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**EFFECT OF 60 AND 120 SECOND RESTING PERIODS, DURING HEAVY
RESISTANCE EXERCISES, ON TESTOSTERONE DENSITY IN ELITE ATHLETES**

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ABSTRACT

Athletes of different sports must have good physical fitness, bodybuilding, technique and tactic in order to get success at important competition like Olympic Games, world cup competitions, world and intercontinental competitions. Because in this level, the performances and operations of athletics would be very hyperphysical and extraordinary.

In the current study, ten man volleyball players with the age ranges of 25.53 ± 1.93 had been chosen voluntarily and randomly and had been put in on group meaningfully. The participants had set up heavy resistance training, in 7 stations by intensity of 70 percent in one maximum repeat (1RM). In the sessions, the 60 second resting time among sets and stations had been used. To measure the variables, blood samples had been taken before sessions, immediately after and 30 minutes after session, and also it had been taken on a non-training day in the morning.

At 3 stages of training session measurement with 60 second rest, testosterone showed an increase of 14.98 percent immediately after exercise, and 30 in after exercise showed less increase of 4.63 percent than that of before training ($P=0.004$), and immediately after exercise it had its maximum increase ($P=0.036$), and it had reduced 30 min after training which that reduction is more than that reduction of pre-exercise. In the training session of 120 second rest protocol, immediately after training, we had an increase of 5.76 percent , and 30 min after training with a little reduction, we had 2.02 percent increase than that of before exercise, and increase an reduction of testosterone in comparison with 60 second resting time was more softly ($P=0.006$).

According to this exam, it can be said that, the more resting time, testosterone density would be reduced immediately after exercise. On the probable differences of this research and other studies, below probable mechanisms can be pointed out and being into consideration: the population of this study, the 7 stations number in this protocol, and also combination of up and low body movements and exercise intensity and time and the performance location of the protocol.

Keywords: Testosterone, Heavy resistance training, Elite athletes

INTRODUCTION

When resistance exercises with high intensity are done in 3 or 5 sets with repeat of 8 to 12 times, lead to hormonal sharp respond [8, 11]. The hormone levels and time of sharp response of hormones after heavy exercise, probably is related to strength and volume achievement [2, 15]. Sharp response of hormones, has a very important role because anabolic hormones, like testosterones, can increase protein synthesis in muscle's cell [9]. Nevertheless, resting periods in resistance exercises have special importance. The resting time after finishing one set up to next set, and also the physiological situation of the body before resistance exercise up to after

resistance exercise, resting time among sets, like repeat in each set, affect on metabolism and hormonal responses in heavy resistance exercise with some movements in some sets [2, 10, 12, 13, 15]. However, the sharp response of testosterone to short resting periods is not indentified well. In most of sports, athletes need different kinds of exercises such as resistance, endurance, speedy and combinational exercises with different intensities according to exercising seasonal plan, which all are correlated to each other. Among these sports is volleyball, which needs resistance exercise besides volleyball training, and according to training

season and level of players involve different training protocols and intensities.

Bosco *et al* (1989) designed a systemic model in order to estimate physical fitness and tiredness in elite lifter athletics during a one year period and used hormonal parameter to complete the system [4]. Individual changes of subject's physical fitness level were correlated meaningfully with individual changes of density of testosterone and ratio of FT: C. Individual changes of tiredness were also correlated similarly with individual changes of density of testosterone and ratio of FT: C. But, change in the T: SHBG ratio was correlated only with physical fitness changes [1].

Bosco and Viru (1996), in other research, investigated testosterone, LH and SHBG changes during annual training of elite athletics [4]. The investigations had been focused on 6 weeks training period. This 6 weeks, contains 4 weeks of heavy training and 2 weeks of light one, and during heavy training period, the level of serum testosterone had been reduced and this reduction had been accompanied with increase of serum LH density. There had been a good correlation between LH hormone of serum and physical level of fitness; change in the ratio of light training period had a

meaningful correlation with LH fluctuations during heavy training period. From the result of his research, it is concluded that, LH response is an indication of testosterone density reduction, and pituitary is not the reason for hypothalamic axis inefficiency. The situation of tiredness and fitness of the athletics will affect on LH response to reduction of testosterone density.

Grostita *et al* (1999) studied the effect of heavy resistance training on eruptive strength and hormonal responses in handball players. After 6 weeks of heavy resistance training, no meaningful change in testosterone and cortisol level was discovered, but tendency for disorientation of these two hormones was discovered, and the fluctuation of these two was accompanied with overtraining syndrome [7].

Kraemer *et al* (1999) examined the response of testosterone and ACTH of cortisol to 10 weeks resistance training on young and old men. The results of this research indicated that, heavy resistance training causes to testosterone increase in both groups (old and young), but after training, at resting time on the weeks 6 and 10, testosterone density is higher in youth than older people. Free testosterone density of youth was higher in the weeks 8 and 10 rather than beginning weeks. But in the older men, density of free

testosterone was remained without any changes. The density of ACTH in both groups remained without any changes during 10 weeks, and quantity of cortisol in the 3rd and 10th weeks was less than that of beginning weeks [11].

Bottaro *et al* (2009) didn't find any differences in T/C ration in response to short resting periods of 30,60and 120 second in trained women [5]. Ahtiainen *et al* (2005) did not find any meaningful difference in T/C ratio in response to resting periods of 2 and 5 minutes in total testosterone, free testosterone and cortisol. Rahimi *et al*. Rahimi *et al.*, 2007; (2010) indicated a meaningful difference in serum testosterone of 90 and 120 second resting periods in comparison with 60 second resting periods in men [2].

So, the target of present research was study of affect of very short 60 and 120 second resting periods during heavy resistance training on testosterone density in elite athletics.

SUBJECTS AND METHODS

The population consisted of ten elite male volleyball player of Orumieh with volleyball exercise background of 10.98 ± 1.8 with reputation of weight training of 7 ± 2.4 having the age range of 25.53 ± 1.93 , who were in one group. The subjects attended in two highly intensity resistance exercises with one week

interval, and in each session ,blood sample were taken pre-test, post-test and 30 seconds after each exercise. 3 cc Blood samples at the time 15:30 as pre-test and immediately after exercise and 30 min after exercise, were collected. Due to hormones circadian rhythm has been recognized, one week before performance of protocol, after 8 h of night sleep at 8 o'clock and 12 h fasting also one sample had been collected.

All the subjects did two session of exercise in order to get familiar with exercise plan before starting exercise period, and their 1RM has been measured in these sessions indeed. Both two sessions of heavy resistance exercise have been started with general warming-up, and also to warm-up special muscles had been practicing each of the movements with one set of 15 repeats or with very light work load.

Resistance practical movements were bench press; pull over, shoulder press, squat, and machine leg extension, machine leg curl and triceps extension which were done in the case of cycle exercise. Between each set and each station, 60 second of rest had been considered. Each strength practical movement was done in 3 sets with 10 repeats and 70 percent of one maximum repeat. To investigate the significant differences in variables, analysis of variance (ANOVA) with repeated measurements was used.

For all the population exams a meaningful level of 0.05 was considered, and the statistical software SPSS version 16 was used for doing statistical calculation.

RESULTS

General specifications of the participants in the research according to the variance and average have been shown in **Table 1**.

Athletics' averages of testosterone density in 60 and 120 second resting protocol, before training, immediately after training and 30 minutes after training and in the morning are shown in **Table 2**.

Results of the table showed that:

1. The minimum rate of testosterone density, in 60 second resting group, was 15.75 nmol/lit before exercise. Maximum testosterone density rate, in 60 second resting group was 18.11 nmol/lit immediately after exercise.
2. Minimum testosterone density rate, in 120 second resting group, was 15.78 nmol/lit relevant to before exercise .maximum testosterone density rate, in 120 second resting group, was 16.69 nmol/lit immediately after exercise.

In 3 stages of measurements training session with 60 second resting protocol, testosterone, immediately after exercise showed a 14.98

percent of increase and 30 min after exercise with a little reduction showed a 4.63 percent increase in proportion to before training (P=0.004) and it has its maximum increase immediately after exercise (P=0.036), and was reduced 30 min after exercise and this reduction is more than that of before exercise. In the training session of 120 second resting protocol, testosterone immediately after training had an increase of 5.76 percent, and 30 min after exercise with a little reduction, this increase was 2.02 percent in proportion of before training, and increase and decrease of testosterone had a lightly process in comparison with 60 second resting period (P=0.006).

In both two sessions, the quantity protocol of testosterone, in comparison with morning quantity of testosterone, from morning up to before training, showed an additive increase. Comparison between the quantities of two sessions showed that maximum increase of testosterone was related to immediately after training with 60 second resting time.

Table 1: General specifications of the subjects

Variables	The ten elite man volleyball player
Age (year)	25.53±1.38
Weight(kg)	91.04±6.46
Height(cm)	191.85±4.72
Volleyball practice reputation(year)	10.68±1.8
Resistance exercise reputation(year)	7±2.4
Body mass index	24.72±1.02

Table 2: Statistic explanation of average and standard variance of testosterone density

Variable	Testosterone	Fasting	before exercise	immediately after exercise	30 minutes after exercise
60 second resting group	Average ± standard variance	14.43±3.87	15.75±3.03	18.11±3.01	16.48±2.45
120second resting group	Average ± standard variance	14.43±3.87	15.78±3.95	16.69±4.29	16.10±4.74

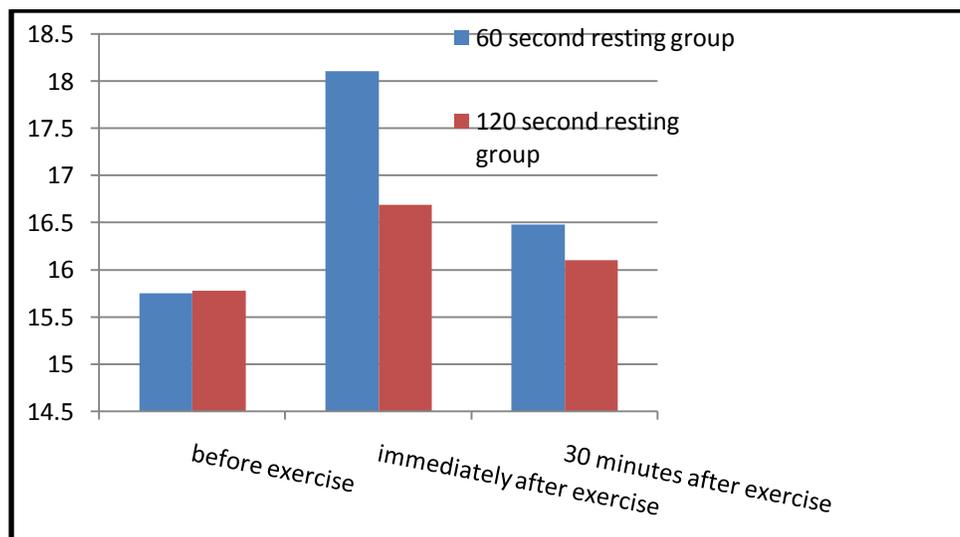


Chart 1: Testosterone density in resting periods of 60 and 120 second

DISCUSSION

Resistance training is a very effective method in increase of anabolic hormone density which in fact stimulates increase of strength

and volume of muscle [6, 13, 15]. Resistance training of high intensity, when they are done in 3 to 5 sets with repeat of 8 to 12 times, would lead to sharp hormonal responses [8,

11]. The hormones level and the time of hormones' sharp responses after heavy resistance training would be probably related with strength and volume achievement [2, 15]. Sharp response of hormones, have a very significant role because anabolic hormones like testosterone can increase protein synthesis in muscular cells. However, resting periods in resistance training are so important. Time of resting after finishing one set, up to next set, and also physiological situation of the body before training up to resistance training, resting intervals among sets, like the number of repeats in each set, affects on metabolism and hormonal responses in heavy resistance exercise with some movements in some sets [2, 10, 12, 13, 15].

Results of this research showed that in 3 stage of training sessions with 60 second resting protocol ,there had been an increase in testosterone level up to 14.98 percent immediately after training, and 30 minutes after training, with a little reduction, an increase of 4.63 percent in proportion of before training (P=0.004). However Rahimi *et al* (2011) had observed a very little reduction of testosterone with different training protocol in the same resting time immediately after training and increasing of the testosterone after 30 minutes. Rahimi *et al* (2010), proved a meaningful increase in serum testosterone

of resting periods of 90 and 12 second in comparison with 60 second resting in men [14]. Buresh *et al* (2009) indicated that testosterone density hadn't been changed more, after one week of training in short resting periods of 1 minute, than resting period of 2.5 minutes in men. In all the 3 times, density of testosterone was different and had its maximum increase immediately after training, and had decreased 30 minutes after training, and this reduction is higher than that of before training [6].

In training session of 120 second resting protocol, testosterone increase was 5.76 percent immediately after training, and 30 minutes after training, with a little reduction, an increase of 2.02 percent in proportion of before training, and increase and decrease of testosterone had a lightly process in comparison with 60 second resting period (P=0.006). However Rahimi *et al* (2011) had been observing increase of testosterone with different training protocol in the same resting time immediately after training up to 30 minutes after training. Buresh *et al* (2009) indicated that cortisol density hadn't been changed more, after one week of training in short resting periods of 1 minute, than resting period of 2.5 minutes in men [6]. In both two sessions, the quantity protocol of testosterone, in comparison with morning quantity of

testosterone, from morning up to before training, showed an additive increase. Comparison between the quantities of two sessions showed that maximum increase of testosterone was related to immediately after training with 60 seconds resting time ($P=0.036$).

CONCLUSION

According to this research we can say that, the much resting time there will be much reducing testosterone density immediately after exercise. On the probable differences of this research and other studies, below probable mechanism can be pointed out and being into consideration: The population of this study, the 7 stations number in this protocol, and also combination of lower and upper body movements and exercise intensity and time and the performance location of the protocol.

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