

EXERCISE AND STRESS REDUCTION

PAUL J. ROSCH MD, FACP
American Institute of Stress, Inc.
Yonkers, NY

Better to hunt in Fields, for Health unbought,
Than fee the Doctor for a nauseous Draught.
The Wise, for Cure, on Exercise depend;
God never made his Work, for Man to mend.¹

John Dryden (1631-1701)

■ The public's perception and participation in the delivery of health care has changed rather dramatically over the past decade. The reasons for this are varied but, to a large extent, have been part of a growing "wellness revolution" that emphasizes the individual's ability and responsibility for determining personal health. Over the same period, there have been increasing concerns about adverse reactions and unknown long-term side effects of medications previously stamped as safe by the Food and Drug Administration (thalidomide, Selacryn, Oraflex) and a growing interest in holistic or naturopathic approaches to illness treatment and health enhancement. Many feel that our healthcare system describes a deceptive double misnomer. What we really have in the United States today is a "sickness-cure" approach. Health centers are really for sick patients, and we purchase health insurance to take care of us when we are ill—not to promote health.

Few physicians learn anything about improving health or preventing illness in medical school or postgraduate training, except for rudimentary information on vaccinations, sanitary procedures, or the evils of tobacco, carcinogens, alcohol, and dietary indiscretion. The word "health" cannot be found in the index of standard textbooks of medicine such as Harrison's, Cecil-Loeb, or even the monthly updated *Scientific American Medicine*. Our usual concept of health is a *negative* one, namely, that health is the absence of illness. For many persons that makes no more sense than defining peace as the absence of war. It is not likely that we would use the term "peaceful" to describe our relationships with the Soviet Union or Cuba.

Similarly, physicians are apt to tell patients that they are "perfectly healthy" if a physical examination, laboratory tests, and appropriate X-rays reveal no abnormalities. However, those criteria would apply to scores of the "worried well" that appear in our offices daily for advice concerning a variety of complaints not supported by objective abnormalities. In addition, patients are increasingly seeking advice on not how to get *well*, but how to get *better*. Their definition of health is a very positive one that is oriented not only toward realizing their maximal potential for physical well-being but also toward acknowledging the importance and in-

Reprint requests to Dr. Rosch, American Institute of Stress, Inc., 124 Park Avenue, Yonkers, NY 10703.

separability of the mind-body relationship. However, few physicians would know how to deal with a healthy patient who asked, "Doctor, I have no specific complaints, but, on the other hand, I think that I probably could feel even better, and I want to make sure that I stay well. What can I do to insure this? I think it's an important investment in my future, and I want to prepare for it properly. I have set aside a budget of \$500 a year; is that enough, too much? How can I find out more about what kind and how much exercise would be good for me? What kind of diet should I follow? What kinds of or how many vitamins and minerals should I be taking? How can I find out if I am under too much stress, and what can I do about it?"

Most of us do not have the training or expertise to respond to such inquiries intelligently or authoritatively. As a consequence, we have unwittingly created a vacuum that has been rapidly filled up by a variety of other health-care practitioners promoting various programs, nostrums, and nutritional and naturopathic approaches, which, although harmless, are of dubious value. Many such persons are well meaning and sincere, but others are zealots, entrepreneurs, or even charlatans eager to profit from the proliferating fitness fad.

What can be done to achieve optimum health or "euexia" as it has been termed by some? The Chinese believed that it could come only through what they call *Tzu-li-Keng-sheng* or "regeneration through one's own effort." In ancient China, physicians were paid only for keeping their patients healthy rather than for treating illness. In our society, however, there are few financial incentives for practicing preventive medicine or health maintenance efforts, since fiscal intermediaries reimburse primarily or exclusively for treating disease. This division or duality of medical approaches has existed since the earliest records of Western medicine and is revealed in ancient Greek mythology.

The myths of Hygieia and Aesculapius symbolise the never-ending oscillation between two different points of view in medicine. For the worshippers of Hygieia, health is the natural order of things, a positive attribute to which men are entitled if they govern their

lives wisely. According to them, the most important function of medicine is to discover and teach the natural laws which will ensure a man a healthy mind in a healthy body. More skeptical, or wiser in the ways of the world, the followers of Aesculapius believe that the chief role of the physician is to treat disease, to restore health by correcting any imperfections caused by the accidents of birth or life.²

What we are now witnessing, therefore, is a swinging of the medical pendulum toward the followers of Hygieia. To a large extent, interest in this approach has also been fueled by concern over rapidly rising health costs that are now estimated at close to \$400 billion annually or more than a billion dollars a day, threatening to bankrupt the Social Security system. Compare that to 41.7 billion dollars 20 years ago or 132 billion dollars less than 10 years ago. According to some estimates, the bill for 1990 is likely to top \$700 billion. Stress in the workplace is estimated by some to have a price tag of \$100 billion annually in terms of absenteeism, diminished productivity, and insurance and direct medical costs. Put into perspective, that is more than ten times the costs incurred by all strikes combined.

Small wonder that industry and the government are taking a hard look at measures that might provide effective ways to contain health costs by actively pursuing an investigation of harmful behavioral patterns, life-style habits, and mechanisms that can promote and maintain wellness. Two important facets of this search that have provided productive results include various stress reduction and exercise programs. This presentation will focus primarily on evidence for the beneficial effects of exercise with particular emphasis on its function as a stress reduction strategy.

The enormous popularity of exercise is attested to by the approximately 15 million habitués of over 5000 health clubs in the U.S. and more than 30 million confirmed daily runners. By the end of 1981, it was estimated that on any given day, there were 70 million Americans engaged in some form of structured exercise or workout. Americans will spend in excess of \$30 billion this year to pursue such activities, and whole new industries have been

spawned. According to a recent *New York Times* article (May 21, 1984), sales for home exercise equipment exceeded the \$1 billion a year mark and were expected to increase 20% in 1984; 2.4 million stationary bicycles, half a million rowing machines, 1 1/2 million jogging trampolines, and 727,000 multipurpose gym units were purchased by individual consumers in 1983. Power treadmills costing between \$1700 and \$5000 and home gym sets ranging from \$1500 to \$4000 are also popular high-ticket items. Running appears to be the most popular activity, however, probably because of the minimal expense involved and the widely advertised beneficial effects on cardiovascular function. As a consequence, the market for running shoes alone is now well in excess of \$1 billion annually.

Convincing proof that exercise reverses coronary arteriosclerosis or reduces coronary heart disease is scanty. One recent study did demonstrate a reduction in coronary arteriosclerosis in monkeys on atherogenic diets who were subjected to conditioning exercises,³ but most support comes from retrospective epidemiologic studies.^{4,7} However, there does appear to be a general consensus that regular aerobic exercise does enhance the quality of life by improving capabilities for work and play, and also has beneficial effects on mood and emotions. Because of such considerations and the skyrocketing costs of health care, some 500 corporations have set up "wellness programs," most of which emphasize exercise and stress reduction, as well as other efforts to combat smoking, alcoholism, and obesity. One report indicated that employers spent in excess of \$700 million in 1981, merely to replace the 200,000 middle-aged men who had heart attacks. Xerox estimated that replacing a top executive costs more than \$600,000. Other large corporations such as Kennecott Copper, New York Telephone, and Kimberly-Clark have indicated that their programs show distinct bottom-line benefits in terms of reduced absenteeism, improved work performance, and decreased medical costs.

In general, exercise can be classified as either primarily aerobic or anaerobic. Jogging, swimming, and bicycling are good examples of aerobic exercise, which essentially involves utiliz-

ing large skeletal muscles on a steady basis to promote a continuous balance between oxygen consumption and utilization. As a consequence, there is an increase in respiratory rate and flow of blood to skeletal muscles to supply necessary amounts of oxygen and metabolic needs. As work requirements are increased, a steady state is achieved because of compensatory increase in cardiac and respiratory function to maintain an equilibrium between oxygen utilization and uptake. Provided such requirements can be met, an optimal state of aerobic exercise exists. If, however, workload increases to such an extent that this steady state is upset and an increase of metabolic end products from skeletal muscles develops, the activity is now no longer aerobic but becomes anaerobic, and the exercising individual is apt to experience prompt and significant fatigue.

A second type of exercise is primarily anaerobic. Usually, this type of exercise is characterized by relatively brief periods of exertion involving intense muscle activity, which rapidly outstrips the normal metabolic aerobic pathways. Available blood glucose, oxygen, and muscle glycogen are rapidly used up, and there is a surplus of metabolites. Wrestling, vigorous bursts of rope skipping, sprinting, vigorous swimming for short periods, or racketball are good examples. Isometric exercises that require lifting, pushing, or pulling heavy loads with comparatively little motion of the exercising muscles are also anaerobic. Frequently, such activities are accompanied by a marked increase in arterial pressure and heart rate, probably caused by the increased sympathetic nervous system stimulation and concomitant catecholamine excretion. A good example of this is hand grip exercise, which is confined to forearm muscle activity and causes a significant rise in heart rate and systolic and diastolic pressures, but also results in an increased demand for myocardial utilization of oxygen. In the presence of significant coronary artery disease, this can produce disturbing anginal symptoms.

Therefore, it should appear obvious that aerobic exercise improves cardiovascular and physical function because of its steadily increasing demand for oxygen and metabolic fuels that the body can supply. On the other hand, anaerobic exercise in the form of weight

lifting or other short-burst exercises exerts similar demands on the myocardium, but does not provide a mechanism to satisfy those needs. Some types of exercise and sports have both aerobic and anaerobic components. From the standpoint of cardiovascular and physical work capacity, aerobic or isotonic activities are most beneficial, since they generally involve sustained rhythmic activity of large muscle groups while at the same time they increase respiratory and cardiac function to provide a balance between oxygen transport and need. Weight lifting or isometric exercises, on the other hand, do not have a beneficial effect on the cardiovascular system and, indeed, in some instances can tax it severely because of high oxygen requirements that cannot be met. Nevertheless, both forms of exercise can at times provide beneficial, emotional, and stress-reducing activities. This is best exemplified by mood changes that accompany aerobic activities such as jogging or calisthenics, and also anaerobic procedures such as progressive muscular relaxation or *tai chi* in which various muscle groups are made to contract and relax.

Most individuals, regardless of age, can exercise safely by increasing their physical activity level judiciously, but any such program must be individualized, depending on age, medical or orthopedic considerations, and current physical status. In general, it is recommended that individuals over 35 or 40 years, especially if they have been physically inactive, should have a physical examination and probably an exercise stress test to determine current functional capacity. This is usually based on the value in METS of oxygen consumption for the highest exercise intensity completed on the exercise test. A variety of conditioning exercises can then be selected, depending upon individual preference, ranging from walking, jogging, running, bicycling, rowing, skating, and cross-country skiing, all of which have established MET values. For maximal physical conditioning effects, the activity chosen should be sustainable for 15 to 60 minutes and should produce 50% to 85% of the METS achieved during the stress test or a heart rate that is 60% to 90% of the maximum.

Obviously, there is a great deal of individual variation, and for those with very low func-

tional capacities of 3 or 4 METS, it may be advisable to start with one or two sessions a day of only five or ten minutes activity, with gradual increase as performance improves. By proceeding in such a stepwise fashion, there is a rather prompt and sustained increase in physical activity ability after only a few weeks of such structured exercise. All of this, however, relates only to the physical conditioning effects. Emotional and stress reduction benefits do not necessarily increase in a concomitant fashion and are even more highly individualized and variable, since they are due to psychological and neurochemical alterations that are less clearly understood but are gradually being uncovered.

Perhaps the most widely publicized example of this has been the "high" experienced by many joggers and runners. Although difficult to describe, many have compared it to a sort of trance-like state combined with a euphoric feeling of omnipotence that enhances creativity and mental function in addition to a sense of almost effortless ability to continue running. Many researchers believe that this is due to stimulation or release of small brain peptides such as the enkephalins or β -endorphins. These substances are often referred to as "natural opiates," since they appear to produce effects very similar to opium and can be blocked by opium antagonists such as naloxone. This may also account for the addictive aspects of jogging and running experienced by many who become significantly depressed when deprived of their favorite pastime. However, not all runners experience this unusual sensation, and even in those who do, more than half report that it happens in less than one out of three runs. It rarely occurs in beginners who are out of shape and is almost impossible to achieve if bad weather or distractions such as motorists, barking dogs, or rough terrain interfere with ideal conditions.

Runners often get a "second wind" after a few minutes, as their body temperature rises and blood is shunted to the large muscles of the legs and arms. However, that is different than the "runner's high" that is also sometimes referred to as a "third wind," since this usually requires at least 30 or 35 minutes of steady running. Some researchers believe that this phenomenon is primarily psychological and is re-

lated to the hypnotic repetitive rhythms of running that produce a "meditative effect." On the other hand, the chemical theory has gained increasing support, because it is known that the enkephalins that exist in the brain and spinal cord act as chemical messengers at certain receptor sites where they can block pain perception by intercepting messages being relayed to the brain. Similarly, β -endorphin and congeners such as dynorphin, which originate in the pituitary and are liberated in the blood stream, also have pain killing properties about 20 to 100 times more potent than morphine. These substances can be found in large amounts in the blood of joggers after a long run. In one Italian study, 8 experienced runners were able to increase their endorphin levels from a resting level of 350 to 1650 pg/mL after only 12 minutes of warmup and vigorous exercise, and this sustained increase persisted for as long as two hours after the exercise. This may explain the curious absence of pain seen in runners with severe orthopedic injuries or other problems because of apparent lack of appropriate sensory input, which would normally bring a halt to their activity. Studies also show that persons who exercise regularly and are physically fit produce β -endorphins more rapidly and in larger amounts than those who are usually sedentary, again suggesting a potential mechanism for addiction to running.

Other biochemical research reveals that running also causes an increase in catecholamines and similar substances released by the sympathetic nervous system. Brain catecholamines are reduced in many patients with depression, and, indeed, running has been advocated as an effective method of treating endogenous depression.⁸⁻⁹ This appears to be particularly true in treating the depression that occasionally follows a heart attack.¹⁰ Reports also reveal that running and exercise can significantly reduce anxiety¹¹ and agoraphobia, as well as other specific phobias.¹² Additional research suggests that exercise may provide an effective way of reducing type A coronary-prone behavior.¹³ On the other hand, for some macho type A's who must continually strive for faster speeds and longer distances, running might not provide such benefits.

Admittedly, much of the evidence for the

beneficial and stress-reducing effects of exercise is anecdotal. Scientific validation and proof of such benefits is difficult to obtain because of problems in establishing objective parameters and obtaining meaningful biochemical measurements of exotic and often transient neurotransmitters. Another major problem is that from a strictly scientific point of view, stress is really a useless term, since it cannot be satisfactorily or objectively defined, much less measured. Nevertheless, a sense or feeling of being out of control is obviously very distressful. Thus, it may well be that exercise or any other purposeful physical activity reduces stress simply by virtue of the fact that the individual senses that the problem has been identified, and that control of the situation has now been achieved by addressing it in an effective fashion. Others point to a variety of biochemical, neurophysiologic, and psychometric research indicating that the benefits of exercise, like those of meditation, yoga, biofeedback, or even hobbies are simply due to diversion, or taking "time out."¹⁴

Of course, there are many more exotic explanations for the meditative, transcendental, Zen, and other psychic effects of running that some claim permit the runner to tap into the "unconscious and activating evolutionary psychic structures which allow us to 'resonate' with the deepest layers of the unconscious mind."¹⁵ Others believe that the runner carries a psychic charge, which when it detonates "is like a miniature universe in the process of creation, spewing out dreams like stellar bodies whirling into psychic space,"¹⁶ or that running "progresses through stages of deeper meaning, to expand our self-awareness, to become a holistic aspect of our lives. It is indeed a form of worship, an attempt to find God, a means to the transcendent."¹⁷

However, as Dr. Selye, the father of the Stress Concept, often reminded me, "Theories don't have to be correct, only facts. Some theories have merit mainly because of their heuristic value, namely, that they encourage others to develop new facts which lead to newer theories." Thus, while we may not be satisfactorily able to explain why exercise in various forms reduces stress, anxiety, or depression, the facts are quite clear that such beneficial ef-

fects can be consistently derived for a large majority of individuals in a safe, inexpensive, and effective fashion. Further advances in neurochemical and psychometric techniques will quite likely indicate the mechanisms whereby such naturopathic benefits are derived. ▲

REFERENCES

1. Dryden, J: Epistle to John Driden of Chesterton, line 92, in Bartlett, J (ed): *Familiar Medical Quotations*. Boston, Little Brown & Company, 1903, p 270.
2. Dubos R: *Mirage of Health*. London, George Allen and Unwin Ltd, 1960, p 109.
3. Kramsch DM, Aspen AJ, et al: Reduction of coronary atherosclerosis by moderate conditioning exercise in monkeys on an atherogenic diet. *N Engl J Med* 1981; 305:1483-1489.
4. Paffenbarger RS Jr, Wing AL, Hyde RT: Physical activity as an index of heart attack risk in college alumni. *Am J of Epidemiol* 1978; 108:161-175.
5. Paffenbarger RS Jr, Laughlin ME, Gima AS: Work activity of longshoremen as related to death from coronary heart disease and stroke. *N Engl J Med* 1970; 282:1109-1114.
6. Taylor HL, Klepetar E, Keys A: Death rates among physically active and sedentary employees of the railroad industry. *American J Public Health* 1962; 52:1697-1707.
7. Morris WH: Heart disease in farm workers. *Can Med Assoc J* 1967; 96:821-824.
8. Greist JH, Klein MH, Eischens RR, et al: Running as a treatment for depression. *Compr Psychiatry* 1979; 20:41-54.
9. Brown RS, Ramirez DE, Taub JM: The prescription of exercise for depression, *Phys Sportsmed* 1978; 6:34-45.
10. Kavanagh T, Shephard RJ, Tuck JA, et al: Depression following myocardial infarction: The effects of distance running. *Ann NY Acad Sci* 1977; 301:1029-1046.
11. Morgan WP: Influence of acute physical activity on state anxiety. *Proceedings National College Physical Education Meeting*, January 1973, pp 113-121.
12. Orwin A: Treatment of a situational phobia: A case for running. *Br J Psychiatry* 1974; 125:95-98.
13. Blumenthal JA, Williams RS, Williams B Jr, Wallace AG: Effects of exercise on the type A (coronary prone) behavior pattern. *Psychosom Med* 1980; 42:289.
14. Morgan WP, Horstman DH, Cymerman A, Stokes J: Exercise as a relaxation technique. *Primary Cardiology* 1980; 6:48-57.
15. Porter D: *Inner Running: The Ultimate Natural High*. New York, Ace/Tempo Star, 1978.
16. Andrews V: *The Psychic Power of Running: How the Body Can Illuminate the Mysteries of the Mind*. New York, Rawson, Wade, 1978.
17. Henning J: *Holistic Running: Beyond The Threshold of Fitness*. New York, Atheneum Publishers, 1978.