Effect of two tapering methods on interleukin-6, cortisol and performance in elite male wrestler

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Abstract:

Purpose: This study examined that effect of two types of tapering on interleukin-6(IL-6), cortisol and performance in elite male wrestler. *Material*: After 4 weeks of progressive training, wrestlers were randomly divided into three equal groups, 1-control group (N=10) continued performing progressive training for one week, 2-taper group 1 (N=10) continued with a 50% reduction in training volume for one week, 3-taper group 2 (N=10) continued with a 75% reduction in volume of training for one week .plasma blood IL-6 and cortisol levels were assayed from analysis obtained via standard ELISA. Also general strength of muscles was recorded as a performance test. All data were collected before and after progressive training and also after one week of tapering period. *Results*: There were significant reduction of IL-6 and cortisol levels in both tapering group comparing with control group (P≤0.05).There was significant reduction of IL-6 and cortisol levels among tapering 50% and tapering 75% after tapering period (P≤0.05). Also there was significant increase of general strength of muscles between tapering 75% and control group (P≤0.05). *Conclusion*: hence, one week tapering with 75% reduction in training volume after progressive training while the intensity kept high is effective strategy for reduction of IL-6, and cortisol levels and also increase performance. It seems that higher reduction of training volume when the intensity kept high is a good strategy for wrestler before main competition.

Мехранпоур А.Б., Супапорн С., Хасани С.Х., Витид М. Влияние двух методов постепенного снижения нагрузки на интерлейкин-6, кортизол и работоспособность элитных борцов-мужчин. *Цель*: Это исследование изучало эффективность применения двух типов снижения нагрузки на интерлейкин-6 (IL-6), кортизол и производительность в элитной мужской борьбе. *Материал*: После 4 недель прогрессивного обучения борцы были случайным образом разделены на три равные группы: 1-контрольная группа (n = 10) продолжала выполнять прогрессивную подготовку в течение одной недели; 2- сравнительная группа 1 (постепенное снижение нагрузки, n = 10) продолжали с 50% уменьшением учебного объема тренировки в течение одной недели; 3- сравнительная группа 2 (постепенное снижение нагрузки, n = 10) продолжали с 75% уменьшением объема подготовки в течение одной недели. Кортизол и IL-6 в плазме крови анализировали с помощью анализа, полученного стандартным методом ELISA. Также в качестве теста производительности была измерена общая сила мышц. Все данные были собраны до и после прогрессивной тренировки, а также после одной недели периода постепенного снижения нагрузки. Наблюдалось значительное снижение IL-6 и уровня кортизола в обеих группах 2 и 3 по сравнению с контрольной группой (P≤0.05). Отмечалось значительное снижение IL-6 и уровня кортизола среди сравнительных групп с 50% и 75% после периода постепенного снижения нагрузки (P≤0.05). Также наблюдалось значительное увеличение общей силы мышц между 2-й сравнительной группой 75% и контрольной группой (P≤0.05). *Выводы*: Таким образом, за одну неделю постепенного снижения нагрузки с 75% уменьшением объема тренировки сразу после прогрессивной тренировки и с одновременной поддержкой интенсивности на высоком уровне является эффективной стратегией для уменьшения IL-6 и уровень кортизола, а также увеличения работоспособности спортсменов. Очевидно, что значительное уменьшение объема тренировки при поддержке интенсивности на высоком уровне является хорошей стратегией для борца перед главными соревнованиями.

Мехранпоур А.Б., Супапорн С., Хасані С.Х., Вітід М. Вплив двох методів поступового зниження навантаження на інтерлейкін-6, кортизол і працездатність елітних борців-чоловіків. *Мета*: Це дослідження вивчало ефективність застосування двох типів зниження навантаження на інтерлейкін-6 (IL-6), кортизол і продуктивність в елітній чоловічій боротьбі. *Матеріал*: Після 4 тижнів прогресивного навчання борці були випадковим чином розділені на три рівні групи: 1-контрольна група (n = 10) продовжувала виконувати прогресивну підготовку протягом одного тижня; 2 - порівняльна група 1 (поступове зниження навантаження, n = 10) продовжували з 50% зменшенням навчального обсягу тренування протягом одного тижня; 3 - порівняльна група 2 (поступове зниження навантаження, n = 10) продовжували з 75% зменшенням обсягу підготовки протягом одного тижня. Кортизол і IL-6 в плазмі крові аналізували за допомогою аналізу, отриманого стандартним методом ELISA. Також в якості тесту продуктивності була виміряна загальна сила м'язів. Всі дані були зібрані до і після прогресивного тренування, а також після одного тижня періоду поступового зниження навантаження. Спостерігалося значне зниження IL-6 та рівня кортизолу в обох групах 2 і 3 у порівнянні з контрольною групою (P≤0.05). Відзначалося значне зниження IL-6 та рівня кортизолу серед порівняльних груп з 50% і 75% після періоду поступового зниження навантаження (P≤0.05). Також спостерігалося значне збільшення загальної сили м'язів між 2-ю порівняльною групою 75% і контрольною групою (P≤0.05). *Висновки*: Таким чином, за один тиждень поступового зниження навантаження з 75% зменшенням обсягу тренування відразу після прогресивного тренування і з одночасною підтримкою інтенсивності на високому рівні є ефективною стратегією для зменшення IL-6 і рівня кортизолу, а також збільшення працездатності спортсменів. Очевидно, що значне зменшення обсягу тренування за підтримки інтенсивності на високому рівні є хорошою стратегією для борця перед головними змаганнями.

Keywords:

tapering, interleukin-6, cortisol, wrestling, performance.

постепенное снижение нагрузки, интерлейкин-6, кортизол, борьба, производительность.

поступове зниження навантаження, інтерлейкін-6, кортизол, боротьба, продуктивність.

Introduction

Over training may be defined as an increase in the training volume or intensity which results in decrease of performance (Petibois et al., 2002). Six percent of endurance runners, 21% of Australian swimmers and more than 50% of soccer players complained of over training (Smith et al., 2000) and it is estimated that 70% of high level endurance athletes experienced over training during their training (Michael et al., 2014). Tapering is a recovery technique that is used prior to competition to reverse the fatigue caused by intense training with the aim of optimizing performance (Farhangimaleki et al., 2009). During the taper, the intensity, volume and frequency of training may be altered depending upon factors such as previous conditioning, level of fatigue, and the type and significance of competition (Coutts et al., 2007). Some researches indicate that reductions in training volume have varied from 44 to 100% in majority of sport (Houmard et al., 1994). Tapering could effect on reduce physiological and psychological stress of daily training and increase sport performance (Mujika et al., 2004).One of important goals for coaches and wrestlers is to increase

http://dx.doi.org/10.15561/18189172.2015.0811

competitive abilities to maximal levels, and to design a well- training program to ensure that peak performance would be attained at each point of a major wrestler competition (Mirzaei et al., 2009). In fact, there is no definitive training theory that describes the type, quantity or pattern of training and tapering that guarantees a given level of athletic performance (Neary et al., 1992). One of mainly suggested physiological mechanisms of exercise –induce impaired immune function is the elevated levels of stress hormones (catecholamine, cortisol and growth hormone) during and after heavy exercise (Bethin et al., 2000).

On the other hands tapering usually consists of high intensity exercise, with low volumes (Neary et al., 2003). After a period of good tapering, improved performance times have been reported in numerous athlete groups including swimmers (Mujika et al., 2002) runners (Shepley et al., 1992) and cyclists (Neary et al., 2003). However, some coaches and athletes still believe that tapering could lead athletes to detraining. They believe that the tapering period has negative effects on performance (Houmard et al., 1994). Intense and prolong exercise induce high levels of circulation inflammatory cytokine, especially IL-6, and it has been suggested that release of IL-6 in exercise is related to the occurrence of muscle damage and depletion of muscle glycogen (Steensberg et al., 2003; Smith et al., 2000).

Some research indicates that subjects with higher plasma IL-6 concentration had higher cortisol response to ACTH stimulation (Nemet et al., 2002; Smith et al., 2002). It is known that elevation in cortisol may affect cytokine production (Smith et al., 2000). Decrease in cortisol levels during the taper have been proposed as a mean of monitoring positive performance capacity in athletes in order to improve performance and to decrease symptoms of overtraining (Petibois et al., 2002). Some studies have suggested that reduction of training volume should be substantial, somewhere near 85% of normal training volume, whereas others have reported similar improvement after 31% reduction of training volume (Papacostae et al., 2013; Michelle Bartlett et al., 2006).

Many wrestlers reduce their training volume some days before the major competition (Mirzaei et al., 2009). Some studies have suggested that reduction of training volume should be near 85% of normal training volume, others have reported similar improvement after 31% reduction of training volume (Hovanlo et al., 2012; Andre et al., 2013). Although tapering techniques are widely used in a variety of sports, guidelines for the programming of optimal tapering regimens in wrestling have not been well studied. Research data on different types of workload reduction are limited. The overall aim of this study was to determine effects of two types of tapering periods (50% and 75%) on the concentration of post-exercise plasma levels of IL-6 and cortisol and performance in wrestler. We hypothesized that increase of reduction of training volume in tapering period could more benefit effect for elite wrestler before main competition.

Materials and Methods

Subjects

Experimental procedure:

Subject consists of 30 Iranian high-level male wrestlers, after receiving oral and written information about the study plans and all procedures and measurement of baseline and performance tests. All participants completed 4-week progressive training period. After four-week progressive training and before the one week tapering period began, the subjects were randomly divided into three equal groups: 1- non- tapering group that continued progressive training for one week, 2- tapering with 50% reduction in training volume for one week and, 3- tapering with 75% reduction in training volume for one week. All performance data were collected before and after progressive training and also after one week of tapering period.

Performance Test

To estimate general strength of upper and lower limbs of wrestler, bench press and squat test were used. For doing these tests first of all correct performance of bench press and squat test were showed to the wrestler and after warm up maximal effort was recorded. Performance tests were conducted before and after 4 weeks of progressive training and also after tapering period.

Blood sampling

Before and after progressive training program and the end of tapering period blood sample of wrestler was taken

Table1:

Anthropometric and experience data for the subjects at the start of study.

Group	Control (n = 10)	Tapering 50% (n = 10)	Tapering 75% (n = 10)
Age (yrs.)	23 ± 1	22 ± 2	22 ± 1
Body Mass (kg)	73 ± 6	70 ± 8	67 ± 6
Height (cm)	174 ± 3	170 ± 5	167 ± 6
Training experience(years)	6 ± 1	5 ± 2	6 ± 2
Fat percentage (%)	12 ± 1	11 ± 2	11± 1

in order to determine IL-6 and cortisol levels. At every session plasma was immediately separated from blood cells by centrifugation at 2150 g at +4ºC for 15 min, and was transferred into Eppendorf tubes and immediately frozen at −80°C until later analysis. We used high-sensitive Enzyme-linked immune sorbent assay (ELISA) kit from Rand D systems (Minneapolis, MN, USA).

Training Program

Training Program designed in five weeks that included four weeks progressive training and one week tapering.

Training was design for five weeks but all wrestlers passed general fitness training at least two months before. This research and this protocol of training were conducted before main wrestling competition. Program training included six session exercises per week and they lasted 90 minute per session; exercises started with warm up and finished with cold down every session and all procedures were done under control of researcher.

Data analysis

Mean and standard deviation were used for every one of variables. Kolmogorov-Smirnov test was applied to determine homogeneity of data. With respect to normality of data distribution, data were analyzed by analysis of variance with repeated measures. Bonferroni test was used when significant results had been observed. Statistical calculations were performed by SPSS 20 software in $p<0.05$ significance level.

Results

IL6

At the baseline, there was no significant difference in IL6 levels between trials. There was significant difference in IL-6 concentration after tapering period among both

Table 2.

Training program: values in parentheses denote the number of sessions for each item per week.

per week Monocycle	progressive training WEEKS 1.2.3.4				Tapering sessions WEEK 5		
Weeks	1	2	3	4	Control	Tapering 1 %50	Tapering 2 %75
Warm-up(min)	15 (6)	15 (6)	15 (6)	15 (6)	15 (6)	15 (6)	15 (6)
Interval training (min)	20(3)	-	-	-	-	-	-
Resistance training (min)	45 (3)	45 (3)	45 (3)	45 (3)	45 (3)	23 (3)	12 (3)
Speed training (me)	160(2	190 (2)	210 (2)	240 (2)	270 (2)	120(2)	60(2)
Ply metric training (j)	-	30 (3)	36 (3)	42 (3)	48 (3)	23 (3)	10 (3)
Technical training (min)	16 (3)	18 (3)	20 (3)	22 (3)	24 (3)	11 (3)	6 (3)
Wrestling competition (min)	10 (3)	12 (3)	14 (3)	16 (3)	18 (3)	9 (3)	4 (3)
Warm-down (min)	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)

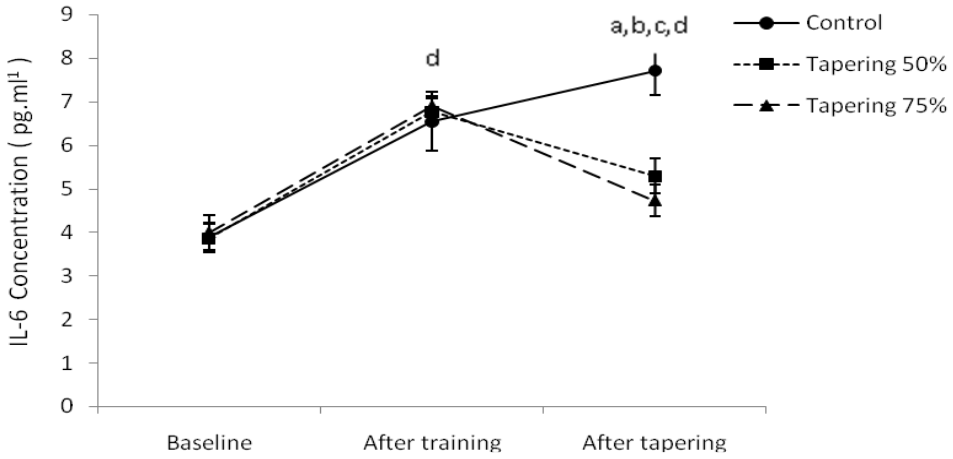

Fig 1: The comparison of the IL-6 plasma levels before, after training phase as well as after tapering period in three groups.

Significant differences between tapering 50% and control group are indicated with (a) where $P<0.05$; Significant differences between tapering 75% and control group are indicated with (b) where $P<0.05$, Significant differences between tapering 50% and tapering 75% group are indicated with (c) where $P<0.05$, Significant differences from baseline are denoted by (d) where $P<0.05$. Values are mean ± SD.

tapering group with control group (P<0.05) and among tapering 50% and tapering 75% group (P<0.05).

Cortisol

At the baseline, there was no significant difference in cortisol levels between trials. There was significantly difference after tapering period among both tapering group with control group (P<0.05) and among tapering 50% and tapering 75% group (P<0.05).

Discussion

Results of present study showed that there were significant reductions in plasma IL-6 and cortisol levels in both tapering group, comparing with control group at the end of one week of tapering period. While this decrement in taper 75% were significant, comparing with tapering 50%. High levels of plasma IL-6 and cortisol in control group may result in high volume of training and thereby contribute to a higher rate of infection in wrestler. These findings are similar to those reported by (Mujika et al., 2011; Mujika et al., 2002; Ronsen et al., 2003) and disagree with those, reported by (Coutts et al., 2007). Elevation of IL6 concentration prevents from protein synthesis due to muscular proteolysis, which finally leads to impairment of performance (Peake et al., 2005). The cytokine theory of overtraining suggests that repetitive trauma of musculoskeletal system is possible, because of high intensity and training volume, related with insufficient rest and recovery time, in other words inadequate rest is the important cause of overtraining. IL6 level indicators of exercise stress reflect changes in training load in various stages of tournament season (Ostrowski et al., 1998). High plasma IL6 and cortisol levels are known as sign and symptom of tissue catabolic actions. In many researches, high cortisol and IL-6 are proposed as indicators of training pressure, but response of these hormones to tapering in wrestler and athlete is not completely certain. According to our results higher

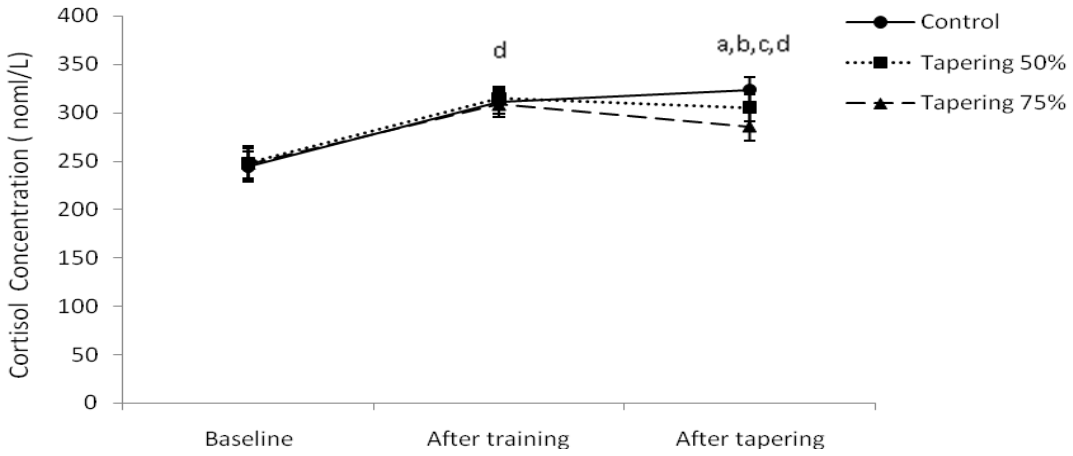

Fig 2: Comparison of the cortisol plasma levels before, after training phase as well as after tapering period in three groups.

Significant differences between control and tapering 50%) are indicated with (a) where P<0.05, Significant differences between control and tapering 75% are indicated with (b) where P<0.05, Significant differences between tapering 50% and tapering 75are indicated with (c) where P<0.05, Significant differences from baseline are denoted by (d) where P<0.05. Values are mean ± SD.

Performance

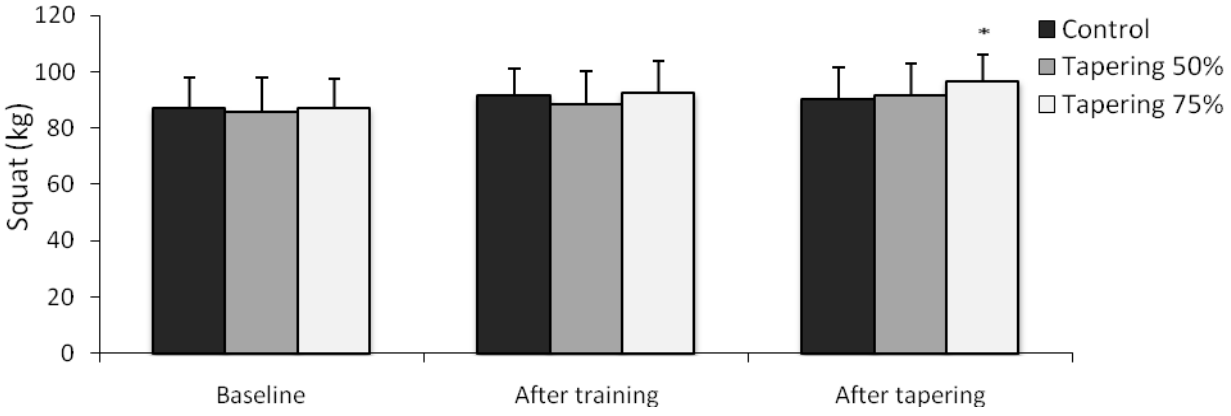

Fig 3. The comparison of means (SD) of Squat test in the three groups. Significant among control and tapering 75% are indicated with (*).

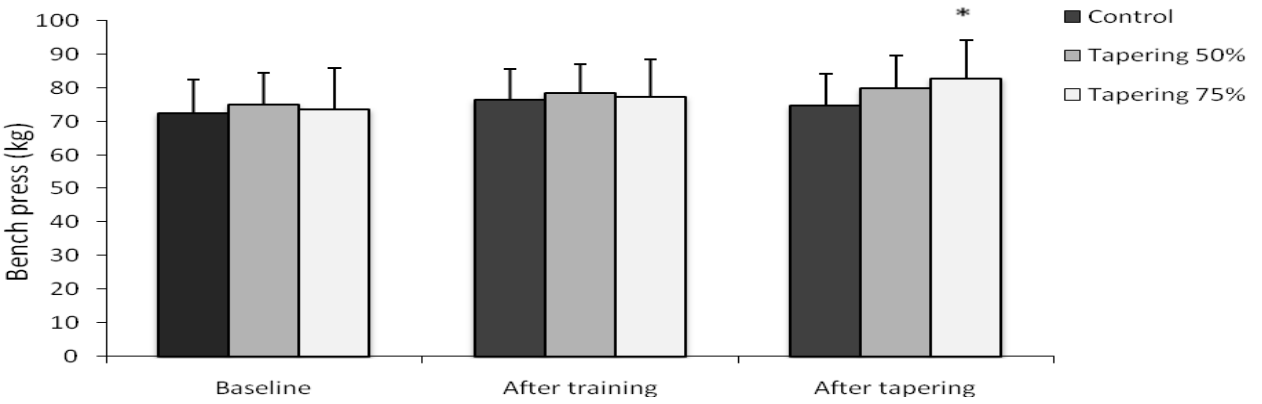

Fig 4: The comparison of means (SD) of Bench press test in the three groups. Significant among control and tapering 75% are indicated with (*).

reduction of training volume (75 % reduction of training volume) enhanced performance hormones. Results of this part are compatible with research results of (Rietjen et al., 2001; Mujika et al., 2002; Neary et al., 2003) but are not compatible with research results of Stone et al (1996). Different results in studies probably are associated with many factors, for example exercise type, intensity and volume of exercise, age and design of training program and also rate of athletic fitness.

Some research indicate that increasing of training volume results in increase of cortisol plasma levels, elevating of free fatty acids releasing and so preventing of immune system and inflammation response.(Yuichi et al., 2013; Kubukeli et al., 2002). Cortisol could increase protein catabolism in body. Combination of increase training volume, IL-6, cortisol levels and inadequate recovery finally can lead to creation of overtraining conditions (Laurent et al., 2007). It seems that the main reason of increasing of cortisol concentration in stress conditions and physical pressures is changing in performance of hypothalamic–pituitary–adrenal axis. This performance stimulated in response to heavy exercises and stressful conditions and increased its activity which results in increasing of secretion of ACTH hormone and then increasing secretion of cortisol (Bethin et al., 2013). Also variation of immune function, related to variation of plasma cytokine " cortisol " catecholamine's hormone and growth hormone (Petersen et al., 2005; Petibois, 2002). Higher levels of IL6 and cortisol representative of segment of inflammatory phase and catabolic situation in body induce exercise. Systematic inflammatory could influence of creation catabolic situation (Pedersen et al., 1995). As our findings showed, after one week of tapering, plasma levels of IL-6 decreased. This is most likely related to the increasing muscle glycogen during the tapering period.

Another finding of present study showed that there was significant increasing in strength muscle (squat and bench press) after tapering period in tapering 75% relative to control group. Accordance with previous research maximal gains of performance are obtained with a tapering intervention of 6-21 days duration, where the training volume is exponentially decreased by 41–60%, without any modification of either training intensity or frequency (Mujika, et al 2011). Result of this part are compatible with research result of (Hovanloo et al., 2012; Coutts et al., 2007). And they are not compatible with research results of (Houmard,. et al 1994). Different results in studies probably are associated with result of some studies that indicate that some variable of performance could be improved with tapering, but depend on choice of suitable time, type and length of tapering strategy, because bad tapering could result in detraining (Mujika et al., 2003; Coutts, et al., 2007). On the other hand Cortisol is one of important catabolic hormones quantity of which increases under mental and physical stress. Increases in plasma cortisol levels can cause an immune response during incremental training and lead to overtraining syndrome. Also over increase of cortisol and IL-6 levels can result in performance reduction in sports. Studies demonstrate that low cortisol concentration is a prerequisite for improved performance in athletic. (Mujika et al., 1996).Our finding from this research support suggestions that a higher reduction in training volume, prior to competition, may reduce negative after effects of overtraining for example regulation of cytokine (IL-6) and cortisol levels and increase performance.

Conclusion

One week tapering with 75% reduction in training volume, while the intensity kept high, is more useful tapering strategy for wrestling. Its seems that one week tapering with higher reduction of training volume(75%) before main competition, is effective strategy for decrease signs and symptoms of over training and also improve performance in elite male wrestler.

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Цитируйте эту статью как: Мехранпоур А.Б., Супапорн С., Хасани С.Х., Витид М. Влияние двух методов постепенного снижения нагрузки на интерлейкин-6, кортизол и работоспособность элитных борцов-мужчин // Педагогіка, психологія та медико-біологічні проблеми фізичного виховання і спорту. – 2015. – N 8. – С. 82-88. http://dx.doi.org/10.15561/18189172.2015.0811

Электронная версия этой статьи является полной и может быть найдена на сайте: http://www.sportpedagogy.org.ua/html/arhive.html

Cite this article as: Mehranpour A.B., Supaporn S., Hasani S.H., Witid M. Effect of two tapering methods on interleukin-6, cortisol and performance in elite male wrestler. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2015;8:82-88. http://dx.doi.org/10.15561/18189172.2015.0811

The electronic version of this article is the complete one and can be found online at: http://www.sportpedagogy.org.ua/html/arhive-e.html

Дата поступления в редакцию: 09.06.2015
Принята: 01.07.2015; Опубликована: 20.07.2015

Received: 09.06.2015
Accepted: 01.07.2015; Published: 20.07.2015