Dynamic Chiropractic

REHAB / RECOVERY / PHYSIOTHERAPY

Exercise Physiology Issues, Part IV

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Exercise and Lipid Metabolism

Wirth et al.[1] have shown the beneficial effects of physical activity on lipid metabolism; serum lipid and those of adipose tissue and skeletal musculature are affected.

Physical training leads to a pronounced lowering of the serum triglyceride level. The decrease in the serum cholesterol and free fatty acid (FFA) levels is still controversial. The concentration of very low-density lipoproteins (VLDL) and low-density lipoproteins (LDL) is reduced and that of high-density lipoproteins (HDL) is elevated. The LDL/HDL ratio is diminished, and with it the risk of arteriosclerotic disease. Epidemiological studies have shown a negative correlation between physical activity and the incidence of coronary heart disease. Physical training can reduce total body fat mass by decreasing fat cell size. In vitro investigations have shown that lipogenesis is inhibited on several levels. To date, methodological problems have hindered the interpretation of the results concerning lipolysis.

In a state of physical fitness, the supply of fatty acids (FA) and glycerin phosphate for triglyceride synthesis is diminished in the fatty tissue. In muscle tissue, a totally different training adaptation seems to occur. During glucose metabolism, an accelerated glucose uptake in the skeletal musculature and increased oxidation in the mitochondria are found. The uptake of FA from FFA and lipoproteins is accelerated. As a result, muscular glycogen and triglyceride deposits are larger in the trained than in the untrained person.

This seems to be a favorable adaptation because substrate oxidation for energy production occurs largely in the muscle. At the same time, physical activity alters the relationship of substrates in the energy deposits; the fat deposit is diminished and the glycogen reserves in musculature and in the liver are augmented. This adaptation is beneficial because glucose from glycogen supplies more energy per liter of burned-up oxygen than FFA from triglycerides.

Physical training may be recommended for patients in whom a lowering of triglyceride levels in VLDL and LDL, as well as augmentation of HDL and reduction of body fat is desirable, provided there is no contraindication to physical rehabilitation.

Walking for Exercise

A regular, vigorous program of walking has been shown to exert a training effect. Schultz[2] has reviewed the literature on health benefits of walking. Walking can be of significant aerobic value. It has been shown to increase maximum oxygen uptake, decrease heart rates and resting blood pressure, and decrease body weight and percentage of body fat. It is estimated that one has to walk for one hour at a rate of 3.5 mph to improve fitness. At a rate of more than 3.7 mph, the energy required for walking increases exponentially. Since there is an apparent tendency to break into a jog because of the biomechanics of walking at 4 -- 4.5 mph, a walk-jog regimen may be helpful for some persons. Variations in grade, terrain, and weight carried can affect the amount of energy expended.

Walking has the salutary benefit of being much kinder to aging joints and is much more readily accepted by the nonathlete and by those not naturally attuned to running. The fact is that running is not easy and it is basically for a long-range program. Add to these facts our knowledge that it is not what you do but how long you do it that really counts in terms of exercise benefits and even caloric expenditure. Walking has much to recommend it.

Physical fitness programs have not induced most people to be physically active. Some activities, such as jogging, are unsuitable for many people and harmful for some. Shoenfeld et al.[3] examined the efficacy of walking with a backpack load as a method for improving physical fitness.

Forty-four sedentary men with a mean age of 19 years (range 18-23 years), a mean height of 178 cm, and a mean weight of 76 kg walked at a speed of 5 km/hour with a 3 kg backpack load for 30 minutes a day, five days a week for three weeks. At this time, 32 (group A) terminated the experiment and 12 continued to march for another week. Of the 12 continuing, six (group B) kept the same backpack load and six (group C) increased their load to 6 kg.

By the end of the 3-to-4-week experiment, predicted aerobic work capacity had increased by 15% in the 32 men in group A, by 18% in the six men in group B, and by 32% in the six men in group C. An improvement in predicted aerobic work capacity of more than 20% occurred in 34% of the men in group A, 50% of those in group B, and 67% of those in group C. A comparison of results for seven men from group A with low initial physical fitness and for seven with high initial fitness showed an increase in predicted aerobic work capacity of 30.4% in the former group and of only 2.7% in the latter group. An increase in work capacity of more than 20% was noted in four of seven men with low initial fitness and in none of the seven with high initial fitness.

It is possible to substantially improve aerobic physical fitness in just three weeks by walking daily with a light backpack load. This program is most useful for people who have low initial aerobic work capacity. Walking is relatively safe, and even more so when shock-absorbing, custom-made flexible orthotics are prescribed for the walker. Walking can easily become part of a rehabilitation program, even for elderly people. The main determinant of the rapid increase in aerobic work capacity is apparently the increase of the weight of the backpack load, rather than speed or duration of walking. This study has resulted in numerous rehab clinics incorporating backpacks as part of treadmill walking.

Fluid/Electrolyte Replacement

Twenty-five football-related deaths resulting from heat illness occurred between 1959 and 1965. This led to investigations of the use of water as an electrolyte replacement to prevent heat illness during strenuous exercise. Donald et al.4 studied the effects of a commercially available glucose-electrolyte replacement drink administered in three different schedules on the work performance of 30 high school football players. The drink contained 23 mEq sodium, 10 mEq potassium and 23 gm glucose per liter. The players consumed the drink on the first day of practice (control) and in amounts of 120 ml or 240 ml during 15-minute rest periods on the succeeding two days.

Environmental conditions were 90-95°F and 60% to 62% relative humidity.

The amount of body weight lost remained essentially constant over the three days, regardless of the amount of fluid consumed. The pre-practice and post-practice physical performance capacities, as measured by predicted oxygen uptake values (VO2max), decreased significantly ($P<.05$) in each group. The VO2max decreased by 31% during the control session, 25% in players following the schedule of 120ml/15 minutes, and 23% in players following the schedule of 240 ml/15 minutes.

The physical work capacity measure, as determined by the time required to complete a 300-meter obstacle course, showed contrasting results. During the control session, the time required to complete the course increased from 67.1 seconds (pre-practice) to 91.8 seconds (post-practice). However, players following the schedule of 120 ml/15 minutes required 81.7 seconds pre-practice to complete the course and only 71.2 seconds after practice. Those following the schedule of 240 ml/15 minutes required 74.0 seconds pre-practice and only 53.5 seconds post-practice. The difference between pre-practice and post-practice times was statistically significant ($P<.05$) for each group, as was the difference in times between those following the schedule of 120 ml/15 minutes and those following the regime of 240 ml/15 minutes ($P<.05$).

The relatively constant body weight loss observed suggests that mandatory consumption of 240 ml of fluids every 15 minutes may be necessary for individuals to maintain adequate hydration under conditions similar to those present during this study. It is not unlikely that all of the fluid emptied from the stomach with a dose of 240 ml/15 minutes; the usual limit of gastric emptying is about 600 ml/hour in an active person. The improvement in physical performance is probably attributable to the psychologic, rather than the physiologic, state of the players.

In most rehab clinics, the temperature and humidity is under constant control. There is little need to buy expensive commercial fluids under the climate conditions specified. Water is generally as effective as any other replacement fluid.

References

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