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The Role of Exercise in Reducing PTSD and Negative Emotional States

Robert Motta

Abstract

There is considerable research indicating that exercise can be of significant benefit in reducing anxiety and depression. There are far fewer investigations of the role of exercise in reducing posttraumatic stress disorder (PTSD). This chapter reviews empirical research on the impact of exercise, particularly aerobic exercise, in reducing PTSD and negative emotional states. A variety of models are reviewed to possibly explain why exercise is so beneficial. Those who suffer from PTSD are notoriously treatment avoidant. Exercise is presented as an effective intervention for PTSD, anxiety, and depression and because it does not produce the level of avoidance that traditional psychotherapies do, it becomes a valuable potential tool for treating PTSD.

Keywords: posttraumatic stress disorder, anxiety, depression, exercise

1. Introduction: the effect of exercise on posttraumatic stress disorder (PTSD)

In the early days of research on the impact of exercise on negative emotional states, there was fairly consistent evidence of its beneficial impact [1, 2]; but there was virtually no evidence of its utility in managing PTSD. The reasoning behind the lack of evidence for the utility of exercise in reducing PTSD was that PTSD is a far more complex and enduring problem than many of the more transitory disorders such as anxiety and depression. PTSD literally transforms the individual sufferer on virtually all levels. It is not as simple as fear of driving on highways but involves an alteration of one's sense of self and one's view of the environment. PTSD sufferers report that they are no longer the person they once were and they no longer see the world in the same way. It seemed that exercise could not have a real impact on such a pervasive and enduring disorder as PTSD. I was somewhat taken by surprise when one of my doctoral students was able to prove otherwise [3].

In her study Dr. Manger obtained a sample of individuals from the community who had experienced a variety of traumatic events including the tragic death of a loved one or friend, a sexual or physical assault, serious accident (most common were automobile accidents), combat, severe illness or disease, or injury. Study participants reported experiencing between two and six traumatic events and on average were 48 years of age. Participants were then required to walk or jog on a treadmill at a moderate intensity level for 30 minutes and then engage in a cool down

for 10 minutes. Moderate intensity exercise was defined as 60–80% of maximum heart rate for half an hour. Heart rate monitors were provided. Participants agreed to exercise two to three times per week for 10 weeks. Overall results showed significant reductions in PTSD, anxiety and depression following the exercise intervention. These results were maintained during the one-month follow-up period. In the exercise intervention presented here there was no need for those involved to deal with traumatic experiences other than, that which may have been encountered in filling out paper and pencil measures of trauma, and answering questions during initial interview. The reductions in negative emotional states that followed the exercise intervention cannot be attributed to any traditional form of therapeutic intervention as none was offered in this study. It appeared that exercise alone was responsible for the reductions in PTSD, anxiety and depression. This of course begs the question, which may be unanswerable: why does exercise have a beneficial effects noted here. To date there seems to be no universally agreed upon answer.

1.1 Additional empirical studies of exercise and PTSD

Another more recent study of adults, focusing specifically on women veterans of childbearing age, was conducted to determine if exercise in and of itself could positively impact PTSD [4]. The protocol involved brisk walking at a rate of 3 miles/hour for 30–40 minutes, 4 days a week for a total of 12 weeks. The exercise duration was gradually increased upward in the first 3 weeks to a full duration of 30–40 minutes per session by the end of week 3. Exercise sessions had a 3–5 minute warm up before advance the walking speed to its targeted intensity level. Results again showed significant reductions in PTSD and depression, and increases in quality of life measures and pain reduction. The authors state: “Finally, for patients with prominent avoidance related to their traumatic events, exercise many provide a safe and structured activity than can address social isolation and promote recovery” (p. 1813).

Avoidance is a major problem in treating PTSD with traditional treatments that require the patient to re-confront and reprocess their trauma experiences. If interventions, such as exercise can be effective in reducing this disorder and do not place a heavy emphasis on re-confronting prior trauma, they have an important place in our treatment choices. No study is without its limitations including this one which did not have a comparison group that was diagnosed PTSD but was not receiving exercise. Nevertheless, the overall thrust of existing empirical investigations certainly seems to point toward exercise as an effective intervention for PTSD.

The majority of research studies on exercise and PTSD, including those presented to this point use a cross-sectional approach whereby a group of individuals, most often adults, with PTSD are enrolled in an exercise program for a specific period and are given pre and posttest measures to see if there have been reductions in negative emotional states. In contrast an online longitudinal study involving 182 individuals who screened positive for PTSD [5] was conducted. In addition to a measure of PTSD participants completed online assessments of exercise behavior, psychological distress, sleep quality, pain, and alcohol/substance abuse. Findings were that there was a significant and direct effect of exercise on avoidance/numbing symptoms of PTSD. This is of no small significance as avoidance is one of the major difficulties in treating those who are traumatized. Numbing refers to emotional dampening and lack of engagement. However, for those who engaged in strenuous intensity exercise, which was defined as vigorous running or cycling, there was significantly less avoidance/numbing and hyperarousal. Those who engaged in strenuous exercise activity also reported better sleep quality, reduced substance abuse, less pain, and a reduction in overall PTSD symptoms than those who were less active.

Overall results of this study point to beneficial effects of aerobic activity particularly for those who exercise vigorously. However, this should not be interpreted to mean that moderate levels of exercise are not of value. The general message from the research literature is that even moderate levels of exercise are effective in reducing both anxiety and depression. Given that anxiety and depression are key components of PTSD, it should be clear that encouraging patients to exercise is generally excellent practice.

There are those who claim that the beneficial effects of exercise may be due to changes in brain morphology, chemistry, and function. These beneficial effects include improved learning and memory, anti-depressant and anti-anxiety effects, reduced cognitive decline related to aging, and improvements in symptoms of neurodegenerative diseases. Exercise appears to improve mood and cognition and to have its greatest effects on the hippocampus where both neurogenesis (nerve cell growth), angiogenesis (increase blood availability through the growth of new blood vessels) have been shown. Although the exact molecular mechanisms responsible for the exercise-induced neuroplasticity needs to be further researched, progress is continuing in this area especially regarding studies of neurotransmitter systems.

Another study [6] examined active and inactive adolescent and adult twins between the ages of 14–24 with diagnosable anxiety disorders. Results showed that exercise reduced anxiety, PTSD, agoraphobia, and other specific phobias in the physically active twin. Twins not engaging in exercise did not have reductions in these disorders. The value of this study is that it helps to nullify genetic explanations as to why individuals may benefit from exercise. The authors kept the genetic factor relatively constant and continued to find that exercise alone benefited the active twin.

1.2 Exercise and PTSD in adolescents

Having found positive results for the impact of aerobic exercise on PTSD in adults, the next step was to determine if the same outcome would occur in an adolescent sample. We recruited participants from a residential treatment center who were female, who had primarily been physically abused, sexually abused, maltreated or some combination of those, were between the ages of 14–17, and who had a diagnosis of PTSD based upon standardized measures [7]. Participants engaged in a structured group aerobic exercise program for 40 minutes, three times per week for a total of 8 weeks. The form of exercise varied with some girls jogging and some doing kickboxing but all of which produced an aerobic effect. Measures of PTSD, anxiety, and depression were taken twice during the beginning and end of a baseline period in which no intervention took place, at the end of the exercise intervention, and at a one-month follow up. Once again, results provided support for the positive effects of aerobic exercise on reducing PTSD, anxiety, and depression. Fewer youngsters met the criteria for PTSD and the end of the study than at the beginning and overall, significant reduction in anxiety and depression were shown. One of the major values of the exercise intervention is that it achieved positive therapeutic outcomes without the need for the adolescents to engage in formal therapy, which they were reluctant to do. It is easy to see that adolescent females may have been immensely troubled by their abuse and avoidant as far as sharing information in a formal therapeutic setting. If significant symptom reduction can be attained by a simple aerobic exercise activity, such activity should become part of the formal structure of interventions for these youngsters.

Finding that PTSD could be reduced through simple aerobic exercise interventions within adult and adolescent samples, another study [8] was conducted with youngsters 14–17 years of age at a private residential treatment facility, but this time the attempt was made to use only moderate intensity walking as the form of

intervention rather than using varied forms of more intense aerobic activity. In this study, participants completed a 5 week baseline and then an intervention which involved 25 minutes sessions of exercise which included: 1 minute of slow leisurely walking (warm up), 23 minutes of moderated intensity walking, and 1 minute of slow leisurely walking (cool down). Heart rates were maintained at 60–90% of maximum. By keeping the intervention unvaried and structured, the hope was to make the study more precise than earlier conducted investigations. The majority of participants showed statistically significant reductions in PTSD symptoms from baseline to post-intervention. There was also a reduction in trauma related stress. Results of anxiety and depression measures were not as clear cut as those from PTSD and this may have been due to the fact that initial levels were not overly high and therefore significant reductions were less likely to occur. Like previous studies, the reductions in PTSD were primarily maintained in follow-up and in some cases the reductions increased over time.

The authors concluded that aerobic exercise interventions might be appropriate for youngsters who demonstrate difficulty with expressing their emotions verbally as is required in traditional CBT type therapies. In addition, aerobic exercise as an intervention for PTSD may be more appropriate than exposure therapies, which is more likely to be tolerated in teens with concentration problems, self-control difficulty, and with histories of sexual-abuse and the avoidance of discussing their traumatic experiences that such abuse usually produces.

A study of adolescent females [9] suggested that peer pressures related to social acceptance significantly affect the high level of anxiety in this group. Issues such as wearing fashionable clothes, having a boyfriend, doing well in school, being popular etc. were factors upon which their peers judged their merit. In this study, individuals in the exercise group participated in 50 minute dance classes, four times a week, for 4 weeks. The classes followed a dance routine to elevate heart rate to 160 beats per minute and ended with a cool-down to bring the heart rate down to 100 beats per minute. Results of the study showed clear benefits in terms of anxiety reduction by engaging in the aerobic dance routine. Thus it appears that a variety of exercises from treadmills, to walking, to kickboxing to dance and others can have beneficial effects on negative emotional states.

2. Why does exercise help with PTSD and emotional disorders?

The short answer to this question is that no one knows for sure why exercise is beneficial in reducing PTSD and the anxiety and depression that accompany this disorder. There are a number of hypotheses, none of which are universally accepted.

2.1 Thermogenic hypothesis

This hypothesis proposes that exercise creates an elevation in body temperature and this has a beneficial impact on emotional states. Specifically, aerobic forms of exercise are said to raise the temperature of brain regions such as the brain stem and this produces a tranquilizing effect along with muscle tension reduction. The hypothesis has specifically been used to explain anxiety reduction rather than depression and PTSD. However, given that PTSD was formerly classified as an anxiety disorder and anxiety is a major component of PTSD, it stands to reason that exercise would have a beneficial impact on PTSD. One of the difficulties with the thermogenic hypothesis is that temperature elevation might be an intervening variable that has little to do with the beneficial emotional impact of exercise. For example, it may be that exercise increases temperature but also alters

neurochemistry and it is the latter that produces the benefit, not temperature elevation per se. From this perspective temperature plays a correlational rather than a causal role. Additionally, living in a warm environment has not been shown to reduce depression, anxiety, or PTSD nor does having a fever, which also increases internal body temperature. The thermogenic hypothesis does not appear to have held up well as an explanation for the beneficial effects on emotion resulting from exercise.

2.2 The endorphin and endocannabinoid hypotheses

Perhaps the most popular explanation for the positive impact on mood that results from exercise is the endorphin hypothesis. This hypothesis is based on the observation that following vigorous exercise of one half hour or more, there is an elevation of a special endogenous opiate (*B*, or beta, endorphin). This endogenous or body produced opiate is released through exercise and is said by some to be responsible for the “runners high,” an elevation of mood following running or jogging or extended periods. The endorphin hypothesis is not without its critics who have carefully examined the data from empirical studies.

One such study compared a jogging group to a relaxation group that did not engage in exercise to a group that did back stretches. The moods that were examined were anger, tension, energy level, calmness, positive mood, depression and others. While all groups produced positive emotional changes there were no differences among the groups. If beta-endorphin is released through exercise, the non-exercise groups should not have shown positive changes and yet they did. Clearly something other than, or in addition to endorphins must be responsible for positive emotional effects of exercise.

A further critique of the endorphin hypothesis is that circulating endorphin levels are not reflective of brain endorphin levels and endorphins cannot cross the blood brain barrier. So even if circulating or peripheral endorphin levels increased, this should not have an impact on brain mediated emotional states. A further critique of the endorphin hypothesis is that when the endorphin blocking substance naloxone, an opiate antagonist, is provided to those experiencing the runners high, the elevation in mood is not diminished. If endorphins were causal to exercise induced mood changes, one would expect a significant deterioration in mood following naloxone injection.

It may be of some significance to note here that a recent alternative to the endorphin hypothesis has come to be known as the *endocannabinoid hypothesis*. Endocannabinoids are bodily produced substances that are similar in action to that of tetrahydrocannabinol (THC), the active constituent in marijuana. Using trained male college students running on a treadmill or cycling on a stationary bike for 50 minutes at 70–80% of maximum heart rate, elevations of endocannabinoids were detected in blood plasma. Because activation of the endocannabinoid system reduces pain sensations, it has been suggested that this might be what is behind the runners high and alterations of mental and emotional processes [10]. Owing to the presence of cannabinoid receptors in the skin, lung, and muscle, it has been suggested that there may be a role for endocannabinoids in producing analgesic effects through exercise. Unlike the endorphin hypothesis where it was noted that endorphins do not cross the blood brain barrier, cannabinoids do appear to operate both centrally (i.e., in the central nervous system) and in the peripheral nervous system. Cannabinoids are reported to reduce anxiety, alter attention, and impair working memory, much like THC does. So, although research is in the early phases, endocannabinoids have been proposed as an alternative to endorphins as the possible mediator of the runners high, analgesic effects and beneficial psychological effects of exercise. The

endocannabinoid hypothesis is of comparatively recent development and is not anywhere near as widely accepted as the apparently doubtful endorphin hypothesis.

2.3 Monoamine hypothesis

This hypothesis is somewhat similar to the endorphin and endocannabinoid hypotheses in that it proposes that exercise produces chemical changes in the body and these are what causes mood changes in exercise. The monoamine hypothesis proposes that exercise results in increased brain availability of brain neurotransmitters such as serotonin, dopamine, and norepinephrine and that these result in reductions in depression and other negative emotional states. Available studies show that while exercise does result in monoamine elevations as assessed in plasma and urine, the question remains as to whether there similar elevations in the brain take place. In fact testing of biochemical hypotheses is difficult in humans because it often involves invasive procedures such as spinal taps for cerebrospinal fluid samples. Further, biochemical samples obtained from blood or other body fluids may not necessarily reflect the availability of similar biochemical samples in the brain. Animal studies suggest that exercise increases serotonin and norepinephrine in the brain but reliable and replicable studies in humans have not been demonstrated.

Another line of reasoning that further clouds the issue of whether biochemical changes following exercise is causal of positive mood enhancement is that all mental activity is in essence chemical activity of the nervous system, especially the central nervous system. So, as will soon be discussed, it may be possible that positive mood states arise from perceptions of having successfully completed some form of strenuous activity, and the positive mental state is what drives the biochemical changes, rather than the other way around. The issue is, what is responsible for causing what? Which came first?

2.4 Distraction hypothesis

This hypothesis suggests that psychological or environmental changes are what are responsible for changes in emotional states following exercise and that biochemical mediators play an ancillary role. The hypothesis proposes that when one is engaged in vigorous physical activity it is difficult to simultaneously entertain depressive thoughts and negatively tinged depressive ruminations. We only have so much attention to go around and when one is busy exercising there is little available attention for depressive rumination. It is usually when one is inactive, immobile, and has few demands on one's time that there is time and space available to engage in depressive thoughts. And, as we saw earlier, negative thinking and cognitive distortions are the basis for negative emotional states according to CBT perspectives.

In some studies exercise has been compared to control groups such as relaxation training, or waiting list controls, where one is distracted yet not involved in physical activity. The results of these studies are varied with some showing reductions in depression following distracting activity and some not. However, when one examines mood elevation and not simply reduction in depression, usually exercise shows greater changes than non-exercise interventions. So, it is possible that distraction serves as a means through which one moves away from depressive rumination, but that for mood elevation to occur, distraction may not be a sufficiently effective means.

2.5 Self-efficacy theory

Self-efficacy perceptions refer to one's self-view of their capabilities to accomplish certain objectives. The originator of self-efficacy theory [11], claims

that people who are depressed are comparatively lacking in a healthy sense of self-efficacy. Those who are clinically depressed see themselves as relatively incapable of setting goals and accomplishing hoped for objectives. These negative self-perceptions eventuate in depressive rumination on, for example, perceived inadequacies, and these perceptions decrease the possibility of engaging in self-validating behaviors.

The studies that have been conducted do in fact show that when one engages in physical exercise they feel more accomplished and more capable of achieving various exercise related goals. Their self-efficacy perceptions, i.e., their view of themselves setting specific exercise targets and accomplishing them has been found to increase following a planned sequence of exercise. The research however, on whether these enhanced views of exercise competence can produce reductions in clinical depression is less clear-cut. It does seem clear that exercise is associated with reductions in depression and elevation in mood. Whether these outcomes are due to alterations in one's self-perceptions of their capabilities is less obvious.

2.6 Conclusion on causal hypotheses of exercise effects

At this point it is unclear as to whether biochemical or psychological factors mediate the positive effects of exercise on mood states such as depression. Depression and anxiety are significant factors in PTSD and the alleviation of the emotional distress that they cause would be a productive step in treating PTSD. It may very well be that we are making an error in seeking out unitary causes for the beneficial effects of exercise and that a combination of biochemistry, psychology, and perhaps even socialization, and in some instances, spiritual issues come into play, and maybe these vary in importance depending on at what point in one's cycle of emotional distress one chooses to intervene. What we can derive from the available literature is that exercise alleviates emotional distress.

Why this is so is, as of this writing, unclear. However, from a practical point of view, it does seem that exercise produces biochemical alterations in the nervous system, even if the specific nature of these biochemical events is unclear, and it is these biochemical changes that improve negative emotional states. Perhaps a biochemical and self-efficacy interpretation in combination is the most useful model of the beneficial effects of exercise.

2.7 From research to clinical perspectives

Those clinicians who have treated individuals suffering from PTSD, anxiety, and depression know that it is a real challenge to get them to engage in exercise, despite its beneficial effects. The American College of Sports Medicine recommends that those between the ages of 18–65 should engage in moderate intensity exercise for 30 minutes 5 days a week. Moderate exercise intensity is defined as 60–80% of maximum heart rate. In general maximum heart rate has been calculated as $220 - \text{age}$ multiplied by .6 to .8. So, for an individual who is 50 the calculation would be $220 - 50 = 170$; $170(.6) = 102$; $170(.8) = 136$. Therefore the 50 year old should exercise in such a way that they maintain a heart rate of 102–136 for half an hour, 5 days a week. Is this reasonable?

The numbers presented above, exercising 5 days a week for a half hour at moderate intensity are, for all intents and purposes, unrealistic, to say the least, for many and especially for those who are depressed. Getting a depressed patient to do anything, other than that which is absolutely necessary to get on with their lives, is often a real challenge. So what is realistic? In many instances just getting them to go for a walk for 10 minutes or so maybe twice a week might be a major

accomplishment. The idea is to start at a non-challenging level as most emotionally troubled patients are not physically fit, unmotivated, and resistant to physical activity. Start slow, be encouraging and move up the exercise level slowly. Baby steps are the guiding principle here. Start emotionally distressed patients with something they might see as enjoyable. A 10 minute stroll in the park might be a suitable starting point. Certainly, a moderate to vigorous intensity level three to five times per week is likely to have a psychologically beneficial effect, but if the exercise demands become overwhelming to a patient, which they easily can, not only will the patient become discouraged, but they may also begin to believe that their therapist does not understand them and is out of touch. The patient's inability to accomplish exercise goals may likely be seen as a failure and this failure further validates a negative, depressive self-view. As in treating PTSD, the mantra here is to move slowly, and at a pace the patient can tolerate.

2.8 Childhood negative affectivity and PTSD reduction through exercise

With the exception of the few studies noted above involving older children and early adolescents, there are few studies that examine the impact of exercise, anxiety, depression, and PTSD in children and yet anxiety and depression are key components of PTSD. It has been noted [12] that only about 36% of children and adolescents participate in physical education and this is unfortunate given the beneficial effects that exercise appears to have in relation to emotional disorders. The few exercise interventions that have been implemented with children do, in fact show that there is an exercise—anxiety reduction relationship. In a study involving children [13] 9–12 year olds engaged in physical activity, resistance training, and stretching for 12 weeks. Exercise resulted in reductions in anxiety, negative mood, and improvements in physical self-concept, and overall self-concept. There have been additional studies that correlated exercise among children with improvements in grades, standardized test scores, and feelings of well-being.

There are literally hundreds of empirical studies showing that exercise significantly reduces depression in adult samples and often to a degree equal to or greater than traditional cognitive therapies and psychotropic medication. As a result, there can be little doubt about the utility of exercise as an adjunct to traditional therapies or a stand-alone intervention for reducing depression. The problem with prescribing exercise, as clinicians are all too aware, is that the more depressed a person is the less likely they are to engage in exercise. They simply lack the energy or motivation to go to a gym or go outside and engage in brisk walking, jogging, or perhaps swimming. The research on childhood and adolescent depression is far less abundant than that of adults.

Children and adolescents who are depressed experience prolonged or temporary sadness, reduced interest in normal activity, negative and self-critical self-evaluation, difficulties in concentration and memory, socialization difficulties, and impairment in everyday functioning. In the United States, up to 2.5% of children and 8.3% of adolescents suffer from depression. The problems of depressed youngsters can extend well past childhood and lead to substance abuse and suicide. Approximately 7% of adolescents who develop major depressive disorder, later commit suicide as young adults. In addition to the treatment options of traditional psychotherapies and medication, physical activity has been researched as an alternative for these youngsters.

A correlational study [14] examined the relationships among self-reported exercise levels, depression, and a number of other interpersonal characteristics including relationship with parents and peers, sports involvement, drug use, and academic performance. A sample of high school seniors completed questionnaires

and, on the basis of their answers, were divided into two groups: low exercise and high exercise. It was found that the high-exercise group reported significantly less depression, lower drug use and better relationships than the low-exercise group. While exercise appeared to produce these positive outcomes, it could be argued that those who were less depressed were more likely to have already been engaging in these positive behaviors, unlike the previously depressed individuals. The problems establishing causality from correlational studies are well known.

In contrast to the above correlational study, typical experimental studies randomly assign participants into groups: those who receive treatment and those who do not. Data are gathered before and after the intervention, and the participants' results are compared to one another. Doing so allows researchers to make inferences about the impact of the treatment, in this case exercise, on depressive symptomology. Another study [15] implemented an after school physical activity program with children 9–12 years of age. After assessing for depressed mood, the youngsters engaged in cardiovascular and resistance exercises three times per week for 12 weeks or did not engage in exercise. Upon completion of the study a significant reduction in depression was found for the exercise group.

A further investigation [16] examined the impact of a physical activity program on the psychological wellbeing of low-income Hispanic 4th grade children. A sample of children participated in a 6-week program. They were assigned to an aerobic group involving stationary bicycling, track running, and jumping on a trampoline or a control group that participated in shooting basketballs, walking, and playing foursquare. Pre and posttest depression scores were obtained and at the end of the intervention the aerobic group reported significantly less depression than the control group. The effect size of $-.97$ indicates a large impact of exercise on depression in this experimentally based study.

While the general thrust of the research shows that physical activity is associated with a significant reduction in depression, there are some who maintain that exercise can be a preventive measure as well. In contrast to other strategies that adolescents often use (substance use, emotional coping, and aggressive behavior), physical activity was found to decrease the likelihood of future depressive episodes. Again, this suggests that physical education programs within the schools can be a real benefit in promoting both physical and mental in youngsters.

3. Conclusion: implications of using exercise to impact anxiety, depression and PTSD

There is abundant and ever increasing evidence that exercise can be of significant benefit in reducing adult affective disorders including PTSD. There are literally hundreds of empirical studies demonstrating the beneficial effects of exercise on adult anxiety and depression and these are major components of PTSD. There are also a growing number of studies showing that exercise can beneficially impact adult PTSD directly. The emerging research shows that it can be of value for adolescents and children. The benefit of physical exercise in reducing negative affect is that exercise fits within the natural ecology of childhood and adolescent activity. In contrast psychotherapy and psychotropic medication are alien to youngsters. Physical education classes often exist within their schools so exercise is seen as an integral part of the educational process and part of what it means to be student within the school system.

Further work is needed to develop empirically sound methodologies for investigating the role of exercise in dealing with PTSD and other affective disorders. Exercise has long been seen as being of value for the physical wellbeing of children,

adolescents, adults, and seniors. Empirical findings indicate that exercise has beneficial effects on psychological functioning as well. Further research should examine its benefits as a method of prevention for children and adolescents at risk for internalizing disorders, i.e., troubling emotional states that do not find outward expression.

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