

The combination of alkaline water provision and asthma-induced gymnastics towards peak expiratory flow rate of asthma patients at Surakarta Lung Clinic, Indonesia

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ABSTRACT

Background: Asthma is an abnormality in the form of chronic airway inflammation which can be reduced by providing asthma-induced gymnastics and healthy lifestyle such as consuming alkaline water.

Aims: The objective of this study is to examine a combination of alkaline water provision and asthma-induced gymnastics towards peak expiratory flow rate of asthma patients at Surakarta Lung Clinic, Indonesia

Methods: This research was a quasi-experimental pre-test-post-test design with control group. The number of respondents in this study was 30 respondents, divided equally into intervention group and control group. The control group was given asthma-induced gymnastics twice a week for 14 days with duration of 60 minutes, while the intervention group was provided with a combination of alkaline water pH9+ for 14 days as much as 1,200 ml/day and asthma-induced gymnastics 4 times a week for 14 days with a duration of 60 minutes.

Results: There was a significant difference in the value of peak expiratory flow for 14 days in the intervention group and the control group ($p < 0.001$). There was an improvement in the average of peak expiratory flow rate values for each measurement in both groups, however, this study orchestrates that the intervention group has a higher improvement than the control group. The combination of alkaline water and asthma-induced gymnastics effectively and significantly improves the peak expiratory flow rate values at the Day 8 ($p = 0.039$) and the Day 14 ($p = 0.012$).

Conclusion: The combination of alkaline water and asthma-induced gymnastics can be applied in nursing care management in patients with intermittent and persistent asthma.

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INTRODUCTION

Asthma is a disorder in the form of chronic inflammation of the airways that causes bronchial hyperactivity to various stimuli [1]. Asthma has affected more than 5% of the world's population, with a tendency to increase. The increased prevalence is allegedly due to undiagnosed asthma, poor air quality, and changes in people's lifestyle [2]. World Health Organization (WHO) in collaboration with Global Asthma Network (GAN) predicts that the number of asthma patients in the

world reaches 334 million people. It continues to increase to 400 million people in 2025 with 250 thousand deaths due to asthma among adults and children [3]. While asthma prevalence in Indonesia shows a tendency to decrease from 4.5 percent in 2013 to 2.4 in 2018 [4, 5], in Central Java province, 113.028 asthma cases were reported (in 2015 only), with the Surakarta as the highest rank with a total of 10.393 cases [6].

The indicator of asthma can be seen from the score of pulmonary function that has decreased or the results of the clinical picture of the peak expiratory flow rate value

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of less than 60%. Patients with pulmonary function disorders, the ventilation capacity to maintain blood gas at normal levels is not working properly. As a consequence, an increase in pCO₂ causes a decrease in blood pH, and lead to an acidic state [7] which will negatively affect cells and molecules in the organs and overall human body.

Asthma management includes controllers, reliever, physical activity, and compliance. Efforts to improve the health status of asthma patients are not optimal currently, hence, it is needed the development of asthma management in the form of combination intervention such as providing alkaline water and exercise. The alkaline improves the cells' hydration through the diffusion of damaged cell membrane due to the extreme acidic state. The provision of alkaline water also increase the blood pH to become more alkaline so that hemoglobin will bind to a higher amount of oxygen and increase the bronchial muscle contractility in asthma patients. The adequate hydration will help in cell recovery and advanced restoration of bronchus to prevent irreversible remodeling[8]. Alkaline water also serves as anti-allergen mechanism through the modulation of immune cells TH2 which play an important role in asthma [9]. The provision of alkaline water will suppress the histamine production which will reduce the hyperactivity of bronchus and mucus secretion in asthma patient[10, 11]. The airways will be free from obstruction and smooth muscle spasm which improve the expiration air and increase the peak expiratory flow rate value [12].

There is a bulk of evidences that risk factors of asthma is not only limited to the dysfunction of bronchus but also due to lifestyle changes. Poor diet and lack of physical activity has been shown to decrease the immune system and increase the likelihood to suffer from asthma. The overwhelming majority of studies demonstrated the capacity for asthmatic subjects to exercise safely and significantly improve their cardiovascular fitness and quality of life [13, 14] as exercise training is the key component to pulmonary rehabilitation. Asthma-induced exercise such as walking, swimming, cycling, running, rowing, calisthenics, and gymnastics have been shown as good evidences in improved fitness of patients with asthma [13, 15]. The combine effect of alkaline water and asthma-induced gymnastics can strengthen the respiratory muscles and enhance the body's immunological processes by suppressing the allergic process that triggers an inflammatory process in the airways. The objective of this study is to identify the effect of combination therapy by giving alkaline water and asthma-induced gymnastics towards the peak expiratory flow rate value status (APE) on asthma patients at Council of Public Lung Health of Surakarta.

METHODS

This research was a quasi-experimental research using a pre-test and post-test design with control group. This research used non-probability with purposive sampling. Matching was performed to omit patients with similar degree of asthma (whether it is intermittent and persistent), sex and the possible risk factors. Each intervention group and control group was divided equally from each degree of asthma. The inclusion criteria in this research were patients who were willing to become respondents by signing an informed consent by their own or family patients, patients with asthma at intermittent and persistent classification, adult (> 18 years), who were not in a severe condition. The procedures and tools in this present study have approved by Health Research Ethics Commission of Politeknik Kesehatan Kemenkes Semarang (No.030/KEPK/Poltekkes-Smg/EC/2018) on 20 February 2018

Intermittent asthma is classified when asthma symptoms occur two days or less per week, does not interfere with normal activities, when not having an asthma attack, lung function tests are normal and vary little from morning to afternoon, and nighttime symptoms occur two days or less per month. *Mild persistent asthma* is defined when the occurrence of symptoms is more than two days per week but *not* every day, but asthma attacks interfere with normal daily activities and nighttime symptoms occur three to four times a month. Lung function tests are normal when not having an attack and may vary a small amount from morning to afternoon. *Moderate Persistent Asthma* suffered from a daily occurrence of symptoms and a short-acting inhaler is used every day. Symptoms interfere with daily activities, and nighttime symptoms occur more than one time a week, but do not happen every day and lung function tests are abnormal and vary more than 30 percent from morning to afternoon. *Severe Persistent Asthma* is defined when symptoms occur throughout each day and severely limit daily physical activities. Nighttime symptoms occur often, sometimes every night and lung function tests are abnormal and may vary greatly from morning to afternoon.

Thirty respondents were divided equally into intervention and control group. Intervention group were treated by giving alkaline water pH 9+ 1200 ml/day for 14 days and asthma-induced gymnastics 4 times a week for 14 days, with 60 minutes gymnastic duration on the 1st, 3rd, 5th, 7th, 8th, 10th, 12th, and 14th day. While the control group were only treated by giving asthma-induced gymnastics on the 1st, 5th, 8th, and 14th day. The peak expiratory is an important indicator since it serves as the sensitive tools to assess asthma severity, diurnal variation, and response to treatment. Monitoring peak expiratory is important to objectively measured and observe the prognosis of asthma

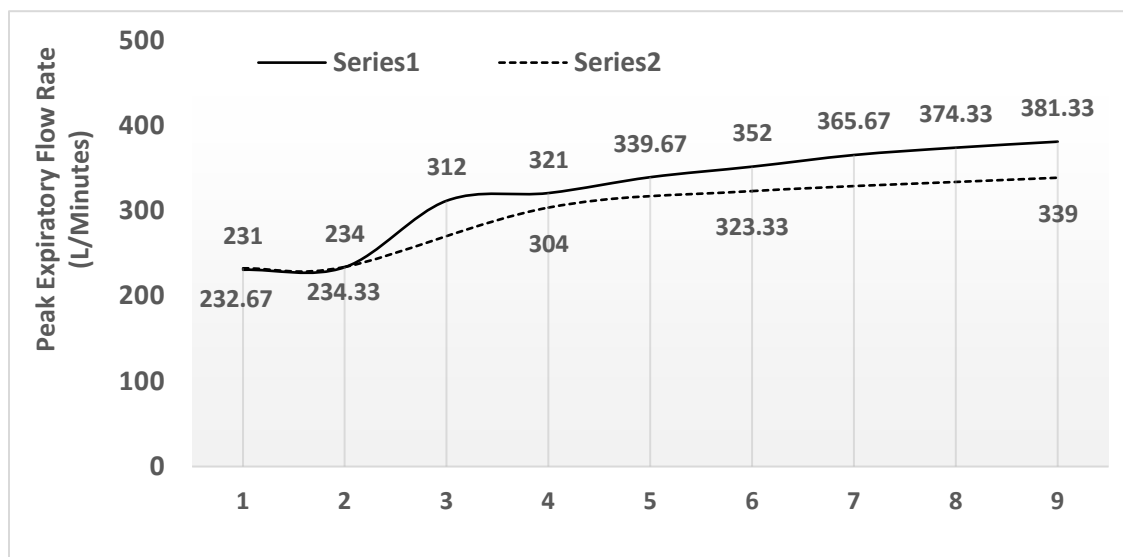


Figure 1. Patients’ peak expiration flow rate (L/min) at control and intervention group over the observation days from Day 1 to Day 14

including the probability of relapse. Using an observational sheet, the researcher measured the peak expiratory flow rate (expressed in l/min) by using a peak flow meter with the following steps, washing hands before the action, explaining to the asthma patients how to examine, put a mouthpiece to the end of the peak flow meter, making sure the marker is in position 0, asking the patient to breathe normally three times, asking the patient to stand or sit with his/her back straight and holds the peak flow meter in a horizontal position without touching or disturbing the marker movement. The patients breathe as broad as possible, then the mouthpiece was inserted into the mouth with the lips closed tightly around the mouthpiece, and exhale as quickly and forcefully as possible. When exhaling, the marker moves and shows the number on the scale, return the marker to position 0, repeat steps 5-8 three times, and note the highest value. Compare the highest value of the patient with the predictive value, clean the mouthpiece by using an alcohol swab, note the APE results on the patient

questionnaire sheet, then recap the observation sheet. Then, it is evaluated from the results of pre-test and post-test, there was a deterioration or improvement with a value of 15% after getting the therapy or the intervention, washing hands after the treatment.

A 1,200 ml alkaline water was provided for patients twice a day (each 600ml), in the morning and evening during the period of the study (14 days). However, patients are recommend to continue consuming alkaline water afterward. Asthma-induced gymnastic was administered as scheduled appointment in the lung clinic four times in a week for 14 days. Subjects of intervention (30 persons) joined the asthma gymnastic club membered of 70 asthma patients. The normality test of the data was using the Shapiro-Wilk tests and Z-Score. Then, the homogeneity test was performed by using the one way ANOVA test. The General Linear Model statistical test was used to determine the difference in peak expiratory flow rate values at each measurement time.

Table 1. Results Analysis of General Linear Model *Repeated Measure ANOVA Test (Tests of Within-Subjects Effects)* (N=30)

Group	Source (Greenhouse-Geisser)	Sum of Squares	Df	Mean Square	F	p value
Intervention	Time	382,280.00	2.40	159,306.049	125.100	.000
	Error (Time)	42,781.11	33.59	1273.429		
Control	Time	150,751.33	2.08	72,477.917	45.107	.000
	Error (Time)	467,88.67	29.12	1,606.783		

RESULTS

A combination of alkaline water and asthma-induced gymnastics effectively improve patients' peak expiratory flow rate

While the normal peak expiratory rate of male should be at least 504 L/min, the average peak expiratory of asthma patients in the intervention group was recorded only at 403 L/min, and those who were in the control group was recorded lower at 347 L/min. Unlike their male counterpart whom their respiratory performance below the normal level, 53% of women in the intervention group showed a better lung capacity with an average peak expiratory level at 370 L/min, above the normal level 351 L/min. The present study indicates that the intervention of combination of alkaline water and asthma-induced gymnastics is effective in improving the peak expiratory flow rate of patients in the intervention group by 65%, and 45% for patients in the control group. More patients in the intervention group showed a higher level of peak expiratory flow rate compared to their counterpart in the control group (see Figure 1). More respondents of the intervention groups are able to achieve scores of normal values of peak expiratory flow rate whereas in the control group only a small proportion reaches normal values.

How effective the proposed combination to improve the outcomes of respiratory performances?

Repeated ANOVA test with Greenhouse-Geisser correction at Table 1, showed that there was a significant difference in the peak expiration flow rate between intervention (p value = 0.000) and control group (p value = 0.000) which means, providing alkaline water and gymnastic will significantly improve the outcomes of respiratory performances. Table 2 shows the differences in the peak expiratory flow rate before and after treatment at each measurement. The intervention combination of alkaline water and asthma-induced gymnastics has a significant effect in improving peak expiratory flow rate in the Day 1 (Post 1) with Day 3 (Post 2), Day 3 (Post 2) with Day 5 (Post 3), Day 5 (Post 3) with Day 7 (Post 4), Day 7 (Post 4) with Day 8 (Post 5), Day 8 (Post 5) with Day 10 (Post 6), Day 8 (Post 6) with Day 12 (Post 7). However, there is no difference in the peak expiratory flow rate Day 12 (Post 7) with Day 14 (Post 8). In the control group, statistical analysis showed a significant difference in Pre-treatment in Day 14 (Post 8), Day 1 (Post 1), and Day 5 (Post 2). The results acknowledge that the effectiveness of alkaline water and asthma-induced gymnastics can be obviously observed on the Day 8 and 14 with values, respectively at p value = 0.039 and p value = 0.012, as shown in Table 3.

Table 2. Analysis of differences in peak expiration flow rate value before and after treatment in intervention groups and control groups (Pairwise Comparisons)

Group	(I) Day	(J) Day	p value	
Intervention	Pre APE	APE Day 14 (Post 8)	0.000	
	Pre APE	APE Day 1 (Post 1)	1.000	
	APE Day 1 (Post 1)	APE Day 3 (Post 2)	0.000	
	APE Day 3 (Post 2)	APE Day 5 (Post 3)	0.031	
	APE Day 5 (Post 3)	APE Day 7 (Post 4)	0.015	
	APE Day 7 (Post 4)	APE Day 8 (Post 5)	0.016	
	APE Day 8 (Post 5)	APE Day 10 (Post 6)	0.042	
	APE Day 10 (Post 6)	APE Day 12 (Post 7)	0.000	
	APE Day 12 (Post 7)	APE Day 14 (Post 8)	1.000	
	Control	Pre APE	APE Day 14 (Post 4)	0.000
		Pre APE	APE Day 1 (Post 1)	1.000
		APE Day 1 (Post 1)	APE Day 5 (Post 2)	0.000
APE Day 5 (Post 2)		APE Day 8 (Post 3)	0.274	
APE Day 8 (Post 3)		APE Day 14 (Post 4)	1.000	

DISCUSSION

The findings showed that there was an improvement in the average value of peak expiratory flow rate in Day 1 or post 1 and continued to increase until Day 14 or post 8 both in the intervention and control group. However, patients in the intervention group showed a higher peak expiratory flow rate value than their counterparts in the control group. The results indicate that providing alkaline water and asthma-induced gymnastic may improve respiratory muscles of the asthma patients and also improve the cell hydration through the diffusion and osmotic processes of cell membranes that are damaged because the body is too acidic due to asthma. Adequate hydration of smaller alkaline water cluster molecules will help the cell healing process and therefore, the body will obtain an additional O_2 from the absorption through the digestive system, although it is not as much as the breathing process [11].

Table 3. Analysis of the effectiveness of alkaline water and asthma-induced gymnastics on the peak expiratory flow rate (Post hoc analysis)

Observations	Peak Expiratory Flow Rate			p value
	Mean	SD	Difference (IK 95%)	
Pre				
Intervention	231.00	18.244	-1.667	0.811
Control	232.67	19.536	(-15.804-12.471)	
Day 1				
Intervention	234.00	17.647	-.333	0.962
Control	234.33	19.988	(-14.436-13.769)	
Day 5				
Intervention	321.00	39.152	16.667	0.295
Control	304.33	46.131	(-15.335-48.668)	
Day 8				
Intervention	352.00	30.343	28.667	0.039
Control	323.33	41.390	(1.523-55.810)	
Day 14				
Intervention	381.33	35.379	42.333	0.012
Control	339.00	49.828	(10.012-74.655)	

Alkaline water that has gone through the process of electrolysis of water and has a high content of hydrogen molecules can easily diffuse into cells and body tissues and it is distributed through blood flow in the body [16, 8]. Specifically, hydrogen molecules have anti-inflammatory and anti-oxidant properties that can be beneficial for allergy patients [16]. According to research by Kullman et al., It is shown that there is an effect of drinking water on the pH variability of the Expired / Exhaled Breath Condensate (EBC). EBC pH is believed to describe the condition of the liquid layer on the surface of the respiratory tract. It is suspected that water consumption can dilute the liquid layer and change the pH value of the respiratory tract. EBC contributes to the stability of blood and urine parameters which are also affected by the CO₂ content in it [17]. Indirectly, it can explain the mechanism of the relationship between alkaline water consumption by drinking which can affect the condition of acid-base balance in the respiratory tract, especially in people with asthma in this study

The multivariate analysis in this study uses repeated measure ANOVA showed that there is a significant difference in overall peak expiratory flow rate value after the provision of alkaline water and asthma gymnastic therapy on day 1 to day 14. Pairwise Comparisons test shows differences in peak expiratory flow rate values for each measurement improves faster in the Intervention group than in the Control group because the movement from gymnastics will train the flexibility of chest muscles resulting in an improvement in vital lung capacity. Asthma gymnastics also will cause the release of epinephrine and norepinephrine which will lead to

dilatation of the airways [18]. Respiratory capacity is doubled during maximum exercise compared when it is resting [19]. Hence, the exercise will have an impact on improving the peak expiratory flow rate value.

Alkaline water affects the inhibition process of histamine production as the most cytokine in the airways of asthmatics. Cells that hydrate due to the acidic environment will produce more histamine to compensate for continued water loss. This histamine will affect the hyperreactivity of bronchial smooth muscle. The alkaline administration of histamine is then expected to reduce bronchial muscle hyperactivity and mucin secretion in the pathophysiology of asthma attacks [20]. Thus, this combination therapy has an effect on improving pulmonary function, especially peak expiratory flow rate value.

General linear model and post hoc analysis shows that the combination of alkaline water and asthma-induced gymnastics is sufficient to improve peak expiratory flow rate value starting at Day 8 with $p=0.039$ and in Day 14. Thus, by consuming alkaline water 1200 ml/day with pH 9+ for 8 days and asthma gymnastic therapy 4 times a week, it begins to show effective results in improving peak expiratory flow rate value. The therapeutic reaction process on Day 8 is the culmination of success because the combination of therapies experienced a process of removing toxins in the body.

Exercise by training the respiratory muscles such as regular asthma-induced gymnastics will improve the work of the heart, consequently, the circulation of blood to the entire body is smoother, especially to the muscles of the

body including respiratory muscles [15]. Smooth blood flow will bring more nutrients and oxygen to the respiratory muscles. Adequate nutrition includes calcium and potassium substances. The increase in calcium ions in the cytosol is due to the increasing release of ions from the sarcoplasmic reticulum [19]. Thus, in this study, the group who are given combination alkaline water and asthma-induced gymnastics had a better peak expiratory flow rate value than the control group who are only given asthma-induced gymnastics therapy. The limitation of the study was due to the absence of blood gas analysis as an indicator in monitoring the function of oxygenation ventilation or pulmonary function values whose relations with alkaline water therapy.

CONCLUSION

The study indicates that the provision of asthma-induced gymnastic was effective in improving the peak expiratory flow rate value by 45% (at control group) whereas the effectiveness increased to 65% when the patients were provided with a combination of alkaline water and asthma-induced gymnastic (at intervention group). Although the peak expiratory flow rate value in asthma patients was improved at the both groups, however, the patients in the intervention showed a higher average value of the peak expiratory flow rate than the control group. The combination of alkaline water and asthma-induced gymnastics was effective in improving peak expiratory flow rate starting at Day 8 and Day 14.

CONFLICT OF INTERESTS

No conflict of interests declared in this study.

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