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# ARE SERUM IMMUNOGLOBULIN LEVELS AFFECTED IN STEPPING/AEROBICS TRAINERS?

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## SUMMARY

Stepping/aerobics exercises are submaximal activities with wide popularity, used to attain a higher level of fitness. Physical activities of a similar level are reported to improve the immune system. The purpose of the present study is to investigate the long-term effect of such training blood immunoglobulin levels in 20-30 yr old female stepping/aerobics trainers. Thus, resting immunoglobulin (Ig) levels (IgG, IgA and IgM) and some haematological parameters of the female stepping/aerobics trainers (EG) (n=15, 25.1 ± 2.1 yr old) were measured and compared with those of a sedentary control group (CG) (n=15, 25.6 ± 2.8 yr old). As a result, serum IgG, IgA and IgM levels were respectively 1130 ± 258 mg/dl, 202 ± 63 mg/dl and 175 ± 78 mg/dl for the EG, and 1078 ± 175 mg/dl, 209 ± 67 mg/dl and 179 ± 78 mg/dl for the CG. Independent t-tests were performed to assess differences between the two groups. No significant differences were found for resting serum Ig levels among the groups. To conclude, in the present cross-sectional study, serum resting Ig levels (IgG, IgA and IgM) of female stepping/aerobics trainers were not affected of any sort.

**Key words:** Immunoglobulins, stepping/aerobics exercise, chronic training, exercise

## *ÖZET*

*STEP/AEROBİK EĞİTMENLERİNİN SERUM İMMÜNOGLOBÜLİN DÜZEYLERİ ETKİLENİYOR MU?*

*Step ve aerobik egzersizleri daha yüksek bir fiziksel uygunluk düzeyi elde etmek için yararlanılan popüler submaksimal etkinliklerdir. Benzer*

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*düzeydeki fiziksel egzersizlerin iimmün sistemi olumlu yönde etkilediği bildirilmektedir. Bu çalışmanın amacı, bu düzey ve türdeki uzun süreli antrenmanın 20-30 yaş grubu bayan step/aerobik eğitmenlerinin kan immünoglobülin seviyelerine etkisini incelemekti. Buna yönelik olarak, bayan step/aerobik eğitmenlerinde (EG) (n=15, yaş 25.1 ± 2.1) ve sedanter kontrollerde (CG) (n=15, yaş 25.6 ± 2.8) dinlenik durumda alınan kan örneklerinde serum immünoglobülin (Ig) (IgG, IgA and IgM) ve bazı hematolojik parametere düzeyleri belirlendi. Sonuç olarak, serum IgG, IgA and IgM seviyeleri sırasıyla EG grubunda 1130 ± 258 mg/dl, 202 ± 63 mg/dl ve 175 ± 78 mg/dl; CG grubunda ise 1078 ± 175 mg/dl, 209 ± 67 mg/dl ve 179 ± 78 mg/dl olarak belirlendi. Bağımsız t-testleri uygula-narak yapılan karşılaştırmalar sonucunda iki grubun serum Ig değerleri arasında anlamlı bir fark gözlenmedi. Bu kesitsel çalışmada bayan step/aerobik eğitmenlerinin dinlenme serum Ig (IgG, IgA ve IgM) düzeylerinin hiç bir yönde etkilenmediği sonucuna ulaşıldı.*

***Anahtar Sözcükler:*** *Immünoglobülinler, step/aerobic egzersizleri, kronik antrenman, egzersiz*

## INTRODUCTION

Regular physical activity can be beneficial in reducing or preventing lifestyle-associated chronic diseases such as hypertension, cardiovascular affections, diabetes or obesity. Stepping/aerobics exercises are generally submaximal activities which may produce such benefits. Insufficient information exists on the effects of long-term practice of stepping/aerobics training on immune function. In this cross-sectional study, the chronic effects of stepping/aerobics training on resting serum Ig levels and some blood parameters in female trainers is investigated.

Chronic intensive training may modify the immune system and increase the incidence and severity of respiratory infections and illnesses (3). In addition, many other factors are involved in exercise-induced suppression of immune function, producing a potential cause of infection. Numerous physical, physiological and psychological factors further complicate the issue (1,11,13).

There is no generally accepted view as to the blood immune response following long-term training. Normal range resting levels of serum immunoglobulins have been widely reported in distance runners (7,9) and other athletes (2,4,15,17,18,19,20,22). However, it is also noted and that long-term moderate exercise can increase the levels of circulating immunoglobulins (14). In contrast, several studies have reported decreases in serum concentrations of IgG, IgA and IgM (6,11) and other immune parameters such as complement (21), and that very heavy training suppresses mitogen-stimulated immunoglobulin synthesis (24). High-intensity training is reported to exert a greater suppressant effect than high-volume training (8). Physical activity clearly affects both cellular and humoral functions of the immune system. To assess the effects of long-term stepping/aerobics training on resting serum Ig levels in 20-30 yr old female trainers is the main scope of the present study.

## MATERIAL AND METHODS

**Subjects:** Fifteen healthy and volunteering female high performance stepping/aerobics trainers (n=15) and matched healthy sedentary women (n=15) participated in this cross-sectional study. The age range of the participants was 20-30 years. Sea level, 21°C average air temperature and 62.8% relative humidity conditions prevailed. Training history, demographic factors, and nutritional behaviors were assessed through a questionnaire. Meals and food weights were recorded by each subject and sources of total dietary energy intake were evaluated. Experimental procedures were explained and informed consent was obtained from each subject.

Subjects with serious allergy, systemic infection or surgery history were not selected for the study. Subjects were non-smokers, non alcohol-consumers, were not been on a reducing diet and were not using medications such as aspirin, anti-inflammatory drugs and anti-depressants which are known to affect immune function. All subjects declared that they had no infections in the last month and passed a complete physical examination. They abstained from strenuous physical exertion for 72 hours. Stepping/aerobics trainers were selected if they had been exercising aerobically for more than 8 h weekly and at least four days in a week, for at least the past two years, and if they had a $VO_2Max$ score greater than 35 $ml.min^{-1}kg^{-1}$. On the average, the stepping/aerobics trainers worked for 9.5 ± 2.0 h per week, for a period of 4.6 ± 2.1 years and they were the highest standard trainers in İzmir. Women serving as controls had an active life style, but were not engaged in any regular sport training.

**Blood analysis:** Following a 72 h period without training, subjects reported to the private chemical pathology lab in fasting conditions, between 8:00 and 9:00 am on the morning of the test. After resting quietly for 10-15 min, blood was withdrawn from an antecubital vein in the seated position. Complete blood count was performed using an automated blood counter (Coulter MD 18 Dif, USA). Resting serum immunoglobulins (IgA, IgM, IgG) were measured by automated nephelometry (Beckman 360 CE Protein Array System). For each subject, exercise testing and blood sampling was performed during the same period of the day in an attempt to control potential diurnal variations.

**Exercise testing:** The Astrand-Rhyming test was used to determine the $VO_2Max$ scores (5). This test was conducted on a cycle ergometer (Monark Model 814, Sweden. Heart rate was monitored using a special watch (Polar Sports Tester, Finland). Body fat percent was assessed by means of a four-site skinfold measurement with a caliper (Holtain Ltd, Crymych, UK) skinfold, using Yuhasz's prediction formula (26). Physical and physiological characteristics of the subjects were measured at the performance laboratory of the School of Physical Education and Sports.

**Statistical analysis:** Independent Student's t-tests were used in comparing all measured variables for the stepping/aerobics trainers and sedentary controls. Statistical significance was set at the $p<0.05$ level, and results were expressed as mean ± SD. Pearson's product-moment correlations were computed to determine the relationship between IgG, IgA, IgM levels and VO2Max, percent body fat, weekly training hours, yearly training experience, body mass index (BMI), and the % of total dietary energy intake from fat.

## RESULTS

Table 1 summarizes anthropometric and physiological characteristics for the subjects. Although the two groups were of similar age, height, weight, and BMI; the stepping/aerobics trainers were significantly ($p<0.05$) leaner and possessed higher $VO_2max$ levels when compared with the controls.

Table 2 and Table 3 present resting blood counts and white blood cell subgroups, respectively. No significant differences were not observed between the trainers and the controls in any parameters, except for a higher percentage of lymphocytes ($p<0.05$). Though red blood cell, haemoglobin and haematocrit counts were relatively low for both groups, all results were within the normal range, considering local population reference ranges.

**Table 1.** Subjects' characteristics (mean ± SD)

| | Trainers | Controls |
|---|---|---|
| Age (yr) | 25.1 ± 2.1 | 25.6 ± 2.8 |
| Height (cm) | 159.8 ± 5.1 | 160.6 ± 4.2 |
| Weight (kg) | 53.2 ± 6.7 | 57.6 ± 10.5 |
| BMI ($kg.m^{-2}$) | 20.8 ± 2.1 | 22.3 ± 3.9 |
| Body Fat (%) | 12.9 ± 2.4 | 16.3 ± 4.1* |
| $VO_2Max$ ($ml.min^{-1}.kg^{-1}$) | 37.1 ± 5.2 | 24.6 ± 5.0* |
| Daily energy from fat (%) | 17.0 ± 3.7 | 19.6 ± 4.4 |
| Weekly training (h) | 9.5 ± 2.0 | |
| Training experience (yr) | 4.6 ± 2.1 | |

*p<0.05

**Table 2.** Whole blood white blood cell (WBC), red blood cell (RBC), haemoglobin (Hb), haematocrit (Hct) and platelet (Plt) counts for trainers and controls (mean ± SD)

| | WBC ($10^3/\mu l$) | RBC ($10^6/\mu l$) | Hb (g/dl) | Hct (%) | Plt ($10^3/\mu l$) |
|---|---|---|---|---|---|
| Trainers | 6.3 ± 1.9 | 4.2 ± 0.2 | 12.2 ± 1.2 | 36.4 ± 2.9 | 219 ± 46 |
| Controls | 6.7 ± 1.6 | 4.3 ± 0.4 | 11.9 ± 1.0 | 36.3 ± 3.4 | 246 ± 59 |
| Reference range | 4.0 - 10.0 | 3.8 - 5.0 | 12.0 - 15.0 | 36.0 - 43.0 | 150 - 450 |

**Table 3.** White blood cell subgroup counts and percentages for lymphocyte (LY), monocyte (MO) and granulocytes (GR) for trainers and controls (mean ± SD)

| | LY ($10^3/\mu l$) | LY* (%) | MO ($10^3/\mu l$) | MO (%) | GR ($10^3/\mu l$) | GR (%) |
|---|---|---|---|---|---|---|
| Trainers | 2.5 ± 0.6 | 41.6 ± 6.5 | 0.7 ± 0.4 | 11.1 ± 3.5 | 3.1 ± 1.1 | 47.1 ± 7.7 |
| Controls | 2.4 ± 0.7 | 36.5 ± 4.3 | 0.8 ± 0.4 | 11.3 ± 5.7 | 3.4 ± 0.8 | 52.1 ± 7.2 |
| Reference range | 0.9 - 5.3 | 20.0 - 50.0 | 0.1 - 1.1 | 2.0 - 10.0 | 1.3 - 7.4 | 30.0 - 70.0 |

*p<0.05

Table 4 presents resting serum immunoglobulin levels of the subjects. Although IgA, IgM levels tended to be lower and IgG levels to be higher in the trainers group, no significant differences were observed, when compared with the sedentary control group. All these results were within the normal range.

**Table 4.** Resting serum IgG, IgA and IgM levels for trainers and controls (mean ± SD)

| | IgG (mg/dl) | IgA (mg/dl) | IgM (mg/dl) |
|---|---|---|---|
| Trainers | 1130 ± 258 | 202 ± 63 | 175 ± 78 |
| Controls | 1078 ± 175 | 209 ± 67 | 179 ± 78 |
| Reference range | 639 - 1349 | 70 - 312 | 52 - 242 |

When relationships between IgG, IgA, IgM levels and $VO_2Max$, BMI, percent body fat, weekly training hours, year-wise training experience, and percentage of dietary energy intake from fat were assessed, no significant correlations were established for the trainers. There was a significant negative correlation between body fat and IgM in the sedentary control group ($r=-0.56$, $p<0.05$).

## DISCUSSION

Aging is accompanied with a decline in most cell-mediated and humoral immune responses. Besides factors such as mental stress, anxiety and improper hygiene; low caloric intake and weight reduction have also been associated with impaired immunity (10,19). Weight control management is crucial for stepping/aerobics trainers. They fear that eating high calorie foods will increase body fat, body weight and consequently impair body shape and performance. Chronic low calorie diet consumption may reduce athletic performance and can impair health, especially in female athletes (25), compromise immuno-competence and decrease resistance to infection (2). The immune system is sensitive to both fat intake and intense exercise. Low-fat, high-carbohydrate diet (15% fat, 65% CHO, 20% protein as source of total calories), typically consumed by athletes, is reported to increase inflammatory processes and to decrease anti-inflammatory factors (23). In the present study, no significant differences were observed between trainers and controls with respect to daily calorie input from fat, and no significant correlations were established between the latter parameter and serum Ig levels in either group.

Chronic exercise training effects immune function: immune cell count is generally normal during intense exercise training, and recent evidence suggests that prolonged periods of intense training may lead to slight impairment of immune parameters such as neutrophyl function, serum and mucosal immunoglobulin levels, plasma glutamine concentration, and possibly natural killer cell cytotoxic activity. Moderate exercise training has either no effect on, or may stimulate these parameters (13). Our study results mostly agree with previous reports (4,7,17,20) which failed to observe any significant changes in circulating leukocytes and Ig levels. Similarly, Cannarella et al. (18) have examined that moderate exercise training is not associated with an improvement in lymphocyte function, but is associated with a 20% increase in serum immunoglobulins. It is expected that future study will apply molecular biology techniques to further identify mechanisms by which exercise influences immune function (12).

Although it is suggested that endurance athletes may exhibit lower resting leukocyte and lymphocyte counts compared with the normal population (11,16), athletes generally exhibit normal resting leukocyte counts and subset distribution (16). Green et al. (7) report that leukocyte phagocytosis and killing, lymphocyte proliferative response, and immunoglobulin concentrations are similar for long distance runners and sedentary controls. In the present study, only the lymphocyte percentage was found to be higher ($p<0.05$) in the trainers, compared with the controls.

To conclude, no significant effect of chronic stepping/aerobics exercise training on resting serum immunoglobulin levels (IgG, IgA and IgM) and leukocyte populations was established in this study. There is still need for further prospective and longitudinal studies in an attempt to identify immunological markers which may be responsible of training-induced alterations of the immune system.

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