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BETA-ENDORPHIN AND RUNNING ADDICTION: USE IN  
THE TREATMENT OF SCHIZOPHRENIA, MANIA,  
DEPRESSION, AND ANXIETY

by

James Glenn Rogers

A report submitted in partial fulfillment  
of the requirements for the degree

of

MASTER OF SCIENCE

in

Psychology

Plan B

Approved:

UTAH STATE UNIVERSITY

Logan, Utah

1985

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James Glenn Rogers



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Beta-endorphin and Running Addition: Use In  
The Treatment of Schizophrenia, Mania,  
Depression and Anxiety

Distance Running

Recent history has witnessed a resurgence in the sport of distance running. Ken Young, the director of the National Running Data Center, noted that in 1977 approximately 25,000 runners completed marathons, an increase of 40% over the 1976 figure (Slovic, 1978). The increased popularity of running is reflected in the numerous popular magazines devoted to running. One major aspect of running dealt with by these magazines is the positive benefits of running.

William Glasser (1976) surveyed runners who subscribed to Runner's World magazine. He hypothesized a "Positive Addiction (PA) state" which consisted of euphoric feelings, occasional flashes of insight, and heightened awareness of the environment in runners who could run for one hour without undue fatigue. Glasser cataloged physiological and psychological effects from running and abstinence from running.

Bortz (1982), also in Runner's World, summarized the research on the euphoric feelings and heightened awareness of runners. He indicated a possible physiological mechanism to account for the "runner's high", i.e., "PA state". Beta-endorphin, an endogenous opiate similar to morphine is

produced in the body in response to extreme physical exertion. Blood samples drawn from runners have indicated that Beta-endorphin production began shortly after running was initiated, lasted throughout the run, and ended a short time after running ceased.

In summary, increased numbers of people are engaged in distance running. According to popular literature these runners experience profound physiological and psychological effects, possibly due to Beta-endorphin.

#### Problem Statement and Questions

Neither Glasser's (1976) survey data nor popular magazine articles (which seldom cite references) have provided conclusive evidence regarding the existence of running addiction or established causality between this addiction and Beta-endorphin. An integration and summarization of research on the effects of opiates, Beta-endorphin and running will answer the following question, or indicate where evidence is insufficient and explore avenues that require further research.

Question 1: Is distance running addictive and if so, what is the role of Beta-endorphin in this addiction?

Secondly, prior reviews of research of the effects of opiates and Beta-endorphin on psychopathological illnesses will be combined with research on both running as a therapeutic tool and its impact on personality. An integration

and summary of the research in these areas will answer the following question, or indicate where evidence is not sufficient plus explore areas for additional research.

Question 2: What implications would running-produced Beta-endorphin have for therapy?

### Methods

Data was gathered on 5x8 notecards. Where possible prior reviews were utilized, though in some areas the original reports of findings were reviewed. Where discrepancies exist between prior reviews, methodological and other rationale were explored for an explanation. Notecards for data from original research, when utilized, contained; sample size, sample composition, methods, results, discussion, and conclusions.

### Definition of Terms

- Addiction: The state in which both dependence and the possibility of withdrawal exist (Randels, McCurdy, Powell, Kilpatrick, Keeler, 1974).
- Aerobic: In the presence of oxygen (Taber, 1965).
- Agonist: A drug which occupies a binding site, does have effects, and is blocked by an antagonist drug (Randels et al., 1974).
- Cross-tolerance: If tolerance to drug A applies to drug B on the first use (Randels et al., 1974).
- Dependence: If a person uses a drug and feels a need for it (Randels et al., 1974).
- Endogenous: Produced within the organism (Taber, 1965).
- Morphine: Main alkaloid found in opium...widely

- used as analgesic and sedative (Taber, 1965).
- Opiate: A drug derived from opium, which is habit forming (Taber, 1965).
- Withdrawal Symptoms: Restlessness, depression and mild disturbances in functioning of the autonomic nervous system (Taber, 1965).
- Tolerance: Need for greater amounts of a drug to cause the reaction originally obtained with a smaller dose (Randels et al., 1974).

### Addiction and Running

#### Opioids and Beta-endorphin

Research History. Bunney, Pert, Klee, Costa, Pert, and Davis (1979) and Verebey, Volavka, and Clouet (1978) reviewed the endogenous opioid research which resulted in identification of Beta-endorphin. Bunney, in Bunney et al. (1979), dates the beginnings of the research as 1973. Three independent laboratories (Pert, Pasternak, & Snyder, 1973; Simon, Heller, & Edelman, 1973; Terenius, 1973) almost simultaneously discovered the existence of specific opioid neurotransmitter sites in rat brain tissue. Hughes, Smith, Kosterlitz, Fothergill, Morgan, and Morris (1975) provided the second advance with the identification of two endogenous opioid peptides in the brains of pigs. They were named Met-enkephalin and Leu-enkephalin. Met-enkephalin (Beta-LPN, 61-65) was recognized by these investigators as an amino acid sequence of a larger peptide hormone of the anterior pituitary gland (Beta-lipotropin i.e., Beta-LPH, 1-91) identified by LI in 1964.

Goldstein (1976) was the first to find endorphins in the pituitary that also had opioid activity. Beta-endorphin, (Beta-LPH, 61-91) was isolated from the pituitary of camels by Li and Chung (1976). Li, Chung, and Doneen (1976) then isolated Beta-endorphin from human pituitary glands. Utilizing radioimmunoassay Terenius, Wahlstrom, and Johansson (1979) also found Beta-endorphin in human cerebrospinal fluid (CSF) while Wardlaw and Frantz (1979) confirmed Beta-endorphin's presence in human plasma.

Analgesia and Addiction. Endorphins have been shown to produce analgesia in rats (Bloom, Segal, Ling, & Guillemin, 1976; Graf, Ronal, Bajusz, Cseh, & Szekely, 1976. Beta-endorphin was determined to possess significant opiate agonist activity (Li et al., 1976). Loh, Tseng, Wei, and Li (1976) estimated that it was 18-33 times more potent than morphine as an analgesic.

Chronic administration of Met-enkephalin into the periaqueductal gray matter of rodent brains resulted in tolerance to enkephalin and morphine as well as naloxone (opioid antagonist) induced withdrawal symptoms (Wei & Loh, 1976). Van Ree and de Weid (1981) demonstrated cross-tolerance between Beta-endorphin and morphine as well as the similarity in the development of tolerance and physical dependence. Two studies with rats by van Ree and associates (van Ree, Dorsa, & Colpaert, 1978; van Ree, Smith, & Colpaert, 1979) demonstrated that Beta-endorphin produced abuse in rats similar to heroin abuse. Vereby et al. (1978)



states in summary that "this peptide possesses all of the characteristics of morphine-like drugs" (p. 878).

Endogenous Opiate System. Wamsley (Note 1) provided an overview of the endogenous opioid system and likely influences. He reported that Beta-endorphin and Met- and Leu-enkephalin are contained in separate neuronal systems in the brain where they act as neurotransmitters. Beta-endorphin may also be a circulating opioid and can last for a couple of hours in peripheral circulation before being destroyed. Enkephalins and endorphins are located in neuronal systems which influence nociception (pain) and behavior. Their receptors are located in regions of the brain known to influence respiration, sleep, plus affect mood, and blood pressure.

Pert, in her review of endogenous opiate systems (Bunney et al., 1979) reports that research with rats does suggest that brain opiate receptor occupancy by endogenous opiates is increased after stress and pain (Pert & Bowie, 1979; Chance, White, Krynock, & Rosecrans, 1978). Also, research with rats confirmed that the pituitary releases Beta-endorphin into the blood after acute stress and pain (Rossier, French, Rivier, Ling, Guillemin, & Bloom, 1977).

Summary. Infra-human research on opioids and Beta-endorphin confirms that Beta-endorphin is an endogenous opioid with powerful analgesic as well as addictive properties. With acute stress and pain Beta-endorphin is released from the pituitary gland into the blood and shows increased



occupation of brain opiate receptors. Beta-endorphin is located in neuronal systems which may influence pain perception and its receptors are located in brain regions which may affect mood. Beta-endorphin has been identified in human pituitary glands, cerebrospinal fluid, and blood plasma.

### Opioid Addiction and Running Addiction

Opioid Addiction. Medical literature describes the effects on humans of opiates, inclusive of its derivative morphine (Taber, 1965). Morphine effects include euphoria and analgesia. With chronic use tolerance, dependence, and addiction occur (Randels et al., 1974). Withdrawal or abstinence symptoms occur when opiates are abruptly withdrawn (Kolb, 1977). They include autonomic, central nervous (CNS), and musculo-skeletal symptoms. Autonomic symptoms include; runny nose, teary eyes, flushed face, perspiration, nausea, vomiting, diarrhea, and loss of appetite. CNS and musculo-skeletal symptoms include; bone and muscle aches, muscle spasms and twitches (Randels et al., 1974). Additional symptoms from Kolb (1977) include; restlessness, pessimism, surliness, insomnia, irritability, increased heart rate, and feelings of weakness.

Running Addiction. Chan (1981), in her review of running as an addiction, began with William Glasser's (1976) hypothesized "Positive Addictive or PA state". The "PA state" consisted of euphoric feelings (author's emphasis)...

achieved by runners who could run daily for 40 minutes to an hour without undue fatigue after approximately one year. Glasser reported the results of a survey of runners who subscribed to Runner's World magazine. He described the positive effects of running and the negative effects of abstinence from running. Glasser's list of positive benefits consisted of; a sense of well-being (author's emphasis), increased self-confidence, decreased hostility, reduced anxiety, mental alertness, increased energy, increased self-awareness, reduced heart rate, weight control, and reduced proneness to infections. Runners who abstained from running reported that they suffered from; Irritability, Insomnia, stomach upset, apathy, mental and physical sluggishness (author's emphasis), decreased self-esteem, headaches, and weight loss. Morgan (1979) also considered running as an addiction but focused on the negative aspects, stating that, "a hard-core exercise addict can't live without daily running and manifests withdrawal symptoms if deprived of exercise" (p. 57). He reported that running produced the sensation of feeling better and "exercise highs" (author's emphasis). Withdrawal symptoms included; muscle tension and soreness, Irritability, Insomnia, depression, restlessness, fatigue (author's emphasis), and anxiety. Morgan reports that he views "exercise addiction as no different than the addictive process in general" (p. 60).

Jacobs (1981) also reviewed research on running as an addiction beginning with Glasser (1976). He included several other studies which provided additional support for running addiction. Little (1979), in a study of 72 male neurotic patients, reported that 39 percent were athletic personalities whose neurosis was precipitated by the shock of a threat to their physical prowess. He further reported that "athletic neurosis" was experienced with running abstinence and was characterized by depression (author's emphasis), and anxiety. Carmack and Martens (1979), in a study of 250 males and 65 female runners, investigated commitment to running, average length of run, discomfort experienced when a run was missed, perceived addiction to running, and the states of mind which occur during the run. One result demonstrated that subjects running greater than 40 minutes per session had a higher commitment to running than those running less than 40 minutes. Jacob's (1981) found this was supportive of the subjective evaluation by Kostrubala (1976) that 40 minutes of running were required for one to experience the "feeling good" (euphoric) stage of running. Jacob reported that "those runners experiencing discomfort were in actuality evidencing withdrawal symptoms, which in turn were the classic indicators that an addictive process was in place" (p. 79).

Running and Analgesia. The reduction of pain while running has been examined in popular running literature. For example, Meisler (1984) suggested that after shorter,

hard runs (i.e. 6 miles at 85% of maximum ability) or during longer runs of 12-15 miles, runners will likely become less sensitive to pain.

Two studies provide support for the connection between Beta-endorphin, analgesia, and running. Von Knorring, Almay, Johansson, and Terenius (1978) found elevated levels of Beta-endorphin in the cerebrospinal fluid (CSF) of 45 patients with chronic pain syndrome. They concluded that patients with high endorphin levels have higher pain thresholds and pain tolerance. Janal, Colt, Clark, and Glusman (1984) tested 12 long-distance runners on thermal, ischemic, and cold pressor pain tests. They also examined mood alterations with the Visual Analogue Scale. After a 6.3 mile run at 85 percent of maximum aerobic capacity, the subjects were able to tolerate more pain and were more euphoric. They estimated that the reduced pain sensitivity was equivalent to 10 milligrams of morphine sulfate.

Running and Beta-endorphin. Wamsley (Note 1) noted that exercise can elicit the release of Beta-endorphin and that after a strenuous work-out runners had elevated circulating Beta-endorphin. The harder the work-out, the more Beta-endorphin released into the bloodstream. While these blood levels were too low to be analgesic he postulated that Beta-endorphin levels most likely relate to the hormonal control of opioids or may reflect the increased activity of opioid-containing neurons in the brain.

Recent studies provide support for Wamsley's position. Beta-endorphin does indeed increase in blood plasma after running. Farrell, Gates, Maksud, and Morgan (1982) found that 30 minute treadmill runs increased the Beta-endorphin levels 2-5 times for 6 endurance athletes. Their review indicated that; while peripheral levels probably did not reflect central nervous system levels (Rossler, et al., 1977) and intravenous infusion of Beta-endorphin did not result in behavior change (Catlin, Gorelick, Gerner, Hui, & Li, 1980), other studies have suggested that exercise may stimulate a general stress response that results in increased pituitary secretion of ACTH and Beta-endorphin into peripheral venous blood (Gulilemin, Vargo, Rossler, Minick, Ling, Rivier, Vale, & Bloom, 1977; Rossler et al, 1977). The results agree with another study which indicated exercise as a stimulus to the hypothalamic/anterior pituitary axis (Colt, Wardlow, & Frantz, 1981).

Summary. Opiate addiction, as described by medical literature does correspond to distance running addiction as reported in popular running literature and research. Opiate usage produces euphoria and analgesia as does distance running. Chronic usage of opiates and regular distance running produce dependency and tolerance while abstinence produces withdrawal symptoms. A large percentage of these symptoms appear to correspond; irritability, insomnia, stomach upset (i.e. nausea), apathy and depression (i.e. pessimism), muscle tension and soreness (i.e. spasms and

aches), restlessness, plus fatigue and physical sluggishness (i.e. feelings of weakness). The research indicates that Beta-endorphin is an endogenous opiate with analgesic and addictive properties which is secreted by the pituitary gland and released into the blood in response to the stress of running.

### Psychopathology and Running

#### Schizophrenia

Naloxone research. Emrich, Cording, Piree, Kolling, Moller, von Zerssen, and Herz (1979) and Vereby et al. (1978) reviewed research which utilized the morphine antagonist naloxone in psychotic patients. The possibility of therapeutic action of naloxone was raised by the discovery of increased levels of CSF endorphins in chronic schizophrenic patients (Terenius, Wahlstrom, & Agren, 1977). They hypothesized that increased endorphin levels by naloxone were implicated in the pathophysiology of psychoses. Gunne, Lindstrom, & Terenius, 1977) further investigated the possible antipsychotic effect of naloxone in a single-blind study of six chronic schizophrenics. They reported immediate reversal of auditory hallucinations in four patients after i.v. injection of 0.4 mg. of naloxone. Several experiments which attempted to replicate naloxone's antipsychotic action on schizophrenics have yielded negative results (Volavka, Malliya, Baig, & Perez-Cruet, 1977; Davis, Bunney, de Fraites, Kleiman, van Kammen, Post, & Wyatt, 1977). Gunne



and Terenius (1978) themselves were unable to replicate their own finding when they employed a double-blind design. Naloxone doses for this group of studies ranged between 0.4 - 10 mg. and most patients received no more than 1.2 mg. per dose (Vereby et al., 1978).

A second series of studies utilized higher naloxone doses and an extended psychological rating period. Berger, Watson, Akil, & Barchas (1979), utilized 10.0 mg. doses of naloxone and reported significant reduction of hallucinations in 11 chronic schizophrenic patients. In their study psychological ratings were extended to 4 hours, as compared to the one hour duration for previous studies (Volavka et al., 1977; Davis et al., 1977; Janowsky, Segal, Abrams, Bloom, & Guillemin, 1977). Emrich, Cording, Piree, Kolling, von Zerssen, and Herz (1977) also utilized an extended rating duration (up to 6 hours). They utilized 4.0 mg. of naloxone in a 20 subject study and reported naloxone-induced reduction in schizophrenic hallucinations. Emrich et al. (1979) replicated the study utilizing a still higher dosage of naloxone (24.8 mg.). They reported that the higher dosage was no more effective than the 4.0 mg. dosage of naloxone. They concluded that 4.0 mg. of naloxone may have a small anti-psychotic effect on schizophrenic hallucinations but is not effective as a short-acting treatment.

In summary, Vereby et al. (1978) suggests that clinical therapeutic experiments using naloxone administered intravenously are difficult to conduct and interpret. Patients

must exhibit psychopathology at the time of administration so that a therapeutic effect is observable. Those patients who show signs of psychosis practically all the time "are rather rare and in no way representative of the schizophrenic population" (p. 882). Also, intravenous injections can have a placebo effect which can distort even the placebo-controlled experiments. Studies utilizing orally administered antagonist (naltrexone) reported no therapeutic effect on schizophrenics (Mielke & Gallant, 1977; Gunne & Terenius, 1979). Vereby et al., (1978) further states that:

experiments with opiate antagonists have provided limited support for the hypothesis of endorphin excess [in schizophrenia] and no support for the hypothesis of endorphin deficiency. While the naloxone doses used in many studies was probably too low, there may be a subgroup of psychiatric patients who do have an important disturbance of the endorphin system. (p. 883).

Beta-endorphin research. Vereby et al., (1978) also reviewed Beta-endorphin research on schizophrenia. Interest in the possible role of Beta-endorphin in schizophrenia was initiated by the findings of two studies which observed that intracerebral administration of Beta-endorphin elicited rigid immobility in rats which was reversible by naloxone (Bloom et al., 1976; Segal, Browne, Arnsten, Bloom, Davis, Gullermin, & Ling, 1979).



Kline and associates (Kline & Lehmann, 1979; Kline, Li, Lehmann, Lajtha, Laski, & Cooper, 1977) have done clinical testing of Beta-endorphin. They administered single i.v. injections of Beta-endorphin (10.0 mg. maximal) on a total of 15 patients with various psychiatric diagnosis. Improvement of schizophrenic (and depressive) symptoms was reported. Verebey et al., (1978) expressed that caution should be utilized in interpreting these results. Since no active placebo was used and the first effects of Beta-endorphin (i.e. feeling of warmth and dry mouth) occurred within minutes after the injection, it is likely that patients were aware that they were receiving an active substance. Also, unstructured interviews were conducted by the authors, who knew what was administered.

In addition to the review by Verebey et al. (1978) two double-blind, placebo-controlled studies, which administered Beta-endorphin i.v. to schizophrenic patients, reported discrepant findings. Berger, Watson, Akil, Elliott, Rubin, Pfefferbaum, Davis, Burchas, & Li (1980) administered weekly injections of Beta-endorphins (20.0 mg.) to 10 male schizophrenics. They reported a statistically significant but not clinically apparent, decrease in schizophrenic symptoms utilizing the Brief Psychiatric Rating Scale (BPRS). Gerner, Catlin, Gorelick, Hul, and Li (1980) reported that 6 of 8 schizophrenic patients became more uncommunicative and withdrawn, as determined by clinical ratings and the BPRS,

following Beta-endorphin injections of 1.5 to 11.5 mg.

Summary. The inconsistent findings of naloxone and Beta-endorphin research in schizophrenia do not delineate a clear role for Beta-endorphin in the treatment of schizophrenics. It appears that Beta-endorphin (in excess) may have a limited, as yet, undefined role in the treatment of a subpopulation of schizophrenics.

### Mania and Depression

Naloxone research on mania. Judd and Janowsky (1981) and Emrich (1982) have reviewed the research on the anti-mania properties of naloxone. Two studies by Segal and colleagues originally suggested that naloxone might have antimania properties. Segal, Brown, Bloom, Guillemin, and Ling (1977) reported that low dose opioid peptides and opiates induced a naloxone-reversible behavioral activation in rats. Segal et al., (1979) also found that naloxone antagonizes a stimulant induced activation.

Two studies clinically tested naloxone on mania. Davis, Bunney, Bucksbaum, de Fraites, Duncan, Gillins, van Kammen, Kleinman, Murphy, Post, Reus, and Wyatt (1979) reported a therapeutic effect in 1 out of 4 manic patients using 10.0-30.0 mg. naloxone. Janowsky, Judd, Huey, Raitman, Parker, and Segal (1978) also reported antimanic effects in 12 manic patients with 20 mg. of naloxone.

In contrast, two studies observed no changes in manic patients with naloxone treatment. Emrich et al. (1979) treated two manics with 4.0 mg. of naloxone while Davis, Extein, Reus, Hamilton, Post, Goodwin, and Bunney (1980) utilized 20 mg. on 10 patients and found no significant changes. Emrich (1982) in summarizing his review suggests that the anti-manic effect of naloxone appears questionable.

Naloxone and Beta-endorphin research on depression.

Emrich (1982), in his review, reported the apparently minimal influence of naloxone on depression based on the findings of three studies. Emrich, et al., (1979) found a tendency towards deterioration in 3 patients with endogenous depression treated with 4.0 mg. of naloxone. Terenius, Wahlstrom, & Agren (1977), in 5 patients, observed no significant changes during a 6-12 day treatment with 0.4-0.8 mg. of naloxone. Similar findings were reported by Davis et al. (1979).

Davis, in (Bunney et al., 1979), Judd and Janowsky (1981) and Emrich (1982) reviewed the research on Beta-endorphin and depression. Kline et al. (1977), in an open study, found that 1.5-6.0 mg. of Beta-endorphin i.v. produced beneficial effects in two depressed patients. Kline and Lehman (1979) summarized their clinical testing of Beta-endorphin on 15 patients with various psychiatric diagnoses including depression. They report that acute administration of Beta-endorphin (6.0 - 10.0 mg.) produced persistent improvements in the symptoms of depression. As

reported in the schizophrenia section of this paper, Vereby et al. (1978) noted that these results required replication utilizing a double-blind design and controlling for the immediate effects of Beta-endorphin administered by injection (i.e. feeling of warmth and dry mouth).

Further research controlled for the injection effects of Beta-endorphin and utilized a double-blind design. Angst, Autenrieth, Brem, Koukkou, Meyer, Stassen, and Storck (1979) administered Beta-endorphin in a slow infusion rather than by injection. They observed a switch to hypomania/mania in 4 of 6 depressed patients with 10.0 mg. of Beta-endorphin. Two more recent studies (Gerner et al, 1980; Gorelick, Catlin, & Gerner, 1981) used a double-blind design and administered 1.5-11.5 mg. of Beta-endorphin by infusions. They found antidepressive effects for 8 of 10 depressed patients as measured by the BPRS. Gorelick et al., (1981) additionally found that 2 depressed subjects later responded at higher doses. This finding could indicate that there "may be a dose threshold for response to Beta-endorphin." (p. 241). Emrich (1982), in his review, concluded that there is evidence that Beta-endorphin has curative effects in depression.

Summary. Conflicted findings on the antimanic effect of the antagonist naloxone have established no clear pattern for its therapeutic use in manic patients. Research with naloxone on the treatment of depressed patients has yielded either slight deterioration or no change. Beta-endorphin

treatment, by slow infusion, has demonstrated a clear therapeutic effect on depressive patients.

### Pain

Chronic pain. Davis, in Bunney et al. (1979), and Terenius (1981) provided reviews of the research on Beta-endorphin and pain. Bushsbaum, Davis, and Bunney (1977) reported that naloxone caused measurable, but clinically insignificant, hyperanalgesia in normal subjects. Another study, utilizing normal subjects, observed an increase in reported acute post-surgical dental pain with naloxone administration (Levine, Gordon, Jones, & Fields, 1978). Research by Almay and associates (Almay, Johansson, von Knorring, Sedvall, & Terenius, 1980) reported that patients with organic pain have significantly lower endorphin levels than patients with pain of psychogenic origin. Further support for the role of Beta-endorphin in pain was found in two studies which reported that intraventricular and intravenous administration produced pain relief in patients suffering from chronic intractable pain (Catlin, Hui, & Loh, 1977; Hosobuchi & Li, 1978).

Migraines. Terenius (1981) reviewed the research on endorphins and migraine pain. Sicuteri, del Bianco, & Anselmi (1979), from a study of the effects of morphine withdrawal on serotonin and dopamine, noted a similarity between a classic migraine attack and the morphine abstinence syndrome. They concluded that migraines may be caused

by disturbances in the endogenous analgesic mechanism. Additional support is contributed by a study which measured endorphin levels in CSF of 7 male and female headache patients (Sicuteri, Anselmi, Curradi, Michelacci, & Sassi, 1978). They found lower endorphin levels in the presence of headache pain and elevated levels (3-4 times) in the absence of pain. Sicuteri, Anselmi, and del Bianco (1978) proposed that migraine pain depends on the variation in endorphin activity and that the attack is precipitated by a sudden drop in endorphin activity. Terenius (1981) concluded that this hypothesis for a mechanism of migraine should be possible to test experimentally.

Summary. Chronic pain and Beta-endorphin research to date has indicated that Beta-endorphin does provide relief for chronic pain. Further research utilizing Beta-endorphin specifically has not been done. Research does suggest that an increase in Beta-endorphin levels might be therapeutic for migraine pain.

#### Stress/Anxiety

Animal research. As noted by Naber, Bullinger, Zahn, Johnson, Huhtaniemi, Pickar, Cohen, and Bunney (1981), animal studies have indicated a stress-induced increase of Beta-endorphin secretion (Rossier et al., 1977; Guillemin et al., 1977). An additional study, using rats, found that plasma Beta-endorphin levels vary in response to different



physical stressors and may reflect the degree of stress experienced (Mueller, 1981).

Human research. The effect of Beta-endorphin on stress in humans has not yet been demonstrated to date (Naber et al., 1981). Naber et al. (1981) investigated the effects of three stressors, (an attentional, a cognitive and a physical task) on Beta-endorphin blood levels and opioid activity in relationship to psychophysiological and psychological variables. From this study of 12 subjects they concluded that neuroendocrine response parallels psychophysical arousal and is dependent on stressor quality as well as individual personality differences. They also reported that neither Beta-endorphin levels nor opioid activity showed a significant stress effect. The authors question whether the endorphinergic systems were susceptible to the emotional or slight physical stressors utilized in this study.

In summation, there is animal research indicating that Beta-endorphin secretion increases in response to stress but there is minimal and non-supportive human research on this hypothesis. Further research is required and as suggested by Naber et al. (1981) more stressful situations may yield marked changes.

### Running Therapy

Depression. The reviews by Jacobs (1981), Wieman (1980), and Sacks and Sacks (1981) were used to examine the

research regarding running as a treatment for depression. Morgan, Roberts, Brand, and Feinerman (1970) researched the psychological effects of chronic physical activity on 67 male subjects. They compared adult males participating in exercise programs with a sedentary control group. While they found that exercise did not significantly reduce depression scores for the entire treatment group, 11 depressed subjects showed significant improvement.

Two correlation studies support the idea that depression changes as a result of physical fitness (Folkins, Lynch, & Gardner, 1972; Kavanaugh, Shepard, Tuck, & Qureshi, 1975). Folkins et al. (1972), in a study of students in jogging classes compared to golf and archery classes, reported that for women joggers an improvement in depression scores correlated significantly with increased physical fitness. Kavanaugh et al. (1985) studied male, depressed, postcoronary patients. Subjects who complied with the exercise-based rehabilitation program demonstrated a significant improvement in their depression scores. Subjects who did not comply at least 60 percent of the time showed no significant change in depression. Folkins (1976), using subjects identified as high risk for coronary disease, found that a 12-week exercise program significantly improved depression scores. A study which compared the effects on depression in a variety of exercise groups with a non-exercising control group reported that; all exercise groups (with the exception of softball) showed some reduction in



depression and that jogging reported the greatest decrease while the control group showed no reduction (Brown, Ramirez, & Taub, 1978). Wieman (1980) in a study which attempted to account for the reduction in depression associated with running found that joggers reduced their depression more than racketball players.

Running as an actual treatment for depression has been examined in a series of studies by Griest and associates (Sacks and Sacks, 1981). In a pilot study of 28 depressed male and female patients, Griest, Klein, Eischens, and Faris (1978), reported that running as a treatment was as effective in alleviating depressive symptoms as either 10 weeks of time-limited or time-unlimited psychotherapy. A subsequent study by Griest et al. (1978), which utilized a higher criteria for depressive symptoms, found greater levels of improvement for the running and time-limited (12 weeks) treatment groups than the time-unlimited treatment group. Griest, Eischens, Klein, and Linn (Sacks and Sacks, 1981), in two studies which were plagued by high drop out rates, treated a total of 60 subjects. They reported that group running reduced depressive symptomology, while group meditation and group psychotherapy failed to significantly reduce depression. A study by Doyne (1981) on clinical depression in 4 women patients found greater decreases in depression during the aerobic exercise phase than during the attention-placebo phase. She concluded that aerobic

exercise was an effective and active treatment for clinically depressed women.

Colt, Dunner, Hall, and Fieve (Sacks and Sacks, 1981), reported that 22 female runners had a higher prevalence of affective disorder than norms. In male runners the prevalence of affective disorders was non-significant as compared to male controls but in the same direction as female runners.

In summary, research on running as a treatment for depression has supported the therapeutic effect of running for both male and female depressives. This therapeutic effect appears to be as powerful as psychotherapy in the treatment of depression. Limited evidence has indicated that runners (especially female runners) are also more likely to have an affective disorder.

Anxiety/Stress. Three reviews were utilized to examine the research on running as a treatment for anxiety (Jones, 1981; Jacobs, 1981; Sacks and Sacks, 1981). A primary investigator in the relationship between acute physical exercise and tension/anxiety reduction has been W. P. Morgan. An early study by Morgan, Roberts, and Feinerman (1970), tested the effects on anxiety of treadmill walking (one mile at 3.5 mph) for 36 male subjects. The results indicated no significant difference in anxiety between the three groups; 3.5 mps/zero percent grade, 3.5 mph/five percent grade, and a control group which rested. The authors proposed that the exercise was not vigorous enough

to demonstrate an effect and the IPAT Anxiety Battery was not sensitive enough to detect the changes incurred by the treatments.

Further research which utilized more intensive physical exertion and other anxiety measures reported results which are in contrast to Morgan et al. (1970). Research by Folkins et al. (1972) compared two groups of students for one school semester. Post-test anxiety was decreased for the intense sport activity group but not the light recreation group. A later study by Morgan (1973) found a decrease in state anxiety 20-30 minutes after a 45-minute, vigorous physical workout as compared to pre and immediately post measures. These findings were replicated by Morgan (1973) in a second study of 15 male subjects. The anxiety measure, the State-Trait Anxiety Inventory (STAI), was completed before, five minutes after, and 20-30 minutes after a vigorous run of 15 minutes duration. Significant decreases in anxiety were reported for both post-exercise tests.

Morgan and Horstman (1976) in a series of studies, investigated 177 adult males and 38 adult females. Subjects were required to expend 80 percent of their aerobic power and anxiety was measured by a modified form of the STAI.

In the first four experiments, state anxiety was found to consistently decrease 20 to 30 minutes following the exercise. [In the latter experiments it was found that] state anxiety increased during

the early exercise; reached an asymptote about halfway through the exercise, and then decreased rapidly following exercise. (p. 62).

Bahrke and Morgan In Sacks and Sacks (1981), reported that for regular exercisers acute physical activity reduced state anxiety while meditation and quiet rest did not.

Jones (1981) Investigated the effects of aerobic exercise; anaerobic exercise, and meditation on stress for 85 college students. Subjects were administered the STAI, the Cognitive Somatic Anxiety Questionnaire and The Physical Symptoms Checklist before and after the semester. Subjects in the aerobic exercise group showed significant decreases in both somatic and cognitive anxiety while anaerobic group subjects decreased only in somatic anxiety. The aerobic group reported a decrease in trait anxiety while the anaerobic group increased in state anxiety. No significant changes were reported on the physical symptoms checklist for either of the exercise groups. The results of this study indicated that aerobic exercise reduced trait, somatic, and cognitive anxiety.

Running as a specific treatment for anxiety reduction was investigated in two studies. Lion (1978) administered the STAI to six psychiatric patients before and after a two-month program of running/walking one mile for three times per week. The results demonstrated a significant decrease in anxiety for the treatment group. Dienstbier, Crabbe, Johnson, Thorland, Jorgensen, Sadar, and LaVelle

(Sacks and Sacks, 1981) studied the effects of moderate and marathon running on stress tolerance. They reported that both moderate and marathon running reduced anxiety and positively influenced tolerance for subsequently introduced stress for the 23 subject runners.

Summary. Research on vigorous physical exercise and running have indicated that state anxiety, for both males and females, is decreased following as little as 15 minutes of exercise. Regular vigorous aerobic exercise as indicated by one study, may also result in decreased trait, somatic, and cognitive anxiety. Regular running at both moderate and marathon levels has been reported to increase stress tolerance.

#### Personality Change and Running

Introversion and emotional stability. Three author's reviews of the research on distance running in relation to personality were examined (Chan, 1981; Nakagawa, 1981; Jacobs, 1981). Two of these studies (Chan, 1981; Jacobs, 1981) concluded that distance runners, as a group, tend more toward introversion. Clitstone and Kostrubala (1977), using the Myers-Brigg Type Indicator, reported an extrovert-introvert ratio of 1:1 in 100 marathoners. This ratio differs from the 3:1 extrovert-introvert distribution found in the general population of the United States (Chan, 1981). Jacobs (1981), in his conclusion, suggested that it is possible for individuals to shift along the continuum of

extroversion-introversion as a direct consequence of their involvement in running. Chan (1981) differs in her conclusion, and suggests that "running does not alter an individual's personality structure; rather, certain individuals who possess traits adaptable to the sport of running seem attracted to it" (p. 38). Nakagawa (1981) did not review the more recent studies on introversion. Based on Morgan and Costill's (1972) non-significant findings, Nakagawa reports that distance runners are within normal limits for adults in introversion.

Both Chan (1981) and Nakagawa (1981) concluded that distance runners were characterized by somewhat greater emotional stability (i.e. did not evidence neuroticism). Jacob's (1981) review on self-concept and distance running did not contain research relevant to emotional stability.

In summary, the research on distance running and personality change appears to confirm that distance runners tend to be more introverted as well as more emotionally stable than the general population. Research is conflicted and minimal regarding personality change produced by running.

### Conclusions

#### Addiction and Running

A synthesis of the research on opiates, Beta-endorphin, and running provides an answer to:

Question 1: Is distance running addictive and if



so, what is the role of Beta-endorphin in this addiction?

Research indicates that the properties of the endogenous opiate Beta-endorphin correspond to those of other opioids. Usage produces euphoria and analgesia, while chronic use results in dependence and tolerance. Abstinence results in withdrawal symptomology which include; irritability, insomnia, nausea, apathy/depression, muscle tension/soreness, restlessness, and fatigue. It appears that Beta-endorphin is secreted by the pituitary gland and it is produced in response to the stress of running.

#### Psychopathology and Running

An integration and summary of the research on naloxone and Beta-endorphin in psychopathology, use of running as therapy, and the personalities of runners provides the information to answer:

Question 2: What implications would running produced Beta-endorphin have for therapy?

Four areas of psychopathology were examined for possible effects of Beta-endorphin. In schizophrenia the research indicates that there may be a subpopulation of schizophrenics who have an excess of Beta-endorphins which is reversible by naloxone treatment. The research on mania and depression report conflicted findings for the antimanic effect of naloxone but indicate a clear therapeutic effect for Beta-endorphin on depression. Beta-endorphin produces

pain relief in chronic pain and may possibly be therapeutic in migraine pain. There is minimal and non-supportive research on the effect of Beta-endorphin on stress/anxiety in humans, though animal research indicates that secretion does increase in response to stress.

Running as therapy has been explored in connection with the treatment of depression and stress/anxiety reduction. There appears to be support for the therapeutic effect of running on depression and state anxiety.

Evidence regarding the potential for personality change from running is contradictory and inconclusive but the research does report that runners tend to be more introverted and emotionally stable than the general population.

#### Discussion

A major concern of this paper was to provide information for the practitioner. Toward this end research data was gathered and combined from such diverse research areas as; animal and human physiology, addiction, psychopathology, and personality, as well as, popular running literature. Of primary import for the practitioner is that running as an adjunct or even an alternative treatment to psychotherapy for depression appears to have foundation. Some runners may utilize running as a means of self-medication for their depression. It is possible that runners may self-treat their anxiety in a similar fashion. Running therapy for the treatment of anxiety does seem to have some basis.



According to popular literature, the threshold of running addiction is approximately 40 minutes of running per day, pursued for a period of one year. In view of; the relative accessibility of this addiction, the popularity of running, plus its impact on depression and anxiety, the probability is high that the practitioner will deal with running, in some aspect, in a patient. A practitioner might treat a depressive or anxiety prone runner or possibly an addicted runner suffering the withdrawal symptoms from running abstinence. Recognition of the psychological effects of running and physiological etiology of running addiction would aid in the diagnosis and treatment of runners. The practitioner also may treat the negatively addicted runner whose "need to" run has adversely impacted his social environment, mental and/or physical health. It is even possible that in the future, specific dosages of running or Beta-endorphin may be prescribed for depression and anxiety.

#### Future Research

The second major consideration of this paper was to develop a foundation of knowledge from which to extrapolate areas for future research.

Specific recommendations for future research arose from the area of physiology. To date, the closest approach to measurement of Central Nervous System Beta-endorphin activity is by analysis of concentrations in Cerebrospinal fluid.

Repeated sampling is difficult to justify ethically (Terenius, 1981). Beta-endorphin is produced in the pituitary, outside of the blood-brain barrier. What then is the relationship between blood Beta-endorphin levels, which are too low to account for physiologic effects, and pituitary Beta-endorphin (Wamsley, Note 1).

Pert in Bunney et al. (1979) noted that causality between analgesia and Beta-endorphin would require a demonstration that Beta-endorphin is released in those brain regions that mediate analgesia during the analgesic manipulation. Bunney et al. (1979) concluded that the lack of understanding of the mechanism of addiction remains a major unsolved problem. Other questions remain unanswered, such as; what Beta-endorphin dosage and how much usage is necessary to produce and maintain addiction as well as what amount of Beta-endorphin is produced by various degrees of running.

The research on running and treatment point toward more areas of future research in depression and anxiety. While distance running is therapeutic for depression, this gives rise to additional questions such as; how much running is required to produce a therapeutic result, is there a dose-response curve for Beta-endorphin, how does a practitioner involve a depressed patient in running, and does running actually prevent depression. In anxiety/stress research, is the apparent non-support of human research with Beta-endorphin due to the use of slight emotional or

physical stressors (Naber et al., 1981). The apparent conflict between research on human anxiety, animal research and running as a treatment for anxiety awaits an explanation. A final factor in the research on the running treatment of both depression and anxiety is the ethical considerations inherent in the utilization of an addictive drug on human subjects.

Finally, current research has not clearly demonstrated a one-to one correspondence between opiate and running addiction withdrawal. Research in this area may prove difficult. An indication of this difficulty occurs in a study by Baekeland (1970) in which regular runners refused to be deprived of their exercise despite monetary rewards offered for participation in the study. Even if runners were to voluntarily abstain from running or were unable to run, they could constitute a biased sample.

The possibilities for future research extend beyond those enumerated in this section and beyond even the scope of this paper. It remains to be known what the complete ramifications of the dramatic rise in the popularity of running has upon the physiology and psychology of those who run.

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