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Buteyko Breathing Techniques and Asthma Gymnastics on Improving Oxygen Saturation and Eosynophile Levels among Asma Patients

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Abstract Asthma is a chronic disease of the respiratory system that causes respiratory symptoms, such as wheezing, shortness of breath, and coughing. One non-pharmacological therapy could increase oxygen saturation and eosinophil levels and prevent recurrence independently using the Buteyko breathing technique and asthma gymnastics. This study aimed to examine the Buteyko breathing technique and asthma gymnastics' effect on improving the oxygen saturation values and eosinophil levels. A quasi-experiment study, pre-test – post-test with non-equivalent control group was applied in this study. We involved the 36 asthma patients that were selected through a purposive sampling method. We also divided into three groups, namely 12 respondents in intervention group 1 who received the Buteyko breathing technique treatment. Twelve respondents in the second intervention group received the Buteyko breathing technique and asthma gymnastics, and the control group received only asthma gymnastics. Measurements of oxygen saturation and eosinophil levels were carried out on the 1th, 7th, to 14th day with three measures. Then the data were analyzed using the General Linear Model (GLM) test. Repeated ANOVA test showed a difference in the mean value of oxygen saturation (spo2) and eosinophil levels with a value of p = 0.000. It was indicated that there was a significant difference between the intervention group 2 (Buteyko and asthma gymnastics) compared to intervention group 1 (Buteyko breathing technique) and the control group (asthma exercise). The highest reduction of eosinophil levels was in intervention group 2 -21.66, followed by the control group that is -18.67. The smallest decline in eosinophil value was in intervention group 1 at -7.66. Research conclusions Buteyko breathing technique and asthma gymnastics effectiveness on value improvements oxygen saturation and eosinophil levels.

Keywords: buteyko breathing, oxygen saturation, eosinophil levels, asthma.

Introduction

The health aspect was a form of achievement of the SDGs millennium. It discussed the contamination and pollution in the air, water, and soil. Air contamination is a new concern for the SDGs because it can be a factor in causing respiratory problems, including various health problems, one of which is causing asthma (1).

Asthma is a chronic disease of the respiratory system that often occurs in society and sometimes burdens patients and families. Asthma causes respiratory problems, limitation of activities in sufferers, and attacks that often require immediate treatment and are likely to be fatal to sufferers if not treated immediately. Asthma is defined as disturbances in the bronchial tubes characterized by spastic contractions in the respiratory tract. The bronchi experience hyper-responsive inflammation causes constriction in the respiratory tract, resulting in repeated episodes with symptoms of wheezing, tightness, and coughing, especially in the morning and evening (2).

The incidence of asthma continues to experience rapid development at this time. Asthma is a health problem that occurs not only in high-income countries but also in all countries. Most of the asthma mortality rate occurs in low and middle to low-income countries. World Health Organization (WHO), in collaboration with the Global Initiative Of Asthma (GINA), reported that people living with asthma were 300 million in 2018 and increased to be around 400 million in 2025. Currently, the prevalence in all parts of the world is approximately 339 million. people where as many as 420 thousand people died of asthma and if on average more than 100 people per day (2, 3).

From the 2018 primary health research data, the prevalence rate of asthma for all ages reached 2.4% (1,017,290 people), with the highest number of sufferers being women 2.5% and men 2.3%. The prevalence of asthma in West Kalimantan Province is 3.2% of the average number in Indonesia of 4.5% (4). According to the characteristics, the majority of asthma increases with age (4).

Asthma has three risk factors which are divided into three major domains, namely allergens, irritants, and other things that are not included in allergens and irritants. Each individual reacts differently to the triggers that cause asthma. The main factors that cause asthma are dust, abundant in the house, household furniture, dolls, carpets, pet dander, air pollution, cigarette smoke, and chemical irritants. Changes in people's lifestyles and poor air quality have aggravated asthma relapses. Acute relapses can occur at any time and can occur within minutes or hours. Inadequate respiratory indicators in asthmatic patients are wheezing, shortness of breath, chest feeling heavy, increased respiratory rate, hyperventilation, fluctuations in CO2 levels, and these symptoms will worsen night and morning (2, 5).

People with asthma experience narrowing of the airways that are not evenly distributed in almost all parts of the lung, and there are areas of the lung that are not well ventilated. The body is hyperventilating so that the lack of oxygen can be met. Hyperventilation occurs when CO2 in the blood and alveoli decreases which cause low CO2 levels in the blood and causes acid-base disorders in the blood and low O2 levels in the tissues (5, 6).

Decreased saturation also occurs in asthmatic patients. They reduced oxygen concentration in the blood and increased respiratory rate in response to decreased oxygen saturation. This decrease in oxygen saturation can also occur due to persistent infiltration of inflammatory cells and hyper-secretion of thick mucus and mucosal edema, which causes thickening of the alveolar membrane (7).

The goals of asthma management are to improve lung function optimally, prevent recurrence independently, control and eliminate asthma symptoms regularly, improve fitness with recommended exercises, avoid side effects of treatment, and avoid death (8, 9).

Pharmacological therapy in asthma that is given to treat and prevent airway obstruction consists of control and a reliever. However, there are many asthma control failures because some people living with asthma are not adherent to treatment. Long-term pharmacological therapy also has drawbacks and side effects if it is not treated correctly. The use of asthma drugs in corticosteroids has side effects such as suppressing growth in children, increased enzymes in the liver, headaches, nausea, increased blood pressure. The asthma drugs used for acute attacks are salbutamol and theophylline. It has bronchodilating effects and improves lung function but has cardiovascular side effects and mild anti-inflammatory effects central nervous system (10-12).

Currently, non-pharmacological therapies such as exercise or breathing for asthma patients are alternative therapy to improve health. The optimal exercise enhances the body's metabolism and energy as a driving force for more extensive and more valuable activities. Breathing exercises also improve respiratory function and maintain the balance of IgE levels in the bronchi and reduce excessive responses from the airway (13, 14).

Eosinophil levels in asthma describe the level of allergen exposure that occurs in asthma cases (15,16). Several non-pharmacological therapies are currently applied to asthma patients, such as asthma exercises and Buteyko breathing techniques. Asthma gymnastics is known as a breathing exercise that can increase expiratory air and increase the breathing muscles (17, 18).

From previous research on the effect of the Buteyko breathing technique after being given exercise for four weeks, there was an increase in the value of the subject's average Expiratory Peak Current (APE), namely 413.33 liters/minute, an increase of 89.17 liters/minute compared to the previous pre-test. These results indicate an effect of the Buteyko breathing technique exercise on Expiratory Peak Current (APE) (13). Other research on Buteyko breathing techniques in controlling asthma showed significant results with a p-value of 0.000, which means a difference between controlling asthma before and after implementing Buteyko breathing, which helps control asthma. The results obtained from Buteyko's breathing on asthma control before treatment were 11.33 ± 1.345 and after treatment was 19.60 ± 1.682, with asthma control before treatment, the highest was 14. The lowest was nine, while after treatment, the highest was 22, and the lowest was 17 (1).

Research on asthma exercise obtained significant results in reducing recurrence and increasing oxygen saturation in asthmatics, with the mean for% SpO2 rising from 95.1% to 96.5% and received p-value = 0.001. The Buteyko breathing technique aims to improve breathing patterns in people living with asthma by maintaining a balance of CO2 levels and O2 levels at the cellular level, reducing asthma symptoms and severity (19).

The Buteyko breathing technique is a therapeutic one non-pharmacological, most scientific, and devoted to asthmatics. This technique aims to control breathing patterns by holding your breath, reducing hyperventilation and low carbon dioxide levels. Buteyko's breathing technique is a technique that combines nasal breathing, diaphragmatic breathing, and pause control. Asthma patients are advised to breathe through the nose and close the mouth to prevent allergens' entry that can trigger bronchospasm to become tight. Diaphragmatic breathing that is performed can change thoracic pressure, which results in air movement, expanding the thorax and making the pressure on the intra-pleural negative, thereby expanding the lungs. Control pause, which is part of the Buteyko breathing technique, can reduce hyperventilation, and control pause can reduce asthma symptoms. Control pause is also helpful for increasing CO2 loss due to continuous hyperventilation in asthmatics. The pause would regulate abnormal breathing rhythms and reset the respiratory center in the brain by doing control. This Buteyko breathing technique can be done independently for sufferers because it is a natural and straightforward technique (8,18,19).

Breathing exercises in asthma are breathing exercises, combining reducing respiratory rate and tidal volume and relaxation training to help control asthma symptoms and improve life quality. Repetitive breathing exercises aim to normalize breathing by reducing overall ventilation using the diaphragm. The benefits of exercise the Buteyko breathing technique does not conflict with conventional asthma management. Buteyko breathing techniques complement asthma management. Initially, the benefits of practicing the Buteyko breathing technique were seen in a reduction in symptoms and a reduction in bronchodilator use. Based on the research, most respondents experienced an increase in peak expiratory flow (APE) after the Buteyko breathing technique was carried out (20).

The implementation of Buteyko's breathing technique has had effective asthma control and no side effects from the intervention that has been given. Giving the Buteyko breathing technique is only used to determine its effectiveness for controlling asthma alone. However, research is still rare to decide whether providing this Buteyko breathing technique can increase peak expiratory flow (APE), oxygen saturation, and balance CO2 levels in asthma patients. Based on the above background, the researchers were encouraged to determine the effectiveness of Buteyko breathing techniques and asthma exercises on the balance of oxygen saturation (CO2) and eosinophil levels in asthma patients.

Objective

The study aimed to examine the Buteyko breathing technique and asthma gymnastics' effect on improving oxygen saturation values and eosinophil levels.

Method

A quasi-experiment, pre-test – post-test design with a non-equivalent control group was applied in this study. Researchers divided into three intervention groups: group one received the Buteyko breathing techniques. Group 2 received the Buteyko breathing techniques and asthma gymnastics, whereas the control group only received the asthma gymnastics. The treatment of Buteyko breathing techniques and asthma gymnastics was carried out for 14 days with 28 treatments, namely giving Buteyko breathing techniques two times a day, namely in the morning and evening for 15 minutes within 14 days. Then Buteyko breathing techniques and asthma gymnastics in the treatment group 2 for 14 days with the Buteyko breathing technique were two times a day, namely morning and evening for 15 minutes and asthma exercises are given two times in 14 days 60 minutes, as for the control group. Providing asthma gymnastics was two times in 14 days for 60 minutes. Measurement of oxygen saturation using digital oximetry instruments and eosinophil levels by examining blood samples in the laboratory. Measurement of oxygen saturation and eosinophil levels was carried out on day 1, day 7, and 14 with three measures (pre-test, post-test 1, and post-test 2).

This study's population were asthma sufferers who were undergoing outpatient care and without attacks or in stable conditions in the community health centers working area of Pontianak. Determination of the minimum sample size using non-probability sampling technique with purposive sampling method and based on inclusion and exclusion criteria as many as 36 respondents were divided into three groups with 12 respondents each in intervention group 1 (Buteyko breathing technique), 12 respondents in intervention group 2 (Buteyko breathing technique and asthma gymnastics) and 12 respondents in the control group (asthma gymnastics without Buteyko breathing technique).

In this study, researchers collected data using observation, identification, interview, and filling out observation sheets. The collected data were analyzed through the IBM SPSS version 24.0 program and continued with a different test, namely the parametric test

(Repeated Measure ANOVA). The processed data is used to discuss the problem statement, which is then presented in tabular form to conclude.

Results

Characteristic of respondents

Table 1 described the characteristic of respondents. The results showed that the mean age of respondents was 36.03±10.92. The mean body mass index (BMI) among respondents was 22.13±2.83.

Regarding the exercise habits, the mean of the first treatment group (Buteyko breathing technique) was 4.033±1.150. The second treatment group (Buteyko breathing technique and asthma gymnastics) was 2.967±1.601, and the control group (asthma gymnastics) was 2.967±1.601. It was indicated that the first group exercise habits have more influence on the value in the first treatment group (Buteyko breathing technique) than in and the control group (asthma gymnastics).

Concerning the gender distribution, more than half of the respondents were 58.3%. Based on a history of asthma, those who had a history of asthma were higher than those who didn't, namely 55.6%.

Table 1 Characteristic of respondents by age, sex, BMI, history of asthma, and exercise habits

Characteristics	Mean ± SD	Min-Max	CI 95%
Age (Mean ± SD)	36.03±10.92	18 - 50	32.33 – 39.72
Body Mass Index (BMI)	22.13±2.83	15.39 – 28.19	21.1764 – 23.0936
Exercise habits			
Buteyko breathing technique	4.033±1.150	2.0-6.0	3.303-4.764
Buteyko breathing technique and Asthma gymnastics	2.967±1.601	1.4-6.0	1.949-3.984
Control group (Asthma gymnastics)	1.517±0.867	1.0-4.0	0.966-3.379

Characteristics	Total			
	n	**%**	**n**	**%**
Sex				
Male	15	41.7	15	41.7
Female	21	58.3	21	58.3
Total	36	100	36	100
History of asthma				
Yes	20	55.6	20	55.6
No	16	44.4	16	44.4
Total	36	100	36	100

**Homogeneous test*

Mean difference of oxygen saturation before and after treatment among intervention group and control group

Table 2 described the mean difference in oxygen saturation before and after treatment among the intervention and control groups. The results found that the mean of SpO2 after treatment among the intervention group 2 increased compared with the first intervention group (Buteyko breathing technique) and the control group (asthma gymnastics).

Table 2. Mean difference of oxygen saturation before and after treatment among intervention group and control group

Group	Mean Difference	Score Mean Pre	Score Mean Post
Intervention group 1 (Buteyko breathing technique)	0.50	95.83	96.33
Intervention group 2 (Buteyko breathing technique and asthma gymnastic)	1.83	94.00	95.83
Control group (Asthma gymnastic)	0.42	94.83	95.25

Dependent t-test

Mean difference of eosinophil levels before and after treatment among the intervention group and the control group

Table 3 showed the mean difference of eosinophil levels before and after treatment among the intervention and control groups. The results found that the mean of eosinophil levels after treatment among the second intervention group (Buteyko breathing technique and asthma gymnastics) was higher than the Intervention group 1
(Buteyko breathing technique) and the control group (Asthma gymnastics)

Table 3. Mean difference of eosinophil levels before and after treatment among the intervention group and the control group

Group	Mean Difference	Score Mean Pre	Score Mean Post
Intervention group 1 (Buteyko breathing technique)	-7.66	77.91	70.25
Intervention group 2 (Buteyko breathing technique and asthma gymnastic)	-21.66	148.66	127.00
Control group (Asthma gymnastic)	-18.67	140.58	121.91

Table 4. Analysis of mean differences for oxygen saturation and eosinophil levels before and after treatment in the intervention group and control group

(I) Measurement	(J) Measurement	Mean Difference (I-J)	Sig.	95% CI
1	2	.528	.058	-.009-1.065
	3	173583*	.000	-.75-.004-.-72.162
	4	174500*	.000	-.75-.721-.-73.279
	5	101.083*	.000	-.133-.531-68.635
	6	-85.083*	.000	-.113.531-.-68.635
				-.113.620-.-56.546
2	1	.528	.058	.009
	3	173583*	.000	-.75-.475-.-72.747
	4		.000	-.76-.153-.-73.903
	5		.000	-.134-.056-.-69.166
	6		.000	-.114-.147-.-57.075
3	1	73.583*	.000	72-.162-75.004
	2	74111*	.000	72-.747-75.475
	4	-917*	.000	-.369
	5	-27.500	.184	5.348
	6	-11.500	1.000	17.604
4	1	75.500*	.000	73-.279-75.721
	2	75.028*	.000	73-.903-76.153
	3	.917*	.000	1.464
	5	-26.583*	.222	6.118
	6	-10.583	1.000	18.367
5	1	101.083*	.000	68-.635-133.531
	2	101.611*	.000	69-.166-134.056
	3	27.500	.184	-5.348-60.348
	4	26.583	.222	-6.118-59.285
	6	16.000	.056	-215-32.215
6	1	85.083*		56-.546-113.620
	2	85.611*		57-.075-114.147
	3	11.500		-17.604-40.604
	4	10.583		-18.367-39.534
	5	-16.000		-32.215-.215

Pairwise comparison test

Based on the table above shows that the mean value of all measurements (dependent variable) is significantly different with a value $p<0.05$ in each group of respondents (3 groups of respondents), namely the first intervention group (Buteyko breathing technique), the second intervention group (Buteyko breathing technique and asthma gymnastics) and the control group (asthma gymnastics).

There is a difference in the average value of oxygen saturation (Spo2) and eosinophil levels with a value of $p=0.000$. It was indicated that there is a significant difference between the group with the highest increase in oxygen saturation value in the second treatment group (Buteyko breathing technique and asthma gymnastics). Followed by the first treatment group (Buteyko breathing technique), which is 0.50, and the minor decrease in the value of SpO2 was in the control group (asthma gymnastic) of 0.42. The decline in eosinophil levels was highest in the second treatment group (Buteyko breathing technique and asthma gymnastics), followed by the control group (asthma gymnastics), and the minor decrease in eosinophil value was in the first treatment group (Buteyko breathing technique) of -7.66.

Discussion

The difference in mean values in the measurement table (dependent variable) as a whole where it is seen (all p values=0.000) means significant. The difference in the mean pre-test and post-test SpO2 values was significant (p=0.000), and the mean difference between the pre-test and post-test eosinophil was significant (p=0.004). But in the pairwise comparison test, only the SpO2 pre and post-test had substantial results (p=0.000 or <0.05). Based on the statistical tests conducted by researchers using the General Linear Model (GLM), only the difference in the mean value of the pre-test and post-test SpO2 was significant.

The average pre-test and post-test SpO2 values after the intervention increased in all treatment groups. The most significant increase was in the second treatment group (Buteyko breathing technique and asthma gymnastics) that is 1.83, followed by the first treatment group (Buteyko breathing technique) that is 0.50, and the minor decrease in the value of SpO2 was in the control group (asthma gymnastics) of 0.42. And the difference in the mean value of pre-test eosinophil levels with post-test eosinophil in each measurement (dependent variable) was the decrease in the average value of eosinophil levels after intervention all intervention groups. The most significant reduction was in the second treatment group who received the Buteyko breathing technique and asthma gymnastics. Followed by the control group (asthma gymnastics), which is -18.67, and the smallest decrease in the value of eosinophil levels was the first treatment group (Buteyko breathing technique) -7.66.

This result follows the research, which states that there is an increase in the average value of oxygen saturation from pre to post-test to 1 (15 minutes) intervention to post-test 2 (15 minutes) intervention which is 93.63%. The supply of oxygen to cells depends not only on how much oxygen we breathe but also on how much CO2 we breathe. If we excrete too much CO2, the CO2 content of our blood becomes very low, hindering the efficient distribution of oxygen. Over breathing causes the blood to be cleared of CO2, negatively impacting the cells' oxygen supply [(21).]

The decrease in vital lung capacity triggers an increase in IgE, resulting in airway hyperactivity. It could cause asthma recurrence due to airway obstruction, alveolar hypo-ventilation, hypoxia so that breathwork will increase pulmonary hyperventilation, which will eventually cause respiratory muscle fatigue. Hyperactivity of bronchial smooth muscle causes respiratory distress [(22)]. The Buteyko breathing technique exercise is a unique breathing therapy that uses breath-holding and breath-holding treatments to treat various health conditions believed to be associated with hyperventilation and low carbon dioxide levels. The main component of the Buteyko breathing technique is breathing therapy. The respiratory part aims to reduce hyperventilation through controlling breath reduction, known as slow breathing, and reduce breathing, combined with holding your breath, known as control pause and extended pause. Buteyko's breathing techniques do not conflict with conventional asthma management [(23).]

Easy Breathing Hold (EBH) in Buteyko breathing is the primary breathing indicator if EBH 60 seconds means in optimal health condition. But if lower means the weak condition and chronic disease (asthma), low EBH implies worsening oxygen distribution and low blood CO2 value affecting breathing pattern. The Buteyko breathing technique aims to improve asthmatics' breathing pattern by maintaining a balance of CO2 levels and cellular oxygenation values , which can reduce asthma symptoms. Methods The Buteyko breathing technique is used primarily as a natural technique to reduce asthma symptoms and severity.

Conclusion

Based on data processing and analysis regarding the treatment of Buteyko breathing techniques and asthma gymnastics as alternative, complementary therapies, it can be

concluded that there is a difference in the mean value of oxygen saturation (spo2) and eosinophil levels with a value of p=0.000, which indicates a significant difference. In each group, both in the Buteyko breathing technique first intervention group, the second intervention group Buteyko breathing technique and asthma gymnastics, and the asthma control group.

References

(1) Juwita L, Sary IP. Pernapasan Buteyko Bermanfaat Dalam Pengontrolan Asma. REAL in Nursing Journal (RNJ). 2019;2(1). https://ojs.fdk.ac.id/index.php/Nursing/article/view/476

(2) GINA. Pocked Guide For Asthma Management And Prevention. 2019.

(3) GAN. The Global Asthma Report 2018. New Zealand: Global Asthma Network; 2018.

(4) Kementerian Kesehatan Badan Penelitian dan Pengembangan Kesehatan. Hasil Utama Riskesdas 2018. Jakarta: Kesehatan KKBPdP; 2018.

(5) Melastuti E, Husna L. Efektivitas Teknik Pernapasan Buteyko Terhadap Pengontrolan Asma di Balai Kesehatan Paru Masyarakat Semarang. Jurnal Keperawatan dan Pemikiran Ilmiah. 2015;1(4):1-7. http://lppm-unissula.com/jurnal.unissula.ac.id/index.php/jnm/article/view/466

(6) Dramawan A. Latihan Pernapasan Teknik Buteyko Terhadap Saturasi Oksigen Pada Pasien Asma2017.

(7) Price Sylvia A. Patofisiologi Konsep Klinis Proses-Proses Penyakit Edisi 6. Jakarta: EGC; 2010.

(8) Sutrisna M, Pranggono, EH, Kurniawan T. Pengaruh Teknik Pernapasan Buteyko Terhadap ACT (Asthma Control Test). Jurnal Keperawatan Silampari (JKS). 2018;1(2). journal.ipm2kpe.or.id

(9) Nuari NA, Damayanti D. Peningkatan Nilai Peak Expiratory Flow Rate (PEFR) Pada Pasien Asma Bronkiale Dengan Metode Pranayama. Jurnal Ilmu Kesehatan. 2013;1(1). https://osf.io/preprints/inarxiv/9bfjp/

(10) Prem V, Sahoo RC, Adhikari P. Comparison Of The Effects Of Buteyko And Pranayama Breathing Techniques On Quality Of Life In Patients With Asthma– a Randomized Controlled Trial. Clinical Rehabilitation.2013;27(2):133-41. https://journals.sagepub.com/doi/abs/10.1177/0269215512450521

(11) Chauhan BF, Ducharme FM. Addition-To Inhaled Corticosteroids Of Long-Acting Beta 2-Agonists Versus Anti-Leukotrienes For Chronic Asthma. Cochrane Database of Systematic Reviews. 2014(1). https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD003137.pub5/abstract

(12) Kusumahati E, Nurhasanah, S, Elvano DR. Kajian Potensi Interaksi Obat Pada Pasien Asma Rawat Jalan Di RSAU Dr. M. Salamun Bandung. Jurnal Farmasi Galenika 2017;4(3):62-71.

(13) Prsatyanto Dandy. Kushartanti W. Pengaruh Latihan Pernafasan Buteyko Terhadap Arus Puncak Ekspirasi (APE) pada Penderita Asma. Jurnal Student UNY. 2016. https://journal.uny.ac.id/index.php/medikora/article/view/23199

(14) Kartikasari Dian. Jenie MI, Primanda Yanuar. Latihan Pernafasan Diafragma Meningkatkan Arus Puncak Ekspirasi (APE) dan Menurunkan Frekuensi Kekambuhan Pasien Asma. Jurnal Keperawatan Indonesia.2019;22(1):53-64. http://www.jki.ui.ac.id/index.php/jki/article/view/691

(15) Matucci A, Vultaggio A, Maggi E, Kasujee I. Is Ige Or Eoshinophils The Key Player In Allergic Asthma Pathogenesis? Are We Asking The Right Question?. Respiratory research. 2018. https://link.springer.com/article/10.1186/s12931-018-0813-0
(16) Nugraha Aditya IB, Suryana. Peranan Antibodi Anti-Imunoglobulin E dalam Tatalaksana Asma Bronkial Fakultas Kedokteran Universitas Udayana. 2016;43(8). http://www.cdkjournal.com/index.php/CDK/article/view/97
(17) Warsono W, Fahmi FY. Peran Latihan Pernafasan Terhadap Nilai Kapasitas Vital Paru Pada Pasien Asma (Literatur Review). Care: Jurnal Ilmiah Ilmu Kesehatan. 2016;4(3):132-8. http://www.cdkjournal.com/index.php/CDK/article/view/97
(18) Oktarina Y, Nurhusna N, Nurlinawati N. Pemberdayaan Kader Kesehatan Melalui Pelatihan Senam Asma dan Teknik Pernapasan Buteyko Sebagai Upaya Mengurangi Kekambuhan dan Menurunkan Gejala Asma Pada Penderita Asma di Puskesmas Olak Kemang dan Puskesmas Simpang IV Sipin. Jurnal Ilmiah Ilmu Terapan Universitas Jambi. 2018;2(2):115-20. https://online-journal.unja.ac.id/JIITUJ/article/view/5982
(19) Villareal GMC, Villazor BPU, Villegas AM, Visaya P, Sebastian N, Vista ME, et all. Effect of Buteyko Method on Asthma Control and Quality of Life of Filipino Adults with Bronchial Asthma. The Journal of Macro Trends in Health and Medicine. 2014;1:44-60. http://www.macrojournals.com/
(20) Fitrina Yosi RPS. Efektifitas Antara Teknik Pernafasan Buteyko dengan Diafragmatic Breathing Exercise Terhadap Arus Puncak Ekspirasi (APE) Pada Pasien Asma Di Wilayah Kerja Puskesmas Tigo Baleh Bukit Tinggi Jurnal Afiyah. 2018;V(1). http://www.ejournal.stikesyarsi.ac.id/index.php
(21) Rakimov Artour P. Breathing Slower and Less: TheGreatest Discovery Ever. Rusian2014. Available from: http://www.normalbreathing.com.
(22) Novozhilov Andrey MD. Buteyko Breathing Manual: Breathing Center; 2012.
(23) Bachri Y. Pengaruh Teknik Pernapasan Buteyko Terhadap Frekuensi Kekambuhan Asma Pada Penderita Asma Bronkhial Di UPT Puskesmas Wilayah Kerja Lima Kaum 1 Kabupaten Tanah Datar Tahun 2017. Menara Ilmu.2018;12(8). https://www.jurnal.umsb.ac.id/index.php/menarailmu/article/viewFile/881/792.