Sports Nutrition and Training (Supplementary Notes)
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One Repetition Maximum – refers to the maximum load or resistance that an athlete can lift once, but cannot lift a second time, without a recovery period. Thus, a 5-repetition maximum refers to the maximum load an athlete can lift 5 times, but not six within a given set, and so on.

As a rule, in order to increase muscle hypertrophy when performing weight training the resistance selected is usually between 70-80% of the athlete's one repetition maximum for that particular exercise (moderate resistance), or between 85-90% of their one repetition maximum (high resistance). As an example, it the subject's one repetition maximum for the bench press is 200 lbs, then they may choose to lift 150 lbs (75%) or 170 lbs (85%), enabling them to perform 6-9 repetitions per set, as a means to gain strength and muscle hypertrophy. As the athlete becomes stronger and their one repetition maximum increases, then they need to increase the resistance in accordance with their increased strength, in order for additional strength gains to occur. This is known as the overload principle of training.

Rest intervals between sets should be approximately one minute when training at 70-80% of one repetition maximum (these are athletes who need to work under conditions of higher lactic acid build up, such as hockey and basketball players), whereas rest intervals between sets, when training at 85-90% of one repetition maximum, should be 2-3 minutes to restore sufficient phosphagen stores for the next set.

Circuit Training – circuit training allows an individual to acquire a modest cardiovascular benefit, while performing a weight training routine. The individual performs 12-15 repetitions of a weight training exercise (40-60% of one repetition maximum), and after only a 30 second rest interval moves to another exercise station and does another set of 12-15 repetitions and so on. The high repetition work, coupled with the very short recovery period between sets, keeps the subject's heart rate elevated, and has been shown to increase VO^2 max. by 5-8%, which is a superior oxygen utilization gain compared to standard methods of weight training. However, the overall strength gain from circuit training is far less than other methods of weight training and the oxygen consumption improvement (5-8%) is far less than occurs with traditional methods of aerobic training. Circuit training has its best application for patients with heart disease, who wish to add a component of strength training to their work out routine (note that the maximum heart rate for these patients must first be established by their attending physician), and for patients who wish to lose weight, but also want a muscle toning effect, and only have 30-40 minutes to exercise, three times per week.

Muscle Biopsy findings have shown the following:

Olympic weight lifters:

a. 59% type II (fast twitch fibers)
b. 79% type II fiber area within muscle

c. Type II/Type I area ratio of 1.68 to 1.0 in vastus lateralis muscle.

Lighter Load, High Repetition Athletes:

a. 44% Type II fibers
b. 50% Type I fibers
c. Type II/Type I ratio of 1.3 to 1.0

Reference:

Physician and Sports Medicine: Principles of Resistance Training, 1988; March, April, May, June editions.

Exercise Recovery and Carbohydrate Repletion – even if an athlete does not consume any carbohydrate foods after a strenuous exercise routine, within 12 hours 50% of muscle glycogen will be replenished by the body's ability to perform gluconeogenesis in the liver. The liver then sends glucose through the bloodstream to the muscles, which extract it and replenish their glycogen stores. Thus, alanine, glutamine, lactic acid and the breakdown of other amino acids continue to provide a source of glucose under these conditions, adding to further muscle catabolism, as a means to maintain normal blood glucose levels and enables muscles to re-synthesize glycogen, albeit at a less than optimal rate.

The maximum workload that can be maintained from the oxidation of free fatty acids alone is 50-55% of a subject's VO^2 maximum in an untrained subject. In a well-trained athlete this figure rises to approximately 65% of their VO^2 max. due to the increased size and number of mitochondria within trained skeletal muscle and the increased concentration of aerobic enzymes and the increased intracellular transport of oxygen via myoglobin.

At rest, liver glycogen utilization is 0.5 mmol/min in a fasting state, whereas during exercise glucose output from the liver rises to 2-6 mmol/min, depending upon the workload. With heavy workloads, half of the liver glycogen is depleted within the first hour, and by the end of the second hour, liver glycogen is very low and hypoglycemia follows, unless carbohydrate intake is utilized to stave off glycogen depletion.

A person's basal metabolic rate (BMR) accounts for 60-80% of the daily calorie or energy expenditure. The BMR is affected by:

a. the body surface area
b. fat-free mass
c. thermic effect of food
d. genetic background
e. aging (1-2% decline in BMR per decade from ages 20-75, unless the person maintains their fat-free mass with resistance training and the appropriate protein intake)

For both males and females, at any age, the best indicator of their BMR is their total fat-free mass, or lean mass (assuming no underlying thyroid condition)

Reference:

1. Exercise Physiology. W. McArdle et al. Lea & Febiger. 1986: 121-130
2. Essentials of Training and Conditioning. T. Baechle (editor). Human Kinetics. 1994: 231-237