THE EFFECTS OF 8 WK INTENSIVE JUDO TRAINING ON THE HUMORAL IMMUNE SYSTEM IN JUDO FIGHTERS

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Abstract

The influence of intensive Judo training on serum immunoglobulins IgG, IgM, and IgA was studied in 24 Judo fighters. Subjects were assigned to an exercise training group (EXE; n=12) and non-exercise control group (Con; n=12). Subjects in EXE group participated in exercise sessions 4 days a week for 8 wk. Serum samples were collected before, immediately and 1wk after study period. The IgG levels were significantly increased immediately after exercise training (p=0.001) in EXE compared to Con. However, IgM and IgA concentrations showed significant decrease immediately after exercise in EXE (p=0.001). The concentrations of all immunoglobulins had returned to baseline by 1wk of recovery. In conclusion the increased IgG levels are possibly due to isotype switching or a secondary antibody responses that could be considered as enhancement in immune system function. However, chronic suppression of immuniglobulins IgM and IgA may be mediated by hormonal changes associated with exhausting exercise.

Keywords: Exercise immunity; Judo Fighters; Serum Immunoglobulins

Introduction

Despite the numerous studies aimed at explaining the specefic immune system responses to exercise, there is no agreement in the results obtained so far from these studies. Most of the studies examining the effects of the exercise on immune function, have either focused on only one bout of exercise or the changes following exercise of short duration (1,5). There are limited studies investigating the effect of regular exercise at long term on the immune system (1,10,41). Regular exercise with moderate impact is known to strengthen the immune system and increase the resistance against stress (6,11,14,22,27,21). On the other hand it is also known that vigrous exercise can have negaive effects on these functions (5,24,40,42). Data on serum immunoglobulin levels in athlets are controversial. Several studies have shown clinicaley normal serum Ig concentration in athlets (1,4,35). Some have shown increases (31,34,37) and some have shown lower Ig levels in athletes compared with control subjects (23,28,37,6). However, few studies have investigated the effects of extensive exercise training on serum immunoglobulin (Ig) status. Serum Ig concentrations showed little or no change after acute exercise in trained runners, especially when Ig concentrations are corrected for changes in plasma volume (10). Stephensen et al (12) and Poortmans (39) have reported significant increases in immunoglobulins A and G levels and no change in IgM levels following maximal exetcises. However, a significant decrease in IgG and IgM Levels after 3 month training (130 to 140 min, 5-7 days per week) and a significant increase in IgG and IgA concentrations after 15 min intensive exercise were reported by Garagiola (13) and Wit (49) respectively. Verder (47) showed reduction of IgA and IgM concentrations of elite athlets following short term acute exercise. However, an increase in serum antibody concentrations due to maximal and submaximal exercise have been reported by Nieman (32,34,35,45). Despite numerous studies, no studies are available concerning the effects of Judo specific training on immunoglobulin levels. The influence of acute and long term exercise period on the immunoglobulin responses is important for the trainers and coaches who work and design training programs for amateur and proffesional athlets especially Judo

players. For this reason, our study was aimed to investigate the effects of long term Judo specefic training on immunoglobulin levels of Judo fighters.

Methods and Materials

Subjects

24 elite male Judo fighters (mean age 21) who had regular Judo training for an average of 8–10 hr per week, for at least 5 years, and had fought competitively, were recruited for this study. They were randomized into two groups: exercise and control groups. The athletes were informed about the exercise training program and potentional benefits of the study before they signed an informed consent form. The Exe group participated in an specific exercise program for a period of 8 Wk. The Con group were asked not to participate in any exercise training program during the study. In addition, all subjects had passed a complet medical examination before participating exercise program.

Exercise program

Subjects in Exe group conducted an exercise programe involving specific intensive Judo training 4 days a week for 8 Wk. They were supervised and conducted by experienced instructors. Subjects in the Con group simply maintained their normal physical activity levels during the study.

Blood sampling

Venous blood samples were collected before, immediately and 1 Wk after (recovery period) the exercise program. Serum immunoglobulins IgA, IgG, IgM were measured by rate nephelometry using Beckman Array (Beckman, Brea, CA) analyser.

Statistical analysis

Data were analysed using comercial software (SPSS for windows version 12.0) using General linear model and dependent t-test.

Results

This study investigated the effects of extensive Judo training on serum immunoglobulins levels of athlets. The individual characteristics of Judo players are shown in table 1.

IgG. Contrast testing reveald that IgG was significantly elevated immediately after the exercise program (P=0.001). But at 1 Wk recovery, the IgG concentrations had returned to baseline (table2, Fig1).

IgA. Immediately after the exercise program, there was a significant decrease (P=0.001) in IgA concentrations. At 1Wk, IgA concentrations had returned to baseline (tables3, Fig1).

IgM. Contrast testing revealed a significant decrease in IgM immediately after exercise program (P=0.001). However, by 1Wk recovery IgM concentrations had returned to baseline (table4, Fig1).

Table 1. Subjects Characteristics

	Age (yr)	**Height (cm)**	**Body Weight (kg)**	**Rest HR (beat/min)**	**Fat%**	**BMI (kg/m2)**
EXE	21 ± 27.1	33.178 ± 96.3	50.76 ± 72.7	91.57 ± 45.5	78.7 ± 80.1	47.21 ± 70.0
CON	35.21 ± 64.1	75.178 ± 38.3	66.74 ± 84.7	16.57 ± 25.6	40.7 ± 44.1	37.21 ± 57.0

Table 2. Comparison of the mean (and s.d.) of serum IgG levels over the training season from other athletes and control subjects

	Before	**Immediately**	**Recovery**	**Sig**
EXE	64.1008 ± 19.41	54.1123 ± 30.39	65.1024 ± 7.70	*001.0
CON	58.998 ± 79.39	04.1002 ± 76.38	65.1002 ± 72.37	298.0

* p>0/05

Table 3. Comparison of the mean (and s.d.) of serum IgA levels over the training season from other athletes and control subjects

	Before	Immediately	Recovery	Sig
EXE	43.238 ± 85.19	57.225 ± 01.20	85.235 ± 72.21	*001.0
CON	96.232 ± 97.22	75.234 ± 24.23	55.235 ± 83.23	412.0

* p>0/05

Table 4. Comparison of the mean (and s.d.) of serum IgM levels over the training season from other athletes and control subjects

	Before	Immediately	Recovery	Sig
EXE	87.182 ± 94.14	79.167 ± 64.14	94.179 ± 60.13	*001.0
CON	85.176 ± 05.10	13.179 ± 35.11	08.180 ± 75.10	311.0

* p>0/05

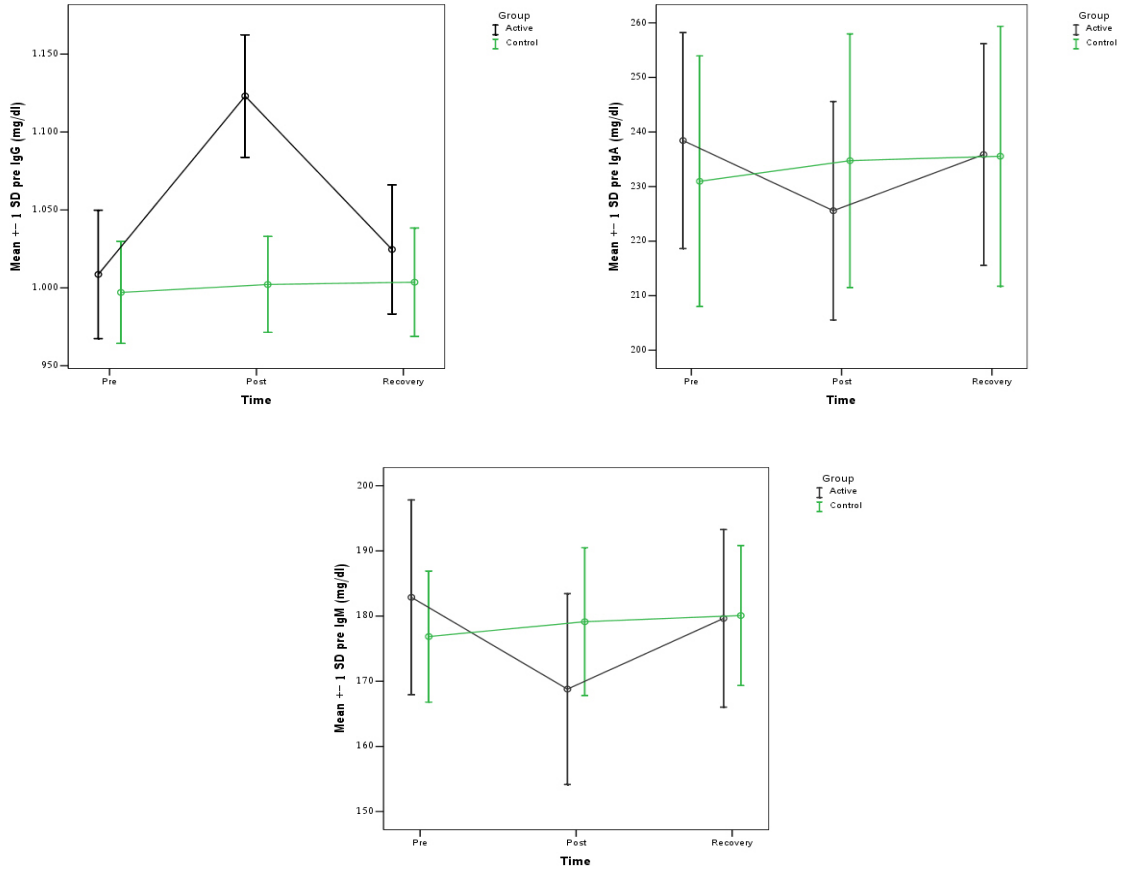

Fig. 1. Serum IgA, IgG, IgM levels (mean ± SD) for samples collected from athletes and controls over the training seasons.

Discussion

The focus of many studies has been to identify changes in serum immunoglobulin concentrations after an acute bout of strenous exercise. However, in this study the discussion will attempt to elucidate changes in immunoglobulin concentrations after a period of exercise training, Judo training.

An interesting finding in this study was the significant increase in total serum IgG immediately after the exercise training program. This increase was accompanied by a signigicant decrease in both IgM and IgA. However, the concentrations of all immunoglobulins had returned to baseline by 1wk recovery. Generally, in exercise immunology an increase in immunoglobulin concentration has been interpreted to represent enhanced immunity, and a decrease has usually been interpreted as immunosuppression.

McKune et al (30) suggest that alterations in different immunoglobulins may reflect isotype switching and interaction with innate immune system. With regard to changes in IgG, it appears that research is conflicting, with few studies measuring this isotype after a period of itensive exercise training. Recently Petibois et al (37) monitored immunoglobulin alterations over 12 month of rowing training, and like the present study, found that the IgG increased as the result of exercise. Similarly, Tartibian and Moazeni (45) reported a significant increase in IgG for Wrestlers in competition phase. But in contrast to our findings, Mashiko et al (23) found a significant decrease in IgG (-8%) after a 20 day rugby training, training two hours a day, six days a week. Gleeson M et al (16) also, reported a significant suppressin of serum IgG in swimmers after long-term intensive swim training. Serum IgG levels decreased with increasing distances swum by the athlets (16), and the suppression of total IgG levels was reflected mainly in lower levels of the IgG2 subclass. Alterations induced by shorter acute bouts of exercise and training have been reported. Poortmans (39) found a significant 12% increase in serum IgG immediately after a progressive cycle ergometer test to fatigue. However Nieman and Nehlsen (34), found that IgG decreased during recovery after a three hour run at marathon pace, reaching baseline concentration 21 hours after exercise. McKune et al (30) also reported significant increases (+12%) in IgG immediately after ultra-endurance exercise. Similar to McKune et al (30) Poortmans and Halambie (38) reported a significant 7% increase in IgG immediately after a 100 km race. Karacabay et al (20) and Diken et al (8), also obtained higher values for IgG immediately after 30 minute aerobic exercise and graded exercise to exhaustion, respectively. However, karacabay et al (21) again, Garagiola (13), Heath (18), Teved et al (46), reported a significant decrease for IgG immediately after exercise. Israel et al (19) also, reported that 25 hours after a 75 km run at high intensity, IgG was decreased by 22%.

One explanation that has been proposed for the increases in IgG after exercise is that non-systemic immunoglobulins are flushed out of the secendary lymph storage sites and/or enter the circulation because of increased lyphatic flow (34). This may have been the reason why IgG returned to baseline concentrations by recovery after exercise, as they then returned to their storage sites. At present there is no evidence to support such an assumption (34) Furthermore, if this had been the case, this would most likely have resulted in significant increases in all immunoglobulins; this did not occur, with certain immunoglobulins showing significant decreases. The authors of this study like to propose that the increase in IgG concentration after such intensive training (for example Judo training) suggests antibody class switching, similar to that which may occur during a secondary antibody response (30). This is a process that has only recently been described and involves a switch in immunoglobulin isotype from IgM to IgG (7). This implies that there will be a decrease in measured IgM as it undergoes genetic rearrangement and is transformed into IgG (7). Isotype switching is coordinated by T helper 2 cytokines (30) - for example, interleukins 4, 10, and 6- as well as the hypothalamicpituitary-adrenal axis and sympathetic nervous system (9). Cortisol (hypothalamic-pituitary-adrenal axis) and noradrenaline (norepinephrine) (sympathetic nervous system) have been shown to promote B cell immunoglobulin isotype switching from IgM to IgG (9). Although the effect of exercise on interleukin 4 has been difficult to detect, interleukin 10, interleukin 6, cortisol, and noradrenaline have been regularly reported to be increased by strenuous endurance exercise (25).

In this study, IgM was significantly reduced immediately after the exercise training period and returned to baseline by 1wk of recovery. To our knowledge no studies have reported concentrations of IgM after Judo training and only a few reports exist about the intensive exercise training induced alterations in IgM concentrations. In consistence with our findings, Mashiko et al (23) found that IgM decreased by 15% after a 20 day rugby training camp, training two hours a day, six days a week. McKune et al (30) and Israel et al (19) reported a significant decrease (23% and 10%, respectively) in IgM concentrations after high intensity running. Gleeson et al (16), also noted a significant decrease of IgM after long-term intensive swimming training. Karacabay et al (21) found that the IgM concentrations of athlets, were decreased, but not significantly, after 30 minute aerobic exercise, with returning the baseline by 5 days recovery. Mackinnon (29) has also shown that moderate exercise but of longer duration has lead to a significant decrease in plasma IgM levels. Bente et al (2) have shown that moderate exercise of long duration has led to a suppression of IgM synthesis in cell culturs. But Nieman et al (34,35) reported that IgM was increased by 7.2% one hour into a three hour run at marathon pace, returning to baseline concentrations during the recovery period at 21 hours. Petibois et al (37) reported a training induced increase in IgM concentration in elite rowers over 12 months. Karacabay et al (20) and Diken et al (8) also showed higher concentrations for IgM immediately and 5 hours after exercise, respectively. It is possible that the immunoglobulin response depends on the duration of the event. There are some possible

explanations for the IgM concentrations detected in our study. Firstly, isotype switching may have occurred as part of a rapid secondary antibody response. Secondly, the decrease may reflect IgM interaction with the innate immune system, specifically complement, in response to exercise training induced tissue damage (34). Immune complexes formed between IgM and complement would have been rapidly cleared from the circulation (3) reflecting reduced concentrations of IgM in the peripheral blood.

In this study, circulating IgA showed a significant decrease immediately after the exercise programe, and returned to baseline concentrations by 1wk recovery. It has been suggested that serum IgA levels are associated with mucosal secretions in the upper respiratory tract (IgA1) and the gastrointestinal tract (IgA2) (16). Therefore, changes in circulating concentrations were not expected, nor were dramatic changes noted. But, in agreement with our results, Gleeson et al (16) revealed significant suppression of serum IgA in athletes after long-term intensive swimming training. Tartibian and Moazeni (45) also found a significant decrease in serum IgA concentrations for wrestlers during competition phase. They showed that the concentrations had returned to baseline at recovery period. A significant decrease in IgA concentrations have been reported by Gleeson et al (15), Wit (49), Mackinnon et al (26), Gregory et al (17) and Kracabay et al (21). However, Nieman (34), Poortmans (39), Karacabay et al (20) and Diken et al (8) have shown a significant increase in IgA levels immediately after intensive exercise. The mecanism of this immunosuppression is unknown, but may be mediated by hormonal changes associated with exhausting exercise (43). At this study the Judo fighters participated in long-term intensive training. Therefore one possible explanation for decreasing serum immunoglobulin levels, could be participating in long-term tarining. Nieman (34) and Garagiola (13) have emphasized on the effect of long-term training period on the changes (temporarily) of immune system in athletes. It has been suggested that, also, during prolonged exercise at high intensity, serum cortisol concentrations are significantly elavated above control levels for severeal hours (33). Cotisol has been related to many of the immunosuppressive changes experienced immediately and several hours after exercies (36). Because the athletes in this study undewent hgih intensity training, it is possible that higher work load for a prolonged period and cocequence hormonal changes are the regulators of serum antibody in Judo fighters.

In conclusion, the results of this study revealed a significant increase in serum IgG levels and a significant decrease in serum IgM and IgA concentrations immediately after judo training. The increase in serum IgG levels may represente an enhanced antibody response. Isotype switching or a secondary antibody responses may regulate this response. The rapid upregulation of such a response probably afforded protection against pathogen and may help account for the maintenance of wellbeing of Judo fighters. However, chronic suppression of both immunoglobulins IgM and IgA, may be mediated by hormonal changes associated with exhausting exercise. The observations provide a framework for assessment of those athletes who present with fatigue and an apparant infection-prone state. These athletes may have a reduction of serum and secretion immunoglobulins or levels at the lower end of the population reference range. Further studies are in place to determine the clinical significance of the current observations, the mechanisms of immune enhancement and suppression, and implications for training and management strategies to enhanced immune system function and/or prevent exercise-induced immune suppression.

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