The present review examined the premise that running is a useful therapeutic strategy in the treatment of depressive states. Four of the major theoretical treatment models of depression were outlined to demonstrate how each conceptualized the relationship of running to improvement in mood. Research was then examined that linked running to improvement in psychological variables other than depression. Finally, research directly pertaining to the effects of running on depression was reviewed. Discussion of conceptual and methodological problems of this research indicated that definitive conclusions regarding the antidepressant properties of running are currently unwarranted. Specific guidelines and refinements for future research were provided.

The dramatic increase in the number of individuals who engage in some type of regular physical exercise has focused attention on exercise, and running in particular, as a means of attaining improved states of physical and emotional health (Fixx, 1977). Running has been proposed as a treatment for a variety of psychological problems including insomnia (Baekeland, 1970; Walker, Floyd, Fein, Cavness, Lualhati, & Feinberg, 1978), obesity (Collingwood & Willet, 1971), anxiety (Driscoll, 1976; Morgan, 1979), and depression (Blue, 1979; Griest, Klein, Eischens, Faris, Gurman, & Morgan, 1979; Kavanaugh, Shephard, Tuck, & Qureshi, 1977).

Research examining the possible therapeutic value of a regular program of running in populations of clinically depressed individuals has been stimulated by reports of nondepressed runners who subjectively experience and report elevation of mood and enhanced alertness (Anderson, 1979; Brunner, 1969; Harris, 1973; Morgan, Roberts, & Feinerman, 1971). A major problem with these subjective reports is the inability to specifically infer a cause-effect relationship between physical activity and improvements in psychological functioning and psychopathological states (Folkins & Sime, 1981).

These subjective reports have dramatized the need for more rigorous evaluations of the relationship between physical exercise and psychopathology, and several investigators have attempted to fulfill this need (Gary & Guthrie, 1972; Griest et al., 1979). Despite such trends, however, very little methodologically sound research specifically examines the physiological and psychological effects of running on depressed individuals.

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The primary focus of this paper is a critical review of the literature that examines the relationship between running and psychopathology. First, contemporary models of depression are briefly reviewed to develop a framework for examining the role of physical activity in alleviating depression. Then the literature that links running to improvement in psychological variables other than depression is discussed. Finally, the literature dealing with the influence of running on depression is reviewed.

Models of Depression

Traditional-Dynamic Model of Depression

The first comprehensive model of depression originated in the psychoanalytic tradition (Abraham, 1955; Freud, 1950). Most early dynamic theories maintained that depression was precipitated by the real or symbolic loss of an ambivalently loved object, and represented a redirecting toward the self of hostile, aggressive impulses formerly directed against the lost object. Ego psychology approaches (Bibring, 1953; Jacobsen, 1971) constituted a further modification of orthodox dynamic models by stressing that depression occurs in the discrepant situation that arises when the ego is aware of a goal and of its inaccessibility. This results in loss of self-esteem and in the internalization of anger, which are considered cardinal features of depression.

These models provide an extensive theoretical framework that can support several different speculative notions concerning the effects of physical activity on depression. First, in the traditional Freudian sense, running may serve a cathartic function, allowing for the safe discharge of emotion and hostility and resulting in an attenuation of depressive symptomatology. As hypothetical explanations of behavior, however, catharsis notions have received virtually no experimental support (Hollon & Beck, 1979).

The orthodox and ego analytic frameworks offer a second explanation for improvements in affective state as a result of running. This view is based on the notion of displacement as an adaptive defense mechanism that creates a situation to help rechannel or deflect anger away from the self. Running may represent the substitution of a consciously or deliberately chosen form of self-discipline that replaces unconscious modes of self-punishment. Within the dynamic framework, the running process may contribute to improved mood by facilitating insight into self, and developing an awareness of personal limits and self-discipline.

Behavioral Models of Depression

Although a variety of behavioral approaches to depression exist (Hollon & Beck, 1979), the model receiving the most attention is Lewinsohn's behavioral view of depression. The basic tenet of Lewinsohn's (1974, 1975) model is that depression is due to low rates of response-contingent positive reinforcement, a situation that is thought to stem from a combination of factors in the individual's life. These factors include a lack of reinforcing events in the environment, personal characteristics that limit available reinforcers, and a lack of requisite social skills, all of which prevents the individual from behaving so as to sustain a higher rate of positive reinforcement. This model has strongly emphasized the remediation of deficits in social skills as a practical means to alleviate depression. Research support for behavioral models of depression has been extensively documented elsewhere (Blaney, 1977).
Lewinsohn's model can be utilized to explain improvements in mood following running in terms of the inherent and acquired reinforcement value this activity has for the individual. Running may serve to facilitate increases in the rate of response-contingent positive reinforcement. Furthermore, running may promote self-esteem as the individual experiences sustained reinforcement for daily physical achievements. Depending on the duration of such activity, various physical changes (i.e., improvement in muscle tone and loss of excess weight) may have additional reinforcing properties. The improvements in self-esteem and body image associated with running could also further improve mood by helping one acquire new social skills. And running itself may afford new opportunities for positive social interactions. Running may therefore lead to improved mood by increasing the number of activities the individual finds reinforcing, increasing the availability of positive reinforcement, and developing reinforceable personal characteristics and social skills.

Cognitive-Behavioral Model of Depression

Cognitive-behavioral views of depression typically have shown that changes in cognitive processes can initiate changes in behavior and correlated physiological states (Beck, 1967; Hale & Strickland, 1976; Miller & Seligman, 1973; Russell & Brandsma, 1974). The position advanced by Beck (1963, 1967, 1976) is that depression cannot be explained merely in terms of environmental contingencies, but that it instead centers upon a basic tendency to mislabel, misjudge, and distort experience. These cognitive processes can predispose individuals to negative evaluations of their role in the world, and of the future, that appear to withstand changes in environmental contingencies (Beck, 1976). Cognitive therapy for depression involves training individuals to properly test and evaluate their hypotheses about self and the world in an attempt to identify and change maladaptive belief systems and dysfunctional means of processing and interpreting environmental events (Beck, 1967).

Cognitive-behavioral models of depression can account for the positive effects of running on depression by emphasizing an interaction between changes in overt behavior and associated changes in cognitive processes. Running may serve to effectively promote a transformation or disruption of the maladaptive cognitive set a person has previously used in facing the world. The exercise activity may result in the formation of more positive internal attributions of achievement, which may then restructure the individual's hierarchy of self-perceptions and self-evaluations. This process increasingly reinforces an awareness that success and mastery are linked with goal achievement and self-competence through effortful, purposive behaviors.

Although the specific processes by which this cognitive change occurs have yet to be described, several hypotheses exist. One of these hypotheses is that the exertion and physical stress induced by running may temporarily interrupt selective attention and ruminations focusing exclusively on negative aspects of events and problems (Griest et al., 1979). Another possible explanation that bears empirical investigation is that depression may be overcome as the gradual physical conditioning achieved through running leads to increased awareness of one's physical fitness. This could serve as a model for effective self-monitoring, in which delayed rather than immediate outcomes are emphasized. The cognitive sequelae paralleling this physical process may result in changes in information processing styles that disrupt the depressogenic pattern of focusing upon the immediate negative aspects of situations.
Biochemical Models of Depression

Current biological theories of depression have focused on the contribution of selected neurotransmitter and endocrine systems in the transmission and etiology of affective illnesses (Baldessarini, 1975; Garver & Davis, 1979). Advances in neurophysiology and neurochemistry have led to the formulation of what is commonly referred to as the biogenic amine hypothesis of affective illness (Coppen, 1967, 1972; Schildkraut, 1965). According to this hypothesis, depression is due to deficits in the amount of catecholamine metabolites such as norepinephrine, dopamine, and serotonin found in crucial receptor sites in the brain. More recently, interest has developed in another class of compounds synthesized within the brain known as the endorphins, which are chemically related to the opiates and which may be responsible for enhanced mood states following exercise (Pickar, Davis, Schulz, Exstein, Wagner, Nabor, Gold, Van Kammen, Goodwin, Wyatt, Li, & Bunney, 1981; Stein & Belluzi, 1978). However, evidence that these biochemical compounds are involved in depression is largely indirect. The inconclusiveness of this evidence stems mostly from methodological limitations of research techniques, small sample sizes, and inadequate control over subject selection (Folkins & Sime, 1981; Mendels & Frazer, 1974).

Despite the limitations of the biogenic amine hypothesis, studies measuring levels of the metabolites of biogenic amines, either in the cerebrospinal fluid or urine of depressed patients, have generally found that the more seriously depressed subjects tended to excrete lower levels of amine metabolites (Goodwin & Post, 1975; Jones, Maas, & Dekirmenjian, 1975; Maas, Dekirmenjian, & Jones, 1973; Maas, Fawcett, & Dekirmenjian, 1968; Schildkraut, Keeler, & Papousek, 1973; Taube, Kirstein, & Sweeney, 1978). Several other studies have indicated that amine metabolite levels also may be related to levels of physical activity (Ebert, Post, & Goodwin, 1972; Howlett & Jenner, 1978; Post, Kotin, Goodwin, & Gordon, 1973). In both the Ebert et al. and Post et al. studies, depressed patients were exposed to periods of increased physical activity. After the activity periods, patients were found to have significant increases in amine metabolite levels. This is consistent with evidence reviewed by Ransford (1982) suggesting that exercise is associated with antidepressant effects; like other treatments for depression including electroconvulsive therapy, antidepressant medication, and REM sleep deprivation (through the resulting REM rebound), these effects are due to enhanced aminergic synaptic transmission.

To summarize, evidence exists that links depressive states with lower levels of biogenic amine metabolites. These metabolite levels also appear to be related positively to physical activity. The notion that running or other physical activity alleviates depression by instigating increased amine metabolite production and transmission rests upon inconclusive evidence, but remains a plausible hypothesis that deserves further empirical testing.

Psychological Effects of Running

Effects of Running on Anxiety and Personality Variables

The next two sections review the effects of running on psychological variables. Within these sections, research is ordered along continua of increasing experimental control and the use of clinical populations. This first section examines the results of
running programs on measures of anxiety, self-concept, body image, and other personality variables, all of which may be adversely affected in depressed individuals. The following section reviews the influence of running efforts on depression. For additional material on the effects of physical activity programs on mental health variables, see Folkins and Sime (1981).

Two studies have focused on possible changes in anxiety due to running (Hammer & Wilmore, 1973; Lion, 1978). Following a 10-week program of daily, individual, self-paced jogging/running sessions, Hammer and Wilmore (1973) assessed relationships among anxiety, personality variables, and physical fitness in high versus low fitness groups. Unfortunately, no information was given about subject recruitment and assignment to groups. At the conclusion of this uncontrolled running intervention, anxiety levels as measured by the Taylor Manifest Anxiety Scale were found to be related to overall fitness levels, but only in those individuals who showed fitness improvements. For those subjects who did not appear to benefit physiologically from running, however, anxiety levels were associated more with overt and enduring personality characteristics and attributes. These data indicate the importance of assessing change in physical fitness as a result of the running program. Only those subjects who demonstrate such physical fitness gains may show change in the target psychological variable.

Lion (1978) investigated the effect of running on anxiety by comparing three chronic psychotic halfway-house residents enrolled in a supervised running program with three control subjects in the same setting who received equal attention but did not run. Subjects were randomly assigned to groups. Exercise consisted of 1 mile of mixed running and walking three times a week for 2 months. The results indicated that the running group exhibited significantly less posttest trait anxiety as measured by the State Trait Anxiety Inventory than did the attention control group. These results must be qualified by the small sample size and the failure to bring each runner to a predetermined fitness goal. Lion (1978) invoked a multiple channel notion of anxiety, and conceptualized running as an activity that disrupts anxiety through cognitive processes. Lion suggested that the relaxation following periods of running reduced anxiety by decreasing the levels of cognitive and somatic tension, though change in these variables was not assessed.

In addition to examining anxiety and tension reduction, several studies have examined specifically the relationship between running and changes in self-concept and other personality variables. Jones and Weinhouse (1979) assigned 12 volunteer subjects to a 1-year-long running program. The subjects showed significant pre- to posttest increases in cardiovascular function as measured by a stress electrocardiogram. On the Cattell 16 Personality Factors Test, running subjects reported significant pre- to posttest improvement in assertion, intelligence, relaxation, and happiness. But the use of volunteer subjects and no experimental controls lessens the value of these findings.

In an uncontrolled study, Saipe (1978) found that running promoted positive self-concept changes in volunteer students, ages 19-25, who were enrolled in physical education classes. This research attempted to determine whether running improves physical conditioning and whether the psychological and physiological changes observed could be related to voluntary maintenance of running beyond the initial intervention period. Sixteen students participated in a 1-hour running session twice weekly for 6 weeks. At the conclusion of this program, physiological conditioning (as measured by percent body fat), heart recovery, and a 1.5-mile walk-run test was
significantly improved over baseline levels. Furthermore, a 3-month follow-up determined that only those individuals who experienced increases in both physical condition and self-concept during the original 6-week running sessions continued to run as a personal fitness program.

Gary and Guthrie (1972) administered a battery of personality scales to 36 hospitalized male alcoholic patients, ages 25-56, who were then randomly assigned to either a physical training program that involved running 1 mile each day, 5 days a week, for 4 weeks or a no-exercise control group that only participated in the routine therapeutic milieu of the hospital ward. Ten subjects in each group completed treatment. Subjects in the running group experienced a marked increase in physical fitness as well as a trend toward improved self-concept and body image.

Hilyer and Mitchell (1979) assigned 40 college students to one of three treatment conditions: a fitness training program of flexibility exercise and systematic distance running, the fitness training program plus 1 hour per week of group counseling, or a no treatment control group. Following the 10-week running program, both fitness groups made significant gains in self-concept in comparison to no-exercise controls. All subjects had previously been divided into high and low self-concept groups on the basis of pretest scores. Of those subjects who were initially low in self-concept, only those who participated in the combined physical training and counseling group reported significant positive changes in self-concept upon termination. The combined running and counseling group may have given individuals the opportunity to process the experience and feedback generated from the running program. A counseling-only group would have strengthened the conclusions drawn from this experiment, but the use of random assignment of subjects, examination of subject variables, and a control group are valuable additions to this literature.

Three of the studies presented in this section, Hammer and Wilmore (1973), Jones and Weinhouse (1979), and Saipe (1978), did not employ adequate experimental controls and so cannot support running as a positive force in modifying mental health variables. A fourth study, Lion (1978), while offering a control group, relied on exceptionally small sample sizes. Only two experiments, Gary and Guthrie (1972) and Hilyer and Mitchell (1979), used random assignment of adequate sample sizes to experimental and control groups; both studies found that exercise groups showed both physical fitness and self-concept improvements. However, the Hilyer and Mitchell study suggested that, in addition to running, counseling was needed to improve the self-concept of subjects who began the study with a relatively low self-concept.

These data lend little support to the hypothesis that running may positively affect anxiety, self-concept, and personality variables. The next section presents research that specifically addresses the relationship of running to changes in depressive states.

**Effect of Running on Depression**

This section is devoted to studies that directly examine the effects of running on measures of depression. Sharp and Reilley (1975) investigated the relationship between physical fitness and various personality traits including depression. Male college students \((N = 65)\) ages 18-23 participated in twice-weekly 45-minute aerobic running and exercise periods. At the end of the semester, fitness levels were assessed using a 12/min. run test and measures of oxygen uptake. Postprogram testing indicated that increased physical fitness was associated with lowered depression scores on the MMPI. The single group design did not include comparisons involving a nonrunning group, and since subjects were not clinically depressed, generalization to
a clinical population is not possible. Similar problems were apparent in a series of case studies reported by Blue (1979), in which significant reductions in depression were found to coincide with participation in a running program.

A study by Buffone (Note 1), which investigated psychological change associated with a combined cognitive therapy and aerobic running program for 12 moderately to severely depressed subjects, also suffered from experimental design problems. After a 4-week baseline, these subjects participated in an 8-week treatment period. Running sessions were conducted once a week in a group format. Psychological changes were recorded in pre- and posttreatment tests evaluating intensity of depression, hopelessness, and body image. Subjects monitored their moods daily, and were interviewed daily to assess their reactions to therapy.

Results from the five subjects who completed the entire study indicated no significant changes in psychological variables during baseline. A significant reduction in level of depression was found after completion of treatment. The author cited a number of confounding factors that may have been responsible for the affective improvement. These factors included therapist attention, experimenter demand and expectancy cues, and group activity interaction effects. This intervention, similar to others in this area, offers no experimental controls that would increase confidence in the ability of running programs to modify psychological states.

A clinical population of 44 coronary patients who evidenced elevated depression scores on the MMPI was followed by Kavanaugh et al. (1977) to determine the effects on mood of a 4-year program of distance running. Pre- and postprogram measures of depression revealed a significant decrease in depression. Because appropriate control groups were not included, it is possible that these positive results were not due to the rehabilitation program, but merely to the passage of time or other uncontrolled variables. Matched control groups of nonrunning coronary patients are needed in order to more reliably discuss the long-term effects of running in the psychological and medical management of recovering heart patients.

In a somewhat more adequately controlled group design, the physical and psychological effects of a semester-long running program for college students was investigated by Folkins, Lynch, and Gardner (1972). A running exercise group drawn from a jogging class was compared with a control group that participated in golf and archery classes. Sixty-two subjects in each group began the experiment, with 44 joggers and 50 control subjects completing the effort. Each group comprised equal numbers of men and women. Based on pre- to posttest changes in heart rate and average times on a 1.75-mile running test, a significant improvement in physical fitness was found for both men and women in the experimental group. Improvement in measures of self-confidence, personal adjustment, anxiety, depression, work efficiency, and sleep restfulness was attained predominantly by women in the running group. Folkins et al. (1972) concluded that the observed psychological changes were related to changes in physical fitness.

However, several major design problems cloud the Folkins et al. interpretations. First, although both the experimental and control groups were given pre- and post-intervention measures of psychological functioning, only the experimental group received the physical fitness tests. This prevents the direct comparison of changes in fitness across groups, and makes it difficult to interpret the role of physical activity in the obtained differences in psychological variables. A second problem was the failure to equate groups on psychological measures. At pretest, women in the experimental group were found to be significantly more anxious, more depressed, less
self-confident, and less well adjusted than their male treatment group counterparts and control subjects. Due to these pretest differences, the significant gains made by female subjects can be explained solely on the basis of statistical regression.

In a subsequent study, Folkins (1976) selected a clinical population of 40 firemen and policemen, ages 40 to 58 and at high risk for heart disease, and randomly assigned them to an exercise/running group or an exercise control group to determine if a relationship existed between exercise and mood state. He found that the improvements in physical fitness for the exercise group were accompanied by decreases in anxiety and depression, while no such changes were observed in controls. However, the increase in physical well-being was not associated with significant changes in measures of emotional adjustment, self-confidence, and body image.

Recently, Griest et al. (1979) presented a relatively comprehensive experiment investigating the therapeutic value of running in the treatment of depression. In a pilot study, 13 male and 15 female moderately depressed patients were randomly assigned to either running therapy, time-limited individual psychotherapy, or a time-unlimited psychotherapy group. The running therapy consisted initially of three or four sessions each week with a running therapist. This schedule of therapy contacts was gradually reduced to one session per week though subjects ran a minimum of three times per week. Conversation with the running therapist during these sessions focused on the mechanics of running; attempts to discuss depressive symptomatology were ignored. The therapist attempted to focus on the physical aspects of running, such as breathing, and awareness of stride and posture.

Six of the eight individuals who completed the 10-week running program showed improved physical fitness as measured by maximum oxygen uptake. Comparison of running therapy with the two psychotherapy groups indicated that running alone was as effective as psychotherapy in alleviating depression. However, procedural problems with this pilot study included lack of adequate supervision of the therapy processes, inexperienced therapists, and lack of comparability between groups after initial screening for depression.

To overcome some of these problems, Griest et al. (1979) formed two additional psychotherapy groups that were followed in order to compare outcomes with the original pilot study running patients. Therapy was conducted in an outpatient clinic under closer supervision with time limits strictly adhered to in the time limited therapy group. The results again showed that running was at least as effective in alleviating depression as either time limited or unlimited psychotherapy.

Griest et al. (1979) suggested that running may be conceptualized as a form of stepwise skill training that has inherent self-reinforcing capabilities. The authors viewed running as an activity consisting of comfortable, rhythmic movements of large muscle groups. Cardiovascular and skeletal muscular adaptation to this activity follows, resulting in self-reinforcing cognitive changes. They suggested that running promotes a sense of satisfaction and mastery due to the successful acquisition of a difficult skill; that running facilitates persistence and self-attributions of the capacity for personal change; and that running increases self-acceptance as a result of improvements in health and body image. Griest et al. also asserted that running can distract individuals from preoccupations with minor physical signs of depression; that running fosters generalization of newly acquired self-esteem to other endeavors; and that running becomes a source of positive reinforcement and a substitute for more negative defenses and habits.

Although Griest et al. (1979) regarded running and psychotherapy as equally ef-
ffective for treating mild depression, their findings are handicapped by experimental design problems. They employed running therapists who may have modeled cognitive strategies effective in coping with depression. These running therapists may also have reinforced subjects for nondepressed behavior. Finally, this study did not include a nonrunning exercise group to control for the exercise experience, and did not control for the social component of the physical activity.

Experiments that examine the effects of running on depression offer only minimal support for its use as a therapeutic treatment strategy. Only one study reviewed here, Folkins (1976), demonstrated that a running program increases subjects’ physical fitness and decreases depression scores when compared to a nonrunning control group. However, subjects in this experiment were not clinically depressed and no comparisons were made with other therapy modalities. The Griest et al. (1979) study employed moderately depressed subjects and indicated that running therapy was as effective as psychotherapy in reducing depression. These findings were confounded by loosely controlled therapy experiences and an active social component in the running group.

Problems such as those described above have consistently plagued research evaluating the effectiveness of running as a treatment for depression. The concluding section summarizes the state of existing research on running and depression, and offers suggestions for generating more definitive conclusions regarding the usefulness of running in treating depression.

Conclusions and Recommendations

This review examined the premise that running is a useful therapeutic tool for treating depression. The existing literature clearly suggests that running leads to improved physical fitness as shown in increased efficiency and capacity in cardiopulmonary function. Psychologically, running appears to be related to the development of a general though transient sense of well-being. However, there is little clear evidence to support running as a strategy for modifying depression or other clinical measures such as anxiety.

Research directly assessing running and depression is relatively scarce and reflects an unfortunate lack of conceptual and methodological sophistication. To identify a relationship between running and affect change requires increased procedural and experimental rigor.

Procedural Recommendations

Necessary procedural steps call for the use of clinically depressed subjects and random assignment to treatment and control conditions. The independent variable, the running program, must be thoroughly specified, and a comprehensive set of dependent measures of depression including behavioral observation should be collected. These include self and other ratings of behavior, mood and cognitive processes, physical fitness changes and, where appropriate, measures of relevant biological systems (cf. Folkins & Sime, 1981). Such comprehensive assessment should help investigators to identify whether running plays a causal role in affect change or is associated with physical, social, and cognitive processes that are instrumental in affect change. These dependent variables must also be assessed at meaningful periods after treatment (e.g., 1 year) to examine the durability of affect change.
The comprehensive specification of the dependent variable is crucial if we are to test the efficacy of running as a treatment for depression. Depression is often invoked as a unitary descriptive concept despite longstanding evidence suggesting that this is unwarranted (Akiskal & McKinney, 1975; Arieti & Bemporad, 1978; Mendels, Stern, & Frazer, 1976). This research implies that distinctive differences in etiology, maintaining conditions, behavioral manifestations, and long-term prognosis in depression do in fact exist, and that employing stringent criteria in order to isolate as much as possible a homogeneous, clinically depressed population is vital. Running as a therapeutic strategy for depression may be differentially effective depending upon the particular diagnostic subgroup of depression involved.

**Experimental Recommendations**

Given an adequate approach to the experimental paradigm, several basic questions remain. The issues of therapy outcome and therapy process discussed by Gottman and Markman (1978) build a framework for evaluating running as treatment for depression. Does running therapy return depressed individuals to nondepressed or normative levels? Is running therapy as effective as other data-based treatments for depression? And, if running therapy is effective in treating depression, what processes in the running effort lead to these changes (see Campbell & Stanley, 1963)?

Kendall and Braswell (1982) have argued that clinical interventions must demonstrate general impact, that is, the ability to bring dysfunctional individuals to functional levels. To evaluate the impact of running interventions in depression, running groups of depressed individuals must be compared to matched groups of nondepressed subjects.

Several treatments for depression have demonstrated an empirical efficacy. To prove their worth, running treatments would have to be compared under controlled conditions to other treatment modalities including Beck’s (1976) cognitive therapy for depression, Lewinsohn’s (Zeiss, Lewinsohn, & Munoz, 1979) pleasant events/social skills formulation, chemical treatments (Morris & Beck, 1974) and credible placebo groups (cf. Kazdin & Wilcoxon, 1976).

If outcome research reveals running therapy to be an effective treatment for depression, then process studies are needed to isolate the specific components of the running effort responsible for affect change. While running may put in motion a set of reciprocal processes involving an interaction among physiological changes, awareness of these physiological happenings, skill mastery, self-attribution of achievement and competence, social activities and relationships, and distraction from depression and maladaptive cognitive sets, it is conceivable that individual components or subsets of components of this model may be central in reducing depression.

Relevant control groups can be used to isolate active treatment components and test theoretical assumptions (Morgan, 1981). To evaluate psychoanalytic positions, depressed subjects can be randomly assigned to a running treatment or a nonrunning condition that produces cathartic and self-punitive experiences. Behavioral and cognitive-behavioral theories can be examined by including nonaerobic activity groups (e.g., archery) to control for the act of engaging in an activity and being distracted from the depressive state; nonrunning aerobic groups (e.g., swimming) to control for physical fitness changes and identify treatment effects specific to the act of running; physically inactive skill mastery, self-efficacy building experiences (e.g., intellectual achievement) to account for these cognitive benefits; physically inactive...
social activities (e.g., discussion groups) to control for the social component in most running experiences; and combinations of these components to identify interaction effects. Evaluation of biological theories can be accomplished by comparing running programs with nonrunning experiences that influence amine metabolites, endorphins, or other biological processes thought to influence depression. Experimental efforts across all theoretical positions require credible placebo groups and, where appropriate, waiting-list control groups.

Several other important questions and basic issues regarding the use of running to improve mood in depressed persons must eventually be addressed. These include specifying the amount of running necessary to effect changes, the frequency and duration of running programs required to produce and sustain these changes, whether cessation of running leads to return of depressive behavior and affect, and the extent to which individual differences in level of fitness interact with cognitive and affective changes.

The available experimental literature does not indicate that running plays a significant role in modulating affect change, though this conclusion is based on a small body of poorly designed research. More definitive, possibly less depressing conclusions regarding the efficacy of running as a treatment for depression must await the outcome of more extensive and sophisticated research.

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