THE PSYCHOLOGICAL EFFECTS OF AN ELECTRICAL STIMULATION WALKING PROGRAM FOR PERSONS WITH PARAPLEGIA

by

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Abstract

The purpose of this study was to determine whether persons with spinal cord injury who participate in an ambulation training program, using electrical stimulation, experience changes in the psychological variables of physical self-concept, depression, self-efficacy and mood states.

Participants were 12 men and 3 women of mean age 28.4 (SD=6.6) and mean duration of injury 4.03 years (SD=3.14) with spinal cord injury between T4 and T11. Treatment consisted of ambulation training 3 times weekly for 12 weeks. Prior to the first session participants were assessed on the above measures using the Tennessee Self-Concept Scale (TSCS), the Beck Depression Inventory (BDI), the Self-Efficacy Scale (SES) and the Profile of Mood States (POMS). They were reassessed at posttreatment. Also at posttreatment participants were interviewed to document their subjective reactions to the training program.

Repeated measures analysis of variance indicated that changes on the TSCS and the BDI occurred in the expected direction and the changes were statistically significant. The change on the POMS was not statistically significant. Unexpectedly scores on the SES changed opposite to the expected direction and the change was statistically significant. Content analysis was performed on the interview data and responses occurring three times of greater were reported.

The results from both the objective and the subjective data are discussed as are the implications for future research and practice.

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Introduction

The psychological effects of exercise in the general population have been much debated and studied in recent years. There is now a growing interest in effects of exercise in special populations. One area where research is notably lacking is the disabled population. Exercise plays a vital role in the maintenance of physical functioning and quality of life in this population, yet outside of traditional hospital and rehabilitation settings, suitably adapted exercise programs are often lacking. Research suggests that in the general population exercise may have a positive effect on psychological health, particularly in improving self-concept and self-efficacy, and in moderating or alleviating symptoms of depression and anxiety (e.g., Martinsen, Hoffart, & Solberg, 1989; McCann & Holmes, 1984; Short, DeCarlo, Steffer, & Pavlain, 1984). It would be logical to suppose that these same effects might be found in persons with disabilities. However, there is a very limited body of research dealing with the effects of exercise in this population (e.g., Horvat, French, & Henschen, 1986; Valliant, Bezzubyk, Daley, & Asu, 1985). In addition, the general mental health status of persons with disabilities has not been well documented.

The purpose of the present study was to examine the psychological effects of exercise in a population of adults with a specific disability. The population studied was adults with spinal cord injury, specifically traumatic onset paraplegia.

Paraplegia results when injury occurs below the cervical level of the spinal cord in the thoracic or lumbar regions.
The lower but not the upper extremities are affected in paraplegia. The type of exercise undertaken was a computerised electrically stimulated walking program that allows persons with paraplegia to stand and walk for short distances. The device was developed by a company called Sigmedics, based in Chicago. It has received FDA approval and is now being marketed throughout the United States and Europe. The system uses surface electrodes placed on muscles in the legs and hips with the sequencing controlled via a battery-operated computer unit. This unit is connected into a walker that has switches on the handles which allows the person to activate the necessary muscles in the desired sequence. (See Appendix A for further description of the device.) The level of performance achieved with the device varies widely between individuals. The most successful walkers may be able to use it in a functional way, for example around their house or at the office. It is also possible to use it for activities such as going out to a movie or restaurant. Other individuals may be more limited and will use it mainly as an exercise device in a controlled setting. The speed of walking is slow, the average person takes 6 to 8 minutes to walk 150 feet. The energy cost of this type of exercise is high and it provides an intense workout, often in the range of 80-90% of maximum heart rate. Health related benefits derived from this type of exercise are currently being investigated and may include increases in

muscle mass in the legs, improvement in circulation and increases in cardiovascular fitness.

Spinal cord injuries (SCI) affect people in the prime of life, generally between 18 and 35 years of age. Eighty percent are male and they were often athletically active individuals prior to their injury. With advances in management of medical problems subsequent to the injury, persons with SCI now have an almost normal life expectancy and quality of life has become an important issue. An exercise program such as the one under investigation may have significant physical and psychological benefits. In contrast to other commonly available forms of exercise, this is one of the few activities that allows the spinal cord injured person to leave their chair and this may have a powerful psychological effect in restoring a sense of normalcy to the individual, even if the activity is only of short duration and they must return to the chair afterwards. The aim of this study was to examine these psychological effects to determine the utility of such a program in the promotion of mental health. Specifically the study examined whether the exercise program resulted in improved scores on the Physical Self subscale of the Tennessee Self-Concept Scale (Roid & Fitts, 1988), the Beck Depression Inventory (Beck, Rush, Shaw & Emery, 1979), the Profile of Mood States (McNair, Lorr, & Droppleman, 1971), and the Self-Efficacy Scale (Sherer, Maddox, Mercandante, Prentice-Dunn, Jacobs, & Rogers, 1982).

Review of Literature

In the following sections the literature concerning the psychological effects of exercise is reviewed. As there is such a lack of experimental research in the disabled population, I first examine the literature concerning the effects of exercise on self-esteem and depression in the general population. These are two of the major variables to be examined in the current study. The studies relating to disability and exercise are mainly correlational in nature and often make comparisons between athletically active and inactive persons with disabilities. Only one study was located that used an exercise intervention for persons with disabilities. This study examined changes in self-concept following stationary bicycle training in a small group of persons with hemiplegia. Hemiplegia refers to paralysis affecting one side of the body and usually occurs following a stroke.

Limitations of the Data Base

It should be noted from the outset that this is an area of research that has been fraught with methodological difficulties. John Hughes (1984) undertook a comprehensive review of the literature dealing with the psychological effects of aerobic exercise. He identified over 1000 articles and of these only 12 met his criteria for experimental design! In the studies reviewed he found three consistent deficits--poor choice of measures of psychological constructs, experimenter/subject biases, and inadequate description of methods. More recent research has attempted to address some of these problems and there has been an increase in the number of randomized, controlled studies. One trend that became apparent was that there needed to be a deficit in the variable being studied in order for any change to be seen to take place as a result of exercise.

Self-Concept and Exercise

Considerable attention has been devoted to the effect of exercise on self-concept. (This term is used interchangeably with self-esteem in the literature.) Sonstroem and Morgan (1989) have developed a model that seeks to explain the pathway through which changes in self-esteem and possibly depression may occur. Although this was not an empirical study, several subsequent studies have used the model to carry out experimental research, therefore it is reported here. It may also provide a framework for understanding how psychological changes may take place in the group with SCI being studied. Sonstroem and Morgan developed their model in response to what they viewed as simplistic self-esteem theory in relation to exercise and the lack of new theory emerging from current studies. Their model contains "self-esteem components theoretically arranged indicative of progressive influence by exercise participation." (p.329)

At the base of the model is "physical self-efficacy." Self-conceptions at this level should be the most accurate and the most readily influenced by environmental interaction. Increases in physical self-efficacy in relation to exercise would in turn bring about changes at the next level which is "physical competence"--defined as a general evaluation of the self as possessing physical fitness. Increases in physical competence in turn lead to changes in "physical acceptance"--defined as the degree of satisfaction with various parts and processes of the body. Satisfaction with the body has repeatedly demonstrated strong empirical relationship with general self-regard. These two constructs in turn influence overall self-esteem. The authors comment that:

> The model appears to possess particular utility for studying the rehabilitation of the physically impaired. It is capable of assessing the manner and stages by which physical therapy activities impact on global self-esteem via the mediating processes of physical self-efficacy and physical competence development. (p.335)

Sonstroem, Harlow, Gemma, and Osborne (1991) undertook a study to test their model. Participants were 145 adults in the maintenance phase of a cardiac rehabilitation program. They completed measurement scales of self-esteem, physical competence, and self-efficacy and were fitness tested on a bike ergometer. The authors performed complex statistical procedures (structural modelling analysis) to test the fit of their model. They report that "this study provided support for the discrete levels of competence self-perceptions, their measurement and their association as proposed by the Exercise and Self-Esteem Model." (p.359)

Caruso and Gill (1992) also used Sonstroem's model as a basis for their study. They measured the effects of a weight-training program and aerobic training program on self-perceptions, global self-esteem, and body satisfaction in college-aged women. The study used a non-random design. Thirty-four women volunteered from physical education activity classes--13 weight-training, 15 aerobic, and 6 controls. Strength and physical work capacity were measured pre- and postexercise. Participants exercised three times a week for 10 weeks. The control group did fencing, volleyball, and bowling. Results supported the hypothesis that physical self-perceptions and fitness are enhanced by participation in an exercise program. Correlations among the various measures revealed that physical self-perceptions are significantly related to overall physical self-worth and to more general constructs such as global self-esteem.

The only study that examined exercise mediated changes in self-concept in persons with disabilities was undertaken by Brinkmann and Hoskins in 1979. Participants had various levels of hemiparesis following a stroke. All had completed acute phase rehabilitation. Seven volunteers entered the study and six completed. Each rode a stationary bike at 70% of age predicted maximum heart rate, three times weekly for 30 minutes. Fitness testing was performed on the bicycle ergometer. Self-concept was measured using the Tennessee Self-Concept Scale (TSCS). The normative group was 626 normals. Initial testing revealed that all participants were deconditioned and self-concept scores reflected a devaluation of the self as compared to normals. They scored significantly lower on four of the subscales--Total P, a measure of overall self-esteem, Identity Score, Physical Self, and Personal Self. Posttraining scores for these measures showed significant improvement and approached more normal levels. There was also a significant improvement in aerobic capacity. However, the Physical Self scores still remained significantly lower than normal. The authors hypothesised that the change in self-concept was brought about by the volunteers participating in what they believed to be a positive action program with highly desirable outcomes and goals. This study has been discussed in some detail due to its potential application to the population of people with spinal cord injury.

Doyne, Ossip-Klein, Bowman, Osborn, McDougall-Wilson,& Neimeyer,(1987) measured the effect of exercise on depression. Their group published a separate study using the same group of depressed women but evaluated the effect of exercise on self-concept (Ossip-Klein, Doyne, Bowman, Osborn, McDougall-Wilson & Neimeyer, 1989). Thirty-two women were randomly assigned to either aerobic exercise or weight-lifting groups. Both groups demonstrated a significant increase in self-concept as compared to controls and there was no difference between groups. A follow-up study revealed that the changes were sustained over 1 year. Given the changes in the weight-lifting (non-aerobic) group, this study points again to the possibility of graded mastery and self-efficacy changes as being responsible for the changes in self-concept, rather than simply an aerobic effect.

Short, DiCarlo, Steffer, and Pavlain (1984) studied the changes in self-concept with exercise in a group of obese men. Participants were 45 police officers all 20-50% above ideal body weight. The study was designed to test if self-concept and physical fitness increase in individuals matched for diet but exposed to instructional classes only or classes plus physical conditioning. The exercise group completed walk/jog activities at 80% of maximum heart rate, 45 minutes, three times weekly for 8 weeks. Self-concept was measured using the TSCS. Both groups showed an increase in aerobic capacity but the exercise group increased significantly more than the controls. Both groups made significant gains on the Physical Self subscale of the TSCS and the exercise group also had significant increases on the Personal Self and Self-Satisfaction subscales. Interestingly both groups scored 1 standard deviation below the mean for normative groups on Physical Self subscale and although their scores increased they were still below the mean at posttest.

Depression and Exercise

One of the most widely studied psychological variables in the exercise literature is depression. It should be noted that most of the following studies are dealing with persons who have been diagnosed as being depressed. Several of the following studies examined the effects of aerobic exercise only, others have compared it with strengthening programs. McCann and Holmes (1984) undertook one of the first controlled studies of the influence of aerobic exercise on depression. Subjects were 43 female psychology students with scores greater than 11 on the Beck Depression Inventory (BDI) (Beck et al., 1979). Participants were randomly assigned to aerobic exercise, relaxation training (the placebo condition), or no treatment. In order to control expectancies, participants were led to believe that the experiment involved learning how to deal with stress. All completed a 12-minute walk-run test and the BDI at pre- and posttraining. At the outset, an ANOVA on the depression scores revealed no difference between groups. At posttreatment, all groups had a significant reduction in depression scores. (The authors comment that this points to the need for a control group in these type of studies.) Volunteers in the aerobic group had a 10% increase in aerobic capacity. Statistical analysis of covariance demonstrated that the aerobic exercise group had reliably lower depression scores than did those in the other two groups.

Martinsen, Medlus, and Sandvik (1985) studied 43 male and female inpatients hospitalised with DSM 111 criteria for major depression. For 33 of the patients the episode of depression had been ongoing for greater than 6 months. All the patients were receiving individual psychotherapy and occupational therapy and 23 were on tricyclic antidepressants. Prior to commencing the study, participants completed a submaximal VO2 test (a measure of aerobic conditioning) on a bicycle ergometer, this was repeated at the end of the study. Depression was measured using the BDI at start, 3, 6, and 9 weeks. Participants exercised for 1 hour three times weekly at 50-70% of maximal aerobic capacity. The control group attended extra Occupational Therapy during the exercise time. Results showed that the volunteers in the exercise group had a significant increase in aerobic capacity and a significant decrease in depression scores as compared to the control group, although depression scores did decrease in the control group also. Further analysis revealed that the decrease in depression score was correlated with increases in maximum oxygen uptake.

In a more recent study, Martinsen, Hoffart, and Solberg (1989) compared aerobic with non-aerobic exercise (weight-lifting) in the treatment of depression. Participants were 99 inpatients, 38 men and 61 women, at the same facility in Norway. The aerobic group performed brisk walking or jogging at 70% of VO2 max, the other group performed strength and flexibility training. Both groups exercised three times weekly for 8 weeks. Depression was measured using the BDI and ratings by psychiatrists. There was a significant increase in aerobic capacity in the aerobic group. Both groups had equal mean depression scores at the start of the study and they decreased to the same degree in each group at the end. These results are in contradiction to the previous study where decrease in depression was related to change in aerobic capacity. The authors argued that the results in their more recent study were more reliable because of the larger sample size. Their conclusion was that psychological mechanisms such as mastery, self-efficacy, and response contingent positive reinforcement may mediate the reduction in depression scores rather than purely the aerobic conditioning effect.

Spinal Cord Injury and Exercise

In this final section of the review some of the psychological variables related to persons with SCI are examined in a somewhat roundabout way. Two of the studies explore self-concept and life satisfaction in SCI and the remainder are studies of the psychological profiles of wheelchair athletes. Most of these studies use group-comparative and correlational design rather than experimental design. Together they provide some useful background information from which to proceed but the lack of studies using interventions soon becomes apparent. This section helps to justify the need for more studies looking at specific interventions in this population.

Green, Pratt, and Grigsby (1984) administered the TSCS to 71 persons with SCI, 49% were quadriplegic and 51% paraplegic. The mean age was 40 and the mean duration of injury was 11 years. Participants were contacted by mail, 220 packages were sent and 71 responded. This poor response rate immediately draws the conclusions into question. Student t-tests were used to compare respondents' subscale means to the TSCS norm means. On six of the subscales, respondents had higher mean scores than did the norm group. Personal Self, Social Self, and Moral-Ethical Self were significantly higher. Physical Self scores were significantly lower than for the norm group and there was a significant negative correlation between scores on this subscale and age at injury. Perceived independence was found to be positively and significantly related to Physical, Personal, Social, and Total Self scores. Overall the authors reported that their volunteers had very positive self-concepts although they did mention the non-random nature of their sample. They speculate that a "growth through adversity" theory may in part explain the high scores.

Estimates of the prevalence of depression in persons with SCI vary. Craig, Hancock, and Dickson (1994) conducted a longitudinal study of depression and anxiety in the first 2 years following spinal cord injury in a group of 41 men and women. Depression was measured using the BDI. Assessment was performed at approximately three months post-injury, 6 months, 1 year and 2 years. Analysis revealed that about 30% of the group scored above 14 on the BDI and that those who were depressed initially showed little improvement by 2 years post-injury. They comment that response to SCI is very individual. The majority were not depressed but it cannot be assumed that those who do develop symptoms of depression will necessarily improve with time.

A study by Kinney and Coyle (1992) examined the perception of life satisfaction among persons with physical disabilities. Three hundred and forty-four persons with a variety of disabilities were interviewed--SCI, multiple sclerosis, cerebral palsy, and blindness. Participants completed measures of depression, self-esteem, and life satisfaction. The authors found that leisure satisfaction was the most important predictor of life satisfaction, explaining 42% of the variance in life satisfaction scores. In their discussion the authors point to the implications that these results have for designing therapeutic recreation programs for persons with disability.

Super and Block (1990) investigated self-concept and need for achievement in men with disabilities. Participants were 95 men aged between 18 and 40. They were divided into four groups: disabled-athletically active, and inactive, able-bodied active, and inactive. All completed the TSCS. ANOVA was used to test the differences between means on the TSCS. Results showed that the disabled athletically active group had higher mean scores than the inactive group, in fact their scores were very similar to the able-bodied active group. In their conclusion, the authors suggest that athletic participation could have a therapeutic effect for patient populations that have a negative self-concept.

In another study, Valliant, Bezzubyk, Daley and Asu (1985) measured self-esteem in 161 athletic adults with disabilities--disabilities included cerebral palsy, amputations, blindness, and SCI. There was also a control group of non-athletes (n=22). The athletes with disabilities were found to have higher self-esteem and to be more satisfied with life than non-athletes.

A study by Horvat, French, and Henschen (1986) used the Profile of Mood States (POMS),(McNair, Lorr, & Droppleman, 1971) to evaluate the mood states of athletes with disabilities. They investigated 33 men and 62 women who were wheelchair athletes. Comparison groups were elite level able-bodied athletes. The POMS has been widely used in the able-bodied population to predict athletic success. Athletes generally demonstrate what is known as an "Iceberg Profile" on the POMS. (Morgan, 1980) This is characterised by low scores on the Depression, Anger, Fatigue, Tension, and Confusion subscales and a peak on the Vigor subscale. The authors analyzed the results statistically as well as doing a visual comparison. Male wheelchair athletes demonstrated an Iceberg Profile very similar to able-bodied athletes. The women also had an Iceberg Profile but its shape was less dramatic than the men's. The inherent design weakness of their study is that it was correlational in nature and did not include a control group, however the authors recommended further research into the therapeutic value of sport and recreation for persons with disabilities.

Conclusions

This review has explored possible psychological effects of exercise, specifically on the variables of depression and self-esteem. Next I examined, in a very preliminary way, the psychological status of active and inactive persons with disabilities. This was done to give some background for the present study examining the psychological effects of a walking program for persons with paraplegia. What conclusions can be drawn from this review? Dealing first of all with the literature concerning depression and self-esteem, conclusions must be drawn cautiously due to the wide variety of populations studied and persistent methodological weaknesses. The majority of studies reviewed here did use control groups but common problems identified were lack of random assignment to groups, small sample size, and frequent attrition from studies. Bearing this in mind it does appear that persons who are mildly to moderately depressed or who have low self-esteem, may benefit from a regular exercise program. Well-designed studies by Doyne et al. (1987) and Martinsen et al. (1989) support this conclusion. The mechanism by which this improvement takes place is still not entirely clear. Earlier research focused on possible physiological changes that occurred as a result of aerobic exercise, a popular theory being that release of endorphins was stimulated through exercise, which brought about a feeling of well-being. This has never been fully proven to occur. The more recent studies seem to point to cognitive-behavioral mechanisms as being to a large extent responsible for the changes. Many of these studies included a group that performed non-aerobic strengthening exercises as well as the traditional aerobic type and most showed equal improvement in self-esteem and depression. Sonstroem and Morgan (1989) developed a model that laid the foundation for studying these mechanisms in more depth. A reasonable conclusion would appear to be that participation in exercise programs,which provide experiences of progress and success, increase the individual's sense of mastery, self-efficacy, and self-acceptance which, in turn, can lead to increases in self-esteem and decreases in depression.

The studies reviewed in the area of SCI and exercise allow for only tentative conclusions. The majority used group omparative designs, often included a variety of disabilities, and very few attempts were made to control variables. For example, some included individuals with very different disabilities such as blindness, cerebral palsy, and amputations as well as persons with SCI. These disabilities have very different manifestations, some are acquired, some congenital, some progressive and some static. Therefore, the psychological status of these individuals may be quite variable. Even within the population of persons with SCI, level of injury, age at onset, and level of education may all play a role in determining the person's psychological health. Despite all this, a large number of the studies appeared to support the conclusion that persons with disabilities who are athletically active demonstrate positive psychological attributes when compared with able-bodied athletes and with the general population. On tests such as the POMS, they tended to score higher than disabled non-athletes. The study by Green et al. (1984), in which the TSCS was administered to 70 persons with SCI, indicated that Physical Self-Concept is an area where this population tends to score lower than the norm and which might be amenable to improvement through exercise intervention via the mechanisms discussed earlier. Particularly in this group, small changes in strength or aerobic capacity could lead to quite significant changes in levels of functional independence, which in turn could have an effect on self-efficacy cognitions and overall self-concept.

Hypothesis

The purpose of this study was to examine the psychological effects of an electrical-stimulation walking program for persons with paraplegia. The research question was: does this walking training have an effect on measures of self-concept, depression, mood states and self-efficacy?

Stated formally, the hypotheses are:

1. The exercise training, consisting of an electrical stimulation walking program, will result in improved scores between pre- and posttesting on the Physical Self subscale of the Tennessee Self-Concept Scale.

2. The exercise training will result in improved scores between pre- and posttesting on the Beck Depression Inventory.

3. The exercise training will result in improved scores between pre- and posttesting on the Self-Efficacy Scale.

4. The exercise training will result in improved scores between pre- and posttesting on the Profile of Mood States, Total Score.

All hypotheses will be tested at the $p < .05$ level of significance.

Method

In this study participants with SCI completed a 3-month ambulation training program using functional electrical stimulation. Changes in four psychological variables were measured pre- and posttraining. The variables measured were: physical self-concept, self-efficacy, depression, and general mood state. In addition, interviews were performed at the end of the training period to assess the participants' reactions to the program. It was considered reasonable to perform these interviews given the exploratory nature of this study. The aim was to gather additional information about the participants' subjective experiences through content analysis of the interview data.

Participants

Participants were 12 men and 3 women with SCI of traumatic onset. All were motor and sensory complete injuries, i.e., no active motor function below the level of injury and no appreciable sensory function. Injury level was between T4 and T11. This is a requirement for use of the device. Persons with higher injury levels tend to have inadequate hand control and balance. Injuries below T11 result in damage to nerve roots rather than to the cord itself and these individuals generally have no muscle response to electrical stimulation. The mean age of participants was 28.37 (SD=6.6). Mean duration of injury was 4.03 years (SD=3.14). The group was ethnically diverse and consisted of 7 Caucasians, 6 Latin Americans (2 from Venezuela, 1 from Chile, 1 from Argentina, 1 from Equador, and 1 from

Columbia), 1 African-American, and 1 West Indian. Eleven of the participants had high school level education, 3 were attending college or university, and 1 had graduate-level education. Other physical requirements for the program included adequate bone and joint integrity as measured by x-ray and bone densitometry, full lower extremity range of motion, no recent fractures or uncontrolled spasticity and no history of head injury or psychiatric illness.

All potential participants were evaluated by myself, following a set format. (See Appendix B for evaluation forms) Prior to formal admission into the study they were examined by an Orthopedic surgeon who reviewed the x-rays and bone density results and also performed a brief history and physical examination.

Identification of Participants

Participants were identified using several different methods. The Miami Project maintains a computerised mailing list of all persons who have contacted the institution and expressed an interest in the research being conducted. Persons from this list of potential participants with the appropriate injury level were contacted by telephone and/or letter by myself. The nature of the study was described and if they expressed an interest they were invited to come for a screening evaluation. This list is comprised of persons from all over North America as well as overseas, mainly South America. It gives access to persons with varied socioeconomic, educational, and ethnic backgrounds. Many persons with SCI tour the Miami Project and a couple heard of the study and expressed an interest in participating, at which point an evaluation was arranged.

Measures

The Tennessee Self-Concept Scale (TSCS). The TSCS was first developed by Fitts in 1965 (Roid & Fitts, 1988). It was chosen for this study for a number of reasons. First it provides a measure of global self-concept but also measures self-concept on a number of subscales such as Family Self, Social Self, Moral-Ethical Self and Physical Self. Of particular interest in this study is physical self-concept. A purely global self-concept scale would not allow access to this information. Second, the TSCS has been widely used in research, over 200 studies are published annually using this scale, and a wealth of reliability and validity data is available, as well as normative data.

The normative data was established using a sample of 626 people of heterogeneous background. They were aged between 12-68 with an approximate balance between ethnic, socioeconomic, and educational backgrounds. In subsequent research, the effects of SES, intelligence, gender, and ethnicity have been found to be small.

A comprehensive study of internal consistency was conducted using data from 472 responses. Cronbach alpha for the total score was found to be .94 and the subscales ranged between .70 and .87. Test-retest studies were done over a 2-week interval and were found to be .92 for the total score and .80 to .91 for the subscales. Standard error of measurement has been found to lie between 3 and 6 T-score points.

The widespread use of the TSCS in counselling, educational, clinical, and medical settings has provided substantial evidence for the validity of the scale as a measure of self-concept. A number of studies have compared the TSCS to other measures that would be expected to relate to the construct of self-concept, e.g., most of the TSCS scores correlate with MMPI (Butcher, Graham, Tellegen, & Kaemner, 1989) scores in ways that would be expected. The TSCS has been found to correlate .75 with scores on the Coopersmith Self-Concept Scale (Coopersmith, 1981). It has also been shown to have a high negative correlation with the Internal-External Locus of Control Scale (Rotter, 1966), i.e., those with high internal scores tend to have higher self-concept. In studies comparing psychiatric groups with normative group data there were significant differences on TSCS scores. The TSCS has also been found to discriminate between different types of psychological problems e.g., delinquency, alcoholism, and drug abuse. In conclusion there is strong evidence for construct, criterion, and convergent validity of the TSCS scale.

The range of scores on the Physical Self subscale is from 35 to 90 and the mean score on this subscale for the normative group is 71.8. The higher the score the stronger one's self-concept.

<u>Beck Depression Inventory</u> (BDI). The BDI was developed in the 1960s by Aaron Beck and has been widely used as a self-report measure of depression (Beck et al., 1979). The decision was made

to use a depression scale in this study because this has been one of the areas to show significant changes as a result of exercise in previous research. However, it has been pointed out in numerous studies that if no depression is present then obviously scores cannot be expected to change in a positive direction. I did not expect that the research participants in this study would be severely depressed, however, it was possible that they could be experiencing symptoms of mild to moderate depression. Advantages of the BDI include its widespread use in over 1900 research studies. Also it is easy to administer and takes only 10-15 minutes to complete. Possible disadvantages are that the items are very obvious, therefore it would be easy to fake or give socially desirable responses if the person wished to. The test consists of 21 items scored from 0 to 3. The possible range of scores is 0 to 63. Total scores of 0 to 9 represent no depression, 10 to 18 mild depression, 19 to 29 moderate-severe depression, and 30 to 63 extremely severe depression. (Beck & Steer, 1987) The manual suggests that the BDI measures two subscales of depression, these are cognitive-affective and somatic-performance.

Internal consistency estimates range from .73 to .95. Test-retest reliability is difficult to measure due to the variability of depression but range from .60 to .90 for non-psychiatric patients. For non-patients test-retest reliability was found to be .90 over a two-week interval. The BDI measures six of the nine DSM 111 criteria for major depression. In studies of concurrent validity the BDI has been found to correlate .61 with the MMPI (Butcher et al., 1989) Depression subscale and .76 with the SCL 90 (Derogatis, 1977) Depression subscale.

Profile of Mood States (POMS) (McNair et al., 1971). The POMS is a 65-item, 5-point adjective rating scale which measures six identifiable mood states: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, and Confusion-Bewilderment. The POMS has been shown to be a sensitive measure of the effects of various experimental interventions in both normal and psychiatric populations.

Internal consistency measures for all six mood scales are above .90. Test-retest reliability studies were done with a group of 100 psychiatric patients. Scores from intake to pretreatment ranged from .65 to .74. From intake to six weeks of treatment ranged from .43 to .53. The authors point out that for a test that is measuring mood states, which are subject to change, high test-retest reliabilities would not necessarily be desirable.

Concurrent validity was measured by comparing results on the POMS with the SCL-90 (Derogatis, 1977). Moderate to high correlations were found between scores on the POMS subscales and on the Somatization, Anxiety, and Depression subscales of the SCL-90. Correlation between the Tension-Anxiety subscale and the Taylor Manifest Anxiety Scale (Taylor, 1953) was .80. Results from multiple brief psychotherapy studies and controlled outpatient drug trials have provided substantial evidence of the predictive and construct validity of the POMS as reported in the manual.

Normative data has been compiled for psychiatric outpatients as well as for adult non-patients. The POMS can be scored by looking at each subscale separately or an overall score called "Total Mood Disturbance" can be generated by adding together all the subscales except the Vigor subscale and then subtracting the Vigor subscale. For this reason it is possible to have a negative score on the test if levels of mood disturbance are very low and the Vigor score is high. The possible range of scores is from -32 to 228. The mean score for the college, non-patient normative group is 40. In this study the Total Mood Disturbance score was used. The higher the score the greater the mood disturbance.

Self-Efficacy Scale (SES). The SES is a 22-item scale developed by Sherer et al.(1982) that measures general levels of belief in one's own competence that are not tied to specific situations or behavior. It consists of two sub-scales: general self-efficacy and social self-efficacy. The assumption underlying the scale is that individual differences in past experiences or attributions of success lead to different levels of generalized self-efficacy expectations. It has been found to be useful in monitoring the course of progress in clinical interventions. The SES uses a 5-point Likert scale scored from 1 to 5. The possible range of scores is from 22 to 110 and higher scores indicate greater self-efficacy. No normative data has been produced by the authors of the test.

The SES has fairly good internal consistency with alphas of

.86 for the general sub-scale and .71 for the social subscale. No test-retest data was reported.

It was shown to have good criterion-related validity by accurately predicting that people with higher self-efficacy would have greater success than those who score low in past vocational, educational, and monetary goals. It has also demonstrated concurrent validity by correlating significantly in predicted directions with measures such as the Rosenberg Self-Esteem Scale (Rosenberg, 1979).

<u>Procedures</u>

<u>Informed consent</u>. A full description of this study was submitted to the Investigational Review Board at the University of Miami for approval. Forms were also submitted to the UBC Ethics committee. Approval was received from both committees. Prior to commencing the study all participants completed informed consent forms that described the procedures to be used in the study in detail. (See Appendix C) Verbal explanations were also given and participants were informed of their right to withdraw at any time.

<u>Testing</u>. Once participants completed the screening requirements, they underwent pretesting on a number of different measures prior to commencing walking training. The effects of this exercise on a number of different physiological functions were measured in addition to the psychological measures. These included bone density, blood circulation to the legs, blood cholesterol and hormone levels, aerobic capacity, upper extremity

strength, and muscle girth in the legs. Only those related to the present study are discussed here.

To determine if the exercise brings about any changes in physical fitness, a maximum VO2 stress test (Franklin, 1985) was performed prior to commencing training and again after 3 months. As subjects are unable to walk prior to training this test was done using an arm ergometer (bicycle). VO2 levels were measured using a metabolic cart and EKG monitoring was also performed simultaneously to detect any abnormal cardiac response to the exercise. This testing was performed under the supervision of a physiologist who specialises in cardiology.

Psychological evaluation. Psychological status was evaluated using four instruments: the Tennessee Self-Concept Scale, the Beck Depression Inventory, the Profile of Mood States, and the Self-Efficacy Scale. Verbal explanations for completing the tests were given to each subject. Spanish translations were provided for any persons whose ability to comprehend English was inadequate for completing the tests. Diligent efforts were made to provide translations that accurately captured the concepts being tested. A quiet area was provided for completing the tests. The TSCS takes about 20 minutes to complete and the others approximately 10 minutes each. Participants completed the TSCS on one day and the others on a subsequent day.

To maintain confidentiality, score sheets were marked only with the participants' initials and an identification number. Files were stored in a locked cabinet. The same tests were readministered following completion of 3 months of training.

Interviews. In order to obtain more in-depth information concerning participants' reactions to the program and psychological changes experienced, individual interviews were performed following 3 months of training. (See Appendix D for interview protocol.) Participants were asked to respond to a series of open-ended questions. These questions covered topics such as asking participants to describe their expectations prior to commencing the program and whether or not these expectations were met. They were asked to describe any subjective physical changes noted as a result of the exercise and also any psychological changes. To attempt to avoid bias in the responses it was emphasised that both positive and negative reactions are possible and that the interviewer was interested in knowing about the full range of the individual's experience.

The interviews were semi-structured in that specific areas were addressed. However, through use of empathic listening participants were encouraged to describe their experience in as much detail as they wished. These interviews were tape-recorded and then transcribed. Subsequently the responses given to each of the questions were listed separately and content analysis was performed to look for common responses. Any response that occurred three times or more, in answer to a given question, was reported. In three cases it was necessary to use a translator because the participant did not have an adequate level of English to comprehend the questions or to express his thoughts and feelings.

Training protocol. The gait training phase consists of three sessions weekly for a total of 32 sessions taking approximately 3 months to complete. Volunteers commenced with standing and balance activities in parallel bars and then progressed to walking with a specially adapted walker that connects to the stimulator unit. All training sessions were conducted under the supervision of myself and/or my co-workers. Resting heart rate and blood pressure were monitored prior too0 commencing the session and were reassessed after each walk. Participants generally performed three walks per session. The distance walked each time was determined by the participant's ability. Limiting factors are fatigue of the quadriceps muscle or cardiovascular fatigue.

Participants were free to withdraw from the study at any time if they desired to do so. An Orthopedic Surgeon, affiliated with the Miami Project was available on an on-call basis for the duration of the study to evaluate any person experiencing problems.

Apart from one individual who had a bruised toe, no injuries occurred during the course of the study.

Data Analysis

To test the hypotheses, results from the four psychological tests were analyzed for differences in the pre- and posttraining scores using repeated measures analysis of variance. The BDI and SES yield single scores. On the TSCS, the Physical Self subscale was analyzed for posttraining changes. The POMS was analyzed as a single score, the "total mood disturbance" score. In addition, the data from the VO2 testing was analyzed, again using a repeated measures analysis of variance to determine if any changes in cardiovascular fitness took place between pre- and posttraining.

The audiotapes from the interviews were transcribed and content analysis was performed to look for common responses. Responses which occurred three or more times were reported.

Results

Pretreatment Dependent Measures

Prior to treatment, mean score on the physical self-concept scale was 67.5 (SD=11.25). This score lies approx 2/3 of a standard deviation below the mean (M=71.5) for the normative group (Roid & Fitts, 1988). There was a wide variability in scores. Five individuals scored more than 1 standard deviation below the mean of the normative group with 3 of these scoring more than 2 standard deviations below the mean. Three individuals scored more than 1 standard deviation above the norm mean.

Scores on the depression scale were also quite variable. The mean score at pretest was 8.5 (SD=9.24). According to the ranges of scores that have been set for levels of depression (Beck & Steer, 1987), 10 were not depressed, 2 were mildly depressed, 2 moderately depressed, and 1 severely depressed.

Mean score on the self-efficacy scale was high at pretest - 95, (SD=11.09) The maximum possible score on the test is 110. This score of 95 is indicative of high levels of self-efficacy.

Similarly, at pretest participants were reporting low levels of mood disturbance on the POMS. The mean score was 12.8 (SD=34.4). The mean total mood disturbance score for the normative group of college males was 40 (McNair et al., 1971), so the experimental group scored well below the normative mean at the outset.

Correlation Matrix

An examination of the correlation matrix (Table 1) showed that at pretest, the physical self-concept measure was moderately negatively correlated with the depression and mood states scales, such that high physical self-concept was associated with few depressive symptoms and low levels of mood disturbance. The depression measure was strongly positively correlated with the mood states scale and strongly negatively correlated with the self-efficacy scale, such that few depressive symptoms were associated with low mood disturbance and high self-efficacy. The mood states scale was moderately negatively correlated with the self-efficacy scale, i.e., low mood disturbance was associated with high self-efficacy. Similar relationships between the measures were observed at posttest but the correlations were not quite as strong. No correlation above .35 was noted between age or duration of injury and any of the measures.

Table 1

Intercorrelations Between Age, Duration of Injury, and Outcome Measures Pre- and Posttest

Measures		TSCS		BDI		POMS		SES		AGE
		Pr.	Pt.	Pr.	Pt.	Pr.	Pt.	Pr.	Pt.	
TSCS	Pt.	.70								
BDI	Pr.	-.68	-.52							
	Pt.	-.72	-.59	.80						
POMS	Pr.	-.72	-.61	.85	.88					
	Pt.	-.42	.55	.43	.70	.72				
SES	Pr.	.47	.58	-.81	-.85	-.75	-.59			
	Pt.	.43	.61	-.72	-.86	-.74	-.64	.94		
AGE		.04	-.22	-.35	-.23	-.23	-.17	.11	.17	
DUR		.02	-.22	-.29	-.26	-.12	.07	.05	.18	.78

TSCS=Tennessee Self- Concept Scale, Physical Self
BDI= Beck Depression Inventory
POMS=Profile of Mood States
SES= Self-Efficacy Scale
DUR= Duration of Injury
Pr.= Pretest
Pt.= Posttest

Treatment Effects--Dependent and Ancillary measures.

Repeated measures analyses of variance (ANOVA) were performed on the dependent measures of physical self-concept, depression, self-efficacy, and mood states.

The change on the Physical Self subscale of the TSCS occurred in the hypothesised direction and was statistically significant $F(1,14) = 7.54$, $p < .015$. (See Table 2 and Figure 1 for pre- to posttreatment means and standard deviations.)

The pre- to posttreatment univariate test for the depression scale was also significant in the expected direction $F(1,14) = 5.42$, $p < .035$.

The posttreatment mean score on the mood states scale changed in the expected direction but the change was not statistically significant $F(1,14) = .404$, $p < .53$.

Unexpectedly the posttreatment mean on the self-efficacy scale changed opposite to the hypothesised direction and the change was significant $F(1,14) = 4.89$, $p < .02$.

As a manipulation check a repeated measures ANOVA was performed on the VO2 data from pre- to posttest. There was an increase in peak VO2 from 20.02 (SD=3.27) to 23.01 (SD=3.61) and the change was statistically significant $F(1,14) = 6.47$, $p < .01$.

A test for clinical significance was performed on the Physical Self subscale of the TSCS using the two-fold conservative criteria developed by Jacobsen, Follette, and Revenstorf.(1984) In order to be considered for clinically significant change, scores at pretest need to be more than 2 standard deviations below the mean for the normative group and to move to within 2 standard deviations of the mean by posttest. In addition, a "Reliable Change" index is calculated by subtracting pretest from posttest scores and dividing by the standard error of the mean. A reliable change index greater than 1.96 is considered unlikely to occur without actual change. Based on these criteria, 3 of the 15 participants would be considered to have demonstrated clinically significant improvement. However, it should be noted that only 3 of the 15 participants scored more than two standard deviations below the normative mean at pretest.

In analyzing the interview data, similar responses occurring three times or greater in answer to a given question were reported. (See Appendix E for summary and frequency count of the responses.) The results from the interviews are reported in detail in the next section.

Table 2

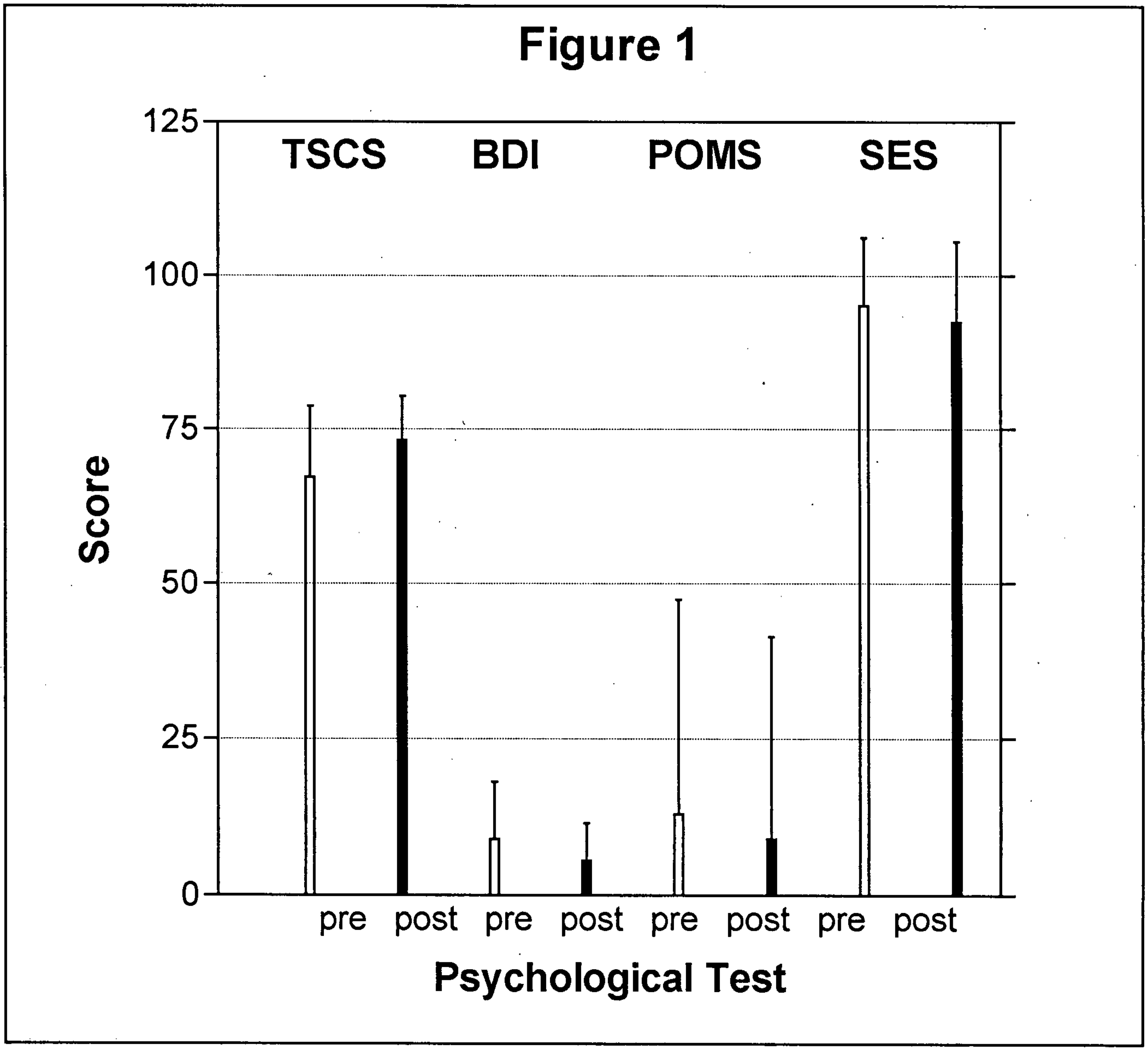
Pre- and Posttest Means and Standard Deviations of Dependent and Ancillary Measures (N=15)

	Pre		Post	
	Mean	SD	Mean	SD
TSCS Phys Self	67.4	11.3	73.2	7.1
BDI	8.8	9.2	5.4	5.9
POMS	12.9	34.5	8.8	32.5
SES	95.0	11.1	92.3	13.2
Peak VO2	20.0	3.3	23.0	3.6

TSCS = Tennessee Self-Concept Scale, Physical Self
BDI = Beck Depression Inventory
POMS = Profile of Mood States
SES = Self-efficacy Scale

Figure 1

Pre- and Posttreatment Means and Standard Deviations of Dependent Measures



Discussion

The purpose of the study was to determine whether participation in an electrical stimulation walking program for men and women with SCI had any effect on measures of physical self-concept, depression, self-efficacy, and mood states. In general it can be concluded that positive and statistically significant changes were noted in the measures of physical self-concept and depression. The change in mood states was not significant and unexpectedly self-efficacy scores decreased significantly from pre- to posttreatment.

I hypothesized that participants would demonstrate a lowered physical self-concept on the TSCS and that the intervention would lead to an increase in physical self-concept from pre- to posttest. This hypothesis was supported statistically. It is interesting to note however the wide variability in scores within the group. Specifically 5 of the 15 scored above the mean for the normative group at the outset indicating that they had a healthy physical self-concept. On the other hand 5 of the participants scored more than 1 standard deviation below the mean of the normative group and of these 3 scored lower than the 16th percentile. Physical self-concept did not appear to be related to factors such as length of time post-injury or to level of injury.

The heterogeneous nature of the scores for this group points to the fact that physical self-concept may or may not be altered following spinal cord injury. The pretest mean for the experimental group is similar to that reported by Green, Pratt and Grigsby (1984) who found that mean score on the Physical Self subscale for a group of 71 persons with SCI lay approximately 1 standard deviation below the mean of the normative group. Thirteen of the 15 participants increased their physical self-concept scores from pre- to posttest. The experimental group mean at posttest was 72.3 which places them just above the mean of the normative group, an increase of approximately 2/3 of a standard deviation. Those who commenced with the lowest scores tended to have the largest changes in scores at posttest.

Using Jacobsen, Follette, and Revenstorf's (1984) criteria for clinical significance, 3 out of the 15 would be considered to have improved, however there were only 3 individuals who scored more than 2 standard deviations below the mean initially. It should be noted that this was a "well" population being studied not a "clinical" group.

The improvement in scores on the depression scale was also statistically significant, however this result needs to be interpreted with caution. The pretest mean score was 8.8 which falls within the range of no depression (range=0-9) (Beck & Steer, 1987). Two participants scored in the mild depression range (10-18), 2 in the moderate range (19-29), and 1 in the severe range (30-68). Therefore, two-thirds of the group reported very minimal levels of depression whereas the other one-third experienced variable levels of depression. At posttest the group mean dropped to 5.5. The 2 in the mild range dropped to no depression, the 2 in the moderate to mild depression, and the 1 in the severe category to moderate depression.

These results would appear to indicate that the 5 who were reporting symptoms of depression experienced a reduction in these symptoms subsequent to the training program. Although the hypothesis was supported, ideally this should be replicated with a larger sample size in order to have more confidence in the effect.

Again it is interesting to note the variability in levels of depression. Time post injury does not necessarily seem to be a factor here, the 3 participants with moderate to severe levels of depression had all been injured within the past 2 years. However there were 3 participants reporting no depression who had also been injured within the previous 2 years.

There were no significant changes in the mood scores from pre- to posttesting, however it should be noted again that the group was reporting low levels of mood disturbance as compared to the normative mean for college men. Pretest mean for the group was 12.8 and the mean for the norm group was 40 (McNair et al., 1971). Eleven of the 15 participants exhibited the "Iceberg Profile" at pretest which has been reported in the literature as being typical of both wheelchair and able-bodied athletes (Horvat et al., 1986). The iceberg profile is characterised by low scores on the Anxiety, Depression, Fatigue and Confusion subscales and a high score on the Vigor subscale.

The results on the self-efficacy scale are surprising. The initial mean score was 95 out of a possible 110, indicating that the participants were reporting very high levels of self-efficacy. Eleven of the 15 participants scored over 90 on the pretest. At posttest the mean decreased to 92.3 and the decrease was statistically significant. However 11 participants still scored above 90. It is difficult to believe that the training program contributed to lowered levels of self-efficacy. During the interviews following training many participants commented on how they enjoyed the challenge of the training and how it felt good to see the progress and increasing proficiency from week to week.

The pre- to posttest correlation on the SES scores was .94 which is higher than the internal consistency of the scale which is reported to be .76 (Sherer et al. 1982). This indicates that this test was not sensitive in tapping the construct of self-efficacy for this group. The problem may have arisen in translating the measure for those individuals whose first language was not English. The wording of the test can be confusing and it is sometimes difficult to determine if the question is being asked in a positive or negative sense. Translating the test may have compounded the problem. It could also be argued that this was not the most appropriate measure of self-efficacy to use in this situation. This scale measures two subscales, general self-efficacy and social self-efficacy. However, in planning this study, no measures of physical self-efficacy were found that were valid for persons with spinal cord injury. They all contained inappropriate items such as "I can run fast" or "I have good muscle tone".

Sonstroem and Morgan's (1989) model of the mechanisms through which changes in self-esteem occur as a result of exercise training was discussed in the literature review. They hypothesized that changes in physical self-efficacy and physical competence occur as a result of exercise which then lead to increases in physical acceptance, which in turn leads to improvements in overall self-esteem. The change in physical self-concept, that is comparable to physical self-acceptance, was demonstrated. However, due to the fact that participants had a high initial score on the self-efficacy test and the afore-mentioned problems with the measure itself, increases in physical self-efficacy were not documented at posttest in this experimental group. Ideally a measure of physical self-efficacy should be developed that is valid for persons with disabilities.

Notwithstanding the non-random nature of the selection process for this study, the pretest scores on the measures do give some indication of the psychological status of a group of men and women with paraplegia. Mean scores on the tests indicate that overall they were reporting low levels of depression, high self-efficacy, and healthy mood state. Physical self-concept was the variable most affected in this group. A closer inspection of the individual scores reveals that approximately 25% of the group were reporting significant symptoms of depression, lowered physical self-concept, and alteration of mood state. The participants reporting these symptoms were all men and, with exception of one individual who had a low score on the TSCS, had been injured in the previous two years. Although the number of participants in this study was small, the incidence of depression reported here supports the findings of Craig et al. (1994) who reported that 30% of a group of men and women with SCI, injured in the past two years, had scores above 14 on the BDI.

As a manipulation check for this study, changes in VO2 were measured from pre- to posttraining. The change was statistically significant indicating the program did have a cardiovascular conditioning or aerobic training effect. The distance walked by each participant was variable, from a low of 150 feet to a high of over 3000 feet. Despite this, all participants experienced an aerobic training effect.

<u>Qualitative data</u>

Fourteen participants were interviewed following completion of training and the interviews were tape-recorded. They were transcribed and subsequently the responses given to each of the questions were listed separately. Similar responses occurring three times or more in answer to a given question was recorded. Atypical responses were also of interest. Again this subjective data is preliminary in its scope yet it reveals other facets of the individuals' reactions to the training program that cannot be captured by the objective data alone.

Some of the most poignant and insightful of the responses deal not just with the participants' subjective experiences but with their perceptions of the attitude of the rest of society towards them as individuals with a disability. For some it seemed that one of the driving forces behind their desire to stand and walk was to appear more normal in the eyes of society and to feel more accepted by that society. This analysis is somewhat informal and takes the form of a discussion with each of the questions from the interview being considered in sequence. Quotations are included where appropriate.

The first question asked how the participant originally heard about the training program. The majority of participants had heard about Parastep through word of mouth or through the media such as magazines or television. Several had contacted the Miami Project and expressed an interest in participating in research studies but did not know much about Parastep before they became involved in the program. Others had had a strong desire to participate in a walking program for several years.

Next the participants were asked to recall what their expectations were prior to commencing the training program. About one third stated that they did not know what to expect, that they just wanted to come and try it. Another group had quite specific expectations, e.g., they wanted to use it as a form of exercise. A couple of people stated that they hoped that using the Parastep and stimulating their muscles might lead to some return of function below the level of injury despite acknowledging that this was not a very realistic goal. One man who had been injured for 9 years said: "I hoped for the ultimate, being able to throw the wheelchair away but I knew this was not realistic."

The third question asked whether or not those initial expectations had been met. Eight were very pleased and felt that it had met all their expectations. A 21-year old man who had been injured for 9 months reported: "Very much, I think I've gotten exactly what I wanted. I had a realistic idea of what it could offer, therefore, I wasn't disappointed."

Three who had unrealistic expectations at the start were disappointed that it did not give them what they hoped for. One woman who had expected to do well and to be able to walk for long distances was disappointed with the distances that she did achieve. Initially she felt frustrated because she was not able to walk as far as the others. She then decided to alter her expectations and not to compare herself with the others but rather to focus on the exercise benefits to her body not the distance walked.

When asked to describe the positive and negative aspects of the experience there were many similarities in the responses. On the positive side, the experience of standing and walking in and of itself was beneficial to many. Most individuals enjoyed the strenuous nature of the exercise, which they said they were unable to achieve with other forms of exercise. They liked the process of getting in shape and reported feeling healthier as a result of the exercise. Several individuals reported that the increase in the size of their leg muscles was very positive for them.

On the negative side, several participants had a struggle to get a good step response initially and this led to some frustration as it slowed their progress in the early stages of training. Those whose expectations were not met stated that this was a negative aspect of the experience and led to some feelings of disappointment at the end of training.

When asked to describe any physical changes noted as a result of training there were again many similar responses given. The most common response noted was an increase in the muscle tone and bulk of the lower extremities. Many of the men reported that they had felt ashamed to wear shorts since their accident because they felt that their legs looked too thin, but since commencing training they had taken to wearing shorts again. Other frequent answers were that breathing felt less restricted, they generally felt healthier and that there had been some changes in sensation to the lower extremities. Some developed more awareness of deep pressure and of muscle contraction in the legs during the training. Only one individual reported that he noticed very few changes as a result of the training. This was a young man who had hoped that use of the Parastep would help restore function in his legs and who was disappointed when this did not occur.

The next question asked whether participants noted any psychological changes subsequent to the training. A common response here was that the participants reported a sense of accomplishment from having seen the training program through from beginning to end and watching the progress from week to week. They also reported increased feelings of well-being and self-confidence. Others reported that their self-concept had improved due to the physical changes. Several participants lived alone during the study for the first time since their injury and found that this increased their sense of independence by proving to themselves that they could manage alone. It should be noted that this psychological change is not a result of the walking itself but came as part of the whole experience. Another common theme was that the experience of being upright led to the individual feeling more "able". Somehow just knowing that they could get out of the wheelchair whenever they wished made them feel better about their situation. One participant commented that he did not have to feel like a different person any more. On the other hand, one individual reported that he continued to feel depressed about his situation, that his attitude went up and down like a roller coaster, and that he did not feel like continuing with the exercise any more. This was the same participant who reported that he noticed very few physical changes as a result of the exercise.

Some of the most interesting responses came in answer to the question "Why was it important to you that this program involved standing and walking?" I report some of the responses individually rather than just reporting what was common in the responses. A couple of people mentioned that they believed that humans have a basic need and a right to stand and walk. This is denied following spinal cord injury and using the Parastep even for limited periods helps to fulfil that need and right. One male participant commented: "Maybe its because I was given the right to walk. I screwed up and took it away from myself and now I'm given the chance to go again and I want to do it."

There was also the belief that being in the chair fundamentally altered the attitude of other people towards them, and this seems to lead to a diminished sense of personal worth in the person with a disability. (This is inspite of the fact that they frequently recognise that the problem lies with others and not with themselves.) The ability to stand upright again seems to help restore a sense of normalcy to the individual. A female participant who has been injured for 9 years reported:

> Man was meant to walk upright. The fact that I'm in a chair, there's a different attitude from people. I know that's their problem and not mine but you still have to interact with other people and deal with it. So this gives me the ability to alter that personal body space and attitude and that's good.

Standing upright and talking to other people eye to eye instead of looking up at them was mentioned by several people as being important:

> You feel more like a man. (In the chair) I feel helpless even though I'm not helpless. I mean its like people are looking down at you all the time. Its just good to have people look up at you for a change.

For others what was important was just the ability to take a break from the chair. Doing everything in a sitting position seems to become very tedious for many. A woman who had been recently injured commented:

> When someone sits in the chair all day long from the beginning of the day to the night its too difficult, for eating, for working, for washing, everything in the chair. When I'm walking in the program I feel good....I see no difference with the rest of the world, I feel more normal.

Another participant reported that standing and walking reminded him of how he used to feel before his accident:

> When you leave the chair you're upright and you can walk. Maybe you feel like you felt before when you could walk and stand. Sometimes when you're in the car you wish instead of bringing the chair you could at least get out of the car and just walk. That's something I'm going to try.

For another individual the importance lay in small but significant things that it would allow him to do at home such as standing up and reaching into a cupboard himself instead of having to ask someone else to help, or being able to stand at the front door and greet his girlfriend when she came home from work.

Two male participants who had been recently injured said that they hated the wheelchair and could not accept it. One of these individuals also worried about how the Parastep would look to others and felt that it would draw negative attention to himself if he was out in public with it:

> Even with the Parastep its still going to bother me because people will look at you. It's like, look at him he's 20 and

> he's walking with a walker. It's like he's got all these wires on his body, what's wrong with him?

Another point that was made several times throughout the interviews, not necessarily specifically in answer to this question, was that many individuals felt a certain pressure from friends and family to do well with the walking and to be up out of the chair. It seemed that these people cared for and were concerned about the person in the chair but at the same time they sometimes had unrealistic expectations about what the individual would be doing once they came home with the system. One participant had quite a bit of concern about returning home and reported that she had to constantly emphasize to people that she would not be throwing her wheelchair away and that she would only be able to walk for short distances at a time.

Finally, several people mentioned that standing and walking was important to them because it would help them stay in shape in case a treatment or cure became available:

> I'm not sitting in a wheelchair like most guys, moping all day. I'm trying to help myself, trying like hell. I'm trying to keep my muscles in shape and my bones strong, that's the most I can do.

The participants were next asked how they would rate exercise with the Parastep as compared to other activities such as wheelchair racing, swimming, or weightlifting. Most people said they felt Parastep provided better exercise. The most common reason given was that this was the only type of exercise that would work the muscles below the level of the injury. All other forms of exercise work only the upper half of the body. Consequently, Parastep allows individuals with paraplegia to exercise at a more intense level and many participants commented that they liked the high intensity of exercise and the ability to work up a sweat. Several of the participants had also trained previously with long leg braces and they all said they preferred Parastep because there was less bulky equipment to put on and the gait pattern with Parastep looked more natural. However, one individual mentioned that he liked the element of competition in activities such as wheelchair racing and that he missed that with Parastep.

Next the participants were asked how they felt about continuing the exercise in the long term. Eight out of the 15 participants purchased their own units at the end of training. The rest either could not afford to do so or chose not to for other reasons. All who purchased the system wanted to continue the exercise but some were a little concerned as to how high their motivation would be once they returned home and left the structured training environment and all the support. Several had already thought of some strategies to help maintain their motivation such as choosing a regular place to walk where they could time themselves and record the distance walked. Some reported that the fact that they had spent so much money on the unit would help them to stay motivated to use it regularly. Similarly, a couple of people had received financial assistance from friends and family and said that their willingness to contribute towards the cost of the system would also be a motivating factor to continue with the exercise.

The final question put to the participants was "If someone were to ask you whether the time and effort involved in learning to use the Parastep were worth it, what would you tell them?" The majority reported that for them, it was worth it. Many cautioned that a person needed a lot of willpower and motivation to stick with the program and that it was not for the lazy. They recommended that each person would have to try it for themselves to see if they liked it because individual reactions vary. One person said that it was his personal opinion that it was not worth it because it did not give him what he had hoped for.

Conclusions, Limitations, and Recommendations

This study was undertaken in order to explore the effect of an electrical stimulation walking program on the variables of physical self-concept, depression, self-efficacy, and mood states in a group of men and women with paraplegia. It was considered a relevant and necessary study due to the lack of literature dealing with exercise interventions for persons with disabilities. It was intended to build on the previously documented literature on the psychological effect of exercise in the able-bodied population.

Two of the four hypotheses were supported, i.e., there was a statistically significant increase in physical self-concept and a significant decrease in depression, bearing in mind however that both pre- and posttest means on the BDI were below the cutoff score for mild depression. Those with the lowest self-concept and the highest levels of depression experienced the greatest improvement in scores. There was no significant change in mood state. Unexpectedly the self-efficacy scores showed a statistically significant decrease. However on the mood states and self-efficacy measures, initial mean scores showed low levels of mood disturbance and high levels of self-efficacy, therefore there was not much opportunity for statistically or clinically significant increases to take place.

Several conditions were present that limit the generalizability of the findings from this study. To begin with, the participants were not randomly chosen. Individuals had to meet specific physical criteria such as general health status, height and weight, joint integrity, and flexibility, in order to be eligible for inclusion. They were also in a sense self-selected as the majority had already contacted our institution, a spinal cord injury research center, and expressed an interest in participating in research. It is possible that these individuals could be more motivated or psychologically healthy than those who did not make contact.

Second, the type of exercise is not typical of what is generally available. More usual exercise programs might include weight-training, swimming, or wheelchair basketball. It could be argued that there is potentially a stronger psychological effect from an exercise that involves "walking". The act of standing and walking after being confined to a wheelchair for a number of years may restore a sense of normalcy to the individual that could be powerful psychologically. On the other hand, if the person had unrealistic expectations as to what the program could offer and if it did not meet their expectations, i.e., too slow, too cumbersome, too high of an energy cost, there could be negative effects as the person realized that they would not be free from their wheelchair after all.

Finally, another possible confounding variable relates to the nature of our institution. It is a large, multi-disciplinary group of scientists who are working together to develop a cure for paralysis. It is possible that coming to Miami, and being associated with the rehabilitation side of the research, may have a psychological effect in and of itself, quite apart from the exercise being undertaken. Also, many of our research volunteers came from out of state or out of country, and the camaderie, and friendships that were developed with other persons in similar situations may have been psychologically beneficial.

Several design limitations are present. One is the lack of a control group. Because of the non-random selection process in this study it was decided not to include a control group, however the lack of a control group limits the ability to ascribe changes noted to the walking activity itself. The other design limitation is small sample size. It was not possible to study a larger sample due to the intensive, individualised nature of the training, and constraints of time and staffing.

Despite these factors it was felt that this study was still an important one to undertake, given that so little research has been done in this area to date. Also the system is going to become more widely available in the next couple of years following FDA approval, and it is important to gain some understanding of how its use might affect psychological, in addition to physical well-being.

These results do provide some preliminary evidence that a gait training program such as the Parastep may be helpful in improving physical self-concept and reducing depression in persons with paraplegia. It would be interesting to offer this training to a group of people with paraplegia who had been diagnosed with depression to see if significant reductions in depression occurred. It would also be interesting to compare the changes in self-concept with other more conventional exercise programs such as weight-lifting or swimming. Clearly the interview data brought out the fact that there are some important psychological issues involved in standing and walking for a person who is paralysed that go much beyond the exercise itself. According to the respondents, these included the sense of freedom from the chair, and improved sense of self-worth from the ability to stand and interact with others at eye level, as well as the satisfaction that came from seeing the muscles below the level of the injury working again. These may have been some of the factors that led to the documented increases in physical self-concept in this study. However it is also possible that other types of exercise programs would lead to improvement in physical self-concept, particularly if individuals had been sedentary prior to commencing a training program.

The interview data provided a perspective and depth to the participants' experiences not captured by the objective data. Although subjective in nature and therefore not generalizable it helps to give a window on what the ability to stand and walk, however limited, means to a person who is paralysed. There are several observations that can be made of which health professionals who work with persons with spinal cord injury should be aware. First, although many of these participants stated that they had been able to accept having to use a wheelchair they still reported that they have a desire to stand upright, and they feel that this is a basic human need. Despite the fact that the wheelchair is still the most energy efficient and fastest means of mobility, and the inherent limitations of a walking system such as the Parastep, the act of standing and walking seems to in some way restore a sense of normalcy to the individual. The knowledge that they can be free of the chair even for short periods, and that they can stand and interact with other people eye to eye, seem to be two of the ways in which this takes place.

Another factor specific to walking systems that use electrical stimulation, is that they restore a sense of connection with the lower half of the body that is visible to the individual yet at the same time cut off from them. Many respondents commented on how good it was to see the leg muscle size increasing, to see the leg swinging and taking steps and to have some sense, however vague, of the muscles contracting below the level of the injury. Perhaps the conclusion from this is that a person with spinal cord injury may feel more whole if he or she has some means to maintain a sense of connection with the paralysed portion of the body, and to meet the need of standing and walking in whatever way possible.

On the negative side there were a couple of individuals who were disappointed when they realised the limitations to the walking with the Parastep. They had hoped that it would allow for a more natural, less energy-consuming gait or that use of the system would restore permanent function to the muscles below the level of the injury. One possible way to prevent this disappointment would be to have potential participants fill out a questionnaire prior to training that specifically asked about expectations of the walking program. In this way, unrealistic expectations could be more fully addressed prior to training, thus helping to reduce the likelihood of disappointment. Although a comprehensive verbal description of what the Parastep could and could not do was given to each participant prior to training, some individuals obviously did not fully absorb everything they were told or perhaps chose to deny the reality of the information.

The results from this study have several implications for counselling practice and theory. First, counsellors working with clients with spinal cord injury should be aware that psychological status post-injury is quite variable. Those most recently injured in this study tended to be the ones with the highest levels of depression and the greatest alteration in physical concept, however, there were equal numbers of participants with recent injuries reporting no symptoms of depression or lowered physical self-concept.

Second, a counsellor working with a client who is in the process of adjusting to living with a spinal cord injury should know that reaching a point of accepting the reality of the wheelchair and retaining a strong desire to stand and walk are not necessarily mutually exclusive. Many of the participants in this study reported that they had accepted having to use a wheelchair but that use of the Parastep helped to fulfil their desire to stand and walk. These issues should be explored individually with clients because again, due to the variability of responses, what may meet the needs of one person may only serve to frustrate another.

Finally, based on the results from this study and from the literature, counsellors exploring lifestyle issues with their clients can recommend participation in exercise activities both as a means of maintaining physical health and for promoting optimal mental health.

In terms of counselling theory, several recommendations can be made for research. First, there is a need for more studies examining the psychological effects of exercise programs for persons with disabilities. There are many different exercise interventions that could be used and a wide variety of persons with physical disabilities who might benefit from such interventions.

Sonstroem and Morgan's (1989) model provides a useful framework from which to proceed in terms of determining the mechanism through which psychological changes take place. Ideally some instruments should be developed and validated to measure physical self-efficacy specifically for persons with disabilities.

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APPENDIX A

Description of Parastep

Parastep Clinical Programs at Rehabilitation Institutions

Sigmedics, Inc. currently provides Parastep Programs through collaboration with physicians and physical therapists at leading rehabilitation institutions and hospitals across the United States, Europe and Middle East.

The staff of Sigmedics serves as a support arm for the clinics' professional staff and Parastep users. Professional educational programs are provided by Sigmedics' clinicians to participating physicians and physical therapists.

In addition, ongoing technical and service support for healthcare professionals and users is provided.

The Parastep® I System enables appropriate spinal cord injured patients to stand and take steps. The Parastep I is not intended for all patients. Patients must generally be in good health and have the ability to demonstrate adequate trunk control and balance to maintain an upright posture. The Parastep I is contraindicated for individuals with severe scoliosis and osteoporosis as well as a variety of other conditions. A prescribed period of physical therapy training is necessary for the safe and effective use of the Parastep I. For complete information on the Parastep I, including indications, contraindications, warnings, precautions and adverse effects, contact Sigmedics, Inc., at One Northfield Plaza, Suite 410, Northfield, Illinois 60093-3016, (708) 501-3500.

CAUTION: Federal law restricts this device to sale by or on the order of a licensed physician.

Sigmedics, Inc.

Sigmedics, Inc. designs, manufactures and markets rehabilitation products which help improve the quality of life for those who are neurologically impaired. For further information, contact:

SIGMEDICS, INC.

One Northfield Plaza, Ste 410, Northfield, IL 60093, U.S.A.
Tel: (708) 501-3500 Fax: (708) 501-3404

THE PARASTEP® I SYSTEM

A non-invasive system for standing and taking steps

The Parastep System has been shown to be a safe and effective means to enable standing and short distance walking by people who have sustained a spinal cord injury. As a functional neuromuscular stimulation (FNS) device, it comes from the medical engineering sciences known as neuroprosthetics.

The Parastep System is a FNS modality provided as an alternative to traditional bracing and other orthotic approaches to long term rehabilitation management of spinal cord injury. Candidates for The Parastep System are spinal cord injured individuals for whom standing and gait training is indicated following evaluation by medical professionals.

Control of paralyzed muscle for limited ambulation

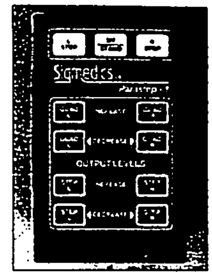
It has long been accepted in rehabilitation medicine that prolonged inactivity has extensive deleterious physiological consequences. Few question the benefits of standing after spinal cord injury. The use of functional electrical stimulation by individuals with neurological impairments has been shown to be therapeutically effective for retarding and reversing muscular atrophy; increasing local blood flow in stimulated muscle; and increasing the range of motion at inactive joints.

The Parastep affords the user the ability to activate his/her own muscles and stand and bear weight on the long bones of the legs when and where the individual desires to do so, whether at home or in the workplace.

The Parastep System, when used in an approved program of long-term spinal cord injury management, will enable the individual to stand and walk short distances. Users of the system report that the Parastep improves emotional and psychological well-being by enhancing self-esteem and morale.

User Independence and Control

Available upon physician prescription, the Parastep, a compact and lightweight system, consists of the following components:



- A microcomputer-controlled functional neuromuscular stimulation unit
- A battery activated power pack with recharger
- The Paratester™, a unit for pretesting system operation and cable integrity
- Surface applied electrodes
- Power and electrode cables
- A control and stability walker with finger activated control switches
- Physical therapy training at an approved clinical site
- Full technical and service support

Reusable electrodes are easily applied and removed. Set-up is usually performed in less than 10 minutes.

The user controls the system by initiating commands to the microcomputer-controlled stimulator. The stimulator unit activates electrical impulses to the lower extremities to enable standing and walking.

The user initiates commands either through a user-friendly keypad on the stimulator unit or via control switches mounted on an electronically adapted walker. The walker provides balance and stability to the user while standing and walking.

The stimulator is powered by eight AA-NiCad batteries and is housed in a lightweight waistpack.

APPENDIX B

Sample Evaluation Form

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Physical Therapy Assessment

PATIENT NAME	ID #
DATE	INSTITUTION

Pre-training Assessment:

		yes	no
Musculo-Skeletal Evaluation			
Is the user without signs of joint instability at hip, knee or ankle which precludes standing or stepping?	1	☐	☐
Is the user without signs of soft tissue inflammation related to stress or over use?	2	☐	☐
Skin			
Does the user's skin tolerate stimulation?	3	☐	☐
Upper Extremity Strength			
Is strength adequate to enable a patient to lift his body weight out of a chair and into a standing walker?	4	☐	☐
Is the patient able to stand using one arm for support?	5	☐	☐
Trunk Control and Balance			
Can the patient maintain upright stance with minimal upper extremity effort?	6	☐	☐
Does the patient display protective extension reactions?	7	☐	☐
Does the patient display protective equilibrium reactions?	8	☐	☐
Does the patient demonstrate an adequate sense of balance?	9	☐	☐
Is spatial orientation adequate?	10	☐	☐
Is awareness of posture accurate?	11	☐	☐
Lower Extremity FES Force Production			
Is FES muscle power sufficient to maintain locked knees while full weight bearing in standing double support? (A grade of fair+ with FES MMT)	12	☐	☐
Can the patient detect quadriceps fatigue and properly adjust stimulus intensity?	13	☐	☐
Circulatory Adjustment			
Do heart rate and blood pressure respond appropriately to upright stance?	14	☐	☐
Do heart rate and blood pressure return to resting levels within 5 min after standing?	15	☐	☐
Posture			
Is standing posture erect with less than 20% of body weight born by the upper extremities?	16	☐	☐
Fatigue/Recovery			
Can the patient stand for a minimum of three minutes?	17	☐	☐
Does the patient recover standing capability reasonably soon (5-10 min) after fatigue?	18	☐	☐
I have evaluated the above individual and determined (him/her) to be a candidate for the Parastep functional electrical stimulation program to maximize (his/her) ambulatory potential.	19	☐	☐

_____________________________ PT

SIGNATURE

Submit this form to the medical monitor prior to the initiation of parastep training

PARASTEP® FES System

Medical Acceptance Evaluation

PATIENT NAME	ID #
DATE	INSTITUTION

Medical Criteria:

		yes	no
1.	Status six months post recovery spinal cord injury and restorative surgery (if any)	1 ☐	☐
2.	Stable ortho-neuro-metabolic systems	2 ☐	☐
3.	Intact lower motor units (L1 and below)	3 ☐	☐
4.	Without history of long bone fractures, severe osteoporosis, hip or knee degenerative joint disease	4 ☐	☐

Clinical Criteria:

		yes	no
1.	Does the patient demonstrate and express appropriate motivation and commitment to the therapeutic program?	5 ☐	☐
2.	Is muscle and joint stability available for weight bearing at upper and lower extremities?	6 ☐	☐
3.	Is sufficient range of motion available at all extremity articulations?	7 ☐	☐
4.	Does the patient demonstrate appropriate muscle contractile response to Functional Electrical Stimulation (FES)?	8 ☐	☐
5.	Is motor hyper activity sufficiently controlled to allow safe independent upright stance?	9 ☐	☐
6.	Does the patient demonstrate adequate learning ability to successfully employ the PARASTEP SYSTEM?	10 ☐	☐
7.	Does sensory perception of electrical stimulus allow sufficient level required for muscular contraction?	11 ☐	☐

Functional Criteria:

		yes	no
1.	Is FES muscular force at the hip and knee sufficient for required function?	12 ☐	☐
2.	Does the patient respond to upright positions and with adequate hemodynamic and ventilatory responses?	13 ☐	☐
3.	Is the patient independent in all transfers?	14 ☐	☐
4.	Does the patient demonstrate adequate standing tolerance to perform biped activities?	15 ☐	☐
5.	Does the patient demonstrate adequate balance and control skills to maintain an upright supported posture independently ?	16 ☐	☐
6.	Does the patient demonstrate adequate hand and finger control to manipulate system controls?	17 ☐	☐

Exclusionary Criteria:

		yes	no
1.	Cardiovascular disease or pulmonary insufficiency	18 ☐	☐
2.	Epilepsy	19 ☐	☐
3.	Pregnancy	20 ☐	☐
4.	Severe scoliosis	21 ☐	☐
5.	Osteoporosis related fractures	22 ☐	☐
6.	Skin disease at stimulation sites	23 ☐	☐
7.	Irreversible contracture	24 ☐	☐
8.	Morbid obesity	25 ☐	☐
9.	Vision or hearing impairments which interfere with training	26 ☐	☐
10.	Autonomic Dysreflexia	27 ☐	☐
	I have evaluated the above individual and determined (him/her) to be a candidate for the Parastep functional electrical stimulation program to maximize (his/her) ambulatory potential.	28 ☐	☐

________________________ MD

Sigmedics© 05/93

Submit this form to the medical monitor prior to the initiation of parastep training

APPENDIX C

Informed Consent Form

Department of Counselling Psychology
Faculty of Education
5780 Toronto Road
Vancouver, B.C. Canada V6T 1L2
Tel: (604) 822-5259
Fax: (604) 822-2328

Informed Consent

Purpose. The purpose of this study is to determine the psychological changes that take place as a result of spinal cord injured paraplegics participating in a walking system training program. We have shown that paraplegics can learn to stand and take steps using a walking system which supplies neuromuscular stimulation (NMS) to drive the muscles of the lower extremities. We have been studying the changes in physical fitness that take place and are now interested in examining whether any psychological changes occur.

Procedures: To participate in this study you must fulfill the following criteria: be 18-45 years of age, have been discharged from initial hospitalisation at least six months, and have a spinal cord injury from thoracic vertebrae 4-12. All volunteers will be evaluated to determine: if the passive range of motion movements in the lower extremities are within normal limits, joint integrity of the hips, knees and ankles and bone density of the head of the femur.
Before commencing the study you will be asked to complete four psychological questionnaires. These questionnaires are designed to measure self-concept, general mood states, depression and "self-efficacy" - which measures how confident you feel about your ability to successfully learn new tasks. The results will be kept strictly confidential. Any questions or concerns you have regarding these questionnaires will be addressed. On completion of 32 sessions of training you will be asked to complete the same tests again.
In addition to the self-report measures, following the completion of training, an interview will be conducted with you in which you will be asked to respond to several questions regarding your experiences during the training process. This interview will be tape-recorded and subsequently analysed. Following analysis the tapes will be destroyed.

Therapy and Modalities: If selected to participate in this study you will begin with leg training to build up the strength of the quadriceps muscle. Once it has been determined that the quadriceps are strong enough to support the body in an upright position for at least five minutes, standing will begin. The goal will be to achieve the ability to take steps for 150 feet or greater within 32 sessions. It will take approximately 12 weeks to complete the 32 sessions at a frequency of three times a week.

APPENDIX D

Interview Protocol

Appendix

Interview Protocol

A general orientation to the interview will be given initially, explaining the purpose for doing the interview and emphasizing that the interviewer is interested in learning about all aspects of the participant's experience, including both positive and negative reactions and that a wide range of reactions are possible. Confidentiality of responses will also be stressed and participant's will be assured that in the final analysis,only common themes in responses will be reported and no individual will be identified by name.

1. Can you describe for me how and why you became interested in learning to use the Parastep walking system?
2. Try to think back to the beginning of the program and describe for me what your expectations were, i.e. what did you hope to achieve by participating in this program?
3. Now that you're nearing the end of the program do you feel that those expectations were met? If not, how was the experience different to what you expected?
4. Can you describe for me the positive and negative aspects of this experience?
5. Do you feel in any way different physically now as compared to when you started the program? Please describe.
6. How about mentally or psychologically, has anything changed for you over the last few months? Please describe.

7. How do you feel about continuing this type of exercise in the long-term after this program ends?

8. How would you rate this form of exercise in comparison to other activities that are available to you such as swimming, weight-lifting or wheelchair racing?

9. Can you explain to me whether or not it was important to you that this particular exercise program involved standing and walking.

10. If so can you describe why it is important to you to be able to stand and walk?

11. If someone else were to ask you whether the time and effort involved in learning this activity were worth it, what would you tell them?

APPENDIX E

Summary and Frequency Count of Interview Data

Summary and Frequency Count of Interview Data

1.Can you describe for me how you became interested in learning to use the Parastep walking system?

Frequency	
7	Word of mouth or through the media
6	Had contacted Miami Project and expressed interest in participating in research and was told about the walking program

2. Try to think back to the beginning of the program and describe for me what your expectations were prior to starting, i.e., what did you hope to achieve by participating in this program?

3	Did not know what to expect
5	Had specific expectations, e.g., to use it as a form of exercise
3	Hoped it might lead to return of function

3. Now that you're nearing the end of the program do you feel that those expectations were met? If not how was the experience different to what you expected?

8	Expectations were met
3	Expectations were not met

4. Can you describe for me the positive and negative aspects of the experience?

	Positive
4	The experience of standing and walking
3	The strenuous exercise
3	The process of getting in shape and feeling healthier
3	The increase in size of the leg muscles
	Negative
3	Initial difficulty getting a good step response was frustrating
3	Expectaions were not met

5. Do you feel in any way different physically now as compared to when you started? Please describe.

10 Increase in size and tone of the leg muscles
3 Breathing feels less restricted
6 Generally feels healthier
3 Noticed some changes in sensation below the level of the injury, e.g. increased awareness of muscle contraction or deep pressure

6. How about mentally or psychologically, has anything changed?

8 Sense of accomplishment from completing the training
8 Increased feeling of well-being and self-confidence
3 Improved self-concept due to the physical changes
3 Increased sense of independence from living alone during the study
4 Feel more "able" knowing that they have the ability to get out of the chair

7. Can you explain to me why it was important to you that this exercise program involved standing and walking?

Responses reported individually for this question.

8. How would you rate this form of exercise in comparison to other activities such as swimming, weight-lifting or wheelchair racing?

5 Better, because it works the muscles below the level of the injury
7 Better because the exercise is more intense
3 Better than long leg braces

9. How do you feel about continuing this exercise in the long-term?

7 Would like to continue the exercise
3 Would like to continue but has some concerns about maintaining motivation level

10. If someone else were to ask you whether the time and effort involved in learning this activity were worth it what would you tell them?

7 Yes it was definitely worth it

3 Its worth it but a person needs a lot of willpower and motivation to stay with the training program