Dynamic Chiropractic

SPORTS / EXERCISE / FITNESS

Primer of Exercise Prescription

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This second article is a directed, clear-cut cookbook, outlining some of the basics of prescribing exercise programs for apparently healthy adults. This article only covers the essentials to safely and effectively get your patients moving. Certainly, a full understanding of testing and prescriptive techniques requires more reading from other sources (in particular, the American College of Sports Medicine's resource manual, and Guidelines for Exercise Testing and Exercise Prescription, by Lea and Febiger, 1994). These concepts are essential if one is planning to embark in clinical exercise testing, and/or prescription of adults at high risk, or with potential or coexisting circulatory and cardiopulmonary diseases, or diabetes. In my MPI seminar #5, I cover these aspects in detail.

The main thrust and emphasis in the exercise prescription description in this article is endurance ("aerobic") training. This is because it forms the predominate theme for most adults who need to exercise, in view of its overwhelming relationship to reduction in body fat, prevention of diabetes, stroke, and coronary artery disease, not to mention its association with many positive psychological benefits.

In designing an exercise prescription for your patients, the central tenet to remember is that exercise training is, ironically, a form of stress, as one is voluntarily subjecting the body to a physical stimulus/stressor. Exercise stimulates the amazing adaptive powers of the body's cellular biochemical and genetic functions, eliciting a supercompensation effect (healing of the "trauma" plus, subsequent building of even more tissue or capacity): for example, a greater capillary network in the stimulated muscle; more contractile proteins in muscle; production of more blood volume; increased production of oxidative enzymes in the muscle mitochondria, etc.).

If rest is allowed to intervene between exercise bouts, the body grows stronger, and the subsequent stimulus seems easier over time. What was maximal is now submaximal. Fitness ensues. This applies whether the stimulus is lifting heavier weights, or engaging in prolonged activities like running or cycling.

If the stimulus is applied too intensely, or not enough rest is allowed, the system will not adapt, and it will break down (e.g., burnout, overuse injuries, sickness). This highlights the art of prescribing exercise, whether for the sedentary 55 year old, or the nationally-ranked 10,000 meter runner; balancing the intensity/volume with rest/recovery so that progression to higher levels of fitness will occur. As some of you will realize already, this process is strikingly similar to what Selye described as the general adaptation syndrome. If you understand Selye's theory, then you are well on the way to understanding exercise prescription.

Exercise training has several components that comprise the core of the exercise prescription: intensity, duration, frequency, type, and structure.

Intensity of training is by far the most important. It usually makes or breaks the prescription and eventual compliance with exercise, and is the parameter which relies heavily upon prior exercise testing, and/or many of the objective methods of calculation available. Gauging the relative intensity can be done most easily by heart rate. Several equations have been developed to arrive at

the appropriate level. The most scientific method would be to exercise test the individual with direct gas-analysis equipment on a treadmill or cycle ergometer, determine the VO2max, and then prescribe an intensity equivalent to 50-75 percent of VO2max. However, since we know that heart rate is linearly related to oxygen uptake (or exercise intensity), heart rate alone can be used in most cases, and is surprisingly accurate (and a lot more inexpensive). In this case, intensity is usually expressed as a percentage of maximal heart rate (HRmax). To estimate HRmax, use one of the two equations: (1) HRmax = 220-age. (2) HRmax = 210 -0.65 (age). A target "zone" of between 60-75 percent of HRmax is usually sufficient to induce a training effect, and approximates about 65-85 percent of functional capacity. This equation may be used:

Karvonen equation: Training HR = 0.65 - 0.85 (HRmax-HRrest) + HRrest.

Choose the intensity range anywhere between 0.65-0.85. For beginners, choose the lower end; as fitness improves (i.e., HR is lower for the same walking speed, or workload on a bicycle trainer or stairmaster), scale up the relative intensity to continue progression.

The only pitfall is that the HRmax estimation is just that, an estimation, and has been shown to be in error by as much as 20 percent. This is where some subjective measures should be augmented to fine-tune the exercise intensity. One method is to gauge the relative effort, using variations of the Borg rating of Perceived Exertion Scale. This is a scale of 0-10, with 05 increments, each with a subjective effort rating. A "somewhat hard" rating usually corresponds to 70 percent of HRmax. A more popular method is the talk-test. One should exercise at a "conversational" pace, one that causes light sweating and a heavier exertion rate, but that does not cause so much dyspnea (a shortness of breath), that a full sentence cannot be formed without gasping. This also corresponds to the 70 percent intensity threshold. With the increasingly popular use of wireless HR monitors and their rapidly declining costs, they can also be considered by your patients to self-monitor exercise intensity.

Duration. Improvements in fitness can be attained with as little as 10 minutes of activity, but the target duration for most adults (for optimal levels of body fat loss, cardioprotective alterations of blood lipids and cardiocirculatory adaptations) is 40-60 minutes. From a starting level of 10 minutes, most healthy adults can attain this duration after about 6-8 weeks. Structured exercise classes sometimes fail people after they graduate from the early beginning phase, simply because they never progress past the 15-20 minute aerobic phase duration. Remember, the metabolism of fat in the mitochondria of slow-twitch muscle fibers only really begins by the 20 minute mark. Before then, mainly muscle and liver glycogen is the prime fuel.

Frequency. Minimum for attaining a training effect is two days/week if the intensity is high enough. Optimally, five days/week is ideal for progression, but fitness can be maintained adequately with three days/week. However, with the cessation of training, detraining effects will be noticeable by 2 weeks. The extent of detraining effects following a lay-off is inversely proportional to the length of training. Athletes who have been training for years will still retain good physiologic adaptations in the muscles and circulation a month or more after cessation of training. Seven days/week training is generally not recommended, except for elite athletes, and then only by alternating hard with easy days. For some subgroups of patients (obese, high-risk) two small sessions/day might have to be adopted until exercise can be combined into one 20-30 min. session.

Type. For optimal development of fitness, the activities which use the large muscle groups in a continuous, rhythmic pattern over long durations qualify as good candidates for eliciting a training effect. The list in the 1990s includes running/power walking/pool running, stepping (machines or steps), in-line skating, cross-country skiing, rowing, paddling (machine or real), swimming (simulator or real), hiking on a grade or briskly on the flat, cycling (rollers, trainers, or real), or the

newer hybrid aerobic full-body trainer devices. Activities chosen must reflect the person's personal preferences, habits, location/climate, body-type/anthropometrics, convenience, and potential for compliance. The reason distance running exploded in popularity throughout the 1980s was because of the physiologic demands, simplicity, and convenience. However, the injury rate is high. Many runners not particularly cut-out anatomically for running have now switched to a combination of different activities, while maintaining excellent levels of fitness. Often we also include in the discussion of exercise type, supplementary exercises for injury prevention and muscle balancing. These include back, abdominal strength training, and flexibility exercises.

Structure. Most exercise scientists generally recommend that people vary the intensities, durations, and modes of exercise from day to day, just like athletes, since for most people full recovery from the workout takes 48 hours. This gives the micro-damaged muscle fibers a chance to restore and supercompensate. The first 5-10 minutes of exercise should be warm-up activity. Start out slowly and break-out into normal pace only after the muscles and circulation have adjusted. Raising the temperature in the muscles gradually brings muscle temperature into the range where biochemical and enzymatic functions are optimal. It also lessens the strain on the circulation and heart. Conversely, after the workout, gradually warming down for 2-5 minutes, slowly reducing the intensity restores circulation, prevents blood from pooling in the extremities (and causing dizziness and fainting). It also allows for dissipation of body heat.

Light stretching exercises can be done after the warm-down, while the muscles are still warm and viscous. Avoid hot tubs and saunas within one hour after exercise, as this will accentuate blood pooling in the dependent areas, and is absolutely dangerous for those with cardiovascular diseases after exercise.

In terms of outside environment conditions, appropriate precautions and clothing must be understood, for they directly affect all the factors above. High heat and humidity place often underappreciated strain on muscle fuel, cardiovascular and thermoregulation status. Intensities and durations must often be curtailed. Monitoring of heart rate will aid tremendously, as in high heat/humidity conditions, a disproportionately high heart rate for the same intensity will herald potential heat-induced injury if monitoring is not taken seriously. In contrast, though exercise in the cold is generally not as problematic from an intensity and duration standpoint, there is the problem of clothing selection, breathable fabrics (and paradoxical overheating), layering, and avoidance of hypothermia and frostbite injuries.

In addition to the above objective techniques of exercise prescription, several essential and general principles are also important to consider when prescribing exercise: 1. Specificity; 2. Individual variation; 3. Starting fitness level.

1. Specificity: It appears that the body responds very specifically and rapidly to exercise training stimulation. The exercised muscles are the muscles that respond histologically and biochemically to training. This has been documented in scores of scientific studies comparing responses of swimmers vs. runners to either upper or lower body exercise challenges: runners do poorly in upper extremity endurance tests, and the reverse for the swimmers. Triathletes are another case, since they train both muscle groups, however even in this group, they score lower in both arm and leg aerobic fitness tests than specialists in those respective sports. Notwithstanding, there are substantial generalized training adaptations which do occur across all endurance activities, which is mainly why the cross training effect is observed in multi-sport athletes. These effects include the hypervolemia and increased red cell mass, increased cardiac performance, modified endocrine function, enhanced lactate clearance, and heat-tolerance adaptations. However, the most important adaptations which explain endurance and strength fitness reside in the muscles, and are specific not only to the type of exercise but within the type, the volume/intensity/duration too. Just because I train by

running five days/week, 6 miles each time, does not necessarily mean I can complete a 50 km cross-country ski race successfully. They are two very different endurance activities, with their own subset of motor skills, muscle recruitment patterns, fuel requirement, and biochemical adaptations.

2. Individual Variation: Genetics determines (i) how rapidly we adapt to exercise training, allowing us to move to more challenging intensities/durations at a faster pace, and (ii) the upper ceiling of our capabilities. Most people can tolerate about a 5-10 percent rate of progression of total training volume per week. Some inherently talented people can reach excellent fitness levels, tolerate enormous stress easily, while others may nudge the red-line only once in a while, otherwise they self-destruct. Aging negatively impacts upon this aspect, as does biomechanical genetic endowment, especially with weight-bearing activities like running. The author is a classic example of this. I have a decent engine, but my chassis (chronically-developed imbalances, forefoot and rearfoot pronation and awful lower extremity biomechanics) has ruled me out of becoming a really good runner. As far as ultimate fitness levels, this is entirely a mix of the above: hard work, motivation, and genetic predisposition. A maximum oxygen uptake (VO2max) of 85 ml/kg/min is part hard work, part opportunity, and part who your parents are. Thus, individual variations must form the basis for the exercise prescription.

3. Starting Fitness Level. The law of diminishing returns applies in fitness training. People with initially low fitness, although requiring a low level of exercise intensity to spur adaptations to occur, will improve rapidly. Many changes will be noticeable within 10-14 days after training is commenced. In these people VO2max can improve anywhere from 25 to 50 percent. In contrast, individuals who have been active for years might only be able to realize an improvement of 2-10 percent in fitness, and probably no change in VO2max. In these individuals, improvements in fitness are a result of better thermoregulation and lactate metabolism, enabling one to exercise at higher percentages of VO2max without excessive lactate accumulation.

The beginner usually needs exercise intensities prescribed just within the critical of 60 to 70 percent of maximum threshold, and might require an interval-based approach until improving fitness levels allow 20-40 minutes of continuous activity without rests, as ability to clear lactate improves. This concept is especially important for obese and extremely sedentary individuals.

Finally, from both a safety and legal perspective, the DC should make themselves familiar with the various medical contraindications of exercise testing as well as exercise training before prescribing exercise for high risk patients and those with known disease.

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