



## Serum immunoglobulins and white blood cells: effect of small-sided recreational soccer

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### General Note

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### ABSTRACT

We examined effects of small-sided recreational soccer on serum immunoglobulin and white blood cells in untrained males. Twenty-three male with mean age 18.75 years were randomized into two different groups namely; experimental group (n = 8), control group (n = 15). Participants in experiment group played four a side supervised recreational football artificial outdoor pitches for sixteen weeks. Participants played football for 30 minutes in each session with two halves of 15-15 minutes. Testing for serum immunoglobulins and white blood cells was performed at designated laboratory as standard protocols. Polar heart rate monitors were used to measure intensity of football sessions. To find significant difference and study effect of recreational football, analysis of covariance was used. Analysis of covariance did not find any significant difference between experimental group and control group in IgA ( $F_{1,17} = .103$ ,  $p = .752$ ), IgG ( $F_{1,17} = 6.47$ ,  $p = 0.021$ ) and IgM values ( $F_{1,17} = 6.71$ ,  $p = .019$ ). We did find a significant difference in

total white blood cell count between intervention and control group ( $F_{1,17} = 4.549$ ,  $p = .048$ ), Neutrophil ( $F_{1,17} = 4.743$ ,  $p = .044$ ) and Eosinophil counts ( $F_{1,17} = 4.321$ ,  $p = .053$ ). However, there was no significant change observed in Lymphocytes counts ( $F_{1,17} = 1.952$ ,  $p = .180$ ), Monocytes ( $F_{1,17} = 2.649$ ,  $p = 0.122$ ) and Basophil counts ( $F_{1,17} = 1.241$ ,  $p = .281$ ). Neutrophil and total WBC counts increased significantly whereas eosinophil counts decreased significantly post football sessions. Four-sided recreational football did significantly change serum immunoglobulin (IgG and IgM) but failed to bring any significant change in serum IgA values in untrained males. Neutrophil and total WBC counts increased significantly whereas eosinophil counts decreased significantly post football training.

**Keyword:** Small Sided Football, Serum Immunoglobulin, Recreation

## 1. INTRODUCTION

Football game is very much familiar and popular around the world and it appears to be significantly popular among youth in Saudi Arabia. Football as a recreational game is enjoyed by large number of young population. Football can be played as three against three or four against four (Hoff et al., 2002; Impellizzeri et al., 2006; Folland and Williams, 2007; Jones and Drust, 2007; Kelly and Drust, 2009). More over the aerobic demands of recreational football are quite same compared to that of elite football training (Krustrup et al., 2007; Krustrup et al., 2009; Krustrup et al., 2010).

Serum Immunoglobulins are very important to fight body against infectious diseases (Koch, 2010; Laing et al., 2005). Consistency in serum immunoglobulin (IgA, IgM, and IgG) can be changed as a result of exercise (McKune et al., 2005; Dimitriou et al., 2002). Regular football playing can be effective in promoting health in untrained 20-55 years of age men (Krustrup et al., 2010; Krustrup et al., 2009; Krustrup et al., 2010a). Football organized as small sided games can bring marked physiological response in youngsters (Krustrup et al., 2010b).

There are contradictory outcomes on exercise and its effect on immunological system. It appears that there is dearth of research on long-term effects of recreational soccer on immunity. Keeping this in mind and seeing the immense interest of soccer in Saudi Arabia along with its unique social cultural environments, authors examined the effects of small-sided recreational soccer on serum immunoglobulin and white blood cells in untrained males.

## 2. MATERIALS AND METHODS

### Participants

Twenty-three male undergraduate students with mean age 18.75 years were randomized into two different groups namely; first one as experimental group ( $n = 8$ ) while second group acted as control ( $n = 15$ ). After 16 weeks of intervention, there was no withdrawal of participants from the experimental group whereas in control group three participants withdrew from the study and did not report for measurements after 16 weeks of intervention. Experimental group played recreational soccer for sixteen weeks. Control group participants are advised to follow their normal routine.

### Study Design

Participants in experimental group played 4a side supervised recreational football artificial outdoor pitches. The football pitches were 30 m wide and 40 m in length. In order to keep up the intensity high, fulltime goalkeeper was not allowed. We choose evening time to organize our sessions of recreational football. Participants played football for 30 minutes in each session with two halves of 15-15 minutes. Before starting session, participants had to perform warming up exercise for 10 minutes. After the end of supervised football session, participants carried out cooling down exercise for 10 minutes, which included stretching exercises, and slow jogging and walking. The intensity of football sessions was measured by monitoring the heart rate of all participants in the experimental group.

### Testing Protocols

All initial measurement was taken at baseline. We measured weight, height and body mass index using standard procedures. Testing for serum immunoglobulins and white blood cells was performed at designated laboratory as per standard protocols. Polar heart rate monitors were used to measure intensity of football sessions.

### Statistical Tests

We have checked normality of data using Shapiro Wilks Test. To find significant difference and study effect of recreational football, analysis of covariance was used. The data was represented as mean & standard deviation.

### 3. RESULTS

Baseline measurements and data are reflected in table 1. Participants mean age was 18.75 years. We did not observe any adverse complications among participants in experimental group during the football sessions.

**Table 1** General Characteristics of Participants at Baseline

Variables	Experimental Group	Control Group
Age(years)	19.50 ± 0.53	18.25 ± 0.45
Height (m)	174 ± 2	171.91 ± 5.29
Weight(kg)	79 ± 8.62	69.87 ± 9.50
BMI (kg/m <sup>2</sup> )	26.08 ± 3.54	23.87 ± 3.32
Average Hear Rate (b/m) (Measured during play)	169.44 ± 8.95	
Maximum Heart Rate (b/m)	192.81 ± 5.59	
Playing Time (min) (Minutes per session)	26.9 ± 3.9	
IgA (mg/dl)	190.12 ± 19.52	169.91 ± 66.92
IgG (mg/dl)	1158.12 ± 103.58	1166.00±202.44
IgM (mg/dl)	150.31 ± 33.48	77.80 ± 19.63
WBC (/cmm)	6056.25±849.74	5764.00±420.48
Neutrophil (%)	36.76± 8.25	44.28 ± 5.63
Leukocytes (%)	48.13± 5.77	39.09 ±10.26
Monocytes (%)	9.03±1.47	8.40 ±1.40
Eosinophil (%)	5.63±3.01	5.01 ±1.89
Basophil (%)	0.40±0.16	0.38 ±0.11

Data is shown as mean and standard deviation

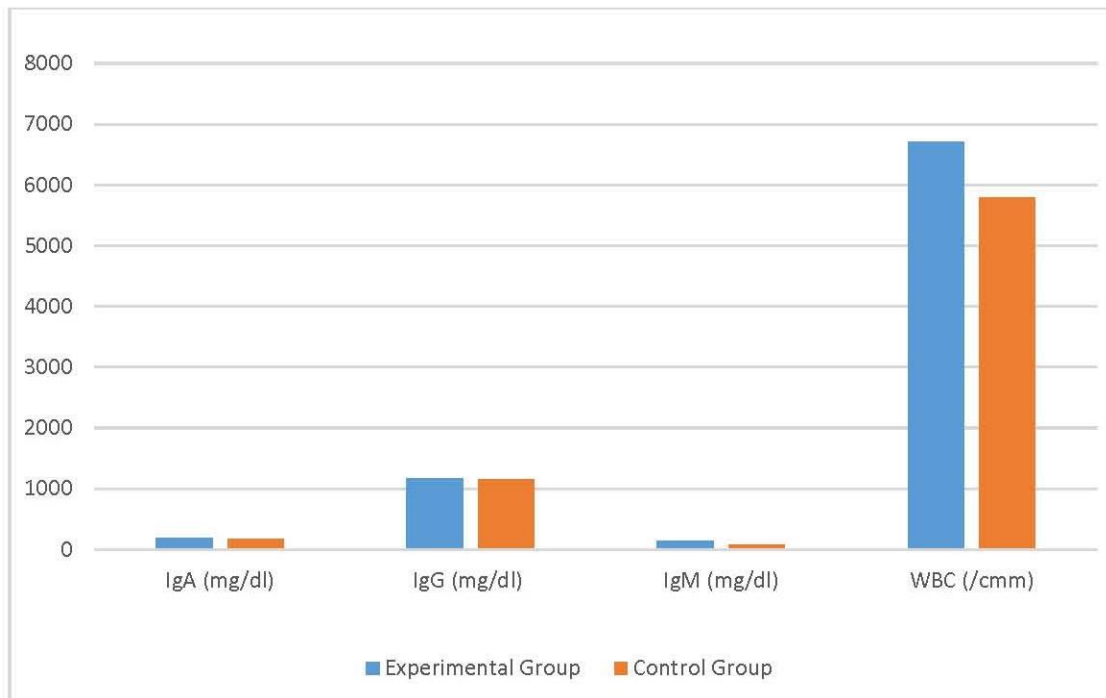
### Serum Immunoglobulins

After sixteen weeks of recreational football, analysis of covariance did not find any significant difference between experimental group and control group in IgA ( $F_{1, 17} = .103$ ,  $p = .752$ ). Findings of present study did not observed any significant change in IgG post intervention between two study groups ( $F_{1, 17} = 6.47$ ,  $p = 0.021$ ). Further, no significant change was seen in IgM values ( $F_{1, 17} = 6.71$ ,  $p = .019$ ) between experimental & control group (Table 2, Fig 1).

**Table 2** Analysis of Covariance: White Blood Cell and Serum Immunoglobulins

Variables	Experimental Group		Control Group		P Value
	0 week	16 weeks	0 Week	16 weeks	
IgA (mg/dl)	190.12 ± 19.52	193.12 ± 22.29	169.91 ± 66.92	172.20 ± 66.98	.752
IgG (mg/dl)	1158.12 ± 103.58	1163.87± 99.20	1166.00 ± 202.44	1147.91±191.42	.021*
IgM (mg/dl)	150.31 ± 33.48	139.31 ± 31.78	77.80 ± 19.63	76.60 ±19.76	.019*
WBC (/cmm)	6056.25±849.74	6713.12±81.07	5764.00±420.48	5794.00±970.29	.048*
Neutrophil (%)	36.76± 8.25	42.60± 6.91	44.28 ± 5.63	46.18 ± 8.06	.044*
Leukocytes (%)	48.13± 5.77	44.03± 5.83	39.09 ±10.26	40.28 ± 6.92	.180
Monocytes (%)	9.03±1.47	8.50±1.34	8.40 ±1.40	8.40 ± 1.14	.122
Eosinophil (%)	5.63±3.01	4.63±2.00	5.01 ±1.89	4.86 ±1.91	.053*
Basophil (%)	0.40±0.16	0.26±0.09	0.38 ±0.11	0.28 ± 0.11	.281

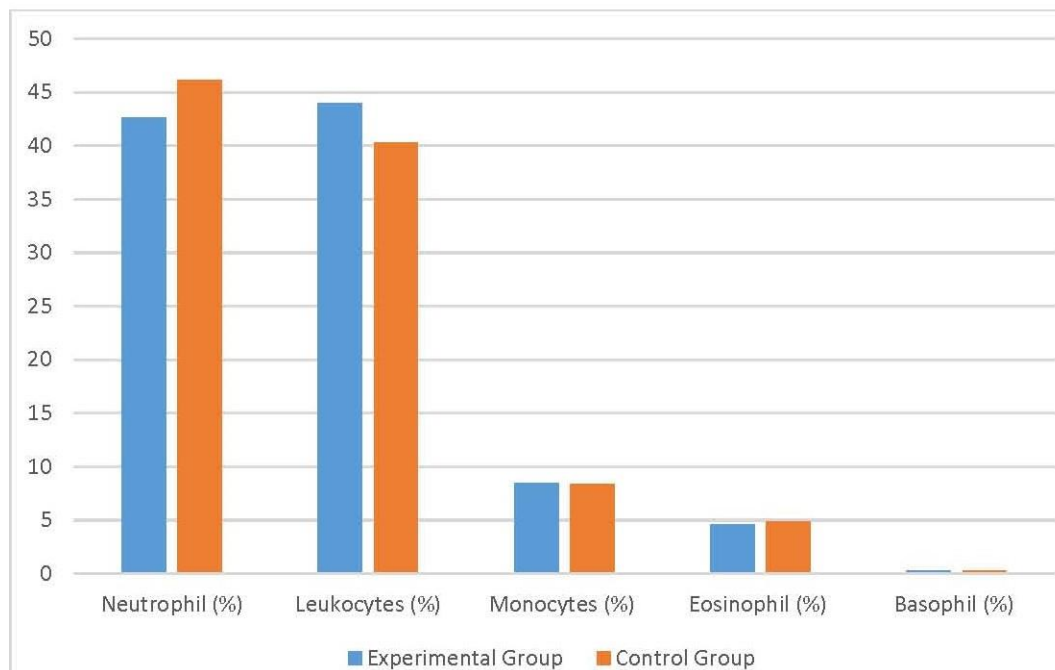
Data is shown as mean and standard deviation\* P <.05, significant difference



**Figure 1** Mean Values of Serum Immunoglobulin and White Blood Cell after 16 week of Intervention in Experimental and Control Group

### White Blood Cell

Post intervention data analysis with one way analysis of covariance did find a significant difference in total white blood cell count ( $F_{1,17} = 4.549$ ,  $p = .048$ ) between intervention and control group. Our data further revealed significant difference in Neutrophil ( $F_{1,17} = 4.743$ ,  $p = .044$ ) and Eosinophil counts ( $F_{1,17} = 4.321$ ,  $p = .053$ ). However, there was no significant change observed in Lymphocytes counts ( $F_{1,17} = 1.952$ ,  $p = .180$ ), Monocytes ( $F_{1,17} = 2.649$ ,  $p = 0.122$ ) and Basophil counts ( $F_{1,17} = 1.241$ ,  $p = .281$ ). Neutrophil and total WBC counts increased significantly whereas eosinophil counts decreased significantly post football sessions (Table 2, Fig 2).



**Figure 2** Mean Values of White Blood Cell after 16 week of Intervention in Experimental and Control Group

## 4. DISCUSSION

### Serum Immunoglobulin

Our results were mixed and contradictory. Serum IgG increased significantly in intervention group following 16 weeks of vigorous recreational football. Heart rate during football training sessions was 169.44 b/min, which indicates that our training was quite vigorous. This vigorous training has generated aerobic demands, which could be similar to those in elite footballers as also reported by some other studies (Krustrup et al., 2007; Krustrup et al., 2009; Krustrup et al., 2010).

On the other hand, serum IgM values in intervention group were decreased significantly following 16 weeks of recreational football training. Results were quite contrast in nature that IgG increased and IgM decreased significantly despite similar intensity and frequency of football sessions. It was surprising to see that no change was observed in serum IgA following similar sixteen weeks of football training. A study conducted on 6a side football by (Tomar and Varghese, 2016) on serum immunoglobulins have shown no change in IgA, IgG and IgM values post sixteen weeks. Another study conducted by (Ghaderi et al., 2011), reported similar findings where no significant change was seen on serum IgA levels in male and female elite athletes groups.

### White Blood Cell Count (WBC)

There was a high intensity football sessions during our study. Mean heart rate of 169.44b/m in our training sessions was equivalent to 87.88 % of MHR (maximum heart rate). These findings in our study are in similarity with another study on 6a side football (Tomar and Varghese, 2016) where total WBC count increased post 16 weeks of football training. Both six a side and four a side football sessions increased WBC count post training. But there some studies which suggest in no change WBC and neutrophil counts post 6 month aerobic training (Johannsen et al., 2012). There was no significant change reported in total white blood cell count after 12 week fitness training in overweight young women (Kostrzewa-Nowak et al., 2015). We have further observed significant increase in neutrophil counts, which is to some extent supported by another study (Northoff et al., 1998) where mainly lymphocytes and neutrophils have substantially increased following acute session of physical activity. We have observed increase in neutrophil numbers & decrease in lymphocyte numbers following sixteen week of football, which is in similarity with another study where football training sessions & football competitions did not show significant change in total leucocytes counts but there was increase in neutrophil counts & decrease in T4 lymphocyte counts (Bury et al., 1998).

## 5. CONCLUSION

The long and vigorous training makes the immune system weak while short and mild strengthen it. Four-sided recreational football did significantly change serum immunoglobulin (IgG and IgM) but failed to bring any significant change in serum IgA values in untrained males. Neutrophil and total WBC counts increased significantly whereas eosinophil counts decreased significantly post football training. Since we have mixed and contradictory results, we cannot generalize and recommend using small four sided football with less intensity.

### Conflict of Interest

Authors hereby declare that they have no conflict of interest.

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### Authors Contribution

Rakesh Tomar - Principal Investigator

Varghese C Antony - Co-Investigator

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## REFERENCE

1. Bury T, Marechal R, Mahieu P, Pirnay F. Immunological status of competitive football players during the training season. *Int J Sports Med.* 1998; 19:364-8.
2. Dimitriou L, Sharp NC, Doherty M. Circadian effects on the acute responses of salivary cortisol and IgA in well trained swimmers. *Br J Sports Med.* 2002; 36:260-4.
3. Folland JP, Williams AG. Morphological and neurological contributions to increased strength. *Sports Medicine.* 2007; 37:145-68.
4. Ghaderi M, AzarbayMani M, Atashak S et al. The Effect of maximal progressive exercises on serum cortisol & immunoglobulin a response in young elite athletes. *Ann. Biol. Res.* 2011; 2:63-56.
5. Hoff J, Wisløff U, Engen LC et al. Soccer specific aerobic endurance training. *Br J Sports Med* 2002; 1; 36:218-21.
6. Impellizzeri FM, Marcora SM, Castagna C et al. Physiological and performance effects of generic versus specific aerobic training in soccer players. *Int J Sports Med.* 2006; 27:483-92.
7. Johannsen NM, Swift DL, Johnson WD et al. Effect of different doses of aerobic exercise on total white blood cell (WBC) and WBC subfraction number in postmenopausal women: results from DREW. *PLoS one.* 2012; 7:e31319.
8. Jones S, Drust B. Physiological and technical demands of 4 v 4 and 8 v 8 games in elite youth soccer players. *Kinesiology.* 2007; 39:150-6.
9. Kelly DM, Drust B. The effect of pitch dimensions on heart rate responses and technical demands of small-sided soccer games in elite players. *J Sci Med Sport.* 2009;12:475
10. Koch AJ. Immune response to resistance exercise *Am J Lifestyle Med.* 2010; 4:244-52.
11. Kostrzewa-Nowak D, Nowak R, Jastrzębski Z et al. Effect of 12-week-long aerobic training programme on body composition, aerobic capacity, complete blood count and blood lipid profile among young women. *Biochemiamedica.* 2015; 25:103-13.
12. Krstrup BR, Rollo I, Nielsen JN, Krstrup P. Effects on training status and health profile of prolonged participation in recreational football: heart rate response to recreational football training and match-play. *J Sports Sci Med.* 2007; 6:116-7.
13. Krstrup P, Aagaard P, Nybo L et al. Recreational football as a health promoting activity: a topical review. *Scand J Med Sci Sports.* 2010;20 :1-13
14. Krstrup P, Christensen JF, Randers MB et al. Muscle adaptations and performance enhancements of soccer training for untrained men. *Eur J Appl Physiol.* 2010; 108:1247-58.
15. Krstrup P, Christensen JF, Randers MB et al. Muscle adaptations and performance enhancements of soccer training for untrained men. *Eur J Appl Physiol.* 2010a; 108:1247-58.
16. Krstrup P, Dvorak J, Junge A, Bangsbo J. Executive summary: The health and fitness benefits of regular participation in small-sided football games *Scand J Med Sci Sports.* 2010b; 20: 132-35.
17. Krstrup P, Nielsen JJ, Krstrup BR et al. Recreational soccer is an effective health-promoting activity for untrained men. *Br J Sports Med.* 2009 ;43:825-3
18. Krstrup P, Nielsen JJ, Krstrup BR et al. Recreational soccer is an effective health-promoting activity for untrained men. *Br J Sports Med.* 2009;43:825-31
19. Laing SJ, Gwynne D, Blackwell J et al. Salivary IgA response to prolonged exercise in a hot environment in trained cyclists. *Eur J Appl Physiol.* 2005; 93:665-71.
20. McKune AJ, Smith LL, Semple SJ, Wadee AA. Influence of ultra-endurance exercise on immunoglobulin isotypes and subclasses. *Br J Sports Med.* 2005; 39:665-70.
21. Northoff H, Berg A, Weinstock C. Similarities and differences of the immune response to exercise and trauma: the IFN- $\gamma$  concept. *Can J Physiol Pharmacol.* 1998; 76:497-04.
22. Tomar R, Antony VC. Effect of 16 Weeks Six a Side Recreational Football on Serum Immunoglobulin and White Blood Cells in Untrained Males. *Indian J Sci Technol.* 2016;9