

Effect of Two Methods of Training, Small Sided Game (SSG) and Resistance-Plyometric, on Plasma Level of Interleukin-6 and Tumor Necrosis Factor-Alpha in Youth Soccer Players

Saeed. Rostami¹ Mohammad. Faramarzi² Golnaz. Arbab³ Leyla. Ahmadi⁴

Instructor Department of Physical Education¹, Islamic Azad University, Mobarake Branch, Isfahan, Iran. Associate Professor Department of Physical Education², Shahrekord University, Shahkord, Iran. Instructor Department of Physical Education³, PhD Student of Physical Education⁴, Islamic Azad University, Bandar Abbas Branch, Bandar Abbas, Iran.

(Received 19 May, 2013

Accepted 27 Aug, 2013)

Original Article

Abstract

Introduction: The aim of this study was to examine the effect of two concurrent resistance-plyometric and small sided game methods on pro-inflammatory in youth soccer players.

Methods: 30 youth soccer players with a range of 14 to 17 years of age were divided randomly in three groups, SSG (n=8), resistance-plyometric (n=11) and control (n=11). Height, weight, BMI and VO₂max of the subjects were measured. The next day, blood samples from the anterior brachial vein of subjects were taken. The experimental groups participated in their exercise program (8 week, 2 sessions per week plus three current sessions). All variables were measured again after 8 weeks. In order to compare data within groups' Dependent t-test was used and for comparison between groups Independent t-test was used by SPSS 17.

Results: The findings showed that after 8 weeks of SSG training plasma level of IL-6 and TNF- α increased significantly. The results in other groups did not show significant change (pvalue \geq 0.05).

Conclusion: SSG training can induce a catabolic environment in youth soccer players' body.

Key words: Interleukin-6 - Cytokine - Soccer Player.

Correspondence:
S. Rostami, MSc.
Department of Management
and Accounting Islamic Azad
University, Mobarakeh Branch,
Isfahan, Iran
Tel: +98 913 1088601
Email:
srostami.20@gmail.com

Citation: Rostami S, Faramarzi M, Arbab G, Ahmadi L. Effect of Two Methods of Training, Small Sided Game (SSG) and Resistance-Plyometric, on Plasma Level of Interleukin-6 and Tumor Necrosis Factor-Alpha in Youth Soccer Players. *Hormozgan Medical Journal* 2014; 18(4): 306-312.

Introduction:

Soccer special exercises usually include exercise games done in a smaller field with a few number of people. This special type of exercise is called small-sided game (SSG) (1). The SSG exercises is often as a part of exercise programs for adult players in various forms depending on

exercise goal (2). The interval exercise by using SSG exercise is effective for improving aerobic preparation and soccer special resistance. Nemeth et.al (2007) surveyed the effectiveness of one hour and a half wrestling exercise on inflammatory cytokines and growth factors in highschool adolescents (aged 14 to 18), and the result showed

that the exercise stages for one hour and a half (12 weeks) with intensity leads to decrease anabolic insulin-like mediators, IGF-1, GH and to increase inflammatory cytokines (3). Also, Anderson et al (2009) in their research, analyzed cytokine responses after two soccer matches in 72 hours. The blood specimen was taken from elite female players between two halves of the first match, 20min after the first match, 69h after the first match and 20min after the second match. The results showed those interleukin-6 amounts, necrotizing, α tumor, interferons, leukocytes, interleukin-12 increased. The return way to the former position had no impact on cytokine secretion (4). On the other side, soccer is a sport based on explosive movements like kicking, jumping and fast replacing. The players traversed about 10Km and needed frequent and fast replacements in regular time intervals during the match. So, one of the most important parts in players exercise programs should be improving the soccer special power defined as a player ability for using the muscle power and ability effectively and continuously in soccer special activity during the match (5).

Pedersen and Febbraio (2008), also studied effectiveness of 6 week combined training (resistance- plyometric) of physical function of 27 boys aged 12-15, and showed that this combined training method has a considerable effect on physical performance of youth-athletes (4). Faigenbaum et.al (2009) surveyed the vertical jump and kick powers in youngster female players. 16 players performed plyometric exercises for 14 weeks, and the above tests were given before and after exercises. The results showed that plyometric exercises lead to increase kick and jump power (6). So regarding to development improvement of physical performance by each one of resistance and plyometric exercises by itself and according to recent investigation, the combination of two exercises leads to more development of physical performance (7).

Therefore, nowadays in exercise programs of most soccer player's especially young players, there are both soccer special resistance exercises like SSG strength-plyometric together. Although, various studies have been done about these exercises effects on physical functions, a few studies have been done about hormonal and biochemical effects of these exercises in youth

separately or compoundly. Cytokines are one of the biochemical factors as well. They are important intercellular message-transfer molecules which regulate inflammatory reaction. The number of leukocytes and IL-6 level increase and α tumor necrosing factors α (TNF α) has been shown in male soccer players in the previous research (1). Also, it was shown that the pre-inflammatory response can be balanced through anti-inflammatory cytokines production after resistance exercises (8).

Today, the complication of anabolic, catabolic response to exercises is unclear. So, in this study, we focused on new mediatory factors studied previously separately which can intervene in this process. It means whether a period of mixed exercises (resistance-plyometric) and SSG in young soccer players can lead to change of resting level of inflammatory factors or not?

Methods:

In this study based on contrastive analysis, the effectiveness of 2 kinds of special soccer training and resistance-plyometric, or modifications of some pre-inflammatory in young boy players, was compared. In this way that two exercise protocols after 8 week training on IL-6 and TNF- α changes in young players were compared.

The related data for measuring the research dependant variables was collected by pre-test and post-test and the effectiveness of independent variable on dependant variable were surveyed in experimental examinees. The studied group including 30 young players with continuous participation in Giti Pasand soccer team were selected for two protocols, soccer specialized and resistance-plyometric. In regard to the topic, the technique and method of study meaning the existence of two experimental and control group, pre-test and post-test and the presentation of independent variable from experimental group, this research is a quasi-experimental study done in the field, and is also applicable due to using the acquired results.

The research examinees included 50 individuals of young soccer players in Giti Pasand club checking by the coach of the mentioned team, 30 subjects participating constantly in exercises (at least for past 1 year) with full physical health and without chronic disease or injury, were selected by, purposeful sampling

technique. Then the subjects Randomized in 3 experimental, 1 (the Soccer Specialized exercise group including 8 people), 2 (the resistance-plyometric exercise group including 8 people) and control group (11 people). The selection method was in a way that at first the questionnaires containing medical history of the selected players by initial checking with the club coaches and managers were distributed among the players.

In this questionnaire, there was emphasis on some entrance conditions in the study including lack of disease history and following an appropriate diet, lack of smoking, alcohol, caffeine and drug.

Then, we selected 30 qualified subjects who had participated continuously in the exercises in order to do two exercise protocols. It is worth mentioning that the players were distributed randomly in both groups and all examinees pronounced that they have had full physical health and haven't had any diseases and infection history. After the necessary checking with authorities and written consent from the parents and players, the planning began to do the investigation. In table 1, the central indexes related dispersion to general characterization of examinees including age, height, weight, body mass index and Vo_2max have been presented.

The examinees were asked to attend the club in order to measure the primary anthropometric indexes such as height, weight, body structure.

The height based on cm and using tape measure and the weight based on Kg and using Seca balance and when they had the fewest clothes on without shoes were measured.

Also, body mass index using an applicant for measuring body structure was measured in the club office.

After measuring these indexes, running test for 12 min was done to measure the maximum consumed oxygen. For measuring the maximum consumed oxygen of the examinees, walking and running test for 12 minutes was used, in this way that the examinees ran around the field for 12 minutes and the traversed distance by every examinee was calculated and then using the following formula, their Vo_2max were calculated.

$$Vo_2(max) = \left(\frac{\text{mili Litire}}{\text{Kg} \times \text{min}} \right) = [D \times 0/0268] - 11/3$$

Which in this formula, D for traversed distance was in meter? (9)

The exercise program was done during 8 weeks divided into two stages in 4 week to adjust the work intensity. The first stage included SSG exercise for 4 weeks with 2 sets for 11 minutes and 120 seconds break between the sets which was performed in 4×4 method in a 40×20m field in the second 4 weeks, SSG protocol included 3 sets for 7 minutes and 60 seconds break which is performed in 2×2 method and a 20×15m field.

This program was used previously by Hill Has et al (2009) and its effective properties were proved (8). These exercises were done twice a week along with current soccer exercises.

The second exercise protocol (plyometric-resistance exercise) accomplished by 11 players included mined exercise for 8 weeks (10).

The examinees performed the plyometric-resistance exercise along with the current exercise. The intensity of exercise was slow in the first two weeks and medium in next six weeks. The resistance exercises including anterior of the pesterort of the tigh, chest press food press and tigh movements and plyometric exercises were the movement with box and medicine ball. The rest of examinees (11 people) as control group will do ordinary soccer exercises under the supervision of their coaches during 8 weeks.

For analyzing the biochemical variables, the blood taking was done after 12-14 hours of fasting and in two stages (before exercises and after 8 weeks of the exercise). In the first stage, the examinees were asked to do on exercise in two days before the test. Then, they attended the medical diagnosis laboratory. The temperature and time of the test were recorded to maintain the conditions in the next stage. 7 mL clogged blood was taken from the vein of left hand in sitting and rest states and immediately the serums were separated. The serum obtained from the lab was kept in temperature -80 °C to be used in case of necessity. After this stage, the examinees were under specialized exercise for 8 weeks and they were invited again to the laboratory to give blood like the first stage after passing the desirable time and 24 hours after the last session of exercise. IL-6 and TNF- α were tested. Using method ELISA and respectively company kits, bender med systems and bioscience.

Analyze data, descriptive statistics, To evaluate the changes in every index from pre-test to post-test and to compare the result between the groups t-test and ANOVA analysis tests were used SPSS 17 software was used to analyze and a significant level ($p \leq 0.05$) in this study was considered statistical significant.

Results:

The result of the recent study showed that interleukin-6 ($p = 0.001$) increased considerably in SSG group which wasn't significant in control and resistance – plyometric groups ($p = 0.052$ and $p = 0.628$ respectively). An exercise period of SSG in this study raised the level of necrotizing factor in tumor α ($p = 0.001$), but this change is not significant

in the resistance-plyometric exercise and control group (repectively $p = 0.602$ and $p = 0.846$). The data related to the comparison between the groups show that there is a significant difference between difference mean of three groups in posttest ($p = 0.005$).

The pursuing test (LSD) is used to determine the difference between groups. There is a significant discrepancy between SSG and control group and also SSG and resistance-plyometric (interleukin-6 is $p = 18\%$ SSG between mixed groups and is $P = 0.0001$ SSG between control groups, necrotizing factor of tumor α is $p = 0.003$ SSG between mixed groups and is $p = 0.013$ SSG) between control groups that show a significant increase in the average amount of inteleukin-6 and necrotizing factor of α in SSG group.

Table 1- Physical and psychological characteristics in enemaines

Group	Statistics	Number	Age (year)	Height (cm)	Weghit (kg)	Body Mass Index (kg/m ²)	VO2MAX (mlt/kg)
SSG Group		8	14.62±3.1	1.81±0.26	69.5±10.5	23.66±2.14	39.22±2.84
Resistance – Plyometric Group		11	14.57±0.9	1.71±0.58	62.29±15.1	21.63±2.95	40.54±3.04
Control Group		11	15.67±0.6	1.74±0.42	68.19±14.7	21.31±2.11	40.89±2.76

Table 2- Descriptive changes of data

Variable	Statistics	Group	Pretest	Posttest	Intra Group P	Inter Group pvalue
IL-6		SSG	1.64±0.42	5.75±1.94	* 0.001	
		Resistance-Plyometric	2.26±1.86	3.44±2.24	0.0527	* 0.005
		Control	2.40±1.28	2.55±0.98	0.628	
TF- α (pg/ml)		SSG	7.47±0.85	11.68±3.26	* 0.001	
		Resistance-Plyometric	1.8±0.3	1.2±0.3	0.602	* 0.009
		Control	10.47±3.40	1017±2.78	0.846	

* Significant Change

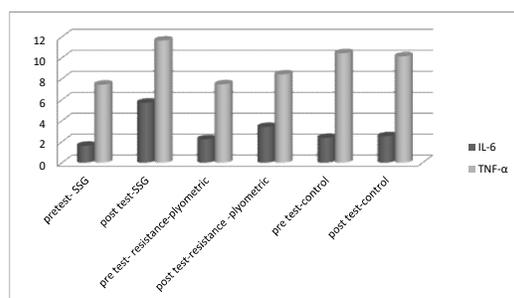


Diagram 1- Changes of IL-6 and TNF during 8 Weeks of Training in Three Group

Conclusion:

The results in the recent research showed that interleukin-6 and necrosis factor of tumor α rose considerably in SSG group which was insignificant in resistance-plyometric control groups. Regular and long-term exercises remarkably change the secretion of interleukin-6 and necrosis factor of tumor α . Respecting the involvement of most lower muscles in research in method SSG, including running pattern, the kind of spasmodic muscle may have an important role to release interleukin-6 and

necrosis factor of tumor α . On the other side, each regular and long-term physical activity causing the increase of spending energy leads to increase the level in pre-inflammatory cytokines cycle. In general, it can be said that long-term stress raises the level of the stress hormones and leads to positive changes in muscular synthesis. Also, the significant increase in IL-6 and TNF- α may be due to increasing in intensity of this exercise method followed by the probable decrease of glycogen storage. In other words, when glycogen in type - 2 muscular fibers during long-term exercise is discharged, type-2 fibers are called respectively to preserve the energy. When these fibers are called, they are duplicated and immediately produce interleukin-6 (11).

A research by Della et al (2009) showed that the effectiveness of volleyball current exercises on male and female players in national level during 8 weeks with significant increase, is compatible with our research (12). In this research, the investigators declared jump, frequent hits and rapid replacements cause tiny injuries in tissues leading to increase inflammatory cytokines. Also in soccer, the frequent hits, jumps and rapid replacements in long-term may lead to such mechanism and be one of the reasons for the rise of interleukin-6 and TNF- α level in this research. Katis and Kellis (2009), analyzed the impact of endurance exercise during 5 weeks on pre-pubertal and early pubertal youths. Also, in this research interleukin-6 and necrosis factor of tumor α rise significantly which is associated with the recent research result (13). In this investigation, it is stated that the increase of interleukin-6, necrosis factor of tumor α can be due to increasing the energy spending by severe physical activity. In regard to much dependence of soccer exercises to muscular glycogen and the probable discharge at the end of each exercise session and relatively high spent energy of these exercises may be the probable reason of the increase of IL-6 and TNF- α in this study. The study by Hill-Haas et al (2009) about the resistance exercises in professional cyclists (8) and the study by Fanchini et al (2011) about cytokine response after two soccer matches with 72h interval showed a significant rise in interleukin-6 which corresponds with the recent research (14).

In a study by Febbraio and Pedersen (2002), profile changes of cytokines in male adolescent gymnasts during 8 weeks exercise after vaccination against

influenza was analyzed and a decrease in interleukin-6 concentration and necrosis factor of tumor α was observed which does not correspond with our study. It can be said that regarding to similarity in exercise duration, perhaps vaccine impact or exercise intensity is the reason of difference in the result with the recent research result (2). In a research by Faigenbaum et al (2009), interleukin-6 and necrosis factor of tumor α had a significant decrease which contradicts our result this difference may be because of perceiving supplemental L-carnitine and observing improvement of immune system function (7). In a study by Rian Kord (2004), interleukin-6 and necrosis factor of tumor α showed a significant decrease which is opposed to our result. This difference may be due to hyper-activity of the examinee during increasing age (15).

It can be concluded that in SSG due to high severe exercise and high level of stress hormones, evacuation of glycogen storage existing in muscle and tiny injuries in tissue emerging from rapid replacements and frequent hits in soccer, the inflammatory cytokines increase significantly. Our findings based on interleukin-6 increase after 8 weeks of SSG show that this interleukin is an inflammatory cytokine sensitive to sport activity. Running and current hits in this training method with intra-tissue injuries might lead to increase interleukin-6 in long term which is one of the reasons for increasing hypertrophy. On the other side, regular and long-term physical activity which causes an increase in spending energy leads to increase the levels in pre-inflammatory cytokines cycle. Generally, it can be said that long stress can increase the level of stress hormones and lead to positive changes in muscle synthesis. Also, the significant IL-6, TNF- α may be due to high intensity of these exercises method followed by the decrease of glycogen storage. The high level of interleukin-6 can cause a decrease in the function of growth-hormone axis – the growth hormone–insulin-like factor 1.

Numerous researches have shown that the pre-inflammatory cytokines have catabolic role in response to long-term exercise. Such changes were not seen in resistance-plyometric method. More analysis to study the coordination and relationship between these variables by growth-biochemical mediators in plasma can illustrate the role of these changes. In this research, the efforts focus on

deciding the limitations as much as possible to draw a realistic conclusion from the findings. The controlled limitation included age, gender, time and taking blood condition and uncontrolled limitations, individual differences like genetic, family and psychological factors, lack of control for examines diet and impossibility of disease control.

Acknowledgment:

It needs to appreciate physical education group in Shahre Kord University and the players and technical personnel in Gitipasand club in Shahin Shahr who helped us in implementation of research sketch.

References:

1. Matavulj D, Kukolj M, Ugarkovic D, Tihanyi J, Jaric S. Effects of plyometric training on jumping performance in junior basketball players. *Journal of sports medicine and physical fitness* 2001; 41(2):159.
2. Febbraio MA, Pedersen BK. Muscle-derived interleukin-6: mechanisms for activation and possible biological roles. *The FASEB Journal* 2002; 16(11):1335-47.
3. Nemet D, Youngman OH, Ho-Seong Kim, Hill M, Cooper D. Effect of intense exercise on inflammatory cytokines and growth mediators in adolescent boys. *American academy of pediatrics*, 2002; 110(4): 681-9.
4. Andersson H, Bohn S K, Raastad T, Paulsen G, Blomhoff R, Kadi F. Differences in the inflammatory plasma cytokines response following two elite female soccer games separated by a 72-h recovery. *Scand J Med Sci Sports* 2010; 20(5):740-7.
5. Pedersen BK, Febbraio MA. Muscle as an endocrine organ: focus on muscle-derived interleukin-6. *Physiological reviews* 2008; 88(4):1379-406.
6. Steensberg A, Hall G, Osada T, Sacchetti M, Saltin B, Pedersen BK. Production of interleukin - 6 in contracting human skeletal muscles can account for the exercise - induced increase in plasma interleukin - 6. *The Journal of physiology* 2000; 529(1):237-42.
7. Faigenbaum AD, McFarland JE, Keiper FB, Tevlin W, Ratamess NA, Kang J, et al. Effects of a short-term plyometric and resistance training program on fitness performance in boys age 12 to 15 years. *J Sports Sci Med* 2007; 6(4):519-25.
8. Hill-Haas S, Coutts A, Rowsell G, Dawson B. Generic versus small-sided game training in soccer. *International journal of sports medicine* 2009; 30(09):636-42.
9. Helgerud J, Engen LC, Wisloff U, Hoff J. Aerobic endurance training improves soccer performance. *Medicine and science in sports and exercise* 2001; 33(11):1925-31.
10. Duthie GM, Young WB, Aitken DA. The acute effects of heavy loads on jump squat performance: an evaluation of the complex and contrast methods of power development. *The Journal of Strength & Conditioning Research* 2002; 16(4):530-8.
11. Pedersen BK, Fischer CP. Beneficial health effects of exercise—the role of IL-6 as a myokine. *Trends in pharmacological sciences* 2007; 28(4):152-6.
12. Dellal A, Chamari K, Wong DP, Ahmaidi S, Keller D, Barros R, et al. Comparison of physical and technical performance in European soccer match-play: FA Premier League and La Liga. *European Journal of Sport Science* 2011; 11(1):51-9.
13. Katis A, Kellis E. Effects of small-sided games on physical conditioning and performance in young soccer players. *Journal of sports science and medicine* 2009; 8(3):374-80.
14. Fanchini M, Azzalin A, Castagna C, Schena F, McCall A, Impellizzeri FM. Effect of bout duration on exercise intensity and technical performance of small-sided games in soccer. *The Journal of Strength & Conditioning Research* 2011; 25(2):453-8.
15. Di Salvo V, Baron R, Tschan H, Montero FC, Bachl N, Pigozzi F. Performance characteristics according to playing position in elite soccer. *International journal of sports medicine* 2007; 28(03):222-7.

تأثیر دو شیوه تمرینی بازی در ابعاد کوچک (SSG) و مقاومتی - پلايومتریک بر سطوح استراحتی اینترلوکین -۶ و عامل نکروز تومور آلفا در بازیکنان نوجوان فوتبال

سعید رستمی^۱، محمد فرامرزی^۲، گلناز ارباب^۳، لیلا احمدی^۴

^۱ مربی، گروه تربیت بدنی، دانشگاه آزاد اسلامی، واحد مبارکه، اصفهان، ^۲ دانشیار، گروه تربیت بدنی، دانشگاه شهرکرد، شهرکرد، ^۳ دانشجوی دکتری، تربیت بدنی، ^۴ کارشناس ارشد، تربیت بدنی، دانشگاه آزاد اسلامی، واحد بندرعباس، بندرعباس، ایران.

مجله پزشکی هرمزگان سال هجدهم شماره چهارم ۹۳ صفحات ۳۱۲-۳۰۶.

چکیده

مقدمه: هدف پژوهش حاضر، بررسی تأثیر ۸ هفته تمرین مقاومتی - پلايومتریک و بازی در ابعاد کوچک (SSG) بر غلظت اینترلوکین -۶ و عامل نکروز تومور آلفا بازیکنان پسر نوجوان فوتبال بود.

روش کار: بدین منظور ۳۰ بازیکن پسر فوتبال با دامنه سنی ۱۴-۱۷ سال (میانگین سن ۱۴±۰/۹ سال، قد ۱۷۱±۰/۶ متر، وزن ۶۲/۳±۱۵/۱ کیلوگرم) برای شرکت در این تحقیق انتخاب شدند و به طور تصادفی در سه گروه بازی در ابعاد کوچک (۸ نفر)، مقاومتی-پلايومتریک (۱۱ نفر) و کنترل (۱۱ نفر) تقسیم شدند. قبل و بعد از ۸ هفته تمرین و در حالت استراحتی IL-6 و TNF-α اندازه گیری شد. سپس آزمودنی ها به مدت ۸ هفته در گروه های مربوطه تمرینات خود را انجام دادند. برنامه تمرین گروه SSG شامل ۸ هفته تمرین بازی در ابعاد کوچک بود که به دو مرحله ۴ هفته ای برای تنظیم شدت کار تقسیم شد و توسط ۸ نفر صورت می گرفت. برنامه تمرین مقاومتی - پلايومتریک نیز توسط ۱۱ بازیکن اجرا شد. این برنامه شامل ۸ هفته تمرین ترکیبی مقاومتی - پلايومتریک بود که آزمودنی ها تمرینات مقاومتی - پلايومتریک را دو بار در هفته و به همراه تمرینات معمول فوتبال انجام می دادند. به منظور مقایسه درون گروهی داده ها از آزمون t همبسته و برای مقایسه بین گروهی از آزمون ANOVA و LSD استفاده شد.

نتایج: نتایج این تحقیق نشان داد اجرای ۸ هفته تمرین بازی در ابعاد کوچک به افزایش IL-6 و TNF-α منجر شد (برای هر سه گروه (pvalue=۰/۰۰۱) و در گروه مقاومتی - پلايومتریک تغییر معنی داری دیده نشد (به ترتیب ۰/۰۵۲ و pvalue=۰/۱۲۶).

نتیجه گیری: به طور کلی، می توان نتیجه گرفت که در شیوه تمرینی SSG به علت شدت بالای تمرین و سطوح بالای هورمون های استرسی، تخلیه ذخایر گلیکوژن عضله و همچنین آسیب های ریز درون بافتی که به واسطه جایجایی های سریع و ضربه های مکرر در فوتبال به وجود می آید، سایتوکین های التهابی افزایش معنی داری می یابد.

کلیدواژه ها: اینترلوکین ۶ - سایتوکین - بازیکن فوتبال.

نویسنده مسئول:
سعید رستمی
دانشکده مدیریت و حسابداری دانشگاه
آزاد اسلامی واحد مبارکه
اصفهان - ایران
تلفن: ۰۸۸۶۰۱۰۸۸۶۰۹۱۲
پست الکترونیکی:
Srostami.20@gmail.com

نوع مقاله: پژوهشی

دریافت مقاله: ۹۲/۲/۲۹ اصلاح نهایی: ۹۲/۵/۲۹ پذیرش مقاله: ۹۲/۶/۵

ارجاع: رستمی سعید، فرامرزی محمد، ارباب گلناز، احمدی لیلا. تأثیر دو شیوه تمرینی بازی در ابعاد کوچک (SSG) و مقاومتی - پلايومتریک بر سطوح استراحتی اینترلوکین -۶ و عامل نکروز تومور آلفا در بازیکنان نوجوان فوتبال. مجله پزشکی هرمزگان. ۱۳۹۳؛ ۱۸(۴):۳۱۲-۳۰۶.