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ORGINAL ARTICLE

The Effects of A Short-Term Detraining on Anthropometric, Hormonal and Functional Factors in Male Wrestlers

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Abstract: The aim of this study was to assess Anthropometrical and body composition and functional changes after a short term of detraining. Materials and Methods: 10 wrestlers (weight 57.1±20.72 kg, height 171.4±4.92 cm, age 22.30±1.41yr) which were experienced in national college competitions were selected for this study. Detraining period consisted of sedentary days for 3-week. Assessments for body mass and composition, girth measurements, vertical jump performance, muscle strength, anaerobic power, and resting hormonal concentration were performed in the present study. The values obtained before and after the detraining period were compared using Student's paired and un-paired t-test. Results: Findings has shown that 3-week detraining period caused significant changes in VO_2max and Peak and Mean anaerobic power in wrestlers, while this intervention did not result in significant effect in body composition, anthropometrical, hormonal and performance. Conclusion: present study showed that 21-day of detraining in wrestlers led to decrease aerobic power, Peak and Mean anaerobic power. However, this detraining period could not affect organs circumference, body fat percent, body weight, agility, strength and growth hormone. From the present findings, we can conclude that three weeks of detraining in wrestlers showed significant reduction in aerobic and anaerobic power.

Keywords: Wrestlers, Detraining, Anthropometric, Body composition, Performance.

Introduction

One of the most important characteristics of skeletal muscle is its dynamic nature. Skeletal muscle tissue has an extraordinary plasticity and is therefore able to adapt to variable states of functional demands, neuromuscular activity, and hormonal signals by reversibly changing its functional characteristics and structural composition. Physical training is a process consisting of a series of physiological stresses that bring about or preserve specific adaptations to enhance a subject's ability to tolerate the stressing factors arising from training. Therefore, training-induced skeletal muscle adaptations are such that the trained muscle increases its tolerance to exercise (Mujika & Padilla, 2000).

The strength training may bring benefits to the physical performance and to the health of subjects such as the improvement on the motive coordination and sportive performance, the improvement on the body composition, in other words, increases on muscular mass, decreases on body fat and the decrease and prevention of lesions in recreative and competitive sports as well as the improvement on the competitive performance (Fontoura et al., 2004). On the other hand, inherent to the concept of training adaptation is the principle of training reversibility or detraining, according to which the stoppage or marked reduction of training leads to a partial or complete reversal of training-induced adaptations, thus compromising athletic performance. Skeletal muscle tissue is no exception to this rule and also readjusts to the reduced physiological stressors during periods of reduced training stimuli or complete training cessation (Mujika & Padilla, 2000).

Detraining often occurs in previously sedentary people who participate in exercise for several weeks or months and then stop (Toraman &

Ayceman, 2005). Few studies have been performed to document the impact of short-term detraining on body composition in highly trained athletes and there is a lack of information with regard to the detraining period; however, a study of Hakkinen and Komi (1985) reports that during a period of eight weeks without the training stimulus, the strength decrease in adults is initially due to the neural disadaptation caused by inactivity. Also a similar decrease occurs in squat strength of 2.5% per week (10% over 4 weeks) for Olympic weightlifters in their off-season (Argus et al., 2010). The modern concept of periodization can be described as the 'long-term' cyclic structuring of training and practice to maximize performance to coincide with important competitions. An essential part of the periodized training programme occurs during transitional phases, which allow athletes to recover and rest after completion of a strenuous training programme. One common occurrence during a transition phase is at the conclusion of the sporting year where, during a post-seasonal break, the athlete may reduce or even stop exercising at their typical training load. This decreased activity allows recovery of body tissues as well as a psychological break from the demands of training and competition.

During these periods training levels are typically lowered, therefore, the physiological adaptations gained as a result of a series of programmed conditioning may be lost or reduced. Detraining negatively affects physical capabilities and can therefore impact greatly on subsequent training and competition performance. If athletic potential is decreased over a post-season break more time will have to be spent retraining to overcome deficiencies and increasing physical capabilities above baseline, rather than improving technical and tactical play (Lee & Rohaan, 2010). Longer periods of training stoppage also brought about declines in fast twitch(FT) and slow twitch(ST) fiber cross-sectional areas, the FT/ST area ratio, and muscle mass in athletes (Mujika & Padilla, 2000). Therefore, the aim of our study was to characterize the detraining effect of wrestlers by analyzing a variety of anthropometric and body composition and functional measures after 21 days of detraining.

Materials and Methods

Eight male trained wrestlers who were experienced in national college competitions volunteered to participate in the study (n=10; mean (SD): age 22.30(1.41) years, height 171.4(4.92) cm, weight 75.1(20.72) kg). All the subjects were had an average of three years wrestling experience in the wrestling championships. For the evaluation of detraining situation of subjects within 21 days, individual measuring method of subjects was used. The detraining period was coincided with the holidays of the New Year in Iran.

At this period, nutritional status of the subjects did not monitor which primarily had formed of carbohydrates and lipid. We should bear in mind that the word "detraining" at the present study is not meant absolute detraining. Since wrestlers had three sessions exercise in each day at the camp organizing time and fulfilling exercises, the word "detraining" has used merely for the condition that wrestlers were away from the said situation.

Anthropometric and body composition

Variables measurements

To estimate the percentage of body fat, the three points skinfold measurement (Chest, Abdomen, and Thigh) was taken on the right side. Measurements were taken when the skin was dry, and not overheated. The Lafayette standard caliper was used to measure the skin-fold thickness in millimeters. Body weight was then determined using the equation of Jackson and Pollock (1985). Relative body fat was calculated using the Siri equation (Siahkouhian & Hedayatneja, 2010). All anthropometric and body composition variables were measured 14 hours after the last training session. We used Pollock and Wilmore (Siahkouhian & Hedayatneja, 2010) methods for measuring anthropometric values.

Bare footed standing heights were measured to the nearest centimeter using Seca stadiometer model 216. To measure the height, the subjects stood erect with their backs touching the stadiometer, their arms held laterally by their sides and their two feet closely apposed. Body weight was measured to the nearest 0.1 kg using Seca scale, with subjects dressed in light clothing or underwear only. In brief, neck, chest, arm, forearm, abdominal, at the level of iliac crest, waist, hip, thigh, and calf circumferences were measured to the nearest centimeter using tape rule, while the subject was standing erect.

Waist circumference was measured midway between the lower rib margin and the iliac crest in the horizontal plane and while the subjects were standing, hip circumference was measured at the point yielding the maximum circumference over the buttocks using a tape measure to measure to the nearest 1 cm. The body mass index (BMI) was calculated from the height (m) and weight (kg) [weight/height^2].All anthropometric measurements were taken in accordance with World Health Organization (WHO) standards.

Functional measurements

The exercises chosen for the analyses of maximal strength, abdominal muscles strength, Shoulder girdle muscles strength, aerobic power, agility, speed and anaerobic power evolution were bench press, sit up, push up, Bruce treadmill test, 4×9 meter, 36-meter dash and RAST test, respectively. Resting growth hormone test also is used to evaluation of hormonal level changes after detraining period.

Statistical analysis was carried out using SPSS version 16.0. All the variables were checked regarding their normal distribution using the Kolmogorov-Smirnov test and data are presented as means ±SD. The data were analyzed using descriptive and inferential statistics for anthropometric, body composition, and functional variables. For data analysis, the paired samples T-Test was used for each period, for all variables evaluated.

Results

The mean values of the anthropometrical, body composition, functional and hormonal level characteristics of those who completed the study are list in Table 2. In Table 1, 2, information related to pre and post detraining period of all variables has collected. Accordingly, results of the study show that three-week detraining has brought about significant change in VO_{2max} and anaerobic power.

On the other hand, based on considered significant levels ($p<0.05$), this period did not brought about significant change at neck, chest, hip, thigh, calf, forearm and, fat percentage, weight, WHR, sit up push up , bench press, agility, speed and growth hormone level. Therefore, VO_{2max} of wrestlers reduced significantly (p= 0.005) after three-week detraining (44.11±4.85 vs. 42.06±4.09). On the other hand, peak and mean anaerobic power reduced significantly (p= 0.035 and p= 0.030) after this period (466.16±100.57 vs. 436.10±86.15 and 390.5±66.51 vs. 366.5±57.92).

Table 2. Values of variables, mean and standard deviation

Variables	Subjects	Pre-test	SD	Post-test	SD	Significant difference
Weight (kg)	10	75.100	20.72	76.72	20.14	0.127
BMI(kg/m^2)	10	25.40	7.12	25.65	7.19	0.316
WHR	10	0.83	0.02	0.83	0.02	0.193
BF(%)	10	13.07	1.73	13.41	1.62	0.137
LBM(kg)	10	66.44	16.923	66.43	16.927	0.095
Waist cir.(cm)	10	81.24	8.39	81.37	8.33	0.179
Hip cir.(cm)	10	96.54	8.27	96.37	8.39	0.074
Thigh cir.(cm)	10	56.90	5.95	56.72	6.06	0.140
Calf cir.(cm)	10	25.10	2.36	25.10	2.18	1.000
Neck cir.(cm)	10	39.60	3.24	39.40	3.45	0.205
Chest cir.(cm)	10	96.60	10.04	96.52	10.05	0.399
Arm cir.(cm)	10	30.50	3.39	30.23	3.26	0.096
Forearm cir.(cm)	10	17.10	1.83	16.91	1.80	0.076
Sit up	10	56.8	3.19	57.6	2.88	0.279
Push up	10	52.5	6.05	52.20	6.19	0.081
VO_{2max}(ml/kg/min)	10	44.11	4.85	42.60	4.09	0.002*
Agility(s)(4*9 meter)	10	8.64	0.31	8.66	0.60	0.052
36 meter dash(s)	10	5.55	0.32	5.56	0.33	0.096
Chest press(kg)	10	99.30	16.15	99.05	16.20	0.322
Vertical jump(cm)	10	47.2	4.54	47.4	3.77	0.606
Peak anaerobic power(w)	10	466.16	100.57	436.10	86.15	0.035*
Mean anaerobic power(w)	10	390.50	66.51	366.50	57.92	0.030*
Growth hormone($\mu g.L^{-1}$)	10	2.12	0.86	2.07	0.73	0.521

BMI: Body Mass Index. WHR: waist to hip ratio. BF: Body fat. LBM: Lean Body Mass. Cir:circumference. VO2max: maximal oxygen uptake.* Significant difference.

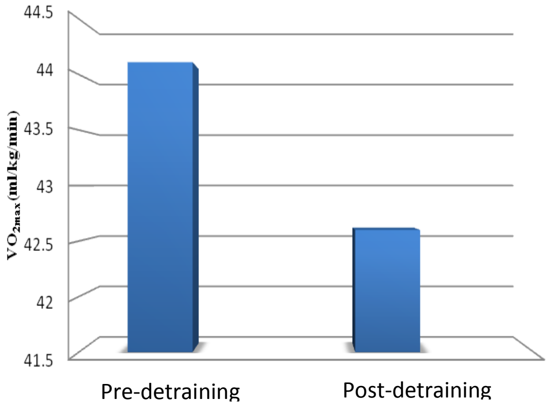

Figure 1. Change in VO_{2max} during the detraining period. Significant difference was observed for this variable throughout the detraining period.

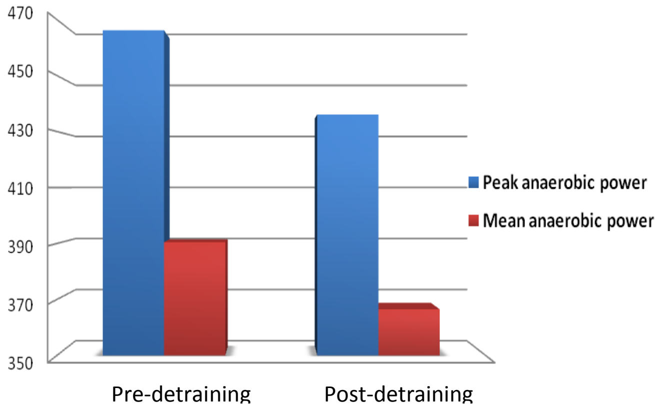

Figure 2. Changes in peak and mean anaerobic power during the detraining period. Significant differences were observed for these variables throughout the detraining period.

Discussion and Conclusion

The results of the present study showed that a detraining course could reduce some of the functional indexes in wrestlers. However, three-week detraining, wrestlers showed significant reduction in their VO_{2max}, peak and mean anaerobic power. Despite three-week detraining, wrestlers did not show significant change in their body composition and anthropometrical factors. In this regard, another study showed that six months reduction of volume and severity of trainings in continuation of resistance exercises could cause increased body weight and fat rate among weightlifters (Fatouros et al., 2005). It should be noted that 13.5-month detraining period among elite weightlifters had caused reduction in their LBM (9.3%), size of their thigh (50%) and arm (11.7%). On the other hand, proportion of circumference of muscular fibers (FT/ST) was reduced from 1.32 to 1.04 after this detraining period (Mujika & Padilla, 2000). Findings of another study showed that the athletes, who experienced one-week detraining period after 12-week strength training, did not show any reduction in their maximum strength and body composition (Prestes et al., 2009).

It seems to the main difference between our results with other authors' results in duration of detraining period which probably 3 weeks detraining cannot affect weight, LBM and organs circumferences. However, another study showed that legs' muscular mass had reduced in a detraining period (Andersen et al., 2003). In addition, another study showed that body weight and BMI of long-distance runners changed, in case of reduction of their distance running within a week. Thus, with the reduction of running distance for each 16 km, significant increase was observed at weight and BMI of athletes (Williams & Thompson, 2006). Another study showed that body composition significantly increased among athletes after either training or detraining periods and this improvement in training period was probably due to the increased lean body mass of the athletic group (Winters & Snow, 2000). Size of hip can reflect rate of thigh fat and skeletal structure of pelvic and also rate of atrophy of thigh-related muscles. Moreover, a few number of studies showed that waist size may have more applicable correlation with the abdominal fat distribution than WHR (Heitmann et al., 2004).

Hence, it can be concluded that it is better to set aside sizes related to the hip in predictive analyses. On the other hand, it has been demonstrated that waist size is a good indicator for abdominal fat which has high correlation with BMI. With due observance to all these findings and proving relation between size of waist and energy density or energy obtained from food (Romaguera et al., 2010) and despite of wrestlers seem to receive more energy from food during three-week detraining period which was coincided with the holidays of the Iranian New Year, too much fat mass was not accumulated in their bodies. In addition, it has reported that lack of exercise can cause weight increase and visceral fat and waist circumference as well (Slentz et al., 2007). In another study, LBM of subjects was increased 1.1 kg after seven-week exercise and then returned to the first state after seven-week detraining period ((Mujika & Padilla, 2000). Another study stated that detraining group, in comparison with the control group, showed significant reduction in their FFM. Interestingly, average reduction of FFM in detraining group had direct relation with the average 0.7 kg reduction in Total Body Water (TBW) (Laforgia et al., 1999). In line with the finding of the present study, it was demonstrated that although 12-week strength training left significant reduction in fat percentage of athletes, one-week detraining period could not leave any significant effect on fat percentage of their body (Prestes et al., 2009). With due observance to the research activities which demonstrated that: Power of individuals retuned to the previous size of training after one-year detraining period (Toraman & Ayceman, 2005). The present study showed that three-week detraining among wrestlers could not leave any effect on forearm, arm, thigh and calf circumference. Although other studies have shown that after 8–12 weeks of detraining, muscle strength can decrease significantly, with values between 12 and 68% (Prestes et al., 2009), our results shown that no significant differences exist in maximum strength after 3-week detraining.

It seems to during of detraining period could affect on strength and for this reason 3-week vs. 8-12 weeks could not affect on wrestlers's strength. In agreement our results, another study reported that no significant differences were observed for hip, waist, arm, thigh, and chest circumferences and bench press but significant decreases were observed in both peak and mean power (8.7 and 10.2% respectively) after 3 weeks detraining. Furthermore no significant difference was observed in vertical jump and resting serum concentrations of GH after 3 and 6 weeks detraining, respectively (Kraemer et al., 2002). The results of the present study support these data because in our study peak and mean anaerobic power decrease significantly after 21 days detraining (6.5 and 6.1% respectively). It could be also hypothesized that reductions in neural activity were most responsible for performance decrements early in wrestlers. Decreased motor unit activity may have contributed to the significant reductions observed in both peak power and mean anaerobic power in studies. In addition, Green et al (1980) reported increased resting concentrations of muscle creatine, creatine phosphate, and adenosine triphosphate (ATP) after training that were significantly reduced during subsequent 5- and 6-week periods of immobilization and detraining, respectively.

Changes in phosphate content and splitting mechanisms may be significant for sustaining the energy turnover needed during high short-term power output activities. Physiologically, high-energy phosphates might also be theorized as a contributing factor to the observed decrease in anaerobic power output (Kraemer et al., 2002). Simoneau et al (1987) observed that 7 weeks of detraining provoked significant decreases in maximal 90-second ergocycle performance, whereas the interruption of training had no effect on glycolytic enzyme markers (PFK and LDH) after a 15-week training program. In contrast, Linossier et al (1997) reported that no significant detraining-induced decreases of newly acquired maximal short-term power output within 7 weeks of training cessation after 9 weeks of cycle short-sprint training (Linossier et al., 1997). Houston et al. did not observe any significant changes in the activities of enzymes representative of phosphagen (creatine kinase) and glycolytic (hexokinase, phosphofructokinase, and lactate dehydrogenase) metabolism, neither after 10 weeks of dynamic strength training nor after 12 consecutive weeks of training cessation (Houston et al., 1983). It has reported that mitochondrial enzyme and glycogen synthase activities decline to pre-training levels after short-term training-DTR protocols (Mikines et al., 1989). It is also likely that the decreases in maximal anaerobic power may be because of concomitant detraining of the acid-base buffering system, which may contribute to some extent to reduction in power output as the muscle becomes more acidotic.

In the present study, dynamic muscular strength and vertical jump performance were retained after 3 weeks of wrestling detraining. Consistent with the data from the current study, Housh et al (1996) reported that strength was maintained during an 8-week detraining period in previously untrained men. Hortobagyi et al (1993) reported no significant changes in dynamic strength, isometric and isokinetic concentric knee extension force, and vertical jump in 12 power-trained athletes after only 2 weeks of training cessation. Hakkinen and Komi (1985) reported a 10% decrease in 1RM squat in Olympic-style weight lifters after 4 weeks of detraining. On the basis of these data, it does appear that advanced lifters (i.e., with higher levels of training and absolute strength levels) show a greater magnitude of strength loss with detraining compared with untrained or moderately trained individuals. It is possible that detraining periods greater than 2–3 weeks may decrease the anabolic hormonal response. This decrease may coincide with the muscular atrophy observed during detraining periods of at least 2 weeks (Hortobagyi et al., 1993). However, more research on hormonal mechanisms during detraining is warranted.

The results of the present study showed that three-week detraining period has not caused significant changes in percent of body fat and organs circumference. On the other hand, these data show the rapidity of the loss of peak and mean anaerobic power with detraining and demonstrate the need for a maintenance program of training to reduce the impact on anaerobic power output in wrestlers.

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