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Original Article

The Effect of Asthma Exercise on Cortisol Hormone and Interleukin-5 in the Indonesian Patients with Persistent Asthma

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Abstract

Background: Inflammatory respiratory tract involves the interaction of several mediators that will cause asthma symptoms. This study aimed to reveal the effect of asthma exercise on cortisol hormone and interleukin-5 (IL-5) in the Indonesian patients with persistent asthma. **Methods:** This is a pre and posttest-designed experimental study in the Prof. Dr. Margono Soekarjo Hospital at Purwokerto, Indonesia. The diagnosis of asthma was established according to the Global Initiative For Asthma 2017. IL-5 levels were determined from peripheral blood mononuclear cells, and cortisol hormone analysis was performed by enzyme-linked immunosorbent assay technique. All parameters were tested before and after performing asthma exercise 4 times/week in 8 weeks with a duration of 60 min. The Wilcoxon and Pearson tests were performed for the statistical analysis. **Results:** Asthma exercise significantly increased the cortisol hormone levels ($P < 0.0001$) and significantly reduced the IL-5 levels ($P = 0.005$). However, there was no significant correlation between cortisol hormone and IL-5 ($r = -0.002$, $P = 0.989$). **Conclusions:** Asthma exercise can increase the cortisol hormone levels and reduce pro-inflammatory IL-5. Asthma exercise should be provided as a nonpharmacologic treatment in patients with persistent asthma.

Keywords: Asthma exercise, cortisol hormone, interleukin-5

Introduction

Asthma is a chronic inflammation of the respiratory tract that involves the interaction of several cell types and mediators that will cause asthma symptoms.[1] Inhaled antigen activates mast cells and Th2 cells in the respiratory tract. As a highly prevalent disease, >80% of death is caused by asthma occurring in developing countries.[2] Classification of asthma consists of atopy (extrinsic) and nonatopic (intrinsic) asthma.[3]

Interleukin-5 (IL-5) is a major cytokine in the pathogenesis of allergic responses that inhibit cortisol and lipid mediators which can damage cells and result in bronchial hyperresponsiveness and mucus hypersecretion.[4] The pathogenesis of asthma also involves the role of the cortisol hormone secreted by the hypothalamic axis pituitary adrenal, which acts as an anti-inflammatory. The cortisol hormone can also increase the response of β-adrenergic receptor in the respiratory tract smooth muscle which can reduce airway hyperresponsiveness in patients with asthma, decreases the circulating eosinophil, and inhibits the production and secretion of cytokines in the respiratory tract.[5]

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The stimulation, such as physical exercise, in the sympathetic nervous system, causes the release of epinephrine and norepinephrine resulting in the respiratory tract dilatation.[6] Asthma exercise can also reduce the frequency of asthma attacks and improve the lung function;[7] however, there has been no study that explores the correlation between cortisol hormone and IL-5. This current study aimed to investigate the effects of asthma exercise on cortisol hormone and IL-5 among the Indonesian patients with persistent asthma.

Methods

This study is an experimental study with the pre and posttest design. The patients were recruited by on the medical records at

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Prof. Dr. Margono Soekarjo Hospital, Purwokerto, Indonesia. The diagnosis of asthma was established according to the Global Initiative For Asthma 2017. The inclusion criteria were patients aged 19–67 years, atopic asthma with classification mild-to-moderate persistent, no worm eggs found in feces, having a good-medium fitness level (6-min fitness test run), and showing positive skin prick test on house dust mite allergens such as *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Blomia tropicalis*, committed to follow asthma exercise at least 24 times (80% of the total number of asthma exercise). IL-5 secreted by peripheral blood mononuclear cell and cortisol hormone in the plasma was measured by the enzyme-linked immunosorbent assay. The study received ethical approval from the Institutional Review Board of the Faculty of Medicine Universitas Indonesia (Ethical Clearance No. 998/UN. F1/ETIK/2017). All parameters were tested before and after asthma exercise 4 times a week during 8 weeks with a duration of 60 min.

The obtained data were subjected to statistical analysis using the Statistic Package for the Social Sciences (SPSS) version 19 (IBM Corp, Armonk, NY, USA). Normality of data distribution was determined by the Kolmogorov–Smirnov test. Non-normal data distribution was presented as median (minimal–maximal). The Wilcoxon test was used to analyze the influence before and after asthma exercise, whereas Pearson test was used to analyze the correlation between numerical variables. $P < 0.05$ was considered to be statistically significant.

Results

This study involves 39 patients, dominantly women, location East Purwokerto, occupation housewife, had a university-based level of education, aged between 18 and 65 years, normoweight, good fitness level, and moderate persistent asthma classification [Table 1].

To investigate the effect of physical activity on circulating cortisol, we first examined the level of cortisol before and after asthma exercise. As shown in Figure 1, there was a significant increase in the cortisol hormone level after asthma exercise as compared to before asthma exercise ($P < 0.0001$).

Next, to evaluate the implication of asthma exercise on the IL-5 levels, we found that asthma exercise resulted in the significant reduction of IL-5 levels in patients with persistent asthma ($P = 0.005$), as shown in Figure 2.

Finally, to determine the correlation between cortisol hormone and IL-5, we performed the Pearson test. As shown in Figure 3, the changes in the levels of cortisol hormone were not correlated with the changes in the circulating IL-5 levels after asthma exercise ($r = -0.002$; $P = 0.989$).

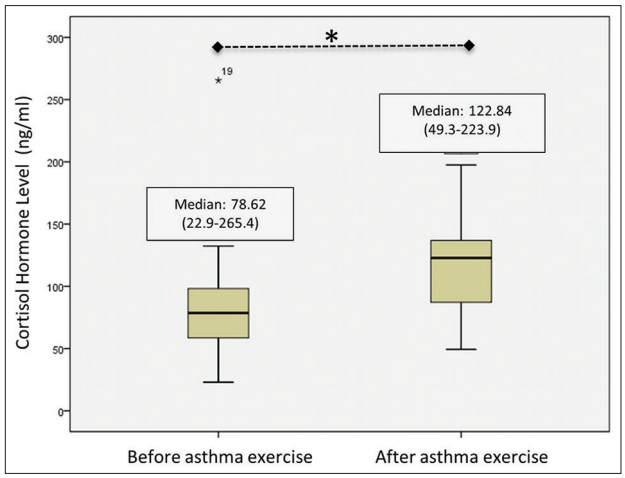

Figure 1: The cortisol hormone levels. Difference in median of cortisol hormone in asthmatics pre and postasthma exercise. *: $P = 0.0001$

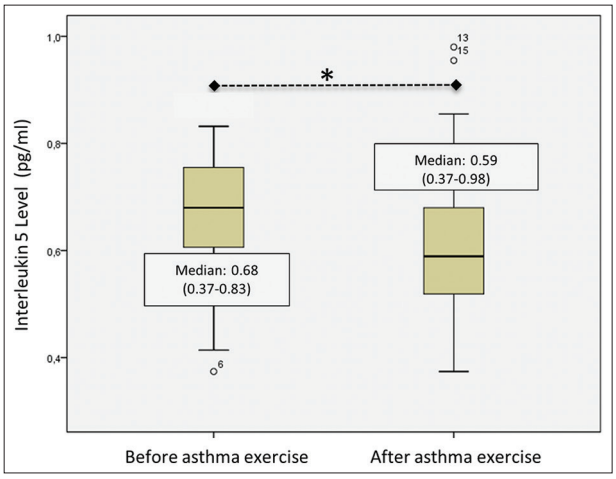

Figure 2: The interleukin-5 level. Difference in median of interleukin-5 in asthmatics preand postasthma exercise. *$P = 0.005$

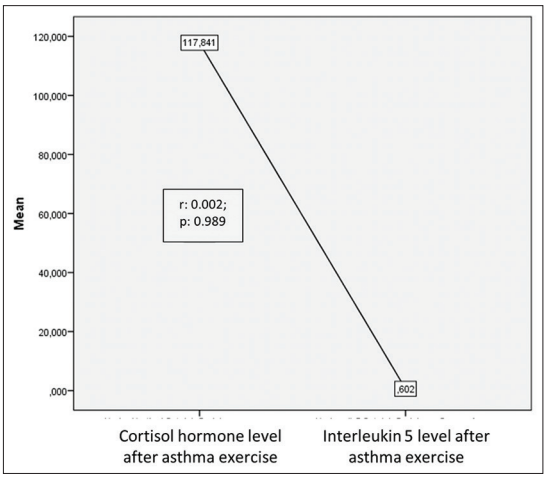

Figure 3: Correlation between cortisol hormone and interleukin-5 level after asthma exercise ($r = 0.002$; $P = 0.989$)

Discussion

Physical activity is one of the important nonpharmacological modalities in the holistic treatment of asthma. Our result showed a significant effect between before and after asthma exercise on the levels of the hormone cortisol. According to a

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Table 1: Characteristics of respondents

Variables	*n* (%)	95% CI
Gender		
Men	9 (23.1)	21.24–24.96
Women	30 (76.9)	73.5–75.7
Address		
South Purwokerto	1 (2.6)	1.8–3.4
West Purwokerto	7 (17.9)	16.15–19.65
North Purwokerto	8 (20.5)	18.7–22.3
East Purwokerto	23 (59)	55.3–62.72
Occupation		
Housewives	18 (46.2)	44.4–48.04
Teachers	10 (25.6)	23.71–27.49
Entrepreneurs	6 (15.4)	13.73–17.07
Students	2 (5.1)	40.23–61.77
Privates	3 (7.7)	64.13–89.87
Level of education		
Elementary school	10 (25.6)	23.71–27.49
Junior high school/senior high school	11 (28.2)	26.28–30.17
Diploma/bachelor/postgraduate	18 (46.2)	27.82–48.04
Age (years)		
Young age (18-65)	38 (97.4)	97.27–97.52
Middle age (66-79)	1 (2.6)	18.11–33.89
BMI		
Normal	37 (94.9)	94.65–95.15
Light fat	2 (5.1)	40.23–61.77
Fitness level		
Good	36 (92.3)	91.93–92.3
Medium	3 (7.7)	64.13–89.87
Classification of asthma		
Medium persistent	14 (35.9)	33.85–37.95
Light persistent	25 (64.1)	62.66–65.54

BMI: Body mass index, CI: Confidence interval

study by Lesti *et al*.,[5] there was an increase in cortisol hormone levels in asthmatic children who were given an exercise in 60 min on Mondays and Thursdays during 4 months which was conducted every 2 weeks. In line with the study of Hiemstra *et al*.,[8] that there was an increase in cortisol levels of salivary examination in children with asthma after 15 min of physical exercise. In contrast, the study of Kallenbach *et al*.[9] reported that there was no response to the cortisol hormone in asthmatic patients after the exercise.

Exercise is considered as a stimulus that can activate the hypothalamus–pituitary–adrenal (HPA) axis to stimulate corticotropin-releasing hormone so that the adrenal cortex can secrete glucocorticoids. Glucocorticoids are very beneficial to humans which can improve metabolic ability, maintain blood vessel integrity, and protect the body against excessive immune system responses. These contain 90% of cortisol secreted by the adrenal cortex which is very important during and after physical exercise, including the formation of gluconeogenesis and the use of fat to produce energy. Cortisol's response to physical exercise depends on the characteristics of both acute and chronic stimulation.[10]

Factors affecting the increase of cortisol hormone levels in this study depend on the intensity and duration of the exercise, psychological stress levels, nutritional status, fitness levels, and circadian rhythm. The increase of cortisol hormone is also associated with the process of lipolysis, ketogenesis, and proteolysis.[11] The previous study suggests that a good level of fitness can produce an optimal level of exercise so that the achievement of cortisol hormone levels can occur.[12] Nutritional status in this study was controlled based on the value of the body mass index (BMI). The BMI of the respondents was mostly in the normal category. Poor or excessive nutritional status causes metabolic stress that can interfere with counterregulatory hormones, the hormone cortisol and triggers the process of catabolism of endogenous proteins, carbohydrates, and fats.[13]

The cortisol hormone examination of samples in this study was conducted at 07:00–09:30 a.m. since it is influenced by circadian rhythms. As an acute response begins with the initial brief alarm reaction, in this stage, the increase of cortisol secretion in the HPA axis resulted in suppression of most immune functions and increased activity of the sympathetic system.[14]

We observed a significant reduction in the levels of IL-5 after asthma exercise. This study is also consistent with the findings from Vieira *et al*. study in which physical exercise can reduce IL-5.[15] The secretion of glucocorticoids and catecholamines was shown to have a role in the regulation of inflammation.[16] Stress hormones can affect the immune balance, such as higher Th1:Th2 cytokine ratio.[17] Exercise is considered as a stimulus that can activate the HPA axis to stimulate corticotropin-releasing hormone so that the adrenal cortex can secrete glucocorticoids.[18]

Our study did not find a correlation between the increasing levels of cortisol hormone and the decrease of IL-5. This is in accordance with the study by Landstra *et al*.[19] that glucocorticosteroid plays an indirect role in eosinophilic and neutrophilic airway inflammation, independent from the IL-5 signaling pathway.

Conclusions

Taken together, our study suggests that asthma exercise can increase cortisol hormone levels and reduce IL-5. However, there is no correlation between the increase levels of cortisol hormone and the decrease of IL-5 after asthma exercise.

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Conflicts of interest

There are no conflicts of interest.

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