Effect of small sided soccer games on Interleukin-18 and blood lactate of teenage soccer players in warm weather

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Original Article

Abstract

Introduction: Training techniques, age, and climatic conditions may play a significant role in physiological responses of soccer players. Therefore, this study set out to investigate changes in the serum interleukin-18 (IL-18) and blood lactate levels of teenagers after playing small-sided soccer games in warm weather.

Methods: In this study, 24 soccer players aged 15-18 years were participated. Among them, 16 players divided into six experimental groups including two 4-member teams (mean age: 16.13±0.88 years; height: 167.00±6.66cm; weight: 58.70±7.34kg: BMI: 20.96±1.79) and four 2-member teams (mean age: 16.80±0.48 years; height: 167.00±5.73cm; weight: 55.16±5.98kg: BMI: 19.78±1.83). Experiments were conducted in two fields, sized 25×20 m^2 and 35×28m^2, respectively. The other 8 players (mean age: 16.18±1.07 years; height: 171.00±6.75cm; weight: 58.86±8.21kg: BMI: 20.03±2.14) were taken as control group and did not perform any [athletic] activity. The blood samples of all groups were collected before and immediately after the games, and then the IL-18 and lactate levels were measured.

Results: According to the results, the amount of IL-18 and lactate significantly increased in the experimental groups ($P<0.05$).

Conclusion: It may put that playing small sided soccer games in warm weather significantly increases IL-18 and blood lactate levels of teenage players.

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Introduction:

Since the early 1900s, lactic acid has been introduced as an anaerobic end-product of glycolysis. In the body, lactic acid is formed as a product of sugar metabolism in cells. Lactic acid ($C_3H_6O_3$) in human body exists in an ionic form, called lactate ($C_3H_5O_3$). Increased lactic acid concentration results in an increase in the concentration of hydrogen ions (through the conversion of lactic acid to lactate and hydrogen ions) in the body. As a result, it decreases blood pH, which per se reduced the release of calcium

ions and its affinity for troponin. This also reduces muscle energy and results in muscle fatigue (1-4). On the other hand, cytokines, as a group of proteins, are produced predominantly (although not exclusively). They play a role in formation and adjustment of immune and inflammatory responses.

These factors are the product of the immune system. They are produced temporarily and controlled through negative self-adjustment. Meanwhile, IL-18 is a proinflammatory cytokine and an interferon gamma (IFNγ) inducing factor that trigger the production of IFNγ in NK and CTL cells. It also results in an increase in killing of these cells by a porphyrin/FasL-dependent pathway (s as natural killer). This cytokine has a salient role in auxiliary activity of T helper 1 (Th1) and induces the expression of such Granulocyte Macrophage Colony–Stimulating Factors (GM-CSF) cytokines as IL-13, T helper 1 (TNF), as well as such chemokines as IL-8 (5-9). Climate and its effects, as well as the type of sport can significantly affect physiological responses to physical activities. In the childhood and adolescence, both long-run and short-run activities have different degrees of impact on the immune and inflammatory factors (10). With respect to the nature of soccer, it is categorized as an intense periodic team sport, which can impose a huge pressure on players, leading them to undergo metabolic and inflammatory changes (11-13).

Concerning scant studies on inflammatory-metabolic factors in teenage soccer players, further investigations seem necessary. It is then important to discover, “What are the changes in serum IL-18 and lactate levels of teenagers playing small sided soccer games in limited-time and warm weather?” The present study was, thus, founded on this question.

Methods:

It was a quasi-experimental study, whose statistical population included teenage soccer players aged between 15 and 18 years. In this study, 24 soccer players of Shahin Soccer Club of Roudan in Hormozgan, Iran, were selected, using convenience sampling technique. They were then included into the study after completing the consent and medical history forms, having full knowledge of research procedure. The subjects were recommended to avoid using ergogenic aids such as dietary supplements, herbs or certain medications that affect the immune system, for a period of one week prior to the study. They were also asked to avoid intense workouts for two days before the experiment. To homogenize the groups, the maximum oxygen consumption (using 1 Mile Endurance Run Test), skill level, and anthropometric properties of the subjects were measure one week prior to the experiment. All subjected attended at the sports complex at 4:00 PM of the phlebotomy day, and their first blood specimens (4cc) were collected at 4:30 PM.

Phlebotomy was performed on left hand vein and blood specimens were placed in ice-cold containers. The lactate levels of the athletes were measured beforehand, using a lactometer (Lactate Scout, Germany). After that, the experimental subjects began playing soccer according to the preplanned training protocol (four 2-member groups and two 4-member groups), at 5:00 PM after 15-minute warm up under the temperature of 40 °C and humidity of 17%. The 2-member teams played eight 2-minute games with 1-minute rest interval between every 2-minute activity in a field sized $20\times25m^2$, without goal keeper; whereas, the 4-member teams played four 4-minute games with 2-minute rest interval between every 4-minute activity in a field sized $28\times35m^2$, without goal keeper (14). During the implementation of the protocol, the competing teams were instructed by two different coaches. Balls leaving the touch lines were immediately substituted. The intensity of the activities was controlled by measuring heart rate, using Polar RS400sd Heart Rate Monitor Watch (made in Finland). The control group did not do any activity during the implementation of the training protocol. By the end of the training protocol, the lactate levels of the subjects were measured again with a lactometer, and post-test blood samples of them were collected at 5:45 PM and transferred to the laboratory in ice-cold containers. To measure IL-18, blood samples were examined with ELISA after the serums were separated by centrifugation. The obtained data was then analyzed through one-way ANOVA in SPSS 16. To examine the normality of data distribution, the Kolmogorov-Smirnov test was utilized. In

addition, the Scheffe post hoc test was used to investigate intergroup changes.

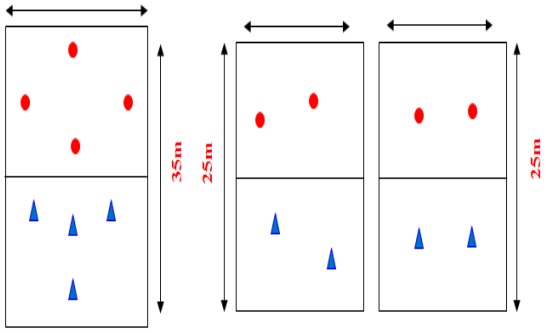

Figure 1. Dimensions of the field and number of participants in training protocol

Results:

Among 24 subjects, 16 subjects (two 4-member teams and four 2-member teams) participated in all research stages and played according to the protocol. The control subjects only underwent pre- and post-test measurements. The Kolmogorov-Smirnov Test confirmed the normality of data distribution. The statistical data of the control and experimental groups are presented in Tables 1-3.

According to Table 2, comparison between the competing experimental groups (2-member team versus 2-member team, and 4-member team versus 4-member team) showed that they were significantly different in terms of lactate level ($P<0.05$; $P=0.000$). This significant difference was also true for IL-18 ($P<0.05$; $P=0.042$).

Table 1. Mean and standard deviation of physical indices of experimental and control groups

Group	Number	Age(year)	Height(Cm)	Weight(Kg)	BMI(Kg/m²)
Control	8	16.18±1.7	171±6.75	58.86±8.21	20.03±2.14
2vs.2	8	16.80±0.48	167±5.73	55.16±5.98	19.78±1.93
4vs.4	8	16.13±0.88	167±6.66	58.70±7.34	20.96±1.79

Table 2. Results of ANOVA for IL-18 and lactate levels of experimental and control groups

Variable	Groups	F	P
IL-18	Control 2×2 4×4	3.701	0.042
Lactate	Control 2×2 4×4	16.390	0.000

Table 3. Results of ANOVA for lactate level of experimental and control groups

Variable	Groups	F	P
Lactate	Control 2×2 4×4	16.390	0.000

Conclusion:

Several researchers have reported an increase in lactate level when playing sports (15-17). Linen et al. (2004) showed the lactate level is higher when sports activities are performed in warm weather, as compared to the controlled temperature (18). Ana Cristina et al. (2007) also showed that lactate values significantly increased at three different temperatures; while, there was no significant difference between the environments (19). Tayka et al. (2009) also reported that playing sports at temperatures above normal degrees increased lactate level and decreased its threshold (20).

Anderson et al. (2010) investigated some proinflammatory and anti-inflammatory cytokines in 100 elite female soccer players following two separate 90-minute games with 72 hours active and non-active recoveries. After the first and the second games, the total leukocyte and neutrophils significantly increased. Increases in proinflammatory cytokines (IL-2, TNFα, MCP-1,

IL-8, MIG ،INfγ, IL-17) and anti-inflammatory (IL -2R, IL-4, IL-5, IL-17, IL-10, IL-13,INFα) were evaluated. Leukocyte and cytokine levels became normal after 12 hours. The active recovery showed no impact on the level of cytokines. A weak response was observed after the second game in IL-12, IL-6, MCP-1, IL-8, and MIG parameters, indicating a modest increase (21). Elmida et al., (2012) investigated the relationship of serum IL-6 and IL-18 levels with the energy received after training in 5 homozygous twins. One pair of the twins performed a submaximal treadmill exercise for 45 minutes. Findings indicated that oxygen consumption was maximum (90%) during the last 7 minute. Results showed no significant change in IL-18 level; whereas, the amount of IL-6 significantly increased. They concluded that there existed a significant correlation between serum IL-6 level and the energy received after an intense workout (22). On the hand, Markovic et al. (2008) applied a 7-day moderate-intensity workout to 12 low-active middle-aged men. Results did not show any significant change in serum levels of IL-10, IL-6, and C-reactive protein (CRP) (23).

Soccer is categorized as an intense and periodic sport. Due to its nature, energy production during a soccer game is done through an anaerobic system with lactate (28). Playing sports in warm weather is associated with different neural and hormonal effects that can affect the performance of involved systems. During physical activity in such conditions, temperature increases the arousal of the sympathetic nervous system, leading to the release of catecholamines. This hormone affects cardiovascular and respiratory systems in order to excrete the heat from the body. Moreover, increase in lactate level is directly connected to an increase in the concentration of glucocorticosteroids such as cortisol. It is due to an increase in the metabolism and accumulation of metabolic waste products like lactic acid, resulting in acidity of blood, reduction of pH, and higher level of H^+ (16). Some studies have shown that the cardiovascular and respiratory factors can strongly affect serum cytokine changes induced during playing sports. On the other hand, catecholamines have direct impact on the expression of inflammatory cytokines (24-27). In general, physical and mental stresses trigger signals from brain that affect the performance of immune and other systems of the body. Playing sports causes a type of stress that activates two main neuroendocrine pathways in the Hypothalamic–Pituitary-Adrenal (HPA) axis. This phenomenon controls the immune system and other body systems through the secretion of glucocorticoids. It also controls the sympathetic nervous system by releasing some catecholamines (epinephrine and norepinephrine). It is then expected that changes in the amounts of catecholamines and glucocorticoidssuch as cortisol manipulate the amounts of proinflammatory serum cytokines such as IL-18 and blood lactate. Results suggest that the proposed mechanism may justify the increase in the amounts of IL-18 and lactate. It may thus concluded that small sided soccer games in warm weather increase serum IL-18 and lactate levels in young players. Due to the type of IL-18 and small number of studies on concurrent serum and lactate changes, the exact effects of small sided games cannot be measured. It then seems that the serum IL-18 and lactate levels should be evaluated in different times and conditions after physical activities. Although, this study has controlled factors such as nutrition and intake of medicine, constructs such as environmental conditions, limited sample size, and stress may have affected the research findings. Therefore, conduction of further studies with a greater sample size and more precise control over limitations on the same statistical population is recommended to achieve more complete results.

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