Wayne T. Phillips, Michaela Kiernan, & Abby C. King:
The Effects of Physical Activity on Physical and Psychological Health.
In A. Baum, T. A. Revenson, & J.E. Singer (Eds.)
Handbook of Health Psychology.
Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey, London (2001)
pp. 627–657

p.627

„Today the majority of the U.S. population is essentially sedentary, reporting little or no exercise of even low to moderate intensity (Centers for Disease Control and Prevention, 1991). The links between such inactivity and the incidence of coronary heart disease (CHD), as well as other chronic disease states, have been well established with both epidemiological and clinical studies (Bouchard, Shephard, & Stephens, 1994; Bouchard, Shephard, Stephens, Sutton, & McPherson, 1990). Impaired psychological health is also a pandemic problem in the United States, with an estimated 8 to 20 million people (3%–8% of the population) suffering from an affective or depressive disorder (D. R. Brown, 1990; Hatfield & Landers, 1987). As many as 25% of U.S. population suffer from mild to moderate depression, anxiety and/or other indicators of emotional disorders (President's Commission on Mental Health, 1978). … Additionally, more than 40% of the adult population are reported as experiencing adverse health effects from stress (U.S. Department of Health and Human Services, 1991). …

The financial and social costs of such levels of physical and psychological ill health are now beginning to be addressed (Shephard, 1990), and are considerable, albeit complex and extremely difficult to quantify…. Considering that physical inactivity has been shown to be an independent risk factor for coronary heart disease (National Institute for Health, 1995), and no more than 25% of the population meets the current physical activity–cardiovascular health recommendations (Haskell, 1995), a substantial portion **(p.628)** of the Klarman (1964) costs could logically be attributed to physical inactivity. In 1980 the cost of mental health care in the United States was estimated at between $19.4 and $24 billion (C.A. Taube & Barrett, 1986). A decade later, this figure had escalated to approximately $148 billion per year with about half of these costs represented by nonsevere levels of mental/emotional disorders like depression and anxiety (National Advisory Mental Health Council, 1993).

The aerobics and running boom of the 1970s and 1980s brought the health benefits of exercise into high profile, and today an increasing amount of available scientific information has been accompanied by an ever-growing media focus on the desirability of physical activity and exercise from fitness and health perspectives. Despite this attention and the apparent public acceptance of the mental and physical benefits of exercise, only a relatively small percentage of the population is reported to be active on regular basis (Casperson & Merritt, 1992; Merritt & Casperson, 1992; U.S. Department of Health and Human Services, 1991)."

DEFINITIONS OF TERMS

With the increasing attention and investigation of its health benefits, there has been a gradual shifting of emphasis toward behaviorally oriented definitions of physical activity rather than defining such activity solely in terms of work performed or force produced (Knutsson, Lewehaupt-Olsson, & Thorsen, 1973). This view of physical activity as a behavior has necessitated the development of new terms, or the revision of existing ones (Haskell, 1994b). This chapter focuses predominantly on the following behaviorally oriented terms.

p.628 (cont.)

Physical activity
This is defined as any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level (Caspersen, & Christenson, 1985; Surgeon General's Report, 1996).

Exercise
Although the term *exercise* has been used synonymously with *physical activity*, it is more accurately categorized as a subset of physical activity, and defined as activity that is planned, structured, repetitive, and purposeful with the objective of improving one or more aspects of physical fitness (Caspersen et al., 1985; Surgeon General's Report, 1996).

Fitness
… In behavioral terms, this can be defined as the ability to carry out daily tasks with vigor and alertness without undue fatigue, and with ample energy to enjoy leisure time pursuits and to meet unforeseen challenges. The components of fitness are considered to be cardiorespiratory endurance (often termed *aerobic fitness*), muscular strength, muscular endurance, muscular power, speed, flexibility, agility, balance, reaction time, and body composition. The definition of fitness has been further subdivided to differentiate those components considered to contribute more to health versus those considered to contribute more to skill or performance (Corbin & Lindsey, 1993).

Health-Related Fitness. This consists of cardiovascular fitness, muscular strength, muscular endurance, flexibility, and body composition.

Performance (or Skill) Related Fitness. This consists of speed, power, agility, balance, and reaction time.

Aerobic Fitness. This term is considered separately here because it is used in many studies as a measure of exercise capacity or exercise training. Aerobic fitness is defined by the body's capacity to take in, transport, and utilize oxygen, and is most accurately measured during a graded exercise test on a treadmill or stationary cycle. The amount of oxygen (O_2) a person's body uses ("takes up") is referred to as "oxygen uptake" and commonly expressed as "VO_2" (volume of oxygen). The amount of oxygen able to be taken up by an individual at maximum effort (i.e., during a graded exercise test) is referred to as "maximum oxygen uptake" and is expressed as "VO_{2max}." This is generally accepted as the best measure of the functional limit of the cardiovascular system and is regarded as the gold standard index of cardiovascular fitness.

Psychological Health
This term, which has also been synonymously with "mental health" had a wide interpretation in the literature. **(p.629)** … This review addresses the constructs most commonly investigated and focuses primarily on the amelioration on negative aspects of mental health such as depression, anxiety, and psychophysiological responses (i.e., stress reactivity).

PHYSICAL ACTIVITY AND PHYSICAL HEALTH

Physical Activity and All-Cause and Cause-Specific Mortality

(629 cont.)
… It appears that if middle-aged men have been habitually active or become active, than they are more likely to reach old age than if they remain sedentary (Paffenbarger et al., 1993; Pekkanen et al., 1987). Men from age 35 to 39 who are assumed to have sedentary jobs, but who expend more than 2,000 kcal per week during leisure time (achievable with regular moderate intensity activity), have a life expectancy 2.51 years longer than similar men who expend than 500 kcal per week (Paffenbarger et al., 1985). At age 55 to 59, this difference decreased to 2.02 years, and at age65 to 69, there was a decrease to 1.35 years. Given that the average life expectancy of American men at age 65 was approximately 15.1 years in 1990 (National Center for Health Statistics, 1993), the more physically active man at age 65 would appear to have increased his life expectancy by approximately 9% over his sedentary counterpart. The data from Paffenbarger and colleagues are similar to those reported for Finnish men living in rural areas (Pekkanen et al., 1987). In that study, the adjusted gain in life expectancy for middle-aged men with high levels of physical activity was 2.1 years….
Very few data are available on sufficiently large samples of women to address the issue of increased longevity as a result of increased physical activity or physical fitness, but the evidence shows Lowe all-cause and cause-specific mortality rates for more physically active and fit younger and older women and is consistent with data reported for men (Blair et al., 1989).

Physical Activity and Cardiovascular Disease
…
Coronary Heart Disease Morbidity
…
(p.630)
Physical Activity and Cardiovascular Disease Risk Factors
No randomized controlled studies of adequate methodological design have yet evaluated the effects of increasing physical activity or fitness on the primary prevention of cardiovascular disease (Haskell, 1995). However, a substantial amount of data reports positive effects on physical activity on the more intermediate endpoints of risk factors for cardiovascular disease.

Hypertension
…
(p.631)…
Physical Activity and Other Chronic Diseases
Although the leading cause of death in the United States remains cardiovascular disease, age-adjusted death rates from CHD have been decreasing, whereas those of certain forms of cancer have been increasing (Lee, 1994). A growing literature suggests a strong inverse relation between physical activity and overall cancer mortality rates. However, because types of cancer (e.g., breast, colon) are thought to have different origins and biological mechanisms (Sternfield, 1992) site specific cancer in women and men is reviewed.

Breast Cancer

...

Colon Cancer

...

PHYSICAL ACTIVITY AND PSYCHOLOGICAL HEALTH

Psychological or mental, health is a multifaceted condition made up of both positive and negative dimensions. However, **(p.632)** in a situation comparable to early views of health as simply the absence of disease, the majority of studies investigating the effects of physical **(p.632 cont.)** activity on psychological function have generally represented mental health in terms of the absence, or reduction, of negative affect (depression, anxiety, and physiologic reactivity).

Caplan (1964) operationalized the preventive aspects of physical activity as either (a) *primary prevention:* Can physical activity protect against the onset of mental health problems "by counteracting harmful circumstances before they have a chance to produce illness?" (Caplan, 1964, p. 23); (b) *secondary prevention:* Can physical activity improve or prevent the worsening of mild to moderate symptoms of mental health problems before they have a chance to turn into those requiring tertiary intervention?; and (c) *tertiary prevention :* Can physical activity serve as a treatment for already existing clinical mental health problems. The following sections briefly review the literature on these three aspects of prevention with regard specifically to depression and anxiety.

PHYSICAL ACTIVITY AND DEPRESSION

Clinical depression affects from 2% to 5% of the U.S. population per year (Kessler et al., 1994), and makes up approximately 6% to 8% of general medical practices (Katon & Schulberg, 1992). This situation, in conjunction with drug therapy that has been the treatment of choice for depressive symptoms, has significant financial implications for individual and national health care costs. Depressed individuals typically spend 1.5 times more on health care costs than nondepressed individuals and, if undergoing drug therapy, spend up to 3 times more on outpatient pharmacy costs than non-drug-treated individuals (Simon, VonKoff, & Barlow, 1995). There has been recent attention on exercise as an alternative therapy to more traditional drug treatments (Martinsen, 1990; Surgeon General's Report, 1996).

Primary prevention

Epidemiological studies. No longitudinal studies of adequate methodological design have yet been conducted to test the hypothesis that physical activity protects against the onset of depression, but associations between these two variables may be investigated by examining evidence from epidemiological studies. These consistently report that physical activity is associated with reduced symptoms of depression. Stephens (1988) carried out an extensive analysis of data from for large databases, two from the United States (i.e., the National Survey of Personal Health Practices and Consequences and the National Health and Nutrition Examination Survey) and two from Canada (i.e., the Canadian Health Survey and the Canadian Fitness Survey). Stephens found that physical activity was positively associated with general swell-bring, lower levels of anxiety and depression, and positive mood. This relation was particularly strong for women and persons over age 40. The results of Stephens (1988) were generally consistent across all four populations and were considered to be very robust due to the diverse nature of the four study populations, the time over which such measures were taken (10 years), and the fact that four different measures of physical activity

and six different mental health constructs were employed. Other epidemiological studies have reported similar reductions in depressive symptoms (…), although only two of these (Camacho et al., 1991; Farmer et al., 1988) are prospective in nature.

Farmer et al. (1988), using data from the National Health and Nutrition Examination Survey, found that baseline recreational activity was an independent predictor of depression at 8-year follow-up in White women, but not White men, who were not depressed at baseline. This relation persisted after adjustment for age, chronic conditions, education, employment, income, and length of follow-up. Similar results were found by Camacho et al. (1991) in a prospective study using data from the Alameda Country Study. Among subjects who were not depressed at baseline, those who reported low physical activity levels at the 1974 follow/up were significantly greater risk (OR=4.32, 95% CI3.17–5.62) for depressive symptoms than those who reported high physical activity (OR = 1). This relation changed little after adjustment for a number of covariates (i.e., physical health, socioeconomic status, life events, social support, and other health habits). The authors also found that increases in physical activity levels between baseline and 1974 significantly reduces the incidence of subsequent depressive symptoms in the 1983 follow/up, although this significance was not retained following adjustment for the covariates listed previously. The greatest change in adjusted odds ratio occurred when going from high to low activity. The prospective nature of these two later studies provides somewhat stronger evidence for an activity–depression association than do the cross-sectional studies cited earlier.

Only one study could be found that investigated, a priori the preventative effects of physical activity on depression. In a longitudinal study, Gotesman and Stiles (1990) examined Norwegian soldiers exposed to a highly stressful life situation. Those who were actively engaged in sports were significantly less depressed 12 weeks after exposure to the stressful situation as compared to those who were inactive.

Secondary and Tertiary Prevention

Intervention Studies. Although exercise is generally believed to make you "feel good," the scientific evidence in support of a causal role for exercise remains somewhat speculative. Despite the fact that the mental health and exercise literature has been noted to be "voluminous" (Sime, 1987), it has been described by at least two major authorities as lacking in reliable, sound research methods (D.R. Brown, 1990; Morgan, 1994). A number of literature reviews on exercise and depression already exist in both narrative (Dunn & Dishman, 1991; Martinsen, 1990; **(p.633)** Morgan, 1994; Raglin, 1990; C. B. Taylor, Sallis, & Needle, 1985) and meta-analysis (Kugler, Seelback, & Kruskemper, 1994;McDonald, & Hodgdon, 1991; North, McCullagh, & Tran, 1990) formats. In general, the majority of these reviews found that exercise exerted a positive effect on depression in both clinical and nonclinical populations…The principal self-report instrument used in such studies was the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Healthy populations have been the least studied, and although early studies reported equivocal results, more recent studies have generally reported little or no effect of physical activity on depression or depressive symptoms (Table 38.3).

Time series studies. One of the earliest scientific studies to investigate the effects of physical activity on depression in noninstitutionalized healthy individuals was conducted by Morgan, Roberts, Brand, and Feinerman (1970). In this quasi-experimental study, 140 men from age 22 to 62 volunteered to participate in one of eight physical activity groups of running, swimming, cycling, or circuit training at an intensity of approximately 85% of predicted maximal heart rate for 2 to 3 days per week for 6 weeks. Depression was measured

by the Zung Depression Scale (Zung, 1965). Mean baseline scores for all groups were within the normal range for this scale and were unchanged after the intervention. However, a subgroup
of 11 of these exercises scored above 53 on the Zung Depression Scale, indicating depressive symptoms of clinical significance (Zung, 1965). When the change scores of this subgroup were analyzed, a significant decrease in depression scores was revealed, and because these subjects were spread across all groups, this decrease appeared to be independent of mode and frequency of exercise….

Since that time, the use of comparative group designs has become the norm in investigating the effect of physical activity on depression. In view of the general agreement in

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the literature on the lack of methodological rigor of many of these studies (D.R. Brown, 1990; Morgan, 1994), the remainder of this section focuses on published studies with either a randomized or a randomized controlled design.

Randomized Studies Focusing on Aerobic Exercise.

Although the majority of reviews generally report positive effects of physical activity on depression, the effect of randomized or randomized controlled trials reported in the literature is limited (Tables 38.1–38.4). … Bosscher (1993) randomly assigned 24 women inpatients matched for depression scores to either a three times per week running group, or a usual care group. The author(s) reported significant reductions in depression **(p.635)** scores for the running versus the usual care group. However, the usual care group consisted of mixed sports activities such as field hockey, soccer, volley ball, trampolinging, and gymnastic activities—some of which also involved a running component.

Randomized Studies Focusing on Anaerobic Exercise.

The majority of studies investigating physical activity effects on depression have utilized aerobic exercise (..Surgeon General's Report 1996) or aerobic fitness training (Folkins & Sime, 1981) as the physical activity intervention. However, the relatively few studies using nonaerobic physical activity, or comparing aerobic exercise to anaerobic exercise (Table 38.4), suggest that increases in aerobic fitness are not necessary to elicit such benefits (Doyne et al., 1987; Martinsen, Hoffart, & Solberg, 1989; Martinsen, Sandvik, & Kolbjornsrund, 1989; Sexton, Maere, & Dahl, 1989; Stein & Motta 1992). The strongest evidence to date on the beneficial effects of nonaerobic exercise was reported recently by Singh, Clements, and Fiaterone (1997). Thirty-two community living men and women subject from age 60 to 84 and diagnosed wit major or minor depressive disorder using *DSM –IV* criteria (American Psychiatric Association, 1994) were randomly allocated to either a progressive resistance training or an attention-control group. The progressive resistance group trained at 80% of a one repetition maximum (The maximum amount of weight they could lift in a single effort), three times per week for 10 weeks. The control group consisted of an interactive health education program of lectures and videos followed by discussion. Depression was measured by the Beck Depression Inventory and the Hamilton Rating Scale for Depression. Following the 10-week intervention program , depression was significantly reduced in the progressive resistance training group as compared to control. This is the first randomized control trial to directly compare the effects on depression of a high intensity resistance training program with a nonexercise control group.

Randomized Studies with Healthy Populations.

… Recent studies in healthy population using randomized control design (Table 38.3) generally report no changes in depressive symptoms following physical activity interventions of up to 1 year.

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Summary
Recent randomized and randomized, controlled clinical trials support the hypothesis that physical activity interventions of at least 8 weeks can significantly and beneficially impact depression in clinically depressed and nonclinical, symptomatic adult men and women. Longer duration and higher intensity intervention appear to be more effective than lower intensity shorter duration. The benefits of such interventions are not confined to aerobic exercise, but have also been reported for nonaerobic exercise such as high intensity running, moderate and high intensity resistance training, flexibility training, and yoga (Table 38.4). Although results of early studies investigating the effect of physical activity on depressive symptoms in healthy populations reported equivocal results, recent studies generally report that groups who score within the normal range of depression scores before a physical activity intervention will score within the normal range after intervention. Whereas the majority of reviews generally report beneficial effects of physical activity on depression, the relatively small number of randomized controlled studies published to date, and the methodical flaws present in a number of these, indicate that a causal effect of physical activity on depression, also tenable, still awaits more solid confirmatory evidence.

PHYSICAL ACTIVITY AND ANXIETY

Approximately 7.3% of the adult U.S. population suffer from an anxiety-related disorder necessitating treatment of some kind (Regier et al., 1988). High levels of stress-related emotions, including anxiety, are common even among otherwise healthy individuals (S. Cohen, Tyrell, & A. P. Smith, 1991). Anxiety is associated with a negative form of self-appraisal typified by worry, self-doubt, and apprehension (Landers & Petruzzello, 1994). Anxiety has been described by some authors (Franks, 1994, p. 3) as a form of "environmental stress" which usually arises when the physiological and psychological response exceed the requirements of the new environment, although Landers (1998, p. 123) has stated that such a definition does not allow differentiation between healthy and unhealthy forms of stress. Anxiety is typically measured by questionnaire instruments that assess either *trait anxiety*, which is the general predisposition to respond with high levels of anxiety across many different situations, or *state anxiety*, which is the particular level of anxiety at a given moment. Although these two subcomponents of anxiety are often assessed separately (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), they have been shown to possess a considerable amount of overlap (R. E. Smith, 1989).

Primary Prevention
Epidemiological Studies. …
Secondary and Tertiary prevention…
Time Series Studies. …

(p. 639)

…

Narrative and Meta-Analysis Reviews.

…All six of the published meta-analyses reported positive anxiolitic effects of exercise with the magnitude of effect ranging from "small " to "moderate." This was consistent for trait and state anxiety as well as for age. gender, and the mental health status of subjects (Landers, 1998).

Although the majority of the narrative reviews conclude that the exercise of higher intensity (70% –80% of VO_{2max}) is necessary to elicit anxiolytic effects, the meta-analytical reviews are not supportive of this claim. No consistent dose–response relationship has been found in these analyses; indeed, exercise at varying intensities and duration has been reported as producing similar significant reductions in anxiety following both acute and chronic exercise (Landers, 1998).

Summary

Exercise is generally reported as having a beneficial anxiolitic effect on subjects of all ages and mental health states. The greatest anxiolitic effects appear to result from aerobic rather than anaerobic exercise and when the length of the exercise training is more than 15 weeks. The law of initial values also appears to apply because subjects who have either lower levels of fitness, or higher levels of anxiety, appear to benefit the most from exercise programs. Exercise-induced reductions in anxiety appear to last between 4 to 6 hours postexercise, after which time anxiety returns to pre-exercise levels (Landers, 1997). More studies are needed to clarify dose–response relationships between intensity and duration of exercise. Current evidence is supportive of the claim that exercise , similar to other known anxiety reducing treatments such as relaxation training, has been consistently related to the relief of symptoms of anxiety.

STRESS REACTIVITY

…

(p.641)

Cardiovascular and Catecholamine Reactivity

…

Is Reactivity Attenuated in Fit Versus Unfit Persons?

…

(p.642)

Can the Reactivity of Unfit Persons Be Attenuated Following a Program of Regular Fitness Training?…

(p.643)

Relevance of Reactivity Studies to the Stress of Daily Living….

Summary

The adverse health consequences of higher sustained stress in daily life are now well established (Kobusa, Maddi, & Kahn, 1982; McEwen & Stellar, 1993; Spielberger, 1987). Heightened cardiovascular and catecholamine response to stress ("reactivity") has been linked with the development of cardiovascular disease process (Beere et al., 1984; McEwen & Stellar, 1993). Exercise has been proposed as a "stress inoculator," that is, as a means of reducing the responsivity to psychosocial stressors and thus, in turn, cardiovascular risk.

(p.644) Evidence to support the hypotheses that exercise evokes a psychological training effect, however, is still equivocal. Methodological problems beset most of the published **(p.644 cont.)** studies and replication studies are still rare. As an example, although aerobic fitness is one of the prime independent variables of concern in the reactivity literature, it has not been assessed consistently across studies. Fitness testing protocols have included self/report, step tests of different kind, heart rate and blood pressure responses to submaximal bike and treadmill tests, or maximal time on treadmill at an absolute work load. Few studies investigating reactivity between fit and unfit groups have used maximal treadmill testing as a fitness measure. Additional points of methodological concern include no or inappropriate control groups, and lack of adjustment of baseline variables such as heart rate and BP, which would generally be lower for fit versus unfit subjects. The familiarity of the stressor should also be accounted for because differences in reactivity have been reported according to whether the stressor is novel or well practiced (Claytor, 1991; Sothmann et al., 1987). Existing research suggests that links between exercise, fitness, and cardiovascular reactivity may be tenable, but as yet too few consistent and reliable studies have been conducted to assert causality. More randomized controlled training studies utilizing direct measures utilizing direct measures of VO_2 are needed, together with greater emphasis on replication of findings.

MECHANISMS

A wide range of hypotheses have been proposed to explain the mechanisms by which exercise may improve aspects of mental health. For example Gleser and Mendelberg (1990) listed five physiological and eight psychologically based hypotheses. Most of these mechanisms remain speculative, however, with little support from the scientific literature. Because no conclusive evidence has differentiated any one mechanism or group of mechanisms, this section focuses on those hypotheses that appear to be the most tenable and/or have received the most attention in the literature.

The Monoamine Hypothesis

This hypothesis proposes that improvements in psychological health are associated with changes in levels of the major neurotransmitters of the brain, principally the biogenic amines, both catecholamines (norepinephrine, epinephrine and dopamine) and indolamines (serotonin). Early evidence of the role of the amines came from pharmacological studies of psychoactive drugs known to alter affective states, but that were also found also produce changes in the brain amines of experimental animals (Schildkraut, Orsulak, Schatzberg, & Rosenbaum, 1983). In humans, because catecholamines are not able to pass the blood–brain barrier, changes in monoamines have been assessed by measuring the metabolite of norepinephrine (3/mothoxy/4hydroxyphenylethylene glycol or MHPG) in ether urine, plasma or cerebrospinal fluid. It is assumed in these studies that increased MHPG reflects brain (central) noradrenergic responses. Studies of the effects of physical activity on MHPG have not yielded consistent results either in depressed of normal subjects….. These inconsistent results may be due in part to methodological problems and inconsistencies. Sample sizes were small, and the levels of physical activity used were very low and not well quantified or standardized. In addition, different types of depression were present in the same treatment group Sweeney et al. (1980), for example, assigned unipolar, bipolar, and schizophrenic patients to the same treatment group.

A small number of studies have examined the effect of acute exercise in nondepressed individuals. …

No studies on the acute effects of exercise have been published, although in a series of studies with nondepressed subjects Sothmann and colleagues (Sothmann, & Ismail, 1984, 1985; Sothmann, Ismail, & Chodzko-Zajko1984) reported no differences in MHPG levels between fitness between fitness groups based on VO_{2max}. However, Lobstein et al. (1983) reported an inverse relation between VO_2 peak and self-rated depression.

Summary

The monoamine hypothesis continues to be promising focus of research attention from a neurobiological perspective of psychological health, particularly in the study of depression. No definite conclusions can be drawn from the existing research, however, due to the wide variation in study methodology, exercise quantification, and patient diagnosis.

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The Endorphin Hypothesis

Endorphins (from "endogenous morphine") are one of the three classifications of the endogenous opiates so far identified, the other two being "enkephalins" and dynorphins." A number of studies conducted in animals and humans have shown significant increases in endorphins during and following exercise and a report of morphinelike effect—that is, an ability to reduce the sensation of pain and even produce a state of euphoria (Morgan, 1985; Ransford, 1982). Exercise has also long been known to produce a "feel good" effect, so a small number studies (Mandell, 1979; Pargman & Baker, 1980; Sachs, 1984) combined with considerable media coverage led to the development of what became virtually an urban legend—the "runners high." Despite the prevalence of this belief, however, scientific evidence supporting the role of endorphin/exercise connection to psychological health remains, at best, inconclusive.

In humans, the effects of exercise on endorphins has been conducted using two distinct approaches: (a) measurement of plasma levels of endorphins either with or without self-report of mood changes postexercise (Carr et al., 1981; Farrell, Gates, Maksud, & Morgan, 1982; Grossman et al., 1984), and (b) manipulation of endorphin levels by the administration of naloxone, an endogenous opiate receptor blocker (Farrell et al., 1986; Haier, Quaid, & Mills, 1981; Janal, Colt, Clark, & Glusman, 1984; Markoff, Ryan, & Young, 1982).

Carr et al. (1981) investigated effects of acute and chronic exercise on levels of endorphins in a group of women during stationary cycling. Significant increase in endorphin levels were found at power outputs between 70 and 100 Watts, and training was also reported as increasing this response. This work is frequently cited in support of exercise-induced endorphin secretion, but has been criticized by several authors on methodological deficiencies (Morgan, 1985). Farrell (1985), in a review of endorphin responses to exercise, listed 11 studies in human reporting increases in post-run levels of endorphin of up to five times than of pre-run levels. … Farrell et al. (1986) investigated the effects on endorphins on postexercise tension and mood in eight males prior to 30 minutes of stationary biking and 70% of previously determined VO_{2max}. The POMS was administered pre/ and postexercise and prior to exercise subjects were given either a placebo or 50 mg of Naltrexone. Tension and mood enhancement were significantly increased for both placebo and naltrexone conditions, and this was interpreted by the authors as negating the effects of endorphins on exercise-induced mood changes.

Summary

The evidence surrounding the endorphin hypothesis is equivocal, able to rejected or accepted depending on the series of investigators that are cited (Morgan, 1985). Although tenable,

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further investigation of this hypothesis is needed with more standardized methodology to allow for study comparisons and replication.

The Distraction Hypothesis

This hypothesis proposes that it is the distraction from stressful stimuli (or taking a "time out") provided by an exercise session, rather than the exercise per se, that elicits the improved affect associated with exercise. This hypothesis was first proposed by Bahrke and Morgan (1978), who randomly assigned 75 adult males to exercise, meditation, or distraction group. The exercise group walked on a treadmill at 70% of $V0_{2max}$, the meditation group practiced Benson's relaxation response (Benson, 1975), whereas the distraction group rested quietly while seated in an easy chair in a sound-filtered room. All three groups experienced reductions in state anxiety with no differences between groups. AS later study reported similar results, but found that anxiety reductions elicited by exercise persisted for a longer time than those elicited by distraction (Raglin & Morgan, 1987). In a recent meta-analysis, Petruzzello et al. (1991) found conflicting support for this hypothesis. For state anxiety, both exercise and cognitively based distraction therapies were equally effective in reducing anxiety. However, for trait anxiety, exercise has greater anxiolitic effects. This review also reported not only that exercise-related anxiolitic benefits lasted longer postexercise than cognitively based therapies, but that the long-term effects of such effects were also greater.

Summary

These results suggest that the distraction hypothesis, although tenable, cannot be regarded as the sole reason for postexercise reductions in anxiety.

The Thermogenic Hypothesis

This hypothesis proposes that elevations in body temperature will produce therapeutic effects. Early anecdotal evidence in support of this theory comes from Scandinavian countries

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who have traditionally used sauna for its alleged health benefits. More objective evidence has reported that whole body warming techniques such as sauna or warm showers reduces somatic tension (deVries, Beckman, Huber, & Deickmeir, 1968) and self-reported state anxiety levels (Raglin & Morgan, 1985). Animal studies have reported a significant effect of whole body and direct brain warming on central and peripheral neuron activity (deVries, et al., 1968). Gamma motor activity is inversely related to hypothalamic temperature (Von Euler & Soderberg, 1957), which contributes significantly to tonic muscle activity (deVries, Wiswell, Bulbulian, & Moritani, 1981). Deep body temperature is increased in proportion to the intensity of exercise (Haight & Keatinge, 1973), and decreased muscle tension has been reported following both exercise and sauna bath (deVries et al., 1981). The anxiolitic benefits of exercise, therefore, may be due to a reduction in muscle in muscle tension secondary to an elevation in body temperature. However one of the few studies that has measured body temperature concurrently with exercise (Reeves, Levinson, Justesen, & Lubin, 1985) conflicts with theory. …

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Summary

More study designs using simultaneous measures of exercise, body temperature, and affect are needed to confirm or deny the tenability of this hypothesis

PHYSICAL ACTIVITY: NEW GUIDELINES

Prevalence of Physical Activity and Sedentary Behavior

…. Data from several countries in which national physical activity surveys have been conducted indicate that only about 15% of the adult population engage in vigorous physical exercise according to American College of Sport Medicine (ACSM) guidelines, with the percentage of adults who are sedentary ranging from 15% to 40% (Philips, Pruitt, & King, 1996). Indeed, in the United States, some of 30% of adults are reported as being sedentary (Casperson & Merritt, 1992; Merritt & Casperson, 1992).

Part of the reason for this low level activity has been attributed to a history of associating "health" with "fitness" and a misperception that exercise-mediated health benefits can only be elicited with vigorous, sustained activity that is aerobic in nature. …

From "Exercise Training–Fitness" to "Physical Activity–Health"

Data supportive the health benefits of moderate intensity activities were evident from early epidemiological studies published even earlier than the 1978 ACMS guidelines (Morris & Crawford, 1958; Morris et al., 1953; Morris, Kagan, Pattison, Gardner, & Raffle, 1966). These studies reported beneficial effects of activities such as gardening, walking the dog, and stair climbing, but such "everyday" physical activities received little attention until some 20 to 30 years later, when interest gradually spread to exercises other than fitness training (Haskell, 1994b). In 1990 (ACSM, 1990) and again in 1998 (ACSM, 1998), the ACSM updated its 1978 position statement on exercise, and although the recommendations still focused predominantly on cardiovascular fitness, its authors recognized that the quantity and quality exercise needed to obtain health-related benefits may differ from what was recommended for fitness benefits.

A major step toward promoting the concept of moderate intensity physical activity occurred in the following year when the U.S. Department of Health and Human Services published a comprehensive set of Health Promotion and Disease Prevention Objectives for the nation entitled *Healthy People 2000* (U.S. Department of Health and Human Services, 1991). Two of the eight health promotion topics identified were physical activity and fitness and mental health and mental disorders. The physical activity recommendations provided research justification for the sated objectives of reducing of cardiovascular disease via low, moderate, and vigorous physical activity in the general population. (Objectives, 1.3–1.7, pp. 97–101). The mental health recommendations included exercise as a related objective and proposed it as a potential mediator of stress-related disorders (Objectives, 6.5, pp. 214–215).

(p.647)

These general objectives laid the groundwork for more specific recommendations related to physical activity, and in February 1995 an expert panel (Pate et al., 1995)

coordinated by the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) published the following recommendation: ”Every U.S. adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week.”

This new recommendation differs from those previously published, which were based on an ”exercise training-fitness” model advocating vigorous physical exercise (ACSM, 1978, 1990, 1998). The CDC/ACSM guidelines embraces a “physical activity–health” paradigm, which uniquely incorporates moderate intensity and intermittent physical activity. Such a paradigm shift broadens the focus on health-related physical activity in four major areas.

First, the types and dose of physical activity thought to produce health benefits are more inclusive… In the physical activity–health paradigm, it is assumed that health benefits can be gained from participation in diverse types of moderate intensity physical activity. … Most of the beneficial activities reported approximately an intensity of 4 to 7 kcal*min^{-1} and includes activities such as brisk walking, house cleaning, and law/garden care….For example, a 24-week moderate intensity (6.4 km*hr^{-1}) walking program with initially sedentary women was equally effective in increasing high density lipoprotein cholesterol (HDL-c) levels when compared to an equidistant but more vigorous (8.0 km *min^{-1}) walking program (Duncan et al., 1991). This suggests that health benefits derived from physical activity may be linked to exercise volume as well as exercise intensity.

Second, a unique aspect of the new paradigm is the concept that health benefits may be gained from multiple daily sessions of physical activity, as well as from continuous daily session. … Results of different studies (DeBusk, Stenestrand, Sheehan, & Haskell, 1990; Ebisu, 1985; Morris et al., 1990; Paffenbarger et al., 1993) support the connection that health benefits associated with improved fitness and increased physical activity are also possible with short, intermittent activity.

Third, the segment of the population most likely to benefit from the paradigm is increased. The new paradigm focuses on mobilizing the large segment of the population that is sedentary to become moderately active rather encouraging the small percentage of already active people to become highly active. This is because the gain in health benefits resulting from the increase in physical activity is hypothesized to be exponentially related to initial activity level, such that sedentary people who increase their physical activity to recommended moderate levels appear to achieve the greatest gain in physical health benefits (Fig. 38.1).

Fourth, the new guidelines assume that physical activity may affect a vas array of health outcomes. It is conceivable **(p.648)** that the mechanisms underlying the relationship between physical activity and health may include those other than increased physical fitness. Indeed, because increased physical fitness may not be the causal mechanism affecting all health outcomes, the prevailing assumption that a “training” response is necessary (i.e., one that increases physical fitness) has been challenged. Health outcomes may in fact be affected by acute bouts of physical activity, repeated acute bouts of activity, chronic (i.e., training) bouts, or interactions between acute and chronic bouts (Haskell, 1994a;Rejeski, 1994). …

(p.648 cont.)

Exercise Participation and Adherence

… The new guidelines serve as more realistic goals for the sedentary adult who wishes to adopt health-related lifestyle activity. Attempting to accrue more moderate intensity physical activity throughout the day may improve adherence to both exercise and weight loss prescriptions (Jakicic, Wing, Butler, & Robertson, 1995)…. It will be important, therefore, for exercise professionals and lay public to recognize that the new recommendations complement, rather than replace previous guidelines.

The definition of "moderate activity" must also be clarified, because this is of paramount importance in the setting and achievement of goals. Although higher intensity activities are often relatively easy to recognize, "moderate intensity" activity is typically more difficult to identify, particularly given the influences of individual differences in perception of work effort. Additionally, many adults routinely engage in household chores, or take occasional walk to the corner stone, albeit at an intensity that may be more appropriately termed "light" rather than "moderate." … For example, being "too busy" is frequently cited as a barrier to being physically active (Dishman, 1990). It would indeed be a shame if busy-ness" was mistakenly interpreted as a health-related activity! The fact remains that most adults are not active enough and would benefit from an increase in physical activity (Surgeon General's Report, 1996; U.DS. Department of Health and Human Services, 1991).

Practical Applications of the New Physical Activity Guidelines

… Suggested physical activity scenarios include: a brisk 10-minute walk in the morning, at lunch time, and after work; a brisk walk to the mail box. raking leaves, and stationary cycling while reading or watching television; or general house cleaning, actively playing with children, and home gardening that requires large muscle group involvement (i.e., raking and digging rather than pruning). The accumulated duration of these activities should be gradually increased toward 30 minutes per day. The key to obtaining positive health results will be to perform these activities at an intensity that at least approximates brisk walking. Because health benefits accrue in a dose-response fashion (Fig. 38.1), adults who currently engage in vigorous activity for 20 to 30 minutes or longer should continue to do so. Furthermore, the importance of muscular strength and flexibility should also not be overlooked. A growing body of data (Haskell & Phillips, 1995; Phillips & Haskell, 1995; Province et al., 1995) indicates that maintenance and/or improvement of these two components of fitness is associated with improved daily functioning and thus critical to a healthy aging process.

Implementation of Recommendations

(p.649)

… In accordance with the approach adopted by *Healthy People 2000* (U.S. Department of Health and Human Services, 1991), the authors of the CDC/ACSM guidelines issued a "call to action" aimed at increasing the joint cooperation and involvement of public health agencies, corporations, schools, communities, and health professionals, as well as individuals and families. Examples of the types of physical activity programs that could be delivered across four hierarchical levels of intervention are illustrated in Table 38.7. Within in these levels, the utility of a developmental or life-span strategy should also be stressed, that is, one that takes account of life periods and transitions that may markedly affect physical activity behaviors (Table 38.8).

Summary

… The extensive research base underpinning the recommendations of the Surgeon General's Report on Physical Activity and Health has provided sufficient initial evidence to assert not only that physical and mental health benefits may be elicited with physical activity or exercise that is of far lower intensity than recommended by previous guidelines, but that such benefits may also be elicited by accumulating shorter bouts of physical activity or exercise throughout the day. This has resulted in what has been termed a "paradigm shift" from an "exercise training–fitness model" to a "physical activity–health paradigm." From a public health perspective, the fact that a wide range of mental and physical benefits may be elicited by commonly performed activities of daily living will bring far greater accessibility to, and

hopefully increased participation in, health-related activity for the sedentary majority of the United States. This is an exciting new prospect for practitioners and health educators alike. … **(p.650)**

However, more widespread acceptance and adoption of the new paradigm will depend on the involvement of public health agencies, educational and corporate institutions, and communities. Finally, if a lifestyle approach to health-related physical activity is to be established , it will require the development and adoption of strategies taking account of transitional life periods that may affect physical activities and behaviors.

Peter Salamon: Effects of physical exercise on anxiety, depression, and sensitivity to stress: a unifying theory. *Clinical Psychology Review,* Vol. 21, No. 1, pp. 33-61, 2001

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Preparation of this review was assisted by a grant from the UK Medical Research Council.

…..**(p.42)**

EXPLAINING EMOTIONAL EFFECTS OF EXERCISE TRAINING

…Explanation of emotional effects of exercise training should therefore be considered in which aerobic fitness does not feature. Diverse suggestions have included changes in body temperature or cerebral blood flow (Folkins & Sime, 1981), distraction from negative thoughts (Morgan, 1985, 1987), or improved retrieval of positive thoughts (Clark, Milberg, & Ross, 1983). However, it is premature to pursue such specific explanations until more general questions have been addressed.

Broadly, there are two possible types of explanation. One is that emotional benefits arise from the accumulation of acute mood improvement caused by the individual sessions of exercise. Accumulation of acute effects has been suggested by mainly anecdotal, single-case, or uncontrolled reports that have suggested that have suggested that mood deteriorates rapidly when exercise regimes are interrupted (Szabo et al., 1998, …).

(p.43) Even reduction in intensity of training has been reported to worsen mood (Wittig, McConell, Costill, & Schurr, 1992). However, a theory based entirely on acute emotional effects is implausible because, as was argued above, exercise is likely to be aversive to many people, particularly at the start of training. Moreover, one controlled report of relatively prolonged deprivation is available which suggests a more complex picture (Morris et al., 1990). This showed that, despite a relatively rapid increase in physical symptoms and feelings of being unable to cope, depression and anxiety increased only after 1-2 weeks of deprivation. The relatively long-term appearance of anxiety and depression suggests a gradual loss of a long-term effect of exercise training, and is consistent with an alternative explanation that repeated exercise recruits an enduring process which gradually improves mood. This will be pursued below.

EXERCISE TRAINING AND RESISTANCE TO STRESS

….

Cross-sectional Studies of Controlled Laboratory Stressors

…

Most negative results accrued from attempts to contrast physiological responses (typically heart rate and systolic and diastolic blood pressure) to mental arithmetic or psychomotor tasks between fit and unfit people drawn from the normal population (…). Significant contrasts have been more likely when this procedure has been modified in one of three ways. Firs, use of more subtle measurements of cardiovascular function to indicate sympathetic activity has yielded effects in some studies (…) but not all (deGeus et al., 1996). A second approach has been to contrast extreme groups finding, in response to stress, less electrodermal lability in marathon runners than sedentary subjects (Keller & Seraganian, 1984), smaller heart rate responses in very fit and very unfit undergraduates (Holmes & Roth, 1985; Light, Obrist, James, & Strogatz, 1987) and smaller increases in heart rate, diastolic blood pressure, and total peripheral resistance in athletes than in normal controls (van Doornen & de Geus, 1989). A similar comparison, but with negative results (Claytor et al., 1988) was based on very small samples (*Ns* = 8).

(p.44)

The third approach demonstrating differences between fit and unfit groups has been to select them from populations known to display greater than normal cardiovascular lability in response to psychological stress. Thus, in subjects with a family history of hypertension, being fit protected against blood pressure responses to a color-word conflict task (Holmes & Cappo, 1987; c.f. O'Brien, Hayes, & Mumby, 1998). Age may be a further moderator of the effects of fitness. In a isolated report, Hull, Young, and Ziegler (1984) found no association of fitness with smaller hemodynamic responses to stress, except in a subgroup aged over 40 years.

Experimental Studies of Controlled Laboratory Stressors

… In a recent randomized comparison, heart rate during recovery from stress was lower after exercise training (which included aerobic and anaerobic components) than a control activity (but this was merely group seminars; Calvo, Szabo, & Capafons, 1996).

Validity of Laboratory Stressors and Responses

…

(p.45)…. it has been suggested that fitness effects on cardiovascular or sympathoadrenal responses are seen preferentially in well-learned tasks rather than novel, threatening ones (Blaney, Sothmann, Raff, Hart, & Horn, 1990). A separate consideration is the ecological validity, or realism, of the stressors. A report in which exercise training did reduced blood pressure and heart rate stress responses in an unselected male group used a more life-like stressor than has been typical: losing a motor task to a female (Anshel, 1996).

The validity of cardiovascular responses which have usually been measured must also be questioned. Their predominance in the literature reflects an assumption that, because the exercise training reduces cardiovascular responses to physical stress, it should have a similar effect in psychological stress. However, this assumption is negated by the different physiological mechanisms that underlie superficially similar cardiovascular responses to physical and psychological challenge (van Doornen, de Geus, & Orlebeke, 1988). Moreover, conclusions cannot be simply generalized from laboratory stressors to ambulatory conditions (Steptoe & Vogele, 1991). Neither can cardiovacular effects be generalized to other responses—even physiological ones. The pituitary-adrenal axis has received little attention in this context, but the few studies in which cortisol or ACTH have been measured have shown no difference between fit and unfit subjects in responses to a variety of tasks (Blaney et al., 1990; Brooke & Long, 1987; Sinyor et al., 1983; Sothmann, Hart, & Horn, 1991). Furthermore, cardiovascular responses do not correlate with mood changes (Steptoe, Moses, Edwards, & Mathews, 1993). Behavioral indices of resistance to stress have been well-developed in animal experiments which focus on persistence, that is, continuing an activity that stress normally disrupts (Amshel, 1972; Gray, 1975). This approach has not been used in human studies.

Cross-sectional Studies of Responses to Real-life Stress

…

More recently, Aldana, Sutton, Jacobson, and Quirk (1996) correlated perceived life stress with low levels of physical activity, after controlling for major life change and self-ratings of physical health….,

(p.46)
There is no reason to suppose that these symptoms were an effect of stress, but other studies have confirmed that the statistical relationship of recent life event scores to illness is weaker in fit than in unfit subjects (Brown, 1991; Brown & Lawton, 1986; Roth & Holmes, 1985) or in exercisers than nonexercisers (Brow, & Siegel, 1988). Although Roth, Wiebe, Fillingim, and Shay (1989) could not replicate this, they categorized subjects according to their own subjective estimates of fitness.

Given the correlational design, this pattern of findings is open to different interpretations. An unmeasured constitutional or environmental variable might lead both to resilience and to readiness to exercise, or people who are less disturbed by stress might simply be more ready to take up exercise training. Alternatively, physical exercise training might confer protection from deleterious effects of stress. Consistent with this, Steptoe, Kimbell, et al. (1998) found that exercise was related to lower perceived stress in day-to-day, within-subjects variations, although only in a subgroup who were low in anxiety.

Experimental Studies of Real-life Stress

…

EXPLAINING EFFECTS ON STRESS RESPONSES

…

(p.47)
There is one uncontrolled report that cardiovascular responses to mental stress did not change after 1 week of exercise interruption, (Szabo & Gauvin, 1992). … Moreover, low-intensity training, which did not increase VO_2max, has more effectively reduced cardiovascular stress-responses than a high-intensity program which did improve fitness (Rogers et al., 1996).

EXERCISE TRAINING AS STRESS ADAPTATION

Divers e explanations have been proposed for one or other psychological effects of exercise training, but many have been inconsistent with understanding of the mechanisms that control emotional state or stress responses (see Dishman, 1995), or have focused on one effect only. Such a theory should accommodate key features of the evidence reviewed here:

1. exercise cam aversive. but also has positive hedonic properties, most clearly after extended training;

(p.48)

2. exercise training has antidepressive and anxiolytic effects;
2. exercise training reduces sensitivity to stress.

In setting out his theory of opponent processes, Solomon (1980) cited exercise as an instance of a class of stimuli which, upon repetition, lost their negative hedonic tone: that is, produced tolerance. This tolerance was attributed to the gradual recruitment of a counter-regulatory process which ultimately leads to a positive hedonic response to such stimuli. Although Solomon thought that the opponent process was automatically elicited, there is evidence to attribute it to classical conditioning (Schull, 1979). The limitation of Solomon's theory for present purposes is that it cannot explain how repeated exercise could change the hedonic response to stimuli other than exercise….

A few experiments have attempted to isolate effects of exertion from the stressors with which it has been confounded in such paradigms, showing that animals with extensive prior experience of running in wheel or of swimming, show reduced behavioral disruption when tested in an open field (a large open arena in which sensitivity to stress is indicated by reduced

mobility: Dishman et al., 1996; Tharp & Carson, 1975; Weber & Lee, 1968) or when tested for escape learning after uncontrollable electrical shock (Dishman, et al., 1997).
…

(p.49)

NEUROCHEMICAL CORRELATES OF EFFECTS OF EXERCISE

… Changes in several neurotransmitter systems have been casually implicated in behavioral adaptation. Review of these is beyond the scope of the present article. However, noradrenergic and opioid effects of exercise have particular implications for understanding clinical effects. Previously, each has been invoked as an explanation for psychological effects of exercise: noradrenergic systems have been suggested to subserve antidepressant effects, and opioid activation has been invoked to explain mood improvement. Rather than using neurochemical arguments in this reductionist way, the approach here is to support the emerging behavioral theory by showing parallels with, and links to, neurochemical adaptation to exercise.

Central Cateocholamine System in Exercise

In general, stressors activate brain norepinephrine system in animals and acutely deplete brain levels of norepinephrine. When stress is chronic, synthesis of norepinephrine is increased so that brain concentrations are preserved. In some theories of resistance to stress, these changes have been regarded as casual. Effects of exercise resemble those of other forms of stress…. Effects of long-term exercise training also parallel repeated exposure to other stressors. Long-term regimes of swimming (Ostman & Nyback, 1976) or running (whether compelled by a treadmill, induced by shock avoidance, or spontaneous) preserve or increase brain norepinephrine levels (Brow & van Huss, 1973; Brown et al., 1979; Dishman et al., 1997).

Opioid Mechanisms in Effects of Exercise

…

(p-50)

In the present context, the functional importance of these opioid responses arises from their inhibitory control of stress responses. Opioid antagonists increase cardiovascular stress responses to both physical and psychological challenge (Grossman & Moretti, 1986; Morris, Salmon et al., 1990), increase the intrinsically smaller stress reactivity in certain individuals (McCubbin, Kaplan, Manuck, & Adams, 1993), and reverse the effect of relaxation training to reduce blood pressure responses to psychological stress (McCubbin et al., 1996). In the central nervous system, also, catecholaminergic stress responses are under opioid inhibition (Tanaka et al., 1983). The key to the role that opioid mechanisms might play in effects of exercise is their dependence on exercise history. For instance, the plasma beta-endorphin response to exercise increases with training (Carr, et al., 1981), and there is evidence that the potentiation of opioid inhibition accounts for the reduction in cardiovascular stress responses after exercise training (McCubbin, Cheung, Montgomery, Bulbulian, & Wilson, 1992).

There are paradoxes in the view that regular exercise recruits opioid activation and the popular belief that attributes many of the effects of exercise to a release of endorphins in certainly an oversimplification. … Nevertheless, available data are consistent with a theory in which adaptive changes in opioid systems link regular exercise to reduced stress responses, particularly those controlled by noradrenergic systems.

IMPLICATIONS FOR FUTURE RESEARCH

The function of proposing that exercise is a human analogue of stress adaptation is not provide answers, but to offer a way of asking questions about effects of exercise in future that are better integrated into psychological theory than hitherto. In reality, no single theory can account for the effects of such a complex stimulus as exercise. Nevertheless, although processes such as social integration, self-mastery, and distraction will, in practice, influence the effects of exercise, the present theory leads to predictions that depend specifically on the stressfulness, or aversiveness, of exercise.

The first prediction is that the development of the positive hedonic tone of exercise, and the long-term protective effects of exercise against emotional disorders and stress, depend on its initial unpleasantness. To confirm this would contrast with the usual assumption that enjoyment of exercise is a prerequisite for adherence and psychological benefits. (Wankel, 1993). It would, for instance, have implications for the expectation that is commonly provided to novices that exercise should be pleasant from the start.

Different sets of predictions arise from the different explanations that have been offered for stress tolerance (Gray, 1982). From a counterconditioning view, it would be predicted that social or other rewards which are conventionally associated with exercise are crucial to its benefits. These would, however, unimportant according to the view that stress adaptation is essentially a function of the repetition of exercise. Although repeated exposure to uncontrollable stress achieves this more quickly (Maier & Seligman, 1976; Weiss & Glazer, 1975). **(p.51)**The particular value of exercise might therefore be that it is a controllable stressor. On this basis, to maximize clinical benefit, participants' perception of being in control of the exercise regime should be maximized. Correlated with stressor controllability is predictability and this may be the more important property for stress adaptation . Indeed, a paradigm of unpredictable stress is used as a model for sensitization to stress (Willner, 1985). On this reasoning, the routine and predictable nature of exercise would prove critical.

CONCLUSION

Claims of the emotional benefits of exercise are routed in philosophical and religious ideas that date from at least 2,500 years ago (Dishman, 1986) and evidence is now catching up with these claims. Undoubtedly, exercise provides a vehicle for many nonspecific therapeutic processes, including physiological benefits of mobilization and psychological benefits of self-mastery and social integration. Effects related specifically to exertion include anxiolytic and antidepressant action, but also resistance to physiological and emotional consequences of psychological stressors.

There is a need for greater clinical realism in evaluating emotional effects of exercise….In particular, future research should explore effects in panic anxiety and clinical depression. In addition to providing a novel approach to familiar clinical problem, exercise permits intervention in new areas. Whereas treatments in clinical psychology routinely aim to alleviate the emotional effects of stressors that have already occurred, exercise training provides a way to ameliorate effects of stressors yet to occur.

The potential value of physical exercise to the clinical psychologist derives not merely from its empirical and theoretical base, but from its popularity and face validity as a way of improving well-being. In this respect, for many individuals, it is likely to contrast with cognitive and behavioral approaches that are more common in the psychologist’s armamentarium. but appear less accessible to the general population. For instance, exercise

(p.51 cont.)
might prove to be of particular use where patients with emotional problems reject ostensibly psychological diagnoses and treatments.

Physical exercise is potentially important to clinical research also, because it may allow the experimental manipulation of resilience in a way that has, hitherto, been largely confined to the animal laboratory. Nevertheless, exercise is a complex psychobiological stimulus, which changes as its cultural significance changes. Therefore the challenge for future research is to be grounded in psychobiological theory, while also being sensitive to the social and cultural context in which exercise occurs.