EXERCISING THE BRAIN

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LEARNING OBJECTIVE

- To understand the benefit physical exercise has on improving overall brain health and to discover how fitness professionals can take advantage of research in this area and "rethink" how medical fitness centers have traditionally "motivated" individuals to exercise.

Key words:
Angiogenesis, Brain Health, Cognitive Fitness, Neurogenesis, Neuroplasticity

The fear of developing dementia or Alzheimer is more common in our society today than ever before. Many individuals motivated to exercise for the ''traditional'' benefits such as improvement in cardiovascular fitness, strength, flexibility, and general wellness are finding new reasons to workout based on the growing research demonstrating the cognitive benefits of exercise. Alzheimer now afflicts 5 million people in the United States, a 50% increase since 1980 with an expectation that the number will rise to 16 million people by 2050. The estimated annual cost according to the National Institutes of Health is $148 billion (8). Society's fear of ''losing their mind'' drives a high demand from consumers for ''brain fitness'' products such as CogniFit's ''MindFit'' and Nintendo's ''Brain Age.'' According to SharpBrains.com, direct sales to consumers of computer-based brain fitness programs grew from approximately $4 million in 2005 to an estimated $80 million in 2007. This exponential growth highlights consumer interest and provides a variety of opportunities for medical fitness centers. Expanding programming to include ''brain-based'' fitness classes and computer-based cognitive training creates a new motivation to exercise, thus creating additional consumer value.

REVIEW OF RECENT BRAIN FITNESS RESEARCH

Arthur Kramer, Ph.D., a prominent internationally respected researcher in the area of cognitive fitness and physical exercise has stated: ''Given what we know today, I would recommend both intellectual engagement and physical exercise. However, we do know from extensive animal studies, that physical exercise has a multitude of effects on brains beyond neurogenesis, (the process by which new nerve cells are generated) including increases in various neurotransmitters, nerve growth factors, and angiogenesis (the formation of new blood vessels)'' (2). Kramer cites in a study published in 2006 in the *Annals of Internal Medicine* that researchers found that ''adults over the age of 65 that participated in a variety of physical activities such as walking, hiking, biking, and swimming after a mean follow-up of 6.2 years, and adjusting for age, sex, and medical conditions, found individuals that exercised more than 3 days per week were 34% less likely to be diagnosed with dementia, than those who exercised less than 3 times per week'' (5). In a second study cited by Kramer, individuals that participated in a 3-month aerobic exercise program had increases in their magnetic resonance imaging (MRI) – measured cerebral blood volume (10). Participants in the study also experienced improvements in overall cardiovascular fitness and in their scores on verbal learning and memory tests (10). Research continues to reinforce that improving overall fitness, which leads to improved oxygen transport and use, is associated with both improved cardiovascular fitness and improved overall brain health. This is further evidenced in a study published in *Stroke* that concluded ''Treadmill exercise significantly improved the health and mobility of individuals following a stroke, and is associated with changes that reflect actual 'rewiring' of their brains'' (7). ''This is great news for stroke survivors,'' according to Daniel Hanley, M.D., professor of neurology at the John Hopkins University School of Medicine, ''because the results clearly demonstrate that

Opportunities for Medical Fitness Centers

1. Discover what the research is reporting regarding the benefits of physical exercise on brain health, and become the expert source of information for your community. Provide workshops on exercise and cognitive fitness with an emphasis on local businesses as the corporate world is continuing to increase their investment in brain health programs for their employees.
2. Develop the evidence-based research information into "brain fitness" programs that you can offer at your center and in a home-based program format to reach individuals in your community that will benefit from your programs but cannot physically make it to the center. Consider offering an online exercise prescription program that integrates physical exercise prescriptions with a cognitive fitness program, providing a comprehensive brain/body fitness program for your members.
3. Track outcomes in whatever programming you decide to do, so you can report the benefits and use this information to grow the value of your program to your center members, hospital, physicians, and community.

long-term stroke damage is not immutable and that with exercise it's never too late for the brain and body to recover." The investigators in this study, using functional MRI studies, analyzed brain scans and found markedly increased metabolic activity in brainstem areas associated with walking among all the treadmill exercisers, in comparison to the brain scans of patients in the stretching-only group that showed no changes (7). "The study results suggest that the brain is responsible for the improvement we saw in patient's walking ability. It seems to be recruiting other regions to take on the job of areas damaged by the stroke," said Andreas Luft, M.D., a visiting researcher on the study (7).

Given that treadmill exercise causes successful "rewiring" of the brain, imagine the positive impact even greater "brain stimulating" physical exercise can have on individuals following a stroke, head injury, or those with early signs of dementia. According to leading brain fitness researcher, Michael Merzenich, Ph.D., "brain-less physical activity is much less useful for cognitive fitness development than physical activity that involves new experiences and continuous learning — that is, what drives continuous brain plasticity!" Merzenich (9) defines "brain plasticity" as "the brain's ability to change, for better or worse throughout life." This is best explained in Figure 1, a photo from research in 1998 and published in 2000 at the Salk Institute by Fred H. Gage, Ph.D., and Chunmei Zhao, Ph.D., showing the birth of significantly more new cells in the hippocampus of adult mice that had logged the most running miles on their wheels versus a much lesser development of new cells in sedentary mice. *Cognitive fitness* is defined as the general state of a good and sharp brain and mind, resulting from exercises to change the brain's functioning and structures. And the good news is that cognitive decline is not inevitable! According to Merzenich (9), "The brain is capable of changing, at any age." Unfortunately, few people realize that a lack of physical activity and associated acute and chronic health conditions also can impact brain health. For example, many individuals concerned about their risk of dementia are completely unaware that being overweight also has a detrimental impact on the brain. According to Kaiser Permanente research scientist Rachel Whitmer, Ph.D., a recent 9-year study showed that people who are obese in middle age (body mass index, >30) are 74% more likely to have dementia than people of healthy weights (12). A Swedish study found that typical heart disease risk factors such as high cholesterol and high blood pressure more than "double" the risk of Alzheimer disease (4). This research presents important evidence that medical fitness centers can use to capture the attention of people that haven't been interested in physical exercise for the "traditional" benefits but might reconsider once they understand the tremendous "cognitive" benefits of regular physical and mental exercise.

MEDICAL FITNESS CENTER SURVEY RESULTS

A 2008 nationwide telephone poll of 50 medical fitness centers revealed that no centers currently offered a dedicated "cognitive fitness" program, and only 4% were currently marketing the cognitive benefits of physical exercise to their membership and community. Of all the centers surveyed, 98% believed that offering exercise programs targeting cognitive fitness development, along with access to computer-based cognitive fitness programs, would

Figure 1. The image shows the addition of new neurons in the adult mouse hippocampus — the brain region involved in learning and memory. This birth of new cells is a major finding in showing how adaptable the brain is, even in adulthood. *(Reprinted from: Gage F, Zhao C. Laboratory of Genetics LOG-G; The Salk Institute for Biological Studies, 2008.)*

be a tremendous addition to their medical fitness center. Two centers were actively embarking on the development of cognitive fitness programs, Memorial Health and Lifestyle Center of Memorial Hospital in South Bend, Indiana, and the Center for Health and Wellness at Saint Barnabas Health Care System, West Orange, New Jersey.

CENTER FOR HEALTH AND WELLNESS AT SAINT BARNABAS HEALTH CARE SYSTEM, WEST ORANGE, NEW JERSEY

The Center for Health and Wellness at Saint Barnabas is in the process of evaluating a computer-based cognitive fitness program for their members. The program will be based out of their Stroke and Neurorehabilitation Center and available at the Health and Wellness Center as a preventive cognitive fitness program for members.

MEMORIAL HEALTH & LIFESTYLE CENTER OF MEMORIAL HOSPITAL IN SOUTH BEND, INDIANA

Memorial Health & Lifestyle Center has made a dedicated commitment to the development of a sophisticated brain health program. The hospital President and CEO, Phil Newbold, had an idea to develop a community brain health center that would provide brain health/fitness checkups and tips on mental fitness. This idea led the hospital board and leadership team to develop and open a life span–based multidimensional brain health center, "Memorial BrainWorks." "A core focus of 'Memorial BrainWorks' is to interpret the important messages from science on neuroplasticity, educate individuals about their personal ability to impact healthy aging, and to translate it into everyday practical application," says Memorial BrainWorks director Debra Raybold. This broad approach to launching "BrainWorks" also expands to Memorial Hospital's medical fitness center, "Memorial Health & Lifestyle Center." Ms. Raybold is working directly with medical fitness center director Alan Loyd to integrate brain fitness development into their exercise programs, classes, and overall center programming, by identifying and certifying the fitness classes that provide the best brain health workout. Memorial Hospital's model for a healthy brain lifestyle is pictured in Figure 2 below.

DEFINING THE BRAIN HEALTH BENEFITS OF COMPUTER-BASED BRAIN FITNESS PROGRAMS VERSUS PHYSICAL EXERCISE

Differentiating the benefits of computer-based brain fitness programs from the benefits of physical exercise on cognitive health has been challenging and is still under investigation. A study at Lakeview Village, a retirement community in Lenexa, KS, has been designed to compare the cognitive benefits of physical exercise, computer-based cognitive training, and physical and computer-based cognitive training combined. This landmark study will be one of the first to measure the specific differences between

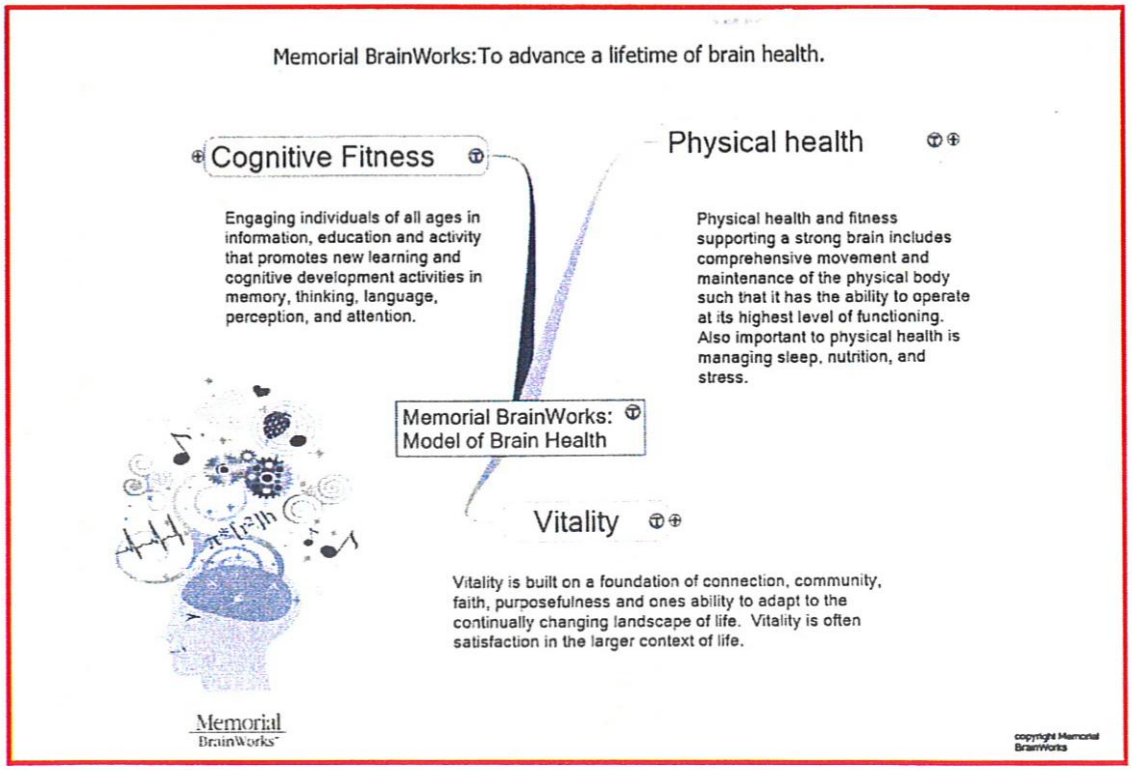

Figure 2. Components of a balanced brain healthy lifestyle.

standard cognitive fitness training using a computer-based program (CogniFit's "MindFit" program) as compared with physical exercise using a medically based functional movement exercise program (LifeSpan's "Fitness Forever" program in DVD format), all being managed and tracked with LifeSpan's on-line exercise prescription and outcomes management system, the Interactive Health Partner. One of the major goals of the Lakeview study is to develop an integrated model of "physical fitness and cognitive fitness" that can be recommended for older adults to improve overall brain health along with improving overall health, fitness, and quality of life. The results of this study should provide a better understanding of the program features and prescription format that health and fitness professionals can recommend to maximize an older individual's physical and cognitive fitness and health.

ARE THERE BRAIN-BOOSTING EXERCISE MOVEMENTS?

As previously mentioned, there are certain exercise movements that have been proven to more positively impact brain health. Incorporating the opportunity to learn a new skill into the exercise program has been shown to increase neurogenesis and stimulates the production of important neurotransmitters like dopamine, acetylcholine, and norepinephrine — the "feel good" brain chemicals that are necessary for learning and memory. Second, and equally as important, is focused attention. Without attention, information taken in does not register in the brain. Concert violinists, pianists, and chess masters all show enlarged cortical areas in the brain, corresponding to the practicing of a skill that demands increased concentration (3). Recent studies using primates taught to pay attention to only one signal, as both sound signals and sensory information was sent to their fingers, showed clearly that neuroplastic changes occurred only in the areas the monkeys were focusing on. No changes occurred in the areas of the unnoticed signals (1). "Brain-based" exercise incorporates the hemodynamic component of cardiovascular exercise with the cognitive requirements of multiple system activities while increasing demand in the cerebellum and basal ganglia for changing patterns of motor activity, resulting in pronounced cognitive and physical improvements. Further studies are needed in this area of brain-based movement to unlock the full potential of cognitive development, but researchers for the past 20 years have found that incorporating the following types of movement into exercise has tremendous benefits for the brain:

Cross-lateral movements — movements that cross the midline of the body increases blood flow in all parts of the brain, making it more alert and energized for stronger and more cohesive learning. Cross-lateral movements also unify the cognitive and motor regions of the brain while stimulating the productions of neurotrophins that increase the number of synaptic connections in the brain (11).

Reaction-based movements — movements that are done following a cue signaling the person to move. A 2004 study on recovering stroke patients using sound cues to signal patients to do a specific physical task resulted in improved arm function when compared with a control group that did traditional post-stroke therapy. In addition, the stroke recovery workout group that exercised after the sound cues also had changes on their functional MRI brain scans when compared with the traditional poststroke therapy workout group that had no differences in their functional MRI brain scans (6).

SUMMARY

The key to a healthy brain is certainly optimizing overall fitness through regular exercise, including brain-specific exercise, along with engaging individuals in regular cognitive fitness workouts such as CogniFit's "MindFit" or other brain-stimulating activities such as crossword puzzles or sudoku. However, it is important to understand that empowering people to achieve a balanced, fulfilling, and manageable life is actually at the heart of achieving a healthy brain. Managing stress, eating nutrient-dense healthy foods, regular relaxation, and practicing focused deep breathing, and even sleep, are all important parts of a healthy brain lifestyle. In the medical fitness center setting, we need to remember to focus on the entire human being, not just their strength, flexibility, and cardiovascular risk. According to Dr. Elkhonon Goldberg, neuropsychologist, clinical professor of neurology at New York University School of Medicine, and disciple of the great neuropsychologist Alexander Luria, "Exercising our brains is as important as exercising our bodies. In my experience, 'use it or lose it' should really be, 'use it and get more of it!'"

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CONDENSED VERSION AND BOTTOM LINE

The evidence-based brain health benefits of physical exercise presents fitness professionals with an exciting new motivation to increase the number of individuals in our society that are regularly exercising. Individuals across the country have become acutely interested in maintaining and improving their brain health, evidenced by the sharp increase in consumer spending on brain health products. Medical fitness centers have an opportunity to seize this consumer interest in brain health by redesigning how they have traditionally marketed the benefits of physical exercise and designed and prescribed exercise programs in their centers and by carefully considering if their center provides resources and programs that will improve both physical and cognitive fitness throughout the life span.