

# The Body-Brain

Studies show that exercise can affect brain chemistry without the side-effects often caused by medication.

By Mort Malkin

**M**UCH HAS BEEN written about the mind/body connection — how the brain influences the body and its state of health. Less appreciated is the body/mind connection — how the brain is influenced by physical exercise. Human bodies are chemical cauldrons with untold numbers of reactions taking place concurrently. Chemical processes are needed to produce energy, build bone, keep blood sugar within a narrow range of 80 to 100 mg/dl, use fats metabolically so that they don't deposit on the inner surfaces of arteries, and maintain a strong immune system — just to mention a few. The following is an exploration of how physical activity affects those processes in the body.

## Brain chemistry and exercise

The chemistry of the brain is complex and difficult to measure, because the brain is less accessible than the heart, liver or kidneys. A few of the neurotransmitters (chemicals that direct brain function) have been identified, and their effects in terms of health and illness are known to some extent. The drugs prescribed for depression, anxiety, Parkinson's disease and, more recently, nicotine addiction, are all intended to adjust the concentrations of individual neurotransmitters. Unfortunately, these medications don't act in only one manner, and at only one site in the brain. As a result, unintended side-effects are frequently seen.

To avoid these side-effects, some people participate in exercise programs. The effects of exercise on calcium metabolism, blood pressure, blood sugar and many other facets of human physiology are well established. Less well-known are the influences of exercise, especially aerobic exercise, on brain function. It turns out, though, that there is a body/mind connection. Early studies designed to measure oxygen use during aerobic training incidentally found that exercise exerted an antidepressant effect. Since then, a number of studies have found significant improvements in intellectual and emotional status because of exercise.

Participants in exercise programs routinely report feeling higher energy levels, mood elevation and a more "mellow" demeanor. A well-known feature of endurance running is the "runner's high." These findings are not a simple matter of higher serotonin or endorphin levels in the brain. There are complex interactions among the neurotransmitters that produce the seemingly paradoxical feelings of being more

energetic and more peaceable. Aerobic exercise causes a change in the balance among several neurotransmitters, including acetyl choline, noradrenaline, dopamine, serotonin, glutamate, GABA (gamma amino butyric acid), opioid peptides and probably others that have been less studied.

But you don't have to be a neurochemist to discern the results. Aerobic exercise brings beneficial change to every aspect of mental health.

## Exercise and affective changes

Affective changes (mood, attitude and emotion) are evident early in any endurance training program. The exercise acts as an antidepressant and calms anxiety. Using drugs to achieve such results would typically require a combination of medications. Exercise has the advantage in that it exhibits no adverse side-effects. The following examples show the effects of exercise on mood, attitude and emotion.

- Several individuals in different aerobic walking programs reported being able to reduce their antidepressant medication by half, and in a few cases, eliminate it entirely.

- One man with bipolar disorder (mania/depression) achieved mood stability within five weeks of starting an exercise program, and reduced his lithium medication by 50 percent.

- Several individuals reported that, when they exercised regularly, they could more easily stick to a healthful diet. One woman who was trying to lose weight said, "Now, I feel I can control my diet. Before, my diet, such as it was, controlled me."

- Many people who begin exercise programs for weight loss initially have a bad attitude about exercise. As they continue, this attitude changes, and they look upon exercise as a helpmate. They even add a couple of minutes to each scheduled workout.

- Exercise can lead to improvements in self-confidence and self-esteem. A 37-year-old woman who was out of work for a few months lost 8 pounds and gained enough confidence to interview for a job. "And I got it!" she exclaimed.

- Many seniors become more limited in their outlook for the future as they reach older ages. Their long-range plans are reduced from years to months. Seniors who become aer-



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obically trained, however, may start to reverse this attitude and set a centenarian lifespan as a goal. They build new homes and invest in bonds and mutual funds for a five- to 10-year return.

## Exercise and neurophysiological changes

Several neurophysiological changes can also accompany aerobic exercise. The following three effects of brain chemistry are illustrative.

**Dopamine levels and Parkinson's disease.** The increase in dopamine levels (and/or increased dopamine receptor sensitivity) lead to striking improvements for Parkinson's disease (Pd) patients:

- Two younger Pd patients, one in her 30s and one in his 40s, were able to increase walking speed, double walking distance and achieve an unhesitating, symmetrical gait.
- A 70-year-old Pd patient increased the distance she could walk by tenfold. As she reached week 12 of her exercise program, she had to discontinue anti-Parkinson's medication because of headaches her physician attributed to the drug. The headaches vanished within the week, and thereafter, she was able to use regular walking workouts in place of medication.

**Dopamine levels and smoking cessation.** Recent studies at the University of Washington found that nicotine addiction is associated with higher dopamine levels. With smoking cessation, dopamine concentrations fall precipitously, leading to the typical craving response and other signs of withdrawal.

Smoking individuals who begin an exercise program, however, are better able to quit. Some have reported that they had little or no residual cravings or anxiety.

**Melatonin and sleep/wake patterns.** Melatonin is normally produced by the pineal gland, an endocrine gland at the base of the brain. Melatonin output coordinates with diurnal dark/light cycles, and is responsible for sleep/wake patterns. Melatonin has a myriad of other functions, including bone growth and repair, maintaining the health of the coronary arteries, enhancing immune system function and slowing the aging of tissues. Melatonin is chemically related to

serotonin, and both are derived from the amino acid tryptophan and the intermediary compound 5-hydroxytryptamine. Both are also responsible for mood elevation. Aerobic exercise is known to increase serotonin levels and, in all likelihood, melatonin levels.

- Because exercise has an effect on melatonin levels, people have found that jet lag can be reduced if they stick with a regular fitness program.
- Many exercise participants report better sleep patterns. Their sleep requirements are slightly reduced and insomnia is virtually eliminated.

## Exercise and cognitive changes

Cognitive changes (intellectual and learning attributes) may also result from aerobic exercise training. The following studies show some examples.

One study showed improved cerebral blood flow in retirees who exercised regularly. Active retired seniors, and those who continued to work, scored better on cognitive tests. These mental performance results are probably the result of other factors, in addition to improved cerebral blood flow. (As a general rule, the workings of the body and brain are determined by multiple influences.) It is generally thought that fitness helps maintain cerebral cortical function.

Two other studies that compared measures of fluid intelligence and fitness levels found a significant direct correlation between the two. Fluid intelligence parallels the integrity of the neurological structure of the brain. Crystal-

**Concentration, resistance to distraction and the capacity to reevaluate an activity or direction of thought are enhanced by aerobic exercise training.**

lized intelligence, on the other hand, increases with education and experience. Until the reports came out, it was thought that fluid intelligence gradually declined as brain neurons and synapses atrophied with age.

Subsequent research compared reasoning, mental reaction time, working memory, attentiveness and concentration, and conceptualization skills with fitness levels as measured by aerobic capacity. The studies found that these mental qualities varied directly with aerobic power.

A dissenting view was reported in a prospective study in which a group of older adults, ages 60 to 83, underwent supervised exercise sessions consisting of 30 minutes of stationary cycling and 15 minutes of brisk walking/jogging three times per week. At the end of 16 weeks, the participants



## Decision making and mental reaction time improve with high fitness levels.

had improved their aerobic capacity by 11 percent. However, they did not exhibit improvement in cognitive tests of letter search and word comparison skills. In a study by another investigator, thought processing improved with a level of exercise that increased aerobic capacity by 27 percent.

Previous research shows that many of the somatic physiological changes that are seen with aerobic exercise (reduction of hypertensive blood pressures, blood sugar stabilization in type 2 diabetes, improvement in blood lipid profiles, etc.) are dose dependent. Longer, stronger workouts bring greater changes. The same can be expected with those facets of brain function that are responsive to exercise.

Still other investigations tested such skills as concentration and resistance to distraction. These skills were found to be enhanced with aerobic exercise training. A third area of skill improvement was in the capacity to reevaluate an activity or direction of thought and make changes when advisable. Thought (and attitude) inertia is not uncommon, especially with advancing years. Aerobic exercise can change that.

### Exercise and decision-making skills

Decision making and mental reaction time can also improve with high fitness levels. Following are some examples.

A study involving 23- to 59-year-olds tested the participants in 10-year age groups. Records were kept for sedentary and exercising subjects in each group. Sedentary subjects were slower in discrimination and choice making at each advancing decade level. Among exercisers, there was no difference in response time across the decades. The 50- to 59-year-old ath-

letes were just as quick as the 20- to 29-year-olds.

Another study of mental reaction time reported that drivers who led sedentary lives exhibited slower braking times in driving tests than fit individuals of the same age.

The brain influences, regulates and/or commands many functions of the body: thought processing, emotional reaction, appetite, blood pressure, heart rate, bronchiolar constriction or dilation, interpretation of sensory impulses, and on and on. The brain is the electrical switchboard for the entire body. There are untold numbers of nerve pathways, synaptic connections, neurochemicals and many unknown ways that the brain is organized. To influence brain function is a complex balancing act. Endurance exercise at optimal levels produces a profusion of chemical/metabolic effects that may be equal to the task. When the exercise is at proper thresholds of frequency, distance and intensity, the total effect is highly beneficial. Both mental and physical health are enhanced. The exercise-trained body can also motivate the brain to say, "I like to exercise and look forward to each workout." It can all come about in a matter of a few weeks, and then be maintained indefinitely.

Mental and emotional fitness can improve with brain exercise. Brain function, in many aspects, also responds to body exercise. Encourage your members to use all of their resources. They will like the results. **FM**

#### Note:

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