

## Overtraining with Resistance Exercise

One of the fastest growing and most popular types of exercise in recent years is resistance exercise, whether used for the purpose of general fitness, rehabilitation, or athletic performance. Resistance exercise comes in many different forms, each of which can produce distinctly different responses (e.g. increased size, strength, power, contraction velocity, muscular endurance, etc.). Each individual training session can be described by the five acute training variables: choice of exercise, order of exercise, exercise volume (sets x repetitions), load or intensity (percent repetition maximum), and rest (between sets). Each of these variables present numerous possible combinations resulting in literally thousands of possible single-session protocols. Over a longer training period or cycle, the training variables can be altered to provide the individual with the necessary variability for long-term improvement. Such variety in the long-term program is called periodization, and helps to ensure that the body is continually being presented with a stress that permits both progress and adequate recovery. Often associated with training programs for advanced athletes, such training variety is also critical for the individual who is embarking on a lifetime exercise program for general fitness. This variation of the resistance exercise prescription also avoids the monotony that can occur when the identical exercise protocol is performed each session with little or no variation.

One common problem when prescribing resistance exercise is determining the appropriate combination of training volume and intensity. Excessive volume or intensity may produce less than optimal results, and may actually create a situation where performance is impaired. If physical performance is depressed for extended periods of time, and requires long recovery periods, overtraining has occurred. This situation may result in a decreased desire to exercise, and can also increase the risk of illness or injury. Such a situation can be avoided through proper prescription of volume and intensity. It must be noted that increasing training volume or intensity is not necessarily bad. There may even be phases of training where an individual experiences short-term performance decrements that are easily recovered from with several days of decreased exercise stress. This is called overreaching, and when carefully prescribed can contribute to long-term progress.

The typical overtraining scenario, however, occurs when either training volume or intensity is excessive for too long. It is also important to note that training volume and intensity are inversely related. In other words, when training volume is greatest, intensity must be relatively low, and vice versa. Unfortunately, many individuals prescribing resistance exercise programs fail to realize this, and simply follow the axiom that “more is better” for both volume and intensity. The net result is that performance is either impaired or at best is less than optimal.

One type of overtraining can occur when training volume is excessive for prolonged periods. This can occur by increasing training frequency, adding exercises, or performing more exercise sets. It appears that this type of overtraining manifests many signs/symptoms similar to those seen with overtraining with endurance exercise. Two hormones often impacted by overtraining are testosterone and cortisol, and overtraining due to high training volumes often results in a decrease in the ratio between resting concentrations of these hormones (testosterone/cortisol). While this ratio may not be directly responsible for the performance decrements observed, it has been repeatedly shown that this ratio decreases as training volume increases. It also appears that the use and mobilization of free fatty acid, which expends more fat by using energy in the metabolic cycle, increases during high volume phases of resistance exercise. This may contribute in part to decreases in body fat with this type of training stress. Although it has been theorized that the sympathetic nervous system may become exhausted with this type of training (the parasympathetic overtraining syndrome), this has yet to be demonstrated with resistance exercise.



At the other end of the training spectrum is the effect of excessive training intensity; that is, using too heavy a resistance for extended periods of time. This scenario seems to present a physiologically different profile than high volume overtraining. The limited data available indicate that the testosterone/cortisol ratio is not altered with this type of overtraining, even when strength performance is dramatically impaired. Exercise-induced concentrations of catecholamines, on the other hand, are markedly elevated with this type of overtraining. This suggests a sympathetic overtraining syndrome where increases in sympathetic activity in the nervous system may be an attempt to compensate for decreases in muscle strength capabilities.

It is believed that most real-life overtraining scenarios are due to a combination of excessive volume and intensity. Furthermore, many exercise programs include not only resistance exercise, but also some form of exercise for cardiovascular fitness. Such a combination presents a very complex setting from a physiological standpoint. The few data available on this type of training suggest that both the resistance exercise and the cardiovascular exercise components may have to be modified somewhat to allow the individual to tolerate such combination training.

Performance decrements may also occur through pathological mechanisms such as joint overuse. When this occurs, strength and power decrements may be due to afferent inhibition from the affected joints rather than due to decreases in muscular capabilities. Perhaps the most intriguing area of research is the evaluation of psychological states accompanying overtraining. Although most data on the psychology of overtraining are from other types of exercise, it appears that a decreased desire to train often occurs with resistance exercise overtraining. Furthermore, measures of self-efficacy (confidence in performance) appear to be adversely affected with some forms of resistance exercise overtraining.

Numerous signs and symptoms of overtraining have been suggested. It should be noted that not all of these symptoms will be present, and that the presence of some of these symptoms does not automatically mean an individual is overtrained. The ultimate determination of overtraining is whether performance is impaired or plateaued. Listed below are some frequently cited signs of overtraining:

### **Performance**

- Decreased performance (strength, power, muscle endurance, cardiovascular endurance)
- Decreased training tolerance and increased recovery requirements
- Decreased motor coordination
- Increased technical faults

### **Physiology**

- Altered resting heart rate (HR), blood pressure and respiration patterns
- Decreased body fat and post-exercise body weight
- Increased VO<sub>2</sub>, VE, and HR during submaximal work
- Decreased lactate response
- Increased basal metabolic rate
- Chronic fatigue
- Sleep and eating disorders
- Menstrual disruptions
- Headaches, gastrointestinal distress
- Muscle soreness and damage
- Joint aches and pains



## Physiological

- Depression and apathy
- Decreased self-esteem
- Decreased ability to concentrate
- Decreased self-efficacy
- Sensitive to stress

## Immunological

- Increased occurrence of illness
- Decreased rate of healing
- Impaired immune function (neutrophils, lymphocytes, mitogen responses, eosinophils)

## Biochemical

- Hypothalamic dysfunction
- Increased serum cortisol and SHBG
- Decreased serum total and free testosterone, testosterone/cortisol ratio
- Decreased muscle glycogen
- Decreased serum hemoglobin, iron, and ferritin
- Negative N2 balance

The majority of these signs and symptoms are derived from endurance exercise overtraining research. Not all of these signs and symptoms have been linked with resistance exercise overtraining, due partly to a lack of relevant research on the topic, and to the fact that resistance exercise presents different physiological stress compared to endurance exercise.

- If overtraining from resistance exercise has occurred, several simple steps can be taken, including:
  - One or more recovery days should be added to each training week.
  - Periodized training programs can provide the necessary training variety to avoid overtraining.
  - Avoid monotonous training.
  - Check that training volume and training intensity are inversely related.
  - Avoid too great a relative intensity (percent 1RM) for extended periods.
  - Avoid too great a training volume (number of sessions, exercises, sets and reps) for extended periods.
  - Avoid performing every set of every exercise of every session to absolute failure, with no variation.
  - Avoid incorrect exercise selection (overuse of certain muscles or joints).
  - Avoid excessive use of eccentric muscle actions.
  - Take into account the cumulative training stresses from other forms of exercise (i.e., cardiovascular training, sport-specific training, etc.)

Overtraining is of growing concern; more research is necessary for full understanding. It is clear that the exercise prescription is critically important to avoid a problem. Periodized training allows variation and is important for best results. Periodization includes phases of high training stress and planned periods for recovery and restoration. This applies to elite athletes well as to individuals exercising for general health and fitness.

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