuder MM, Clark M, Cooley C, et al. A systematic review of the effect of physical activity on asthma outcomes. J Allergy Clin Immunol Pract. 2021; 9: 3407-3421. DOI: 10.1016/j.jaip.2021.04.048.
7. Hansen ESH, Fabricus AP, Toennesen LL, et al. Effect of aerobic exercise training on asthma in adults: A systematic review and meta-analysis. Eur Respir J. 2020; 56 (1): 2000146. DOI: 10.1183/13993003.00146-2020.
8. Jaakkola JJK, Aalto SAM, Kiihamaki SP, et al. Regular exercise improves asthma control in adults: A randomized controlled trial. Sci Rep. 2019; 9 (1): 12088. DOI: 10.1038/s41598-019-48484-8.
9. Santino TA, Chaves GS, Freitas DA, et al. Breathing exercises for adults with asthma. Cochrane Database Syst Rev. 2020; 3 (3): CD001277. DOI: 10.1002/14651858.CD001277.
10. Pothirat C, Chaiwong W, Phetsuk N, et al. Peak expiratory flow rate as a surrogate for forced expiratory volume in 1 second in COPD severity classification in Thailand. Int J Chron Obstruct Pulmon Dis. 2015; 10: 1213-1218. DOI: 10.2147/COPD.S85166.
11. Wu X, Gao S, Lian Y. Effects of continuous aerobic exercise on lung function and quality of life with asthma: A systematic review and meta-analysis. J Thorac Dis. 2020; 12 (9): 4781-4795. DOI: 10.21037/jtd-19-2813.