

The Comparison of Plasma IL-6 Level after Increasing Speed and Inclination Gradually Treadmill Exercise

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Abstract: This study aimed to observe the effect of treadmill exercise with increasing speed and inclination gradually to plasma IL-6 levels. Twenty adult men divided into speed (SG) and inclination groups (IG) running on a treadmill EN_Mill 2007 for 30 minutes, three times per week in 2 weeks. SG started 5 km/h and increased 1 km/h every minute without inclination until the target heart rate is reached (70% MHR). IG started 3 km/h with increasing of inclination 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 20%, 22% every minute until target heart rate is reached (70% MHR). Blood samples taken 30 minutes before and after exercise in first and last training. Significantly decreased of plasma IL-6 levels in both groups before and after exercise at first training ($p=0.001$) and before-after exercise at the last training ($p=0.004$) in SG, while in inclination group plasma IL-6 levels before-after exercise showed no significant decreasing ($p=0.107$) at the last training. In both groups, there is significant delta (Δ) of plasma IL-6 levels between before exercise at the first and last training ($p=0.001$), between after exercise at the first and the last training ($p=0.001$). Plasma IL-6 levels decrease with exercise either by increasing inclination or speed gradually.

1 INTRODUCTION

IL-6 is a pro-inflammatory regulator of exercise in sedentary and active people, produced by contracting muscles and released into the blood. When at rest, subcutaneous and visceral adipose tissues are the principal responsible for IL-6 production during physical exercise, on the contrary, IL-6 production is sustained by the skeletal muscle through intracellular signaling pathways. Depending on the duration and intensity of exercise, plasmatic IL-6 concentration increases exponentially. The main source of IL-6 in the blood circulation in response to acute exercise, but the response is not apparent in trained subjects. The cytokine Interleukin-6 (IL-6) has evidence of its dual nature of as an adipokine (i.e., adipose tissue-derived cytokine) (Lyngsø et al, 2002) and as a myokine (i.e., muscle-derived cytokine) has been a matter of scientific debate (Pedersen and Febbraio, 2004). The synthesis and secretion of IL-6 from skeletal muscle contraction increases to 100 times from basal IL-6 levels, observations did at the end of exercise

(Penkowa et al., 2003). Plasma levels of IL-6 are highly regulated by acute exercise, depending on intensity, mode of exercise, and duration of physical activity. This study planned to observe the effect of treadmill exercise with increasing speed and inclination gradually to plasma IL-6 levels. Can IL-6 be considered an anti-inflammatory marker in moderate-intensity exercise with a treadmill?

2 MATERIAL AND METHODS

Twenty healthy young adult men BMI 18-22,9 kg/m³ and willing to sign informed consent were included. Ethical clearance: no. 0206/KEPK/IV/2018 by Ethical Committee Soetomo General Academic Hospital. Subjects divided into 2 groups, increasing inclination and speed gradually treadmill exercise groups. The exercise is walking on a treadmill EN_Mill 2007 for 30 minutes, with 5 minutes for warming up, 20 minutes core exercise and 5 minutes cooling down, 3 times per week for each group in 2 weeks. The speed

exercise group started with 5km/h and increased 1km/h every 1 minute with no inclination until the target heart rate is reached (70% maximal heart rate). Inclination group started with 3km/h of speed with increasing of inclination 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 20%, 22% every 1 minute until it reaches the target heart rate (70% maximal heart rate). We observed the immediate effect on plasma IL-6 levels. The blood samples were taken 30 minutes before and after exercise at the first training, the second blood samples taken 30 minutes before and after exercise at the first and the last training at the end of 2nd week. IL-6 was assessed with R&D BioSource ELISA kits (Invitrogen) according to the manufacturer's instructions.

3 RESULTS

Statistical analysis all the data were first tested for variance heterogeneity (by ANOVA test). We were analyzed for each study group and within-group changes in plasma IL-6 level for significance by the paired t-test.

Significant decreased of plasma IL-6 levels in both groups before-after exercise at the first training ($p=0.001$) and before-after exercise at the last training ($p=0.004$), while in inclination group plasma IL-6 levels before-after exercise showed no significant decreasing of plasma IL-6 levels ($p=0.107$) at the last training. In both groups, there is significant delta (Δ) of plasma IL-6 levels between before exercise at the first and last training ($p=0.001$), between after exercise at the first and the last training ($p=0.001$).

Speed Group

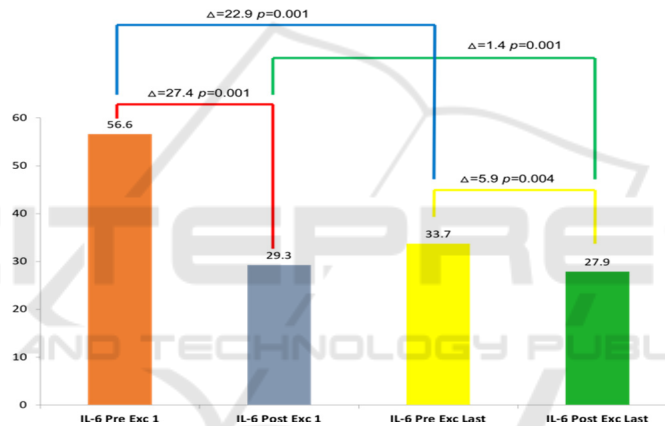


Figure 1: Plasma IL-6 levels in Speed Group.

Inclination Group

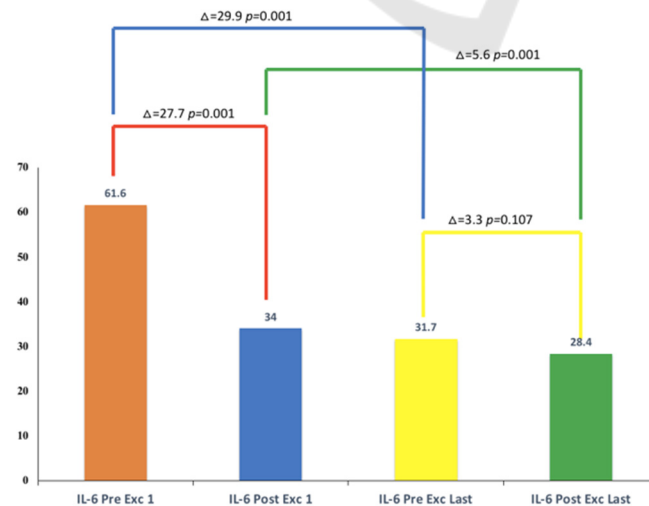


Figure 2: Plasma IL-6 levels in Inclination Group.

Table 1: Characteristics of subjects.

Groups	Speed (n=10)	Inclination (n=10)	<i>p</i>
Age (years)	31.1±2.9	32.8±1.8	0.131
Body Weight (kg)	63.0±7.5	65.4±9.4	0.536
Body Height (cm)	168.7±7.4	168.5±9.4	0.952
BMI(kg/cm ²)	22.1±1.5	22.9±1.9	0.271
IL-6 Pre Exercise ¹	61.6±9.9	56.6±6.3	0.193

4 DISCUSSION

It has been known that the pattern of physical activity involves low levels of inflammation, which is characterized by an increase in inflammatory markers in the plasma such as IL-6, TNF- α , IL-1, and other markers. The primary source of IL-6 in the blood circulation from muscle contraction in response to acute exercise. IL-6 and CRP reflect regular physical activity (Fisher et al., 2007).

Cytokines can modulate metabolism, the endocrine system, and coagulation (Febbraio et al., 2004), produced and secreted by cells also tissues that are not immune systems, such as fat tissue, approximately 30% of IL-6 in circulation during basal conditions, and can be regulated by physical activity. At the end of the exercise, synthesis and secretion of IL-6 from contracting skeletal muscle increase to 100 times from basal IL-6 levels. Levels of IL-6 and CRP are highly regulated by acute exercise, depending on exercise intensity. Furthermore, the basal level of IL-6 in circulation is sensitive to the addition of duration of regular physical activity. Another study reported that basal IL-6 levels were lower in people whose lifestyle was active.

This research showed that the plasma IL-6 level as an inflammatory marker decrease significantly after the exercise. It is proven that regular physical activity lowers basal levels of IL-6 or 30 minutes of exercise did not cause muscle injury so that the production of IL-6 as an inflammatory marker becomes low. The research of Pedersen et al. (2004) showed a drastic decrease in IL-6 is associated with decreased exercise capacity. Basal levels of IL-6 in healthy people are expected to be low, so populations with reduced lifestyle patterns such as

over-nutrition and lack of activity are associated with increased levels of inflammatory markers (Fisher et al., 2007). The subjects in this study consisted of healthy people who were sedentary and active so that the average plasma IL-6 level was high (pre-exercise in both groups).

Since IL-6 is produced upon muscle contraction (Pedersen and Febbraio, 2008), dynamic exercise will elicit more significant hemodynamic changes that contribute to increasing IL-6 to the blood (Barnes et al., 2010). Thus IL-6 is produced a large amount in contracting muscles and is released to the circulation (Steensberg et al., 2002). In this study, the level of plasma IL-6 of before exercise at the last training, showed a significant reduction compared to plasma IL-6 levels before exercise at the first training, whereas between before-after exercise at the last training also showed a significant decrease in plasma IL-6 level (speed group). Regular exercise lowers and maintains the plasma IL-6 level, In this study the regular exercise in the form of 3 times per week for each group in 2 weeks with relatively the same intensity, and may result in a similar reducing of plasma IL-6 level (Febbraio et al., 2004).

5 CONCLUSION

Plasma IL-6 level decreased with exercise on a treadmill either by increasing inclination or speed. IL-6 as an anti-inflammatory marker in exercises with moderate intensity treadmills

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