CHAPTER 24
EXERCISE & ATHLETIC PERFORMANCE

EXERCISE AND HEALTH

Statistics tell us that a sedentary lifestyle without exercise is as bad for health and longevity as smoking a pack of cigarettes a day. Countless studies show the health benefits of regular physical activity. Recent research suggests that moderate but consistent exercise may actually be more beneficial than intense workouts. The trouble is, most North Americans are not even doing enough to reach this plateau. The U. S. Surgeon General reports that 75% of American adults are physically inactive, and 25% get virtually no exercise at all. Such people are at increased risk for the most common ailments and causes of death of our times. Inactivity as a lifestyle leads to heart disease, obesity, high blood pressure, diabetes, osteoporosis, stroke, depression and certain cancers.

Fortunately, in the last decade interest in preventative health care has skyrocketed. Many people are discovering the benefits of exercise: weight control, muscle strength, bone mass and strength, increased energy, reduced stress, greater endurance, more self esteem and longevity. The fitness industry is growing quickly. Enrollment in gyms and aerobic classes, and sales of fitness supplements, bicycles, skates and blades have all reached new heights. This raises new questions, especially about how much exercise is enough and whether there is such a thing as too much. How far can we push the limits of exercise? And of course amateur and professional athletes want to know how to enhance their performance.

Even moderate exercise has a measurable impact on health and longevity. The Norwegian researcher G. Erikssen followed patients over a 22-year period and found that middle-aged men benefited from moderate fitness improvements and experienced lower risks of mortality from all causes. And it doesn't take extreme exertion to improve fitness. University of Washington doctor Rozenn Lemaitre recently showed that walking for at least one hour per week reduces the risk of heart attacks as much as high-intensity physical activity.

An hour three to five times per week of light, moderate or vigorous effort is all that's needed. A light workout can provide the same benefits as a strenuous one if it lasts longer. An hour of light walking, volleyball, easy gardening, stretching and baseball, thirty to sixty minutes of brisk walking, biking, raking leaves, swimming and dancing, or twenty to thirty minutes of jogging, aerobics, hockey, basketball or fast dancing provide similar health benefits.

AGING AND EXERCISE

Aging is associated with major alterations in body composition and exercise tolerance. Muscle mass, immune defense, antioxidant function and GSH levels all decrease. As our immune system ages, exercise workouts tax us more and more. Performance suffers. So does our ability to recover. Older women and men who participate in regular exercise therefore require more antioxidants in general and GSH in particular. Chapter 1 discusses the antioxidant role of GSH. Chapter 6 discusses GSH and aging.

EXERCISE AND THE IMMUNE SYSTEM

Exercise appears to strengthen the immune system, but too much may have just the opposite effect. Many elite athletes come down with viral illnesses when they train intensely. A widespread virus ravaged the athletic community prior to the 1996 Atlanta Olympic Games, upsetting years of hard work. However, few of us will push our immune resources to the limit. By using it in good measure, exercise can bolster our defenses against disease.

Statistical studies show that adults who exercise are ill less often than non-exercisers. The mechanisms of this increased resistance are very revealing. Many studies have found enhanced activity of various white blood cells-our frontline defense against infection. Fit people have a greater count of natural killer cells, macrophages and T-cell lymphocytes-crucial workers in the immune system-and higher levels of virus-fighting immune factors in their blood. Some studies have shown that the saliva of athletes contains higher levels of viral antibodies, offering greater resistance to disease. This is particularly relevant since many upper respiratory infections enter through the mouth. After several well-designed studies D.C. Nieman's team of exercise physiologists at the Department of Health and Exercise, Appalachian State University have said that people who exercise can double resistance to viral illness.

Although it is clear that the immune system responds positively to moderate activity, it has been repeatedly shown that too much leads to a winding down of the immune system-immunosuppression. After a certain time the increase in immune factors and white cell activity initiated by exercise becomes blunted. This period depends on the intensity of the activity and the condition of the athlete's defenses. Dozens of articles have documented a temporary immune deficiency following exhaustive training. Tests conducted on marathon runners revealed that those running over 60 miles per week were twice as likely to catch a cold than those running 20. Some of these effects can be avoided by balancing and regulating nutrition and training levels.

OVER-TRAINING SYNDROME

Besides the obvious possibility of physical injury, serious athletes run the risk of contracting all sorts of sickness. Their weakened immune response following exhaustive training is only one aspect of 'over-training syndrome.'

Adjectives like 'burn-out', 'staleness' and 'plateauing' are used by athletes to describe the physical sensation. Some respond stubbornly by pushing even harder, with increasingly negative effects. Some exercise scientists have shown that decreasing the intensity of workouts may actually improve performance.

The over-trained athlete experiences a host of physiological effects that contribute to poor performance and illness. They include fluctuations in insulin secretion, alterations in glucocorticoid and hormone levels, inhibition of glucose uptake to tissues, catabolic (breakdown) effects on protein and nitrogen excretion and lactic acid over-production.

OXIDATIVE STRESS

While working out, athletes may consume ten to fifteen times more oxygen than usual, so oxidative stress is a major factor in exercise. Physical activity increases oxygen consumption and intensifies numerous metabolic processes. The result is the creation and circulation of liberated oxidative breakdown products, free radicals (see chapter 1).

Some scientists believe that free radicals might play a significant role in the events leading up to muscle inflammation and damage. More and more evidence supports this theory. When cells need more energy their mitochondria (power plants) work harder. In addition to increasing energy, this also boosts production of unhealthy by-products and results in lipid peroxidation-the harmful oxidation of fats. Bad cholesterol and fats, for example, are rendered even more harmful by peroxidation. Another consequence of increased mitochondrial activity is electron transport flux-the chain reaction of atoms snatching each other's electrons and gradually destabilizing cellular structure (see chapter 1). These two threats can be countered both by exogenous antioxidants-derived like vitamins C and E from food sources-and endogenous ones-those produced within the body. The most critical of these in-house antioxidants is GSH.

The body is not entirely defenseless. Exercise also increases the level and activity of many antioxidants. A well-trained body will adapt to increased oxidative stress by developing improved physiological mechanisms, but the drive for better performance can overtake these adaptations and lead to increased muscular fatigue, injury and recovery time. And antioxidants can easily be depleted by over-training. We therefore strongly encourage the use of oral antioxidant supplements.

GSH AND ATHLETIC PERFORMANCE

Because antioxidants are especially critical to those who exercise, researchers have spent considerable time observing and testing them. This research has two possible goals. To avoid the negative potential of over-training and to explore the possibility of improving performance. A great deal has been written about the role of antioxidants in sports physiology. As you might imagine, much of this research is focused on the body's most important endogenous antioxidant-glutathione. Elevated glutathione levels provide better immune defenses and reduced susceptibility to infectious disease. They also help decrease recovery time from workouts, reduce muscle fatigue and soreness and increase performance.

L.L. Ji, C. Leeuwenburgh and a group of researchers at the University of Illinois carried out a series of studies on muscle injury influenced by free radical formation. Their objective was to measure the usefulness of GSH in cellular damage control. It is not easy to test the body's adaptive response to exercise. Two metabolic processes in particular are somewhat unpredictable. One is the variability of GSH levels at any particular site. The other relates to the transport of GSH between tissues. Never-theless, GSH levels were seen to vary in proportion to the level of exertion, the individual's fitness, and his/her nutritional status.

Measuring GSH levels before, immediately afterward, hours after, and days after subjects completed a long-distance run, B. Dufaux's experiments revealed a significant drain of glutathione. Recovery of GSH levels was quite variable, taking from hours to days. Subjects remained susceptible to subsequent illness or injury. Similar studies were conducted on cyclists and other athletes. In all cases, GSH levels in muscle tissue were found to fall with exercise.

Researchers have shown that glutathione levels are more efficiently restored in the elite athlete than in the less well trained. General bodily fitness encourages the manufacture of GSH and its more efficient release from tissues. Some scientists have gone one step

further, suggesting the exercise slows the aging process by increasing one's ability to produce and distribute GSH on demand.

It is known that diabetics in particular can benefit from exercise. This is believed to result in part from the enhanced GSH metabolism of a fit body. It helps diabetics deal with the intense oxidative stress from which they characteristically suffer (see chapter 10). Training in good measure stimulates greater GSH reserves and enhances one's ability to detoxify foreign substances. Tests have shown that well-exercised animals suffer less from acetaminophen toxicity than non-active ones. Some theorists even believe that the enhanced glutathione metabolism following exercise explains why the physically fit suffer less from cancer.

Given all this, it seems useful to take antioxidant or GSH-enhancing supplements prior to intensive exercise. J. Sastre and his group from the University of Valencia in Spain tested this idea using vitamin C, NAC (see chapter 4) and GSH on animal subjects. The result was to successfully reduce oxidative damage and maintain reduced glutathione in blood reserves. Another group at the University of California (Berkley) headed by C.K. Sen proved the corollary-that if greater levels improved antioxidant response, lower levels would worsen it. They forced GSH levels down with the drug BSO and the ability of their subjects to endure exhaustive exercise fell by 50%.

Psychologists investigating the role of GSH in the immune response to exhaustive exercise have shown raised GSH levels to increase the number and activity of white blood cells. Other studies show that taking NAC before a workout diminishes oxidative stress within these white blood cells. Further studies conducted at Baylor College of Medicine in Texas, first on rodents and later on humans, showed that intravenous NAC-which raises GSH levels-enables subjects to perform longer and harder in exhaustive muscle tests.

A dramatic example of increased muscle strength comes from Dr. Larry Lands of McGill University, Montreal. Thinking that oxidative stress contributes to muscular fatigue, his team gave young adults the whey-based GSH precursor Immunocal for three months. During this time they measured peak power and work capacity as indicators of strength and endurance. They found that performance values could be enhanced by a remarkable ten to fifteen percent.

A team at the Peak Wellness Lab in Connecticut examined the effects of whey isolate protein on athletes. They showed that dietary supplementation of this protein could maintain white blood cell levels (CD4 T-lymphocytes and neutrophils) that otherwise fall during extremely intense workouts. Whey proteins have an extraordinarily high 'protein biological value' and are extremely effective in meeting the higher protein demands of athletes, who may require as much as two or three times as much as the average person. For this reason, whey protein is used widely in weight training to increase body mass.

Another study was carried out on AIDS and cancer patients in an attempt to counter the muscle loss (catabolism) they often suffer. This resembles the muscle decline resulting from heavy exercise protein breakdown. A German group led by R. Kinscherf found that NAC-supplemented group undergoing anaerobic exertion lost less body cell mass and interestingly carried less total body fat. The shift of body fat to body muscle is a strong focus in weight training.

CASE STUDY

Susan, a 35 year-old fashion merchandiser and mother of two, was a great fitness advocate. Free weights, aerobics, step and spinning classes-over fifteen years she had done them all. She was persistently dissatisfied about "the ten pounds of fat" that prevented her from achieving the muscular definition she wanted. Nutritionally conscious, she also knew that merely restricting her calories would probably just leave her feeling washed out. She started taking 40 grams/day of whey protein isolate in combination with minimal adjustments in fat and carbohydrate intake. In three weeks she noticed better endurance during her cardiovascular workouts and was able to lift heavier weights with greater intensity. Recuperation between workouts improved, enabling her to continue without the usual soreness. Her weight remained unchanged. Despite not having made any great changes to her routine, six weeks after the dietary supplement, people at the gym commented on how "well cut" she was.

John, a national champion cyclist, understood the phenomenon of over-training and its consequences on the immune system. He and his training partners were quite aware of their tendency to get sick before big events if they pushed too hard. Having two children in day-care certainly exposed him to viral illnesses. Hearing that the product Immunocal had potential immune-boosting effects, he incorporated it into his daily diet. The frequency of viral illnesses decreased and when he did get sick, it was for only a day or two, rather that three or four. To his surprise, his performance times were improved as well as his ability to recover faster from grueling competitions. After some initial hesitancy, he shared the advantages of this product with his teammates.

CONCLUSION

The health benefits of exercise cannot be overstated. Simply put, physically fit individuals are statistically more resistant to illness and live longer. They also show increased antioxidative abilities. This is visibly reflected in glutathione metabolism. However, moderation is crucial. Exercise is not without risk. Over-training may lead to immune deficiency states, prolonged fatigue and depletion of antioxidants, especially GSH.

Research into exercise physiology shows raised GSH levels to increase immune function, help resist infection, decrease muscle damage, reduce recovery time, increase strength and endurance and shift metabolism from fat production to muscular development.

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