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Asthma exercise and *Buteyko* breathing interventions in adolescents: Effects on fitness and exacerbation rates

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Abstract

Background: Asthma in adolescents is a global health challenge. Asthma management includes pharmacological and non-pharmacological approaches. Asthma exercises and Buteyko breathing techniques are non-pharmacological therapeutic alternatives. The lifestyle of adolescents who tend to be less physically active becomes a risk factor that increases the incidence and recurrence of asthma.
Purpose: To determine the effect of asthma exercises and Buteyko breathing techniques on physical fitness and recurrence in adolescent with asthma.
Method: A pre-experimental design with a one group pre-test post-test without control group approach. The sampling technique used total sampling with 33 participants. The statistical test used was the paired sample t-test.
Results: The findings revealed a significant effect of the intervention on both physical fitness and asthma recurrence, with a p-value of 0.001. The combination of asthma exercises and Buteyko breathing techniques proved effective in enhancing physical fitness and reducing the frequency of asthma attacks among adolescents.
Conclusion: Asthma exercises and Buteyko breathing techniques significantly improve physical fitness and reduce asthma recurrence in adolescents.
Suggestion: Schools should integrate these interventions into health programs. Further research with control groups is recommended.

Keywords: Adolescents; Asthma Gymnastics; Buteyko; Fitness; Relapse.

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INTRODUCTION

Asthma is a chronic inflammatory condition of the airways, characterized by recurring symptoms such as wheezing, shortness of breath, chest tightness, and coughing particularly at night or early morning (Global Initiative for Asthma, 2023). This condition involves bronchial hyperresponsiveness and reversible airway obstruction, resulting from complex interactions among inflammatory cells, mediators, and structural cells of the airways. These mechanisms lead to mucosal swelling, increased mucus production, and airway narrowing, producing varying clinical manifestations across individuals (National Heart, Lung, and Blood Institute, 2020; Venkatesan, 2023).

Globally, asthma poses a major public health challenge. The Forum of International Respiratory Societies (FIRS) reported in 2021 that asthma affects approximately 235 million people worldwide, ranking it among the five most prevalent lung diseases (Levine & Marciniuk, 2022). The Global Asthma Network (GAN) highlighted a prevalence rate of 11% among children aged 6–7 years and 9.1% among adolescents aged 13–14 years (Reddel, Bacharier, Bateman, Brightling, Brusselle, Buhl, & Boulet, 2022). Despite variations in prevalence across countries (ranging from 1–29%), the burden is disproportionately borne by low- and middle-income nations, which account for 96% of asthma-related deaths and 84% of global disability-adjusted life years due to asthma (Meghji, Mortimer, Agusti, Allwood, Asher, Bateman, & Marks, 2021; World Health Organization, 2023).

In adolescents, asthma significantly affects both physical and psychosocial well-being. Around 34.27% of adolescent asthma patients experience limitations in physical activity, such as dyspnea and reduced exercise capacity (Lochte, Nielsen, Petersen, & Platts-Mills, 2016). Poorly controlled asthma is associated with increased use of emergency healthcare services—up to 3.27 times higher—and contributes to academic underachievement due to increased school absenteeism (Mitchell, Beasley, Keil, Montefort, & Odhiambo, 2012; Dharmage, Perret, & Custovic, 2019; Hsu, Qin, Beavers, & Mirabelli, 2016; Dharmage, Perret, & Custovic, 2019). Psychological issues such as anxiety are also more common, with asthma patients showing anxiety rates 7.4% higher than their peers without asthma (Dudeney, Sharpe, Jaffe, Jones, & Hunt, 2017). Additionally, impaired sleep quality is prevalent, with 83.57% of asthma patients showing poor Pittsburgh Sleep Quality Index (PSQI) scores compared to control groups (Ali, Thomsen, Ulrik, & Genuneit, 2021).

This situation is particularly alarming in Indonesia, where adolescent physical fitness is critically low. The data revealed that 77.12% of adolescents aged 10–15 years fall into the poor or very poor fitness category, while only 6.79% are classified as having good or excellent fitness. Among older youth (aged 16–30), 83.53% are also in the poor fitness range (Ministry of Youth and Sports of the Republic of Indonesia, 2023). These figures are concerning given that physical fitness is essential for building a healthy and productive generation, particularly in the context of Indonesia's vision for "Golden Indonesia 2045." Adolescents with asthma are especially vulnerable and require targeted interventions to improve their physical fitness and health outcomes.

Non-pharmacological strategies play an important role in asthma management, particularly in adolescents. These include physical activity programs and breathing techniques, in addition to patient education, asthma action plans, and self-monitoring (Tong, Zhang, Wang, Wang, Dong, Gong, & Li, 2024). Asthma-specific exercises have been shown to improve cardiorespiratory fitness and quality of life (Hansen, Henriksen, Dall, Vest, Larsen, Suppli Ulrik, & Backer, 2022; Ministry of Health of the Republic of Indonesia, 2022). Improvements in lung function indicators such as peak expiratory flow (PEF) and forced expiratory volume in one second (FEV1) have been reported (Puspitosari & Herawati, 2020), and reduced exacerbation frequency has been observed following structured exercise interventions (Kustiono & Mukarromah, 2019). WHO recommends daily physical activity of at least 60 minutes with moderate to vigorous intensity to support adolescent respiratory and overall health development (The World Health Organization, 2021).

Complementing physical exercise, Buteyko breathing techniques aim to normalize respiratory patterns and reduce hyperventilation by encouraging shallow, nasal breathing. This method has been shown to improve pulmonary function and reduce

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asthma symptoms and attack frequency (Huidrom, Shiroor, & Ray, 2016; Wijaya, Mertha, & Rasdini, 2020; Lazulfa, 2022). Buteyko breathing can also decrease reliance on rescue medications and improve breathing efficiency (Santino, Chaves, Freitas, Fregonezi, & Mendonça, 2020; Bhuvaneshwari, Maheshwari, & Sudhanya, 2022). When combined with pulmonary rehabilitation, such breathing techniques significantly enhance quality of life and lung function in asthma patients (Udayani, Amin, & Makhfudli, 2020).

According to Roy's Adaptation Model, asthma acts as a focal stimulus affecting the physiological-physical mode. This necessitates the enhancement of adaptation mechanisms through both regulator processes, addressed by physical training, and cognator processes, targeted by breathing interventions (Alligood, 2018). The combination of asthma exercises and Buteyko techniques is expected to promote optimal adaptation by improving both respiratory function and physical fitness. While asthma exercises enhance cardiovascular and muscular endurance, Buteyko techniques work on a deeper physiological level to regulate breathing, reduce bronchial reactivity, and stabilize the airways.

RESEARCH METHOD

A pre-experimental one-group pre-test–post-test design, without the inclusion of a control group. The total sampling technique was used, involving all 33 eligible adolescent participants. The study was conducted at Bina Medika Vocational School, East Jakarta over a period of six weeks, with statistical analysis performed using the paired sample t-test.

Pre- and post-intervention assessments consisted of the Asthma Control Test (ACT) questionnaire and pulse rate measurements. The intervention included a combination of asthma-specific exercises and Buteyko breathing techniques, administered five times per week for six consecutive weeks. All procedures and assessments were conducted by trained researchers following standardized protocols.

Inclusion criteria were adolescents aged 15–18 years, with an asthma screening score of ≥5 based on the Ministry of Health guidelines (Ministry of Health of the Republic of Indonesia, 2017), medically fit for physical activity, able to commit to the full intervention period, and willing to provide informed consent. Exclusion criteria included the presence of other medical conditions such as cardiac disease or severe musculoskeletal disorders.

The independent variable was the combined asthma exercise and Buteyko breathing intervention, measured on a nominal scale. The dependent variables included: Physical fitness, assessed via heart rate recovery, calculated as the difference between heart rate immediately after asthma exercises (pre-intervention) and one minute after performing Buteyko breathing (post-intervention).

Heart rate recovery was categorized using NASM criteria: Score 5: Excellent (decrease > 20 bpm); Score 4: Good (decrease 12–19 bpm); Score 3: Fair (decrease 9–11 bpm); Score 2: Poor (decrease 6–8 bpm); Score 1: Very Poor (decrease < 6 bpm) (National Academy of Sports Medicine, 2024). Asthma exacerbation, measured using the ACT questionnaire, with scores ranging from 5 to 25 and categorized as follows: Uncontrolled: ≤15; Partially controlled: 16–19; Well-controlled: 20–24; Fully controlled: 25.

The intervention sessions lasted 20–30 minutes per session, five times weekly for six weeks. Each session included: Warm-up phase (5 minutes): Neck and shoulder stretches; Core training (15–20 minutes): Diaphragmatic breathing and low-impact aerobic exercises at 50–70% of maximum heart rate; Cool-down (5–10 minutes). This was followed by 10 minutes of Buteyko breathing techniques, consisting of nasal breathing, controlled breath-holding using Control Pause and Maximum Pause, and shallow breathing methods aimed at reducing respiratory rate and volume to improve lung function and asthma management.

This study was approved by the Ethics Committee, under approval number: 0146/F.9-UMJ/X/2024.

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RESEARCH RESULTS

Table Characteristics of the Participants (N=33)

Variable	Results	(Mean±SD)	p-value
Age (Year) (n/%)		(16.88±0.857)	
15	2/6.1		
16	8/24.2		
17	15/45.5		
18	8/24.2		
Gender (n/%)			
Female	30/90.9		
Male	3/9.1		
BMI (n/%)			
Underweight	4/12.1		
Normal Weight	24/72.7		
Overweight	5/15.2		
Exacerbations before intervention (n/%)		(15.64±1.950)	.001
Uncontrolled Asthma	15/45.5		
Partially Controlled Asthma	18/54.5		
Well-Controlled Asthma	0/0		
Exacerbations after intervention (n/%)		(19.48±2.895)	.001
Uncontrolled Asthma	1/3.0		
Partially Controlled Asthma	16/48.5		
Well-Controlled Asthma	16/48.5		
Fitness before intervention (n/%)		(4.42±2.180)	.001
Poor	25/75.8		
Fair	0/0		
Below Average	8/24.2		
Good	0/0		
Excellent	0/0		
Fitness after intervention (n/%)		(13.73±3.412)	.001
Poor	1/3.0		
Fair	7/21.2		
Below Average	0/0		
Good	23/69.7		
Excellent	2/6.1		

Table above presents the characteristics of the 33 participants involved in the study. The average age was 16.88 years with a standard deviation of 0.857. The majority were 17 years old, accounting for 45.5% of the sample. Female participants predominated, comprising 90.9% of the participants. Regarding body mass index (BMI), 72.7% fell within the normal weight range.

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Prior to the intervention, 54.5% of participants were categorized as having Partially Controlled Asthma. Following the intervention, the proportions of both Partially Controlled Asthma and Well-Controlled Asthma were equal, each at 48.5%. In terms of physical fitness, before the intervention, the majority (75.8%) were in the poor category. However, post-intervention results showed an improvement, with 69.7% classified in the good fitness category.

The mean difference in asthma exacerbation levels was 15.64 ± 1.950 before intervention, becoming 19.48 ± 2.895 after intervention. The mean difference in physical fitness levels was 4.42 ± 2.180 before intervention, becoming 13.73 ± 3.412 after intervention. Statistical test results using Paired Samples t-Test obtained p-value = 0.001 (p-value < 0.05)

DISCUSSION

The research findings on the demographic data indicates that the majority of participants were in late adolescence, which aligns with the target population of vocational high school students. The relatively small standard deviation (0.857) indicates that the age distribution of participants was fairly homogeneous and centered around the mean value, with minimal age variation.

Several previous studies have demonstrated the effectiveness of interventions across various age groups; Successful asthma exercises in participants aged 17-35 years (Permatasari, 2018), the benefits of Buteyko breathing techniques in the 12-16 age group (Qorahman, Ningtyas, & Mauk, 2023). The highest results was gained in the 15-49 age range, showing increased muscle strength scores (PEF) after asthma exercise intervention (Astuti, Daro, & Fauzi, 2024), and significant effects of Buteyko breathing exercises were found on Peak Expiratory Flow (PEF) in the 15-24 age range (Prastyanto, & Kushartanti, 2016).

The age characteristics in this study are highly relevant to asthma exercise and Buteyko breathing technique interventions because during adolescence (15-18 years), the respiratory system is still in optimal development stage, thus providing maximum benefits. This aligns with theory explaining that adolescent lung capacity and function experience substantial increases, with tidal volume and vital capacity progressively increasing, with peak growth occurring at ages 14-16 years for female adolescents and 16-18 years for male adolescents (Lynch, Moore, Wilson, Nevrekar, Jennermann, & Humphries, 2018). Pulmonary function in children increases in volume, reaching maximum state at ages 19-21 years (Herring et al., 2014).

Therefore, the age range of participants in this study is within the optimal period where the respiratory system can still develop and adapt well to the given interventions. This study takes an innovative approach by combining both interventions in vocational high school adolescents, which differs from previous studies that only performed single interventions, thus expected to provide more optimal benefits in asthma management and physical fitness improvement in the adolescent population.

The research findings on the gender show significant asthma prevalence among female adolescents. Consistent with several previous studies, one study found 13 participants (81.2%) were female with asthma, more than males numbering 3 individuals (18.8%) (Astuti et al., 2024), while another study found 13 females (50.1%) experiencing asthma and 9 males (40.9%) (Loriana, 2018). Lastly another study showed that asthma patients by gender at Sultan Immanudin Hospital Pangkalan Bun were 13 males (43.3%) and 17 females (56.7%) (Qorahman et al, 2023). Almost all studies and reports found similar results (Udayani et al., 2020; Loriana, 2018; (Chowdhury, Guntur, Newcomb, & Wechsler, 2021; Fuseini, & Newcomb, 2017; Zein & Erzurum, 2015), indicating that the highest prevalence of asthma patients were female. The National Institutes of Health survey also showed asthma prevalence in adolescents aged 15-19 years, with males at 9.8% and females at 10.2% (Centers for Disease Control and Prevention, 2016).

The high asthma prevalence in females can be explained through various biological and anatomical factors. This may be caused by the effects of female sex hormones on lung cells, where hormonal changes during puberty, menstruation, pregnancy, and menopause can affect airway function (LoMauro & Aliverti, 2018). Up to 30-40% of women with asthma report worsening asthma symptoms at certain times in their menstrual cycle. Women also have narrower airways, which can increase susceptibility to airflow obstruction and asthma

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symptoms. Women have smaller lung size and lower breathing capacity compared to men, with all lung parts including alveoli, bronchioles, and trachea having smaller dimensions (Lynch et al., 2021). Male lung function is 20%-25% higher than females due to larger anatomical lung size in males, besides higher male activity making lung recoil and compliance already (Hall & Hall, 2020).

The research findings on the body mass index show that most participants in this study were in the normal category, indicating conditions supporting better asthma control. These results align with a research showing a relationship between Western dietary patterns and doctor-confirmed asthma prevalence, with adjustments for variables including BMI (Emrani, Sasanfar, Jowshan, Behniafard, Nafei, & Salehi-Abargouei, 2024).

The normal BMI condition in the majority of participants differs from various studies showing significant correlation between body mass index (BMI) and asthma incidence, where in children and adolescents with excess BMI, asthma risk tends to increase due to higher systemic inflammation, respiratory function impairment, and increased airway resistance (Fang, Jiang, Su, & Fan, 2025).

European research shows that obesity and certain dietary patterns can increase asthma and rhinoconjunctivitis risk (Stern, Pier, & Litonjua, 2020), while other studies link high BMI with asthma symptoms and wheeze in children (Garcia-Larsen, Del Giacco, Moreira, Bonini, Haahtela, Bonini, & Delgado, 2016).

Asthma is more difficult to control in obese patients due to increased adipokines (Global Initiative for Asthma, 2023). In this study, almost all participants had BMI values in the normal category where adipokine increase did not occur, making asthma easier to control. The optimal BMI condition in the majority of participants provides advantages in implementing asthma exercise and Buteyko breathing technique interventions, as there are no obesity factors that could hinder the effectiveness of breathing exercises and physical activities performed during the study.

Based on research findings regarding asthma exacerbations, initial conditions showed 15 participants (45.5%) experiencing uncontrolled asthma and 18 participants (54.5%) experiencing partially controlled asthma. After intervention, 1 respondent (3.0%) still experienced uncontrolled asthma, while 16 participants (48.5%) achieved partially controlled asthma and another 16 participants (48.5%) successfully achieved well-controlled asthma.

The Wilcoxon test results showed values in group 1 asthma exercise and Buteyko breathing technique intervention of 0.000<0.05, proving significant differences in values before and after intervention, similarly in group 2 asthma exercise intervention with a value of 0.001<0.05 showing significant differences before and after intervention. Mann Whitney-U test results showed statistical value 0.001<0.05, indicating significant differences between groups 1 and 2 in exacerbation frequency results, with mean values showing group 1 had higher average than group 2, indicating greater value changes in group 1 than group 2.

The combination intervention of asthma exercises and Buteyko breathing techniques provides maximum results for exacerbations and physical fitness because both interventions work through complementary mechanisms producing synergistic effects. Asthma exercises focus on strengthening the cardiorespiratory system through structured physical training that increases respiratory muscle strength, vital lung capacity, and overall cardiovascular fitness (Permatasari, 2018). Conversely, Buteyko breathing techniques work at a more fundamental physiological level by optimizing breathing patterns, reducing hyperventilation, and increasing blood CO2 levels that help stabilize airways and reduce bronchial reactivity (Qorahman et al., 2023).

Based on paired samples t-Test results, the mean difference in asthma exacerbation levels was 15.64 ± 1.950 before intervention, becoming 19.48 ± 2.895 after intervention. The mean difference in physical fitness levels was 4.42 ± 2.180 before intervention, becoming 13.73 ± 3.412 after intervention. Statistical test results using paired samples t-Test obtained p-value = 0.001 (p-value < 0.05), indicating statistically significant effects of asthma exercises and Buteyko breathing techniques on exacerbation levels and physical fitness. This aligns with research showing Wilcoxon test values in group 1 of 0.000<0.05 and group 2 of 0.001<0.05, with Mann Whitney-U test results of 0.001<0.05 with group 1 mean of 1.55 and group 2 mean of 1.77.

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Group 1 asthma exercise combined with Buteyko breathing techniques was assessed as more effective in reducing exacerbation frequency than group 2 with asthma exercises alone (Loriana, 2018).

Asthma exercises help increase exercise tolerance, improve pulmonary function, and reduce physical deconditioning often experienced by asthma patients due to activity limitations (Ciptarini, 2015). Meanwhile, Buteyko techniques address inefficient breathing patterns and hyperventilation that can trigger asthma attacks (Udayani et al., 2020). The combination approach shows consistent respiratory improvement patterns with increases in various. physiological parameters such as peak expiratory flow, oxygen saturation, respiratory rate, and pulse rate. Improved asthma control enables increased physical activity, thereby enhancing physical fitness and strengthening the respiratory system.

CONCLUSION

The findings indicate that the combination of asthma exercises and Buteyko breathing techniques significantly improved both physical fitness levels and the proportion of participants achieving good fitness. Asthma control also showed notable enhancement, suggesting the intervention is effective in increasing physical fitness and reducing asthma exacerbations in adolescents.

LIMITATIONS

In this study, researchers did not analyze participants' medication adherence for asthma controller therapy, the specific types of asthma medications used, and the duration of asthma medication treatment. Additionally, the study did not control for environmental factors such as air quality, allergen exposure, and seasonal variations that could influence asthma symptoms and physical fitness outcomes. The pre-experimental design without a control group limits the ability to establish causal relationships and control for confounding variables that may have influenced the results.

SUGGESTION

This study may serve as a valuable reference for future research exploring the effects of asthma exercises and Buteyko breathing techniques on physical fitness and asthma control in adolescents with asthma. Subsequent studies are encouraged to employ randomized controlled trial designs with larger sample sizes and extended follow-up durations to enhance the validity and generalizability of evidence supporting these non-pharmacological interventions in adolescent asthma care.

REFERENCES

Ali, Z., Thomsen, S. F., Ulrik, C. S., & Genuneit, J. (2021). Predictors of atopic disease in children of women with asthma. *Pediatric Allergy & Immunology*, *32*(6).

Alligood, M. R. (2018). *Models and theories in nursing*. Elsevier Health Sciences.

Astuti, L. W., Daro, Y. A., & Fauzi, M. (2024). Pengaruh Senam Asma Terhadap Peningkatan Fungsi Paru pada Pasien Asma di Seketeng. *Jurnal Kesehatan Samawa*, *9*(1), 43-48.

Bhuvaneshwari, G., Maheshwari, R., & Sudhanya, T. (2022). The Effectiveness of Buteyko Breathing Technique on Respiratory Physiological Parameters among Patients with Bronchial Asthma. *Journal of Chengdu University of Technology, 26*(9). Retrieved from: https://www.researchgate.net/publication/358354616_THE_EFFECTIVENESS_OF_BUTEYKO_BREATHING_TECHNIQUE_ON_RESPIRATORY_PHYSIOLOGICAL_PARAMETERS_AMONG_PATIENTS_WITH_BRONCHIAL_ASTHMA

Centers for Disease Control and Prevention. (2016). *National health interview survey: Asthma prevalence among adolescents*. CDC National Center for Health Statistics. Retrieved from: https://www.cdc.gov/asthma/nhis/default.htm

Chowdhury, N. U., Guntur, V. P., Newcomb, D. C., & Wechsler, M. E. (2021). Sex and gender in asthma. *European Respiratory Review*, *30*(162).

Ciptarini, S. T. (2015). *Pengaruh Senam Asma Indonesia Terhadap Frekuensi Kekambuhan Asma pada Penderita Asma di Balai Kesehatan Paru Masyarakat (BKPM) Semarang (Doctoral dissertation*, UNIMUS).

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DOI: https://doi.org/10.33024/minh.v8i8.1376

Dharmage, S. C., Perret, J. L., & Custovic, A. (2019). Epidemiology of asthma in children and adults. *Frontiers in pediatrics*, *7*, 246.

Dudeney, J., Sharpe, L., Jaffe, A., Jones, E. B., & Hunt, C. (2017). Anxiety in youth with asthma: A meta-analysis. *Pediatric pulmonology*, *52*(9), 1121-1129.

Emrani, A. S., Sasanfar, B., Jowshan, M. R., Behniafard, N., Nafei, Z., & Salehi-Abargouei, A. (2024). Association between a western diet and asthma among children and adolescents. *Scientific Reports*, *14*(1), 13240.

Fang, C., Jiang, Z., Su, X., & Fan, W. (2025). The association between body mass index and asthma in children: a cross-sectional study from NHANES 1999 to 2020. *Scientific Reports*, *15*(1), 9448.

Fuseini, H., & Newcomb, D. C. (2017). Mechanisms driving gender differences in asthma. *Current allergy and asthma reports*, *17*(3), 19.

Garcia-Larsen, V., Del Giacco, S. R., Moreira, A., Bonini, M., Haahtela, T., Bonini, S., & Delgado, L. (2016). Dietary intake and risk of asthma in children and adults: protocol for a systematic review and meta-analysis. *Clinical and translational allergy*, *6*(1), 17.

Global Initiative for Asthma. (2023). *Global strategy for asthma management and prevention*. Global Initiative for Asthma. Retrrieved from: https://ginasthma.org/2023-gina-main-report/

Hall, J. E., & Hall, M. E. (2020). *Guyton and Hall Textbook of Medical Physiology E-Book: Guyton and Hall Textbook of Medical Physiology E-Book*. Elsevier Health Sciences.

Hansen, N. B., Henriksen, M., Dall, C. H., Vest, S., Larsen, L., Suppli Ulrik, C., & Backer, V. (2022). Physical activity, physical capacity and sedentary behavior among asthma patients. *European Clinical Respiratory Journal*, *9*(1), 2101599.

Herring, J. A. (2014). *Tachdjian's pediatric orthopaedics: From the Texas Scottish Rite Hospital for Children* (5th ed.). Elsevier Health Sciences.

Huidrom, K., Shiroor, G., & Ray, S. P. (2016). Effectiveness of buteyko breathing technique on respiratory physiological parameters among patients with bronchial asthma. *International journal of recent scientific research*, *7*(5), 11328-11331.

Hsu, J., Qin, X., Beavers, S. F., & Mirabelli, M. C. (2016). Asthma-related school absenteeism, morbidity, and modifiable factors. *American journal of preventive medicine*, *51*(1), 23-32.

Kustiono, A. D., & Mukarromah, S. B. (2019). Pengaruh Senam Asma Terhadap Frekuensi Kekambuhan Dan Kapasitas Vital Paru Pada Penderita Asma Di Balai Kesehatan Paru Masyarakat Semarang. *Journal of Sport Science and Fitness*, *5*(2), 106-110.

Lazulfa, I. H. (2022). *Pengaruh teknik pernapasan Buteyko pada pasien asma bronkial*. *Literatur Review*. Stikes Ahmad Dahlan Cirebon. Retrieved from: https://www.scribd.com/document/657975947/121298316

Levine, S. M., & Marciniuk, D. D. (2022). Global impact of respiratory disease: what can we do, together, to make a difference?. *Chest*, *161*(5), 1153-1154.

Lochte, L., Nielsen, K. G., Petersen, P. E., & Platts-Mills, T. A. (2016). Childhood asthma and physical activity: a systematic review with meta-analysis and Graphic Appraisal Tool for Epidemiology assessment. *BMC pediatrics*, *16*(1), 50.

LoMauro, A., & Aliverti, A. (2018). Sex differences in respiratory function. *Breathe*, *14*(2), 131-140.

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Corresponding author: *E-mail: dayang_laily@yahoo.co.id

DOI: https://doi.org/10.33024/minh.v8i8.1376

Loriana, R. (2018). Kombinasi latihan senam asma disertai teknik pernapasan buteyko efektif menurunkan kekambuhan asma. *Jurnal Citra keperawatan*, *6*(2), 67-70.

Lynch, D. A., Moore, C. M., Wilson, C., Nevrekar, D., Jennermann, T., & Humphries, S. M. (2018). CT-based visual classification of emphysema: association with mortality in the COPDGene study. *Radiology*, *288*(3), 859-866.

Meghji, J., Mortimer, K., Agusti, A., Allwood, B. W., Asher, I., Bateman, E. D., & Marks, G. B. (2021). Improving lung health in low-income and middle-income countries: from challenges to solutions. *The Lancet*, *397*(10277), 928-940.

Ministry of Health of the Republic of Indonesia. (2017). Peraturan Menteri Kesehatan Nomor 51 Tahun 2017 tentang Pedoman Penilaian Teknologi Kesehatan (*Health Technology Assessment*) Dalam Program Jaminan Kesehatan Nasional. Retrieved from: https://peraturan.bpk.go.id/Details/112154/permenkes-no-51-tahun-2017

Ministry of Health of the Republic of Indonesia. (2022). Senam asma untuk meningkatkan fungsi paru penderita asma. *Direktorat Jenderal Pelayanan Kesehatan*. https://yankes.kemkes.go.id/view_artikel/1456/senam-asma-untuk-meningkatkan-fungsi-paru-penderita-asma

Ministry of Youth and Sport of the Republic of Indonesia. (2023). *Kebugaran jasmani dan generasi emas 2045: Laporan Indeks Pembangunan Olah Raga Tahun 2023*. Asisten Deputi Olahraga Masyarakat Deputi Pembudayaan Olahraga. Retrieved from: https://img-deputi2.kemenpora.go.id/files/document_file/2024/06/25/34/1143laporan-nasional-sport-development-index-tahun-2023.pdf

Mitchell, E. A., Beasley, R., Keil, U., Montefort, S., & Odhiambo. (2012). The association between tobacco and the risk of asthma, rhinoconjunctivitis and eczema in children and adolescents: analyses from Phase Three of the ISAAC programme. *Thorax*, *67*(11), 941-949.

National Academy of Sports Medicine. (2024). *NASM essentials of personal fitness training* (6th ed.). Retrieved from: https://ebook.app.hcu.edu.gh/wp-content/uploads/2024/09/National-Academy-of-Sports-Medicine-NASM-NASM-Essentials-of-Personal-Fitness-Training-6th-Edition-2017-_Jones-Bartlett-Learning-libgen.li_.pdf

National Heart, Lung, and Blood Institute. (2020). Asthma Management Guidelines: Focused Updates 2020. Retrieved from: https://www.nhlbi.nih.gov/health-topics/asthma-management-guidelines-2020-updates.

Permatasari, V. D. (2018). Pengaruh Senam Asma Terhadap Fungsi Paru (KVP & FEV1) pada Wanita Asma di Balai Kesehatan Paru Masyarakat (BKPM) Semarang. *Jurnal Kesehatan Masyarakat Indonesia*, *10*(2), 65-80.

Prastyanto, D., & Kushartanti, W. (2016). Pengaruh Latihan Pernapasan Buteyko Terhadap Arus Puncak Ekspirasi (Ape) Pada Penderita Asma. *Universitas Negeri Yogyakarta*.

Puspitosari, D. P., & Herawati, I. (2020). *Pengaruh Senam Asma Terhadap Peningkatan Arus Puncak Ekspirasi (APE) dan Peningkatan Kualitas Hidup pada Komunitas Madupahat di Balkesmas Wilayah Semarang* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

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Qorahman, W., Ningtyas, N. W. R. & Mauk, C. E., (2023). Pengaruh Teknik Pernapasan Buteyko Terhadap Frekuensi Kekambuhan Pasien Asma di RSUD Sultan Immanudin Pangkalan Bun Kotawaringin Barat Kalimantan Tengah. *Jurnal Borneo Cendekia, 7*(1,), 112-120.

Reddel, H. K., Bacharier, L. B., Bateman, E. D., Brightling, C. E., Brusselle, G. G., Buhl, R., ... & Boulet, L. P. (2022). Global Initiative for Asthma Strategy 2021: executive summary and rationale for key changes. *American journal of respiratory and critical care medicine*, *205*(1), 17-35.

Santino, T. A., Chaves, G. S., Freitas, D. A., Fregonezi, G. A., & Mendonça, K. M. (2020). Breathing exercises for adults with asthma. *Cochrane Database of Systematic Reviews*, (3).

Stern, J., Pier, J., & Litonjua, A. A. (2020, February). Asthma epidemiology and risk factors. In *Seminars in immunopathology* (Vol. 42, No. 1, pp. 5-15). Berlin/Heidelberg: Springer Berlin Heidelberg.

Tong, X., Zhang, X., Wang, M., Wang, Z., Dong, F., Gong, E., & Li, Y. (2024). Non-pharmacological interventions for asthma prevention and management across the life course: Umbrella review. *Clinical and translational allergy*, *14*(3), e12344.

Udayani, W., Amin, M., & Makhfudli, M. (2020). The Effect of Combination of Buteyko Breathing Technique And Walking Exercise on Asthma Control in Adult Asthmatic Patients. *Jurnal Ilmiah Keperawatan (Scientific Journal of Nursing)*, *6*(1), 6-12.

Venkatesan, P. (2023). 2023 GINA report for asthma. *The Lancet Respiratory Medicine*, *11*(7), 589. Retrived from: https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(23)00230-8/abstract

Wijaya, I. K. A., Mertha, I. M., & Rasdini, I. G. A. A. (2020). Teknik Pernapasan Buteyko dan Arus Puncak Ekspirasi pada Pasien Asma. *Jurnal Gema Keperawatan*, *13*(2), 111-119.

World Health Organization. (2021). WHO guidelines on physical activity and sedentary behaviour. Retrieved from: https://www.who.int/publications/i/item/9789240015128

World Health Organization. (2023). Asthma fact sheet. World Health Organization. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/asthma

Zein, J. G., & Erzurum, S. C. (2015). Asthma is different in women. *Current allergy and asthma reports*, *15*(6), 28.

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