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The Effect of Two Types of Tapering on Plasma Levels of Pro-Inflammatory Cytokines and Performance in Elite Male Wrestlers

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ABSTRACT

Background. Although tapering techniques are widely used in a variety of sports, guidelines for the programming of an optimal tapering strategy in wrestling have not been well established. **Objectives.** The purpose of this study was to investigate the effect of two types of tapering on the plasma levels of pro-inflammatory cytokines and the performance of elite male wrestlers. **Methods.** Thirty elite male wrestlers participated in four weeks of incremental high-intensity wrestling training (competition season), and were randomly divided into three equal groups to train for one week as the **Tapering 1** Group (50% reduction in training volume), **Tapering 2 G**roup (75% reduction in training volume), and **Control G**roup (training with the same volume). Blood samples were collected from all participants at the beginning of the first week and at the end of the fourth and fifth weeks. Plasma levels of IL-6 and TNF-α were assayed using standard commercial ELISA kits. Aerobic and anaerobic power, sprint, agility, muscular endurance, and strength tests were done to measure performance factors. **Results.** The findings revealed that the performance score ($F_{3,41}$=29.15; p<0.001), IL-6 ($F_{2.729,36.839}$ = 116.7; p<0.001), and TNF-α ($F_{2.846,38.428}$ = 8.11; p<0.001) elevated significantly after four weeks in all groups but decreased, increased, and increased significantly during the fifth week in the Control Group. Besides, after one week of tapering (both 50% and 75% reduction in training volume), performance score and plasma levels of IL-6 and TNF-α increased significantly, decreased, and suppressed, respectively. **Conclusion.** Elevated pro-inflammatory cytokine levels associated with decreased performance score and one week's taper with 50% and 75% reduction in the volume of training essentially reverse these changes and there are no differences between the two strategies of tapering.

KEY WORDS: ***Incremental Training, High Intensity Training, Wrestling, IL-6, TNF-α, Performance.***

INTRODUCTION

The peaking phase is the final mesocycle of the off-season training program in which training intensity is at its highest, while training volume is reduced even further. For some athletes, this phase provides an opportunity to make the final preparations for the most important competition (1, 2). As we know, a taper is a planned reduction in the training load toward the end of a competitive season, with the aim of improving performance (1, 3). The taper strategy can be used in all sports (4). It is common in endurance sports such as swimming, running, and cycling but is often used to some extent in all sports (1). A meta-analysis suggested that the manipulation

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of the training intensity has no effect on performance (3). For instance, many endurance sports reduce the volume of training by up to 85% (4).

It has been suggested that the taper improves performance by approximately 2% to 3% (ranging from no improvement up to a 9% improvement) (2, 3, 5). Izquierdo et al. (2007) demonstrated that, although four weeks of tapering had no effect on power, it increased the upper and lower body strength by 2% (6).

Besides, wrestling is one of the oldest combat sports, involving repetitive bouts of high-intensity actions (e.g., attacks and counterattacks) alternated by submaximal work of low intensity activity and/or pause (7). The physiological demands of wrestlers are complex, requiring athletes to have highly developed capacities of maximal strength, power, muscular-endurance, maximal aerobic power, and anaerobic capabilities (8, 9). Wrestling is directly dependent on power where successfully executed explosive movements such as single-leg and double-leg takedowns and a high degree of anaerobic power (as measured by peak and average power over a 30 s maximal exercise period) are highly rewarded (10). Lambert (2010) suggested to US wrestlers that prior to a competition, they should decrease their training volume, increase their training intensity to optimize their training, optimize performance during individual matches, and take part in multiple matches in a day and multiple-day tournaments (10).

Some previous studies have shown that acute and chronic exercise influence several functional markers of the immune system (11-21). Nemet et al. (2002) reported the effects of wrestling practice on inflammatory cytokines and growth mediators, showing a robust increase in catabolic inflammatory mediators—for example, interleukin-6 (IL-6) and a simultaneous decrease in anabolic growth factors such as insulin-like growth factor-I (IGF-I) (12). In wrestling, individual practice sessions are quite intense, and because it involves forms of exercise (resistive, eccentric) known to cause local inflammation, if not frank microfiber injury (7, 9). Farhangimaleki, Zehsaz, and Tiidus (2009) studied the effect of two different tapering period lengths (one week and three weeks) on the concentration of plasma IL-6, IL-1β, and TNF-α, and performance in elite male cyclists. The results indicated significant reductions in IL-1β, IL-6, and TNF-α concentrations in the tapering group compared to the control group at the end of the three-week tapering period (22).

As mentioned above, a tapering is often accomplished by reducing the duration of each training session or reducing the frequency of training. The duration of the taper varies from one to four weeks, although the vast majority of tapers appear to be two weeks in length (1, 3). The effect of a taper in competitive athletes showed that maximal gains are achieved from a taper of two weeks when the training volume is reduced by 41% to 60%, without changes in the frequency or intensity (3). Clearly, a high-intensity, low-volume taper will substantially improve physical performance when conducted after a period of high-volume, high-intensity training. Thus, it would appear that, before major competitions, a wrestler should be adequately rested by way of a taper (10). Although tapering techniques are widely used in a variety of sports, guidelines for the programming of an optimal tapering strategy in wrestling have not been well established. So, based on the review of literature, we hypothesized two taper strategies in wrestling (50% and 75% reduction in training volume without changes in training intensity) and the primary purpose of this study was to investigate and compare the effect of the two tapering strategies on the plasma levels of IL-6 and TNF-α and also performance of elite male wrestlers.

MATERIALS AND METHODS

Participants. Thirty Iranian high-level wrestlers (age = 21.8±1.3 years, height = 172.6 ± 4.9 cm, BF% = 10.7 ± 2), who were fully trained as if preparing for a competition season, volunteered to participate in this study. Informed consent was obtained from each participant. The training status of each participant over the preceding eight weeks and the training history were obtained through a questionnaire, training log, and personal interview. Before tapering, they were randomly assigned to three equal groups: **Control** Group (regular training), **Tapering 1** (50% reduction in training volume), and **Tapering 2** (75% reduction in training volume).

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Protocols. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee. All participants completed a four-week incremental, high-intensity training (Table 2). Then they were divided into three equal groups of Control (regular training), Tapering 1 (50% reduction in training volume), and Tapering 2 (75% reduction in training volume) (Table 2). Blood samples were drawn from a forearm vein 24 h before the first session, 24 h after the last session of the fourth week (end of incremental, high-intensity training period), and 24 h after the last session of the fifth week (end of tapering). Plasma levels of IL-6 and TNF-α were analyzed by validated ELISA kits (Quantikine; R & D Systems, Minneapolis, MN with sensitivity of 0.016–0.110 pg.ml and 0.038–0.191 pg.ml, respectively). Performance was calculated by the assessment of some physical fitness tests including aerobic endurance (Bruce treadmill test), anaerobic power (30 s Wingate test), muscle endurance (shoulder: chin-up test; abdomen: seat-and-reach test), strength (squat, bench press), agility (4×9 m test), sprint (40-yard dash). So that, data transformed to standardized **z** scores based on their weight range and in comparison with wrestlers' records of Iranian adult national team and so combined together.

Table 2. Training programs; values in parentheses denote the number of sessions for each item per week

Mesocycle	Incremental training				Tapering	
Group					1	2
Weeks	1	2	3	4	5	
Warm-up (min)	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)	22(3)	11(3)
Speed training (m)	160(2)	190(2)	210(2)	240(2)	120(2)	60(2)
Plyometric training (j)	-	30(3)	36(3)	42(3)	21(3)	10(3)
Technical training (min)	16(3)	18(3)	20(3)	22(3)	11(3)	5(3)
Wrestling competition (min)	10(3)	12(3)	14(3)	16(3)	8(3)	4(3)
Warm-down	10(6)	10(6)	10(6)	10(6)	10(6)	10(6)

Statistical Analysis. Repeated measurements (two-way) ANOVA was used to determine the effects of TIME and Group by SPSS software at significance level of p□0.05.

RESULTS

Muchly's sphericity assumption was not met for IL-6 (W = 0.534; p<0.001), TNF-α (W = 0.595; p = 0.001), and performance score (W=0.67; p=0.006). So, we used the Greenhouse–Geisser correction for the degree of freedom.

IL-6. The interaction effect of TIME×GROUP was significant ($F_{2.729,36.839}$=116.7; p<0.001; Partial Eta Squared=0.896). Accordingly, it increased significantly in all groups during four weeks of wrestling [(**Control:** pre-training=4.99±0.26, post-training=7.84±0.21pg/mL), (**Tapering 1:** pre-training=4.82±0.24, post-training=7.61±0.20 pg/mL), (**Tapering 2:** pre-training=4.94±0.21, post-training=7.71±0.22 pg/mL)]. But during the fifth week (tapering period) a significant elevation continued in the **Control** Group (after tapering=8.82±0.22 pg/mL); in contrast, it decreased significantly in the **Tapering 1** (after tapering=6.09±0.13 pg/mL) and **Tapering 2** (after tapering=5.85±0.16 pg/mL) groups (Fig. 1).

TNF-α. The interaction effect of TIME×GROUP was significant ($F_{2.846,38.428}$=8.11; p<0.001; partial eta squared=0.376). Accordingly, it increased significantly in all groups during four weeks of wrestling [(**Control:** pre-training=3.81±0.21, post-training=5.33±0.19 pg/mL), (**Tapering 1:** pre-training=3.66±0.19, post-training=5.41±0.18 pg/mL), (**Tapering 2:** pre-training=3.73±0.17, post-training=5.48±0.19 pg/mL)]. But during the fifth week (tapering period), the elevation continued in the **Control** Group (after tapering=5.45±0.17 pg/mL); in contrast, it decreased in **Tapering 1** (after tapering=5.2±0.16 pg/mL) and **Tapering 2** (after tapering=5.25±0.18 pg/mL) groups (Fig. 2).

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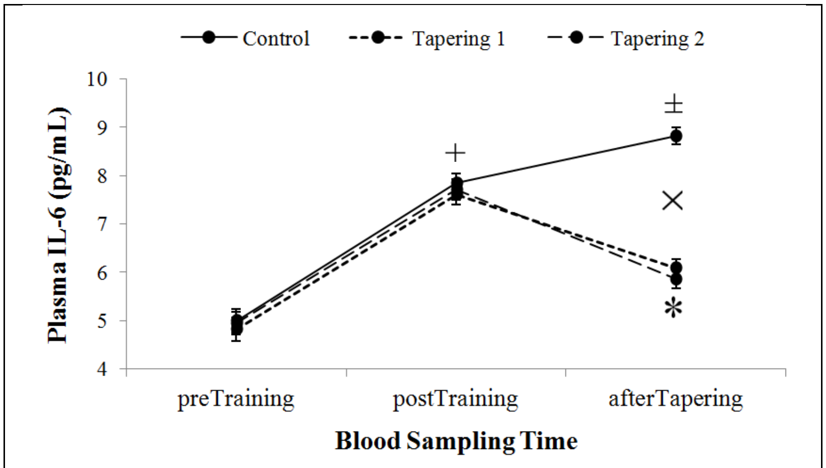

Figure 1. *The Effect of Two Types of Tapering on Plasma IL-6 in Elite Male Wrestlers.* **preTraining:** before 4 weeks. **postTraining:** after 4 weeks. **afterTapering:** after a week tapering. **×:** interaction effect of GROUP×TIME is significant at p<0.01. **+:** Significant difference with preTraining in all groups at p<0.05. **±:** Significant difference with preTraining in Control group at p<0.05. ***:** Significant difference with postTraining in all groups at p<0.05. Error bars are presented as SE.

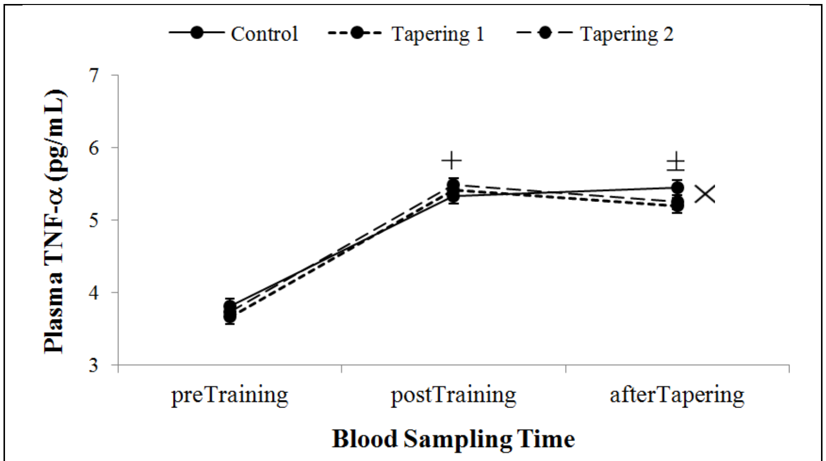

Figure 2. *The Effect of Two Types of Tapering on Plasma TNF-α in Elite Male Wrestlers.* **preTraining:** before 4 weeks. **postTraining:** after 4 weeks. **afterTapering:** after a week tapering. **×:** interaction effect of GROUP×TIME is significant at p<0.01. **+:** Significant difference with preTraining in all groups at p<0.05. **±:** Significant difference with preTraining in Control group at p<0.05. Error bars are presented as SE.

Performance Score. The interaction effect of TIME×GROUP was significant ($F_{3.008,40.607}$=29.15; p<0.001; partial eta squared=0.683). Accordingly, it increased significantly in all groups during four weeks of wrestling [(**Control:** pre-training= -36.4±3.2, post-training=-29.7±2.4 pg/mL), (**Tapering 1:** pre-training= -37.1±3.1, post-training= -30.9±2.5 pg/mL), (**Tapering 2:** pre-training= -33.0±4.1, post-training= -27.1±3.2 pg/mL)]. But during the

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fifth week (tapering period), the significant increase continued in **Tapering 1** (after tapering=-24.5±1.9 pg/mL) and **Tapering 2** (after tapering= -20.1±2.8 pg/mL) groups; in contrast, it decreased significantly in the **Control** Group (after tapering= -35.0±3.0 pg/mL) [(Fig 3)].

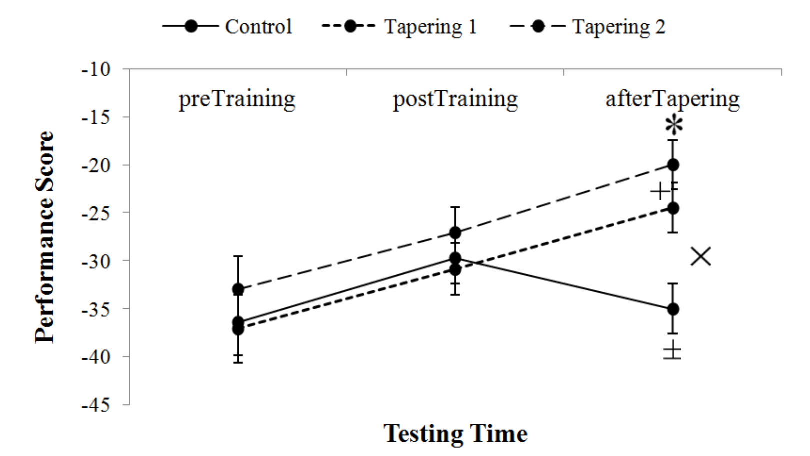

Figure 3. *The Effect of Two Types of Tapering on Performance Score in Elite Male Wrestlers.* **preTraining:** before 4 weeks. **postTraining:** after 4 weeks. **afterTapering:** after a week tapering. **×:** interaction effect of GROUP×TIME is significant at p<0.01. **+:** Significant difference with preTraining in all groups at p<0.05. **±:** Significant difference with preTraining in Control group at p<0.05. ***:** Significant difference with postTraining in all groups at p<0.05. Error bars are presented as SE.

DISCUSSION

The findings revealed that the performance score of wrestlers increased significantly with four weeks of wrestling training but decreased significantly during the fifth week of training compared to a significant improvement after one week of tapering (both 50% and 75% reduction in training volume). It is supported by the literature, which reported that ameliorated performance time was maintained during taper periods of one to four weeks among athletes (3, 4, 22-24). Tapering has been described as a gradual reduction in the training load, allowing the recovery of physiological capacities impaired by previous intensive training and the subsequent tolerance to training, resulting in further training-induced adaptations accompanied by competition performance enhancements (24, 25).

Indeed, current data indicate that four weeks of an incremental, high-intensity wrestling training period induced an increase in IL-6, TNF-α, and performance. So, after one week's tapering (both 50% and 75% reduction in training volume), plasma levels of IL-6 decreased significantly compared to a significant elevation in the Control Group, which continued the wrestling training without tapering; besides, plasma levels of TNF-α were suppressed compared to the elevation in the Control Group. It is demonstrated that the resting blood immune cell status and the plasma levels of TNF-α and IL-6 were unchanged during two weeks of intensive training and tapering, though performance improved after the two-week tapering period(26). Farhangimaleki, Zehsaz, and Tiidus reported increases in plasma IL-6 and TNF-α after a three-week taper but not during the first week of the tapering period, after eight weeks of heavy endurance training among elite male cyclists (22). Interestingly, performance improved from the first week of tapering and was maintained until the third tapering week (22). The restoration or enhancement of the immune function during tapering may be related to the severity of the immune system suppression during the previous phase of intensive training(25).

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It is suggested that elevation of plasma IL-6 and TNF-α concentrations might be factors in elevating the muscular proteolysis (22). Thus, elevated IL-6 and TNF-α levels may suppress the cellular glucose metabolism, thereby limiting optimal athletic performance (27).

We see that four weeks of training cause performance improvement among wrestlers, but their performance decreased significantly when they continued their training for the fifth week; however, both tapering strategies cause an improvement in performance at the end of the fifth week. As we know, systemic inflammation induces disease-like symptoms such as tiredness, sleepiness, and weakness, which can limit the work and effort of athletes (22).

CONCLUSION

Our findings indicate that incremental, high-intensity training for four weeks of elite male wrestlers can significantly elevate the plasma levels of some pro-inflammatory cytokines such as IL-6, TNF-α, and performance related to wrestling's physical fitness factors and that one week's taper with 50% and 75% reduction in the volume of training will essentially reverse these elevations, while, at the same time, improving their performance compared to the control group, which continued the training with the same volumes. So, elevated pro-inflammatory cytokine levels associated with a decreased performance score and one week's taper with 50% and 75% reduction in the volume of training will essentially reverse these changes; and there are no differences between the two strategies of tapering.

APPLICABLE REMARKS

- It is suggested that at least a week before competition, athletes should significantly reduce their training levels.
- Since there is no difference between 50% and 75% reduction in the volume of training, it is better to reduce 50% of the volume for tapering. This is because it seems that its psychophysiological benefits are better than a 75% volume reduction, giving the athletes the time to recover without having to stop their training.

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