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HIV and Exercise: A pilot study of strength training effects on HIV+ patients and a survey of exercise behaviour in the HIV+ population.

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ABSTRACT

HIV infection is a disease that attacks the immune system. Associated conditions include muscle wasting (occurring at more advanced stages of the disease), and mood disturbances due to stressors like the diagnosis itself, treatment, and social stigma. Exercise has been associated with improved muscle function, more favourable psychological function, and improved immunity, in normal populations. The same has also been postulated for HIV+ populations making exercise an ideal candidate for a complementary therapy for HIV+ patients. This study was undertaken in order to investigate the effects of moderate intensity strength training on various parameters in HIV+ patients.

Six subjects were recruited (5 male, 1 female) and randomly assigned to an exercise or control group. At stage 1, the exercise group received 12 weeks of a moderate strength training programme 3 times each week, while the control group went about their normal routines. Changes in variables were compared between the exercise and control group (**2 sample-t-test**). In stage 2 the control group received the exercise programme, and their changes were compared to their changes in stage 1 **(paired-t-test)**.

Results showed that in stage 1 the exercise programme tended to increase muscle function, and this was significant for quadriceps isometric strength when comparing the exercise group to the control group **$t(3)=3.94$, $p=0.029$**. Psychological function also tended to improve, with the strongest evidence coming from the profile of mood states (POMS). Changes reached significant levels for comparison of experimental with control group, for the total POMS scores **$t(4)=3.83$, $p=0.019$,** and two subscales of the POMS, energetic-tired **$t(4)=2.83$, $p=0.047$**, clearheaded-confused **$t(4)=3.60$, $p=0.023$**. The trend of improved mood with exercise

in stage 1, was followed by similar changes in stage 2 for the control group. The immunological data did not show any trends of changes with exercise. Because of the low numbers of subjects results from this study are only indicative and by no means strong. In conclusion, it seems that exercise is associated with improved strength and mood.

The low recruitment for this pilot study indicated a possible motivational issue with exercise and HIV+ people. Exercise adoption and maintenance is a problem for the general population, but it seems clinical populations are especially problematic. As there were no studies on exercise levels and attitudes towards exercise concerning HIV in the literature, it was deemed worthy of investigating those for the Glasgow HIV+ population.

Fifty seven (57) subjects were recruited from the Brownlee outpatients clinic (46 men and 11 women). They were asked to complete a questionnaire on the stages of exercise behaviour, which included the current recommendations for regular physical activity and motivations and barriers to exercise. Medical data (like weight and CD4 cell count) were also collected. The subject population was representative of the whole HIV+ clinic population, in terms of the proportion of subjects who were homosexual, drug users, and "others"(e.g. heterosexuals, haemophiliacs).

Results showed that the activity levels of HIV+ patients a were similar to those of the general population with 38% regularly active, 62% not meeting the current recommendations. However, under closer examination by method of contraction it seemed that the drug users group and 'others' were less active (74% and 80% respectively not meeting the current recommendations for regular physical activity). It was also seen that of the subjects now inactive, 82% were active before diagnosis.

In terms of motivations to exercise the HIV+ subjects did not seem to differ from the general population. In terms of barriers the HIV+ subjects seemed to rate time much lower than the general population and perceive "obstacles" to be higher (e.g. lack of facilities, bad weather), also limiting health reasons were a perceived as higher.

In conclusion, there seems to be a large number of HIV+ patients not meeting the current recommendations of regular physical activity, and this is pronounced for non-homosexual HIV+ patients. Given that exercise is safe and has the potential to be beneficial for HIV+ people, promoting exercise would be appropriate. Results from this study suggest that when designing a health promotion strategy for HIV+ patients, the health benefits of exercise and the fact that exercise is a safe practice for HIV+ people should be emphasised.

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CHAPTER 1:

GENERAL INTRODUCTION

1.1. The history of HIV and AIDS

The Acquired Immune Deficiency Syndrome (AIDS) was first described in 1981 (Mindel and Miller, 1996). This apparently new disease has since become a major global public health problem. However, the cause of this new disease complex was not recognised until 1983, when retroviruses were isolated from lymphocytes of patients in laboratories in France and the USA. In France, the virus was called Lymphadenopathy Virus Type (LAV) and in the U.S.A it was called Human Lymphotropic Virus Type III (HTLV-III). These viruses were found to be essentially the same and the common nomenclature, Human Immunodeficiency Virus (HIV) was adopted in 1986 (Mindel and Miller, 1996). HIV was shown to be associated with AIDS in 1984 (Mindel and Miller, 1996).

The HIV virus has been isolated in most body fluids, however, its modes of transmission are limited. The main ways of documented HIV transmission are: anal and vaginal intercourse, sharing of contaminated needles, transfusion of infected blood and blood products and vertical transmission from mother to foetus *in utero* or at delivery (Mindel and Miller, 1996). Studies of the household members of infected patients have found no evidence of casual transmission of the virus through daily domestic activities (Mindel and Miller, 1996).

At the beginning of the epidemic HIV was thought to concern only the following high risk groups: homosexual or bisexual men, intravenous drug users and people with the need for blood transfusion such as haemophiliacs. However, the rates of heterosexual transmission are rising. By the year 2000 the estimated heterosexual transmission rates will be 80-90% of HIV infection world-wide (Mindel and Miller, 1996). This will mainly be a result of increased heterosexual transmission in the

Western world since this is the main mode of transmission in Africa (Mindel and Miller, 1996).

There are now tests available to determine whether a person is infected with HIV. The most widely used one is the HIV antibody test. This test indicates whether an individual has been infected, but does not give any details about the strength of the immunity system. It is almost certain that HIV positive people will remain infected and are potentially infectious to others. HIV positive people are also almost certain to develop AIDS (Mindel and Miller, 1996).

1.2. The immunology of HIV-1 infection. Disease classifications.

Once an individual gets infected with HIV the production of antibodies to the virus (seroconversion) occurs within 3-12 weeks. The virus infects most tissues but it primarily infects the cells of the immune system, where it transcribes its genetic material from RNA into DNA and produces copies of itself. Eventually the new viruses leave the host cell by breaking the surface membrane and destroying the cell, however some cells are not destroyed. The period between infection and the decline of the immune system is usually a period between a few to 15 years during which time the infected person's immunity functions normally and appears (or actually is) healthy. But as the immunity starts to deteriorate, opportunistic infections develop as the body becomes less able to fight them (Mindel and Milller, 1996).

Immune function is determined by the number of T4 lymphocytes which are primarily responsible for the cell mediated immunity. The T4 cells are also called CD4 cells (Counter Deficit). As the disease progresses the CD4 cell count drops from a normal 800-1300 cells /mm^3 down to bellow 200 cells/mm^3 (Birk, 1996). There is

also another kind of immune cell called CD8 which hasa cytoxic or suppressor function. Their role is to turn the immunity system off (suppress) after an antigen has caused CD4 cell proliferation. In healthy adults the ratio of CD4/CD8 is 2:1, but in an infected person the ratio drops down gradually to reach values of 0.2 (Birk, 1996). This means, in practical terms that the immune system tends to be switched off (suppressed) and is not as efficient.

Defining the stages of HIV infection is not easy as there are a lot of different definitions of disease stages. There are mainly four stages of the HIV infected spectrum and they are defined by CD4 cell count and number of symptoms (also known as the Walter Reed Staging Classification, modified from Rigsby *et al.*,1992):

1) HIV negative status (with normal CD4 cell count of 800-1300)

2) HIV+ with a CD4 cell count above 500 with no symptoms

(asymptomatic phase)

3) HIV+, with CD4 cell count between 200-500, without symptoms (asymptomatic but mildly immunocompromised) or with 1 or 2 major symptoms (Aids Related Complex **ARC**)

4) HIV+, with CD4 cell count of bellow 200 and 2 or more symptoms

(full blown AIDS)

Generally disease progression is classified by the CD4 cell count and the number of major symptoms. The exact definition differs from source to source, and is a fairly complex matter. However, it is generally accepted that infection will lead to AIDS and that anyone with a CD4 cell count bellow 200 has AIDS (although that does not necessarily mean that they will be symptomatic, i.e. have major symptoms).

To add to the uncertainty of disease definition comes the new concept of viral load. Viral load is the number of particles of the virus existing in a millilitre of blood

and is measured in a log scale (in powers of 10). During the first three months of infection viral load is very high, but it drops after that and rises again at the later symptomatic stages of the disease. The importance of viral load on the disease progression and disease definition has now been recognised. A high viral load increases the chances of opportunistic infections in the near future and a reduced viral load in response to antiretroviral therapy is predictive of an improved prognosis (Mellors *et al.*, 1996). These days the best predictors of disease progression are CD4 cell counts and viral load taken together (O'Brien *et al.*,1996).

1.3. Exercise and health benefits

Since the times of the ancient Greeks it has been recognised that exercise can improve health both physiologically and psychologically. Currently, evidence exists to show that exercise can improve several health related factors such as: glucose tolerance and insulin sensitivity, bone density, immune function, psychological function, blood lipid profiles, resting blood pressure and body lipid composition (US Surgeon General's Report, 1996). Therefore exercise is associated with lower the risk of diseases such as: Coronary Heart Disease, hypertension, non-insulin-depended-diabetes mellitus, osteoporosis, colon cancer and anxiety and depression (US Surgeon General's Report, 1996).

The importance of exercise for mental well being has been recognised since the ancient times, although scientists have yet to reach a concise conclusion. The accumulated evidence seems to suggest that exercise has a wide range of psychological benefits, reduced depression (Morgan, 1994), reduced anxiety (Landers and Pretruzzelo, 1994). A large cross-sectional study done in the USA and Canada

showed a positive association between physical activity and mental health (Stephens, 1987). Stephens concluded that the level of physical activity is positively associated with good mental health when health is defined as positive mood, general well-being, and relatively infrequent symptoms of anxiety and depression (Stephens, 1987).

The report of the US Surgeon General (1996) concluded that regular physical activity appears to relieve symptoms of depression and anxiety and improve mood. It also states the possibility of a preventative effect of activity on developing depression, although more research is needed on this topic. The report also stated that physical activity seems to improve health-related quality of life by enhancing psychological well being and by improving physical functioning in persons compromised by poor health (US Surgeon General's Report, 1996).

Exercise has also been demonstrated to have positive benefits on self-esteem (Sonstroem, 1984). Self-esteem is a personal judgement of one's worth (Fox, 1989), which influences behaviour and attitudes. This becomes very important in clinical populations. Mutrie (1997), when reviewing the therapeutic effects of exercise, concludes that the potential for exercise as a way of redefining the physical self for people suffering with chronic conditions is evident.

The International Society of Sports Psychology published a position statement which summarises the psychological benefits of exercise (1992). In conclusion, this states that potentially exercise can:

-Reduce state anxiety.

-Decrease levels of mild depression.

-In the long term, reduce anxiety.

-Serve as an adjunct treatment for severe depression.

-Reduce stress and have beneficial emotional effects.

Assymptomatic HIV+ people should be able to benefit from exercise in the same way as HIV- people.

1.4 Aims of this thesis

The aim of this thesis was to provide information on physiological, psychological and immunological responses to strength training in an HIV+ population using a randomised control trial. The results of this are reported in study one. As a result of difficulty in recruiting subjects a secondary aim of investigating motivations and barriers in an HIV+ population evolved. The results of this investigation are reported in study two.

CHAPTER 2:

FIRST STUDY: A PILOT STUDY OF STRENGTH TRAINING EFFECTS ON HIV+ PATIENTS.

2.1. Introduction

The effects of exercise will be reviewed on immune function and psychological function, as it is relevant to HIV+ people. Each parameter will be discussed separately, and then there will be a section trying to connect the two areas, in a new field called Psychoneuroimmunology, which intergates the effects of psychological variables among the nervous and immune system.

2.1.1. Immunology.

In this section the effects of exercise on immune function will be reviewed, in general and specific for the HIV+ people.

Exercise and immunology

"Physical fatigue, whether caused by exercise or manual work, has long been considered a factor affecting (increasing) susceptibility to illness." (Mackinnon, 1992 p.1). There is also a perception among athletes and coaches that increased intensity training makes athletes more susceptible to illnesses (Mackinnon, 1992). This has come about by observing the number of colds and flues during intense training. Current evidence supports this notion that during training athletes are more susceptible to illnesses. Athletes appear to suffer high rates of certain illnesses such as infectious mononucleosis (Foster *et al.*, 1982). The fact that athletes report more illnesses during intense training, has led scientists to examine the effects of exercise on the immune system. The effects of exercise on T-cells , which are the most

relevant to HIV+ patients, as they are used to indicate disease progression and immune function, will be reviewed in the following section.

In studies on the effect of exercise on specific immune cell populations there are two parameters which are of importance: the exercise mode and the cell measurements. The effects of acute (one bout of exercise) or chronic exercise (regular activity, e.g. 3 times a week for 8 weeks) can be investigated by measuring cell number, cell reactivity to specific antigens (proliferation) or both.

Effects of acute exercise on T cells.

T-cells are divided into CD4 cells which are the helper or inducer cells and the CD8 cells which are the cytoxic or suppressor cells. As mentioned before the ratio between the cells is very important. Studies on acute exercise and CD4 cell count have not reached unanimous results. Most studies report an increase (16%, Shepard and Shek, 1996) , but some report a depression after prolonged low-intensity exercise (Gannon *et al.*, 1995). What is more conclusive is that CD8 suppressor cells tend to increase with exercise (Shepard and Shek, 1996). Although some studies have found that exercise has no effect on the CD4 to CD8 ratio, most studies have shown that the ratio decreases suggesting that acute exercise causes immunosupression (Keast *et al.*, 1988). The ratio is however restored after rest of 60-120 minutes (Shepard and Shek, 1996).

Data from 11 studies reviewed by Shepard and Shek (1996), showed that for moderate, prolonged activity of 60% of maximum aerobic power for 66 minutes subjects with an maximum aerobic power of 58 ± 2 ml/ kg/min had an initial CD4/CD8 ratio of 1.66. This was reduced after the exercise bout by 21% down to

1.31. The CD4 cell count increased by 16.3% and the CD8 cell count increased by 50.4 %. In four of those eleven studies measures were taken again 60-120 minutes after cessation of exercise. At this stage, the CD4/CD8 ratio had increased to 1.81 $\pm$ 0.17. The actual counts were suppressed below initial levels by now 13.9 % for the CD4 and 22.7 % for the CD8.

A further nine studies were reviewed by Shepard and Shek (1996), providing data for the higher intensities of 76% of maximum aerobic power for an average duration of 45 minutes. The subjects had similar aerobic power (58 ml/kg/min) to the previous two studies reported above . The initial CD4/CD8 ratio was 1.81 $\pm$ 0.16 , (slightly higher than the average in the previous group of studies) but it decreased by 38% to 1.14. The CD4 cell count increased by 25.3% (similarly to the lower intensities above). However, CD8 cell counts increased by a much larger 103.5%. Five of nine studies repeated observations after 96 minutes after exercise. At that stage, the CD4/CD8 ratio had increased to 1.83. With CD4 cell counts 2.8 % above baseline values and CD8 cell counts 8.4% below baseline.

On studies done on very prolonged activities such as marathon and triathlon competitions (average duration 230 minutes), the picture immediately after exercise is slightly different. Data from four studies reviewed by Shepard and Shek (1996) show that after such long events CD4 cell counts decreased by 24.1% from baseline levels and, CD8 cell counts decreased by 28.7%. The ratio between CD4 and CD8 cell counts was also reduced by an average of 11% from 1.42 to 1.26 (Shepard and Shek, 1996). What happens after long events like marathons to CD4 and CD8 cell counts and the ratio is not clear. Gannon, *et al.*, (1995) reported that two hours following a 400-min cycling event, counts for both CD4 and CD8 were below baseline, but their

ratio now exceeded baseline values. In contrast, Gabriel (1994) reported that the CD4/CD8 ratio remained very low 3 hours after completion of an ultra-marathon.

Therefore, the general consensus for moderate to high intensity (55-75% of maximum aerobic power) of prolonged exercise (40-70 minutes) is that CD4 and CD8 cells both increase with acute exercise, however, CD8 cells have a greater increase, the CD4/CD8 ratio, therefore, decreases, (when measured immediately after exercise). After 60 -120 minutes the CD4 and CD8 cell counts fall below their initial values, however, the CD4/CD8 ratio returned to baseline levels (Shepard and Shek, 1996).

The values and percentages of the changes in CD4 and CD8 cell counts and their ratio depend on the intensity and duration of exercise and on the initial fitness level of the subjects. Other factors that may influence the response of T-cells to exercise are age, gender, smoking habits, type of exercise, nutritional status and environmental factors (Shepard and Shek, 1996).

Apart from cell numbers and their ratios, another interesting measure of the immune function is T-cell proliferation. After exposure to antigens, lymphocytes become activated and proliferate (Mackinnon, 1992)."The process can be assessed by an in vitro assay that measures incorporation of radioactively labelled precursors into lymphocyte DNA" (Mackinnon, 1992, p.36). Antigens used in such studies include: concavalin A (ConA) and phytohemmaglutinin (PHA) (Mackinnon, 1992).

Response to T cell mitogens (ConA or PHA) may be suppressed by prolonged exercise. Exercise shorter than 1 hour has little or no effect on T-cell responsiveness (Mackinnon, 1992). For example, responses to ConA and PHA were unchanged 30 minutes after a 7K run in marathon runners (Eskola *et al.*, 1978). However, for more prolonged exercise like marathons, proliferation clearly decreases (Mackinnon, 1992,

p.37). For instance, in runners, ConA responsiveness decreased to 50% following a marathon (Eskola *et al.*, 1978; Gmunder *et al.*, 1988). PHA response also dropped about 40% following marathon running (Eskola *et al.*, 1988). This reduction in proliferation might be expected since CD4 and CD8 cell counts drop after marathon type events, as demonstrated in Shepard and Sheck (1996). Mackinnon, however, states that "Lymphocyte redistribution alone cannot account for suppression of mitogenic stimulation, because decreases in proliferative response to T-cell mitogens may occur without changes in lymphocyte or T-cell number" (Mackinnon, 1992, p.37).

Effects of training and T cells.

By training most researchers mean chronic exercise and the type of training used in most cases in endurance training. Although it has been suggested that well trained athletes may have lower resting leukocyte numbers (Green *et al.*, 1981), the majority of research indicated no real difference (Mackinnon, 1992). Cross-sectional studies have shown that there is little difference between trained and untrained populations in their T cells (Nehlsen-Cannarella *et al.*, 1991). Some studies have found that the trained group have a lower CD4\CD8 ratio (Gabriel *et al.*, 1992). Most of the longitudinal studies have shown the same results, after training CD4 cells tend to drop and so does the CD4\CD8 ratio. For example, Neisler *et al.* (1990) noted that after 27 weeks of training the mean CD4 cell dropped from 1272 to 886 (cells/μl) and the CD4\CD8 ratio dropped from 1.99 to 1.62. As Shepard and Shek imply in their review (1996) most of these results have to be interpreted with caution since the intensity of training was not uniform and in some instances not appropriate. For instance in one study the intensity of exercise produced no effect on $\dot{V}O_2$ max

(Nehlsen-Cannarella *et al.*, 1991). Generally, there is no consensus on the results of such studies.

In addition to the effects on T-cells, training seems to influence the cell counts and proportions of other immune cells involved in immunity. For example, training seemed to increase the number of Natural Killer (NK) cells and their reactivity to antigens (Crist *et al.*, 1989; Cameron *et al.*, 1987). NK cells play a very important role in cellular-mediated immunity. Therefore examining T cells alone does not give a complete picture of the effects of exercise on general immune function. In fact Mackinnon (1992) stated that the changes in T-cells with exercise are transitory and it is still unclear whether immune function is influenced by these changes.

Mechanisms for exercise induced T-cell changes .

The connection between exercise and T-lymphocytes is still not very clear. Research suggests that circulating catecholamines, specifically adrenaline, may be responsible for the changes in the number of leukocytes seen the peripheral blood after exercise (Keast 1988). Mackinnon (1992) noted that hormones such as adrenaline and cortisol affect leukocyte distribution between circulating blood and various body compartments such as the liver, spleen, and bone marrow.

McCarthy and Dale (1988) proposed a model in which exercise induced changes in leukocyte numbers can be explained by the combined effect of adrenaline and cortisol. According to this model leukocytosis (increase in number of T-cells and other leukocytes) in brief exercise (less than 1 hour) is due to an increase in adrenaline. Because there is a delay in the appearance of cortisol in response to exercise, leukocytosis due to cortisol only occurs after an hour of exercise. During exercise lasting more than 1 hour, the two hormones act together, possibly synergistically, with a maximum effect on leukocyte numbers occurring 3 hours from

the onset of exercise. After cessation of exercise the rapid decline in leukocytes is due to the fast removal of adrenaline (within 30 minutes), whereas the prolonged leukocyte number elevation is due to the slower return of cortisol to baseline levels. During very prolonged exercise like a marathon (or anytime during exercise in a fatigued athlete), depletion of catecholamines and cortisol may cause a decline in leukocyte number (McCarthy and Dale, 1988).

Some researchers have evidence that altered blood flow may contribute to exercise-induced leukocytosis (Ader *et al.*, 91). Canine studies suggest that exercise stimulates lymph flow from skeletal muscle tissue and that this "tissue pump" effect can deliver large numbers of lymphocytes to the circulation (Lindena *et al.*,1984). A study by Muir *et al.* (1984) suggests that increased perfusion of the lungs may also serve to deliver lymphocytes to the circulation.

Another theory is based on the fact that the lymphocytes rely on glutamine for the production of cells. Glutamine is primarily produced in muscles (Keast 1988). Newsholme (1990) states that the muscular system is part of the immune system and failure to release sufficient glutamine may result in an impairment of the immune system. In the case of chronic overuse of the muscular system, a phenomenon termed overtraining, decreased motor unit recruitment and increased levels of fatigued muscle fibres at rest and in the overtrained state, may result in depressed immune function due to a decreased availability of glutamine for glytaminolysis within otherwise immunocompetent cells (Newsholme, 1990).

Research on exercise and immunology in HIV

There has been relatively little research done on chronic exercise and T-cells in HIV subjects. Most studies have found that exercise does not give a significant increase in CD4 cell counts. However, most of these studies have shown a trend in increase in the number of CD4 cell counts.

Schlenzig *et al.*,(1989), conducted a study in which 28 HIV+ subjects were randomly assigned to either an exercise group or a control group. The exercise sessions consisted of various supervised sports games designed to develop the cardiovascular system, and were conducted for an hour twice weekly for 8 weeks. Participants showed a reduction in depression and anxiety scores and this was correlated to increases in CD4 cell count. The statistical significance of the CD4 cell count was not reported.

The only study that has detected a statistical increase in CD4 cell count after exercise was done by LaPerriere *et al.*, (1990). LaPerriere and his colleagues were investigating the use of exercise as a coping device for the stress of an HIV+ diagnosis and the effects that this stress has on immune function. They recruited fifty homosexual men in the Miami Exercise Intervention Study (LaPerriere *et al.*, 1990) prior to knowledge of their HIV status. Subjects were randomly assigned to a 10 week exercise programme or control group. The exercise training protocol consisted of 45 minutes on an cycle ergometer 3 times a week with a maximum intensity of 80% of predicted maximum heart rate (MHR). During the fifth week of the study the subjects were tested for HIV antibody status. After the completion of 10 weeks the exercise group reported statistically significant increases for CD4 cell counts. The increase was, however, greater for the seronegative subgroup of the exercise group. The HIV negative (exercisers) increased their CD4 cell count by 220 cell/ml, the HIV positive

group increased theirs by 110 cells/ml, which was still significant. This very positive result has not been replicated since.

Other studies show positive results but often lack crucial details. For example, Florijn and Geiger 1991, used 48 HIV+ subjects randomly assigned to an exercise group or a control group. The authors found that the immunological parameters (CD4 and CD8 cell counts) were stabilised in the exercise group but deteriorated in the control group. A description of the exercise programme was not given.

Small subject numbers and high variability of data also present problems. Rigsby *et al.*, (1992), did a study on 37 HIV+ individuals who were randomly assigned either to a 12 week exercise programme which combined strength training, aerobic training and flexibility, or a control group. The exercise programme was performed three times a week for an hour, which included 20 minutes of cycle exercise at 60-80% of Heart Rate Reserve (HRR) followed by 35 minutes of strength and flexibility training. A non significant trend toward increased CD4 cells (58 cells/mm^3) was observed after the exercise treatment. There was also an increase in the CD4/CD8 ratio for the exercise group from 0.47 to 0.49 compared with the control groups 0.33 to 0.34, but again the intergroup difference was not significant. As suggested by the experimenters the lack of significance may be explained by the large range of initial CD4 cell counts varying from 9-804 cells/mm^3.

Subject recruitment and adherence is also problematic in HIV and exercise research. A good example of this is the study done by MacArthur and Birk (1993) in which 25 HIV+ subjects were recruited to participate in a 24 week exercise programme. However, only six subjects managed to complete the course. All six subjects exhibited physiological improvements. Data from 17 subjects who were tested after 12 weeks showed an increase of CD4 cell count of 20 cells/mm^3 , but this

was not a significant increase. In a follow up to this study, Birk and MacArthur examined their six subjects after a year. Five of the six remained compliant to a 3 day per week of aerobic exercise regime and their CD4 cells were found to be slightly decreased but still stable (Birk and MacArthur, 1994). The results in this study are influenced by a selection bias since the data was collected for those that completed the study and there was no control group.

Most of the above studies have several limiting features including: recruitment of subjects at various stages of disease progression (large variation), exercise programmes consisting of more than one type of exercise, relatively small subject numbers, abscence of appropriate control group and group exercise sessions with a strong social support component (LaPerriere *et al.*, 1992). While recognising that subject recruitment in HIV studies is difficult, these limitations make it more difficult to deduce a positive effect of exercise on immune function.

Despite these limitations, the above studies show that an increase of CD4 cell count is possible for HIV+ people with chronic moderate exercise. However, this increase seems to be greater, the higher the initial CD4 cells count (Birk 1996). People with a low CD4 cell count (below 200) can not really expect an increase in CD4 cell count, after exercise (Birk 1996). It should not be ignored that CD4 cell count maintenance or decelerated decrease could be achieved with chronic moderate exercise.

Summary.

The effects of exercise on the immune system, especially on T-cells is still not clearly understood. Acute bouts of exercise show a biphasic response with elevated CD4 and CD8 cell counts followed by decreased counts. All counts, however, return to baseline after sufficient time. These absolute changes depend on the intesity and

duration of the exercise among other factors. Studies of the effects of training on T-cells have not reached a consensus. In general the effects of exercise on immune function are still unclear (Mackinnon, 1992). Studies on HIV+ patients and exercise show that moderate exercise can perhaps increase or maintain CD4 cell counts, thus perhaps decelerating disease progression.

2.1.2. Psychology

HIV and Depression

Any person with a life threatening disease is likely to experience some sort of stress, and this is also the case for HIV infection (Kemeny *et al.*, 1995). Chonic depression is common in patients infected with Human Immunodeficiency Virus (HIV) (Gorman *et al.*, 1991). Apart from the stress induced by the infection itself HIV+ people are confronted with a social stigma due to the method of infection (Morin and Mayon, 1984). Society tends to think that HIV is a disease of homosexuals and drug users. This stigmatises the infected people who are viewed by society in a way similar to the way infected people were viewed in epidemics like the plague and cholera. "AIDS has become inextricably tied to percepetions of the groups among it is most prevalent, and the stigma of disease and death became attached to the groups themselves" (Herek and Glunt, 1988, p.887). Perhaps as a result of these added stresses HIV infected people tend to have elevated rates of clinical depression (Perry, 1990).

Accumulating evidence supports the notion that stressors can have a negative effect on immune function (Riley, 1981; Solomon and Temoshok, 1987). Perhaps depression does accelerate disease progression in HIV infection, but the evidence is conflicting. Burac *et al.*, (1993), collected data from about a 330 homosexual or bisexual men, and showed that the depressive subjects had faster rates of decline in CD4 cell counts than those who were non-depressed (Burac *et al.*, 1993). The CD4 cell counts of the depressed subjects dropped by a rate 38% faster than that of the

main variable in disease progression. It was estimated by the authors that depression explained only 18% of the variance in CD4 cell decline (Burac *et al.*, 1993). Another study done by Luketsos *et al.*, (1993), concluded that there was no evidence that depressive symptoms independently forecast worse outcome in HIV infection.

Caution is required when interpreting data from depression inventories such as the Beck Depression Inventory. The problem lies with the fact that HIV-disease and depression symptoms overlap (Drebing *et al.*, 1994). Several physiological symptoms of HIV disease like loss of sleep and fatigue, resemble symptoms of depression, and are "diagnostically ambiguous in this population" (Drebing *et al.*, 1994). It is very probable that HIV infected people are diagnosed as clinically depressed when they are not, because some of their HIV symptoms are confused for depressive ones (Kalichman *et al.*, 1995, Rabkin 1994).

Whatever the clinical definition and whether depression actually causes disease progression, the issue is that depression is a psychopathological condition that requires treatment to reduce suffering and to improve functioning (Perry and Fisherman 1993). The accumulated evidence suggests that the development of HIV related physical symptoms increases the likelihood of depression, but the depressive symptoms themselves do not increase the disease progression (Perry and Fisherman, 1993; Rabkin, 1994). However, depression may increase disease progression in a behavioural way, because depressed people are less likely at any time to have taken their drug medication (Burac *et al.*, 1993). Also depression could lead to recreational drug use and increased alcohol intake which in turn may have a negative effect on immunological parameters (Burac *et al.*, 1993). It is also very important not to directly suggest to patients that depression causes immune suppression because such

an attitude may encourage self-accusation (which would increase stress), when disease progression occurs (Perry and Fisherman,1993).

Research on exercise and psychological parameters on HIV+ populations.

Most of the studies that have measured the immunological effects of exercise on HIV+ people, have also collected data on psychological parameters. The evidence from these studies supports the notion that exercise is associated with improved mood and improved subjective well being.

In the study by Schlenzig *et al.*, (1989), 28 HIV+ subjects were randomly assigned to an exercise group or a control group. After 8 weeks of intervention the exercise group showed reductions in anxiety and depression correlated with increases in CD4 cell count. Florijn and Geiger (1991), reported a study in which forty-two HIV+ subjects were assigned to either an exercise or control group. Preliminary results suggest a decrease in depression, fatigue and anger, accompanied with an increase in vigour and quality of life in the exercise group.

Rigsby *et al.* (1992),conducted a study in which 37 individuals were randomly assigned to either a 12 week exercise programme (described in 1.2) or counselling control group. A significant decrease in Beck Depression Scores was observed in both the exercise and counselling groups after 12 weeks of participating in the study. These results suggest that for these subjects exercise training was at least as effective in improving affect as counselling therapy sessions. Again it needs to be pointed out that in these three studies reported there is a strong social support component, as exercise was performed in group format, and that was not controlled as a variable.

The limitations observed in the methodology of these studies in terms of making conclusions on immune function also exist for psychological function. Small number of subjects, large variation of data and poor control of variables, all limit the

inference of a causal relationship between exercise and improved psychological function in HIV and exercise research.

However one study done by Lox *et al.*, (1995), concentrated on the effects of exercise on psychological function and had a good experimental design. The following psychological parameters were measured: physical self efficacy, positive and negative mood, and life satisfaction. The 33 participants were randomly assigned to either an aerobic training group (n=11), a strength training group (n=12), or a stretching/flexibility control group (n=10). After 12 weeks of intervention results indicated that both the aerobic and weight training groups enhanced their physical self-efficacy, positive and negative moods and satisfaction of life. The researchers concluded that these findings seem to indicate that exercise may be one therapeutic means capable of improving components of a subjective well-being and should be considered a complimentary therapy for treating psychological and emotional problems and symptoms associated with an HIV+ diagnosis (Lox *et al.*, 1995).

Summary.

The limited research on HIV, exercise and psychological function seems to indicate that exercise has an positive effect on psychological variables of HIV+ patients and should be considered as a complimentary treatment in terms of psychological symptoms.

Suggested mechanisms of improved psychological function with exercise

One of the most studied and discussed issues in exercise psychobiology over the last two decades has been where or not there is a cause and effect relationship between exercise and mood alterations and the mechanisms involved (LaForge, 1995). There are two main areas of hypothesised mechanisms for exercise-associated mood changes, the psychological and the neurobiological. The psychological

mechanisms include: the distraction hypotheses (exercise provides a time out from daily routine and its stresses), placebo effect (if people believe that exercise can improve psychological function , that belief alone can have effects), cognitive dissonance, self-mastery hypothesis (one feels better after improving on a skill), perceived self competence (exercise improves feelings of self competence this improves global self-esteem). The neurobiological mechanisms include: the opponent process theory, opiods, monoamines, neocortical activation, thermogenic changes, and hypothalamic-pituitary-adrenal axis changes.

The neurobiological mechanisms are of importance for HIV infection since effects of exercise on neurobiological systems will possibly affect the immune system. These mechanisms therefore deserve a closer examination, without discounting the idea of synergistic patterns with psychological mechanisms.

The opponent-process model.

In the opponent-process model the stimulus (i.e. the exercise) causes an increase in central nervous system activity which causes, for example, adrenaline release. The opponent process (an opposing process) is stimulated by this increase in adrenaline and acts to buffer this process by returning the organism to homeostasis. Long-term exercise training causes a constant state of arousal, while the opponent and its affective state (relaxation) becomes increasingly stronger. Over time this results in a reduction in anxiety. This model does not specify a neuroendrocrine mechanism, however, it represents a stimulus-response process that is apparently active in nearly all the proposed mechanisms (LaForge, 1995).

The opioid hypothesis.

In the opioid hypothesis, endogenous opiods released in exercise are responsible for mood alterations. Opioids, and beta-endorphins in particular, remain "one of the prime neurobiologic candidates for mood states" (LaForge, 1995). Although the literature is abundant with studies that show an increase of plasma endorphins with exercise, most of them have failed to associate these elevations with mood states. However, there are some data in support of the endorphin-mood relationship. Three studies (Janal *et al.*, 1984; Allen *et al.*, 1987; and Daniel *et al.* 1992), have managed to provide some evidence in support of the opioid hypothesis. These studies suggest that there is evidence that exercise activated mood changes were mediated via endorphinergic pathways. There is also some debate where these mood changes occur in individuals with normal scores, as larger changes are usually observed in subjects who require psychological care (North *et al.*, 1990).

Another very interesting effect of endorphins is on pain perception and perceived exertion. The association between plasma endorphins levels and perceived effort and pain has been well documented in opioid-blocking type of studies (e.g. Allen *et al.*, 1987).

Considerable debate and interest lies in the role of the peripheral (pituitary-produced) vs central endorphin as mood altering substances. The two systems are thought to be separate and must play different roles since the blood-brain barrier is relatively impermeable to opioids. In the brain (central) endorphin receptors are mainly situated in the amygdala, which is responsible for regulating emotion. Generally it appears that endorphins primarily inhibit neural activity in the brain, they

especially suppress excitatory events, such as those mediated by nor-adrenaline (LaForge, 1995). The neurobiological components of mood, including the serotonergic and adrenergic systems, are certainly influenced by endorphinergic systems, however, specific mechanisms and pathways remain unclear and not well understood (LaForge, 1995). The state of non-invasive brain technology being the main drawback in this kind of research (for example brain imaging technology).

The monoamine hypothesis.

The monoamine hypothesis was brought about by observing that physical exercise may affect central monoaminergic metabolism (Chaouloff, 1989) and that mood disorders like depression and anxiety involve central monoamine systems (e.g.Carlsson and Lindqvist, 1978). There are four main monoamine candidates that are responsible for the mood enhancing effects of exercise: dopamine, nor-adrenaline, adrenaline, and serotonin (5-HT). There are several hypothesis about how monoamine systems may influence mood with exercise. Most of them involve an increase of a the specific monoamine with exercise, and evidence that this affects centres of the brain responsible for mood. For example, one theory proposed by Morgan *et al.*, (1970) involves increased serotonin levels by reducing the active re-uptake of serotonin in the brain. Serotonergic receptors can be found in the limbic system of the brain, which is known to play an important role in emotion and mood (LaForge, 1995).

In the theme of monoamines, Dienstbier (1991) has proposed a "physiological toughness" model, after reviewing research on endocrinological responses to stress. In his model trained populations have lower baselines of adrenaline and nor-adrenaline and are hypothesised to have lower cortisol responses to perceived stressful situations. In acute exercise situations this could mean that for a given absolute level

of exercise, the fitter individual would produce less cortisol and thus exhibit less anxiety.

The cortical hypothesis.

The cortical hypothesis states that acute exercise may stimulate cortical regions of the brain (LaForge, 1995). Neurophysiological research has shown that afferent impulses from the exercising muscle are received by reticular activating neurones in the brain stem, which in turn are connected with various areas of the cerebral cortex (Iwamoto *et al.*, 1987). Electroencephalographic (EEG) studies measuring waveforms in the cortex provide support to this "visceral afferent-feedback mode" of the pathway in which acute exercise affects cortical responses. Specific waveforms have been associated with a variety of behavioural states. Alpha-waves have been the focus of most of the research attention. Most of these studies have methodological shortcomings like: non-standard position of electrodes and data on self-reported anxiety (LaForge, 1995). Alpha-wave patterns are generally thought to be characteristic of a relaxed but attentive mental state and may reflect post-exercise relaxation (LaForge, 1995). It is hypothesised that alpha wave changes are directly associated with perception in mood alterations (Hatfield and Landers, 1987).

EEG studies examining the association of exercise-associated changes in alpha waves and mood states have conflicting results (La Forge, 1995). What is interesting is that studies that have found an association between alpha wave increase and reductions in anxiety have found this to be characteristic of fitter subjects (e.g. experienced runners), and this shows a possible linkage between mood alterations and cardiorespiratory mechanisms. It should also be noted that cortical EEG activity reflects local neurotransmitter activity originating from opiod and monoamine neurones, which projects to the cortex (LaForge, 1995).

The thermogenic hypothesis.

The thermogenic hypothesis relies on the observation that exposure to moderate heating elicits muscular and mental relaxation. In this model there is a link between temperature regulation and muscle tension and perhaps cortical activity. The mechanism suggested is that temperature elevations in the brain stem, especially in the reticular cells, could decrease muscle spindle activity and synchronised EEG activity in the neocortex, both of which are reflecting a relaxed state (LaForge, 1995).

Devries and his colleagues (1968) have published data that support the idea that total body warming reduces muscle tension. They also suggested that exercise induced reduction in anxiety could be caused by body temperature increases.There is no question that certain types exercise increase body temperature, but whether that per se induces relaxation is not fully supported by research (LaForge, 1995). A meta-analysis by Petruzzello and others (1991) did not find a relationship between exercise induced increases in temperature and reduction in anxiety. Generally, the thermogenic hypothesis has the least support from the literature of all the neurobiologic mechanisms (LaForge, 1995). However, it should not be dismissed since there is a close association of temperature regulation centres of the brain and select neuropeptide and monoamine systems. Perhaps incorporating more direct measurements of neural activity (e.g. brain imaging technology) with concurrent evaluation of mood will provide more clear evidence on the effects of exercise-induced temperature increases on neurotransmission in the brain stem, neocortex, and hypothalamus (LaForge, 1995).

The HPA model.

The interaction of the hypothalamus, pituitary, and adrenal glands (HPA axis) has been described as one of the main points of "functional interfaces" between the mind and the body (LaForge, 1995). The interaction between the hypothalamus and the pituitary gland and the autonomic nervous system forms a lot of the framework for mind-body communication (LaForge, 1995). The HPA axis has been the focus of psychoneuroendocrine research and it has been shown that it plays a significant part in depression, anxiety and eating disorders. One of the responses of the HPA axis to physical or emotional stress is corticotrophin releasing hormone (CRH), adrenocorticotropic hormone (ACTH), and cortisol. These stress hormones can be modulated with training, this modulation and in particular that of cortisol is though to be associated with acute mood alterations.

In favour of this hypothesis, data by Luger *et al.*, (1987) showed that trained runners (>45 miles a week) had much less activation of the HPA axis at matched absolute workloads than did moderately trained runners (15-25 miles/week); the HPA axis activation was inversely proportional to the level of physical training. Reciprocally, in overtrained athletes, where mood states are negatively altered, cortisol levels are reported as high. O'Connor, *et al.*, (1989) found significant negative associations between salivary cortisol levels and Profile of Mood States (POMS) scores, in female swimmers. Dunn and Dishman (1991), found that a disruption of HPA axis functioning due to cortisol, was evident in about 50% of patients suffering from depression and melancholia. Thus, the evidence shows that elevated cortisol production has negative influences in mood, whether induced by overtraining or psychopathology.

In Diebster's (1991) "toughening" model exercise training increases catecholamine capacities and delays HPA axis responses. With training, over time, fitter individuals respond to exercise with increased catecholamines while sparing high cortisol responses that are associated with depression, anxiety and fear. Again, technological limitations make confirming and clarifying the mechanisms involved difficult.

The synergistic approach.

It is apparent that these proposed neurobiological mood-altering mechanisms, have a lot of structures and neuroanatomic pathways in common. It is possible therefore that the best candidate for exercise induced mood alterations can be evolved from the integrations of each of these central nervous processes, involving many neurotransmitters and feedback systems (LaForge, 1995). Many investigators (e.g. Dunn and Dishman,1991) have proposed that there is an integration of specialised brain systems that contribute to post exercise mood changes. These systems are extremely complex and precise knowledge of their workings are not yet available. So it would be wise no to attribute exercise-induced mood alteration to any single mechanism (LaForge, 1995). It seems therefore that an integration of neurobiological and psychological mechanisms is our best bet in explaining exercise mood improvements.

Summary.

The association of exercise with improved psychological function is still unclear. Many mechanisms of how exercise improves psychological function exist, and it seems synergistic pathways might be the way forward. It is interesting to note that some of these mechanisms share pathways with mechanisms proposed for immune changes with exercise(e.g. pathways involving adrenaline and cortisol). It

seems therefore logical to adopt an integrated approach to exercise and its effects on psychological and immunological function, which is the topic of the next section.

Regardless of **how** exercise improves psychological parameters like anxiety , depression and self-esteem, research on HIV+ patient supports the idea that exercise improves mood and subjective well being. If the stresses of HIV infection are associated with negative mood states, then exercise should be a primary candidate in complimentary therapies.

2.1.3. Psychoneuroimmunology

A new field of science

It is a common belief that stress can make people more susceptible to illness (Solomon and Temoshok, 1987). However, it was not until 1981, when Ader published his book called "Psychoneuroimmunology", that scientists started researching the area extensively. Psychoneuroimmunology is an emerging field that is concerned with the study of the relationships among psychological variables (such as stressors, or affective states like anxiety and depression), the nervous system and the immune system (LaPerriere *et al.* 1994). The main hypothesis of psychoneuroimmunology is that stress, anxiety, and depression, are linked with the immune system via the central nervous system (CNS). However the exact functional mechanistic links among stressors, immune suppression and disease progression are not fully understood (LaPerriere *et al.* 1994). Investigators in this new field are trying to document mechanisms by which stressful experiences via CNS transduction can alter resistance to disease. In the next section, only points relevant to HIV+ people and exercise will be drawn from the vast field of psychoneuroimmunology,

There is an increasing body of evidence on the relationship between behavioural factors (e.g. coping) and cancer progression and prognosis (Temoshok *et al.*, 1985). Further, a number of recent studies in animals and humans have linked stress and/or behavioural factors with immune response and disease outcome (Riley, 1981). The connection between stress levels and immune function seems to be the endocrine system. Stress causes the release of stress hormones, peripheral cathecholamines, ACTH, CRH, and cortisol and these somehow seem to reduce immune function. Antoni *et al.*,(1990) conclude that in sum, evidence exists for the

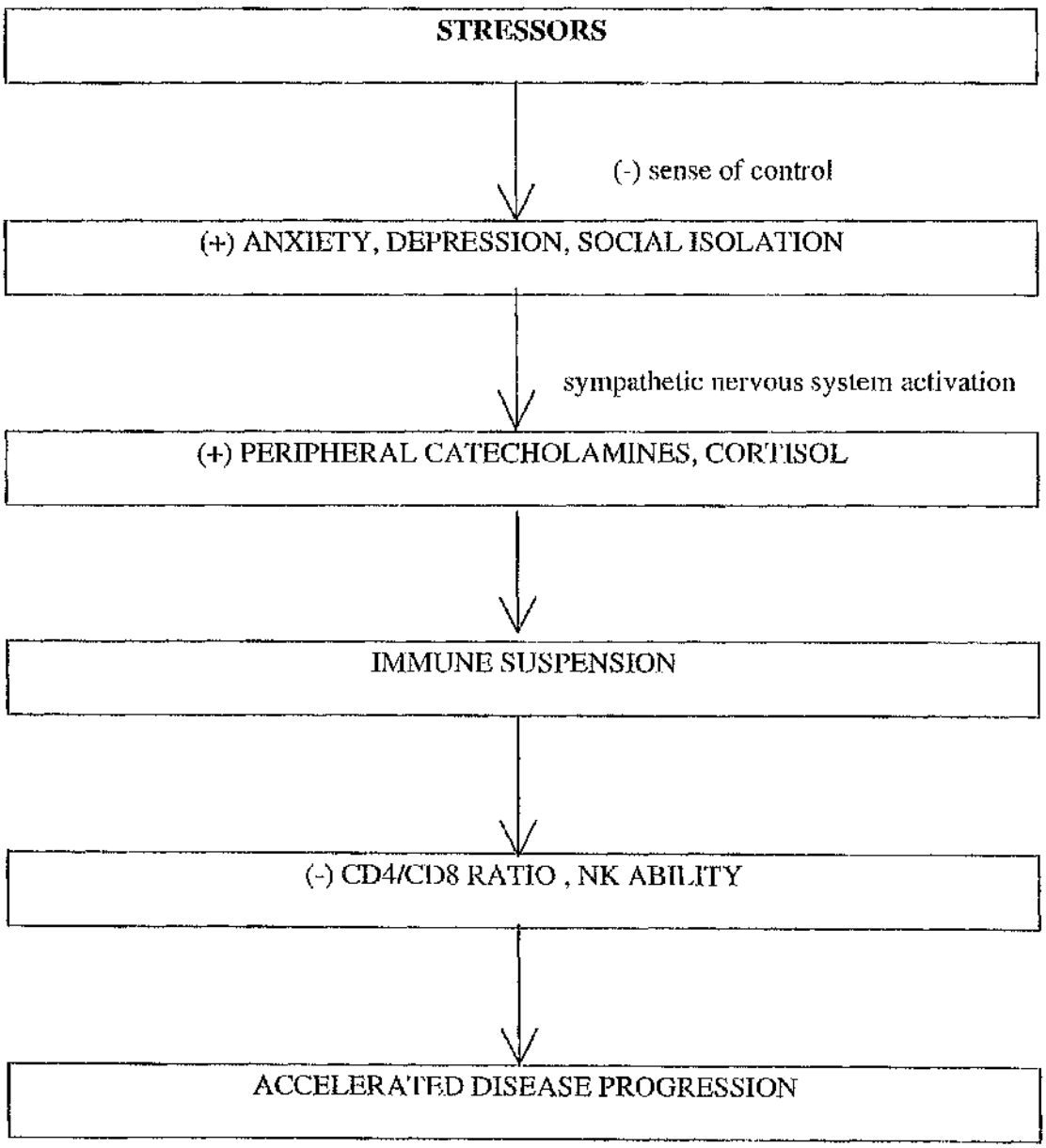
autonomic nervous system (ANS) and neuroendocrine agents playing a modulatory role on several aspects of cellular immunity including lymphocyte and NK cell functioning.

Also several behavioural variables have been associated with neuroendocrine changes and altered immune functioning. In a series of behavioural immunology studies in which social support, mood and NK activity were evaluated among breast cancer patients, a lack of social support predicted poorer NK activity (Levy *et al.*, 1981).

The working model for suggested stressor effects on psychosocial, neuroendocrine and immunological parameters is shown in Figure 1 (Adapted from Antoni *et al.*, 1990).

Figure 1.1 Model for effects of stressors on neuroimmunological parameters.

(Adapted from Antoni *et al.*, 1990).



Note: (-) decrease, (+) increase.

While this is a general model it applies to HIV infection. In terms of HIV+ stressors include the diagnosis itself, the social stigma, and the cost and effectiveness of treatment.

In conclusion, accumulating evidence exists for the link between psychological stressors and the immune system, peripheral catecholamines and cortisol being the main candidates involved.

Exercise and Psychoneuroimmunology in HIV

The rationale for using exercise in a psychoneurologic perspective is suggested by studies that have documented relationships between exercise and various factors as proposed by LaPerriere *et al.*, (1994). The four main reasons are:

1. exercise and mental health. Exercise has been shown to improve psychological function (e.g. reduced anxiety, reduced depression, increased self-esteem, increased physical self-perception). On top of that, many of the proposed mechanisms for that involve neurobiological pathways (La Forge, 95), which could potentially directly effect the immune system.

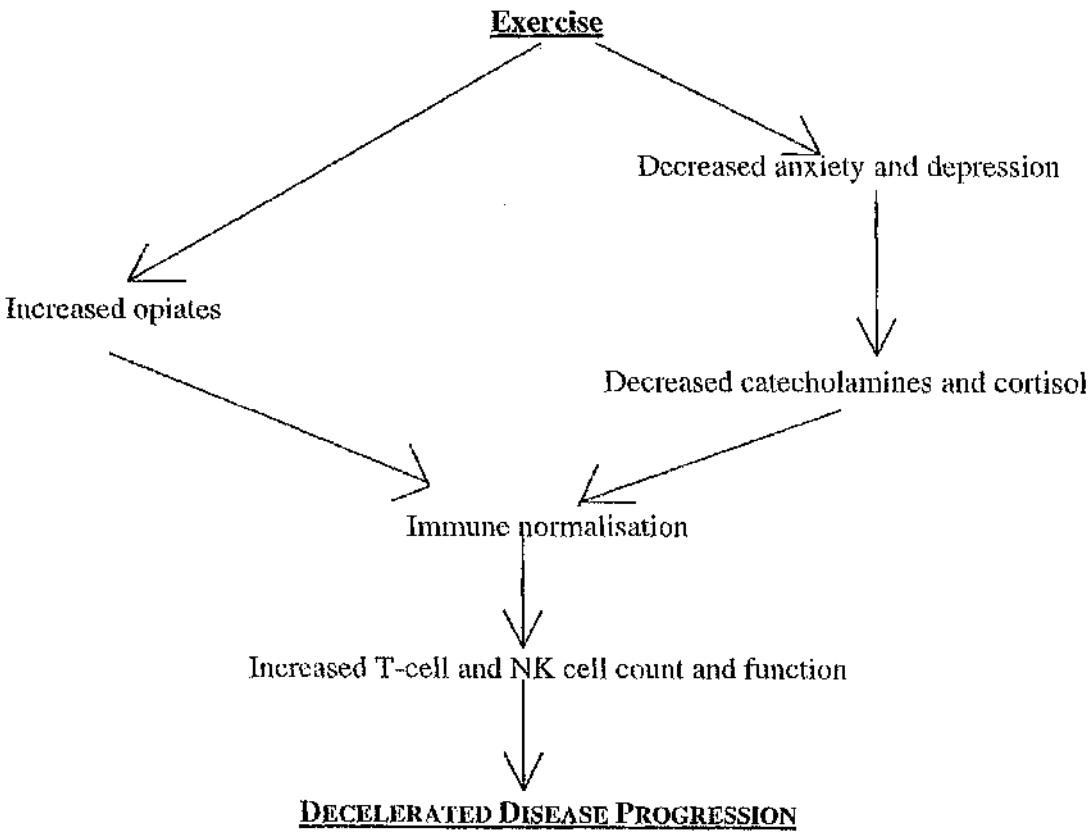
2. exercise and stress hormones. With training the stress hormone response is reduced for the same amount of stress (e.g. less cortisol). In other words, exercise can reduce the stress response (Dienstbier,1991)

3. exercise and opiates. Exercise has been shown to be associated with endogenous opiates, which have "euphoric" effects and might directly influence the immune system (Wybran, 1979).

4. exercise and immunity. Exercise itself has been shown to have immunomodulatory effects, possibly via adrenaline (Keast, 1988), or the effect of the muscular system on glytamine levels which is essential for immune cell function (Newsholme, 1990).

Based on the above LaPerriere and his colleagues (1994) designed a model for exercise on HIV+ which is adapted in Figure 1.2.

Figure 1.2 Possible effects of exercise on HIV+ patients



Conclusion.

It seems plausible that exercise can have positive effects on HIV patients on many levels. There is an abundance of theories that would provide mechanisms for benefits of exercise to the HIV+ patient. The effects of exercise on the central nervous system and the many pathways involved in the central nervous system could benefit both psychological and immunological function. Regardless of the exact mechanisms involved, there is a growing number of studies which show evidence that these benefits do occur with exercise (reviewed in previous sections). This provides a

rational for studying the effects of exercise on immunological and psychological parameters.

2.1.4. Exercise mode

Most studies on the effects of exercise on HIV+ populations have either used aerobic exercise or a combination of types of exercise. Only two studies have focused on strength training. One study done by Spence *et al.*, in 1990, examined the effects of strength training on 24 HIV+ subjects. They found that after six weeks of strength training the exercise group improved in 13 of 15 strength variables used in the study when compared to the non exercising control group. No immunological or psychological variables were measured (Spence *et al.*, 1990). The other study done by Lox *et al.*, in which one of the treatment groups received strength training for 12 weeks and improved in various psychological variables. There was also a small increase in CD4 cell count (mean increase of 22.91 cells/ ml). However, no statistical significance was reported and the mean initial CD4 cell count for the control group was at the very low (149.82 cells/ml) compared to the aerobic exercise group (403 cells/ml), which implies a potential selection bias.

A strength training programme could increase muscle mass which is very important in muscle wasting, a phase of the disease where there is an unexplained loss of weight mainly as muscle tissue. Muscle wasting is probably a multifactorial mechanism (Ferreira and Norwood, 1997). Possible factors involved include suboptimal caloric intake, nutrient malabsorption, decreased activity levels, infections, medication, and metabolic changes (Coodley *et al.*, 1994). So strength training could have a particular benefit for HIV+ people.

Also the relationship between the immune cells and glutamate, suggest that muscle tissue could play an important role in immune function, since it is probably the main source of glutamate production in the body (Keast, 1988, Newsholme, 1990). So, perhaps strength training is better in enhancing immune function than aerobic exercise for HIV+ people.

In terms of the HIV+ population high-intensity high-volume resistance training should be avoided as it might lead to overtraining syndrome. This could be a problem with HIV+ athletes training for competition, but for HIV+ people who are exercising for general fitness overtraining can be prevented easily by avoiding over-strenuous exercise for prolonged periods. Overtraining should be avoided in HIV+ people as it might cause a further decline in immune function (Ferreira and Norwood, 1997).

Another consideration for HIV+ exercisers is exercising with an acute illness with symptoms like: fever, muscle aches, and swollen lymph nodes. When such an acute illness occurs HIV+ exercisers should curtail or refrain from intensive exercise (Ferreira and Norwood, 1997).

Conclusion

Moderate intensity strength training could perhaps be more beneficial to HIV+ patients than aerobic exercise. As the muscular system may be linked to the immune system. It could also prove beneficial to preserving muscle tissue against muscle wasting.

2.1.5. Aims of this study

The aim of this study was to investigate the effects of a strength training programme of moderate intensity on HIV+ patients. The effects on physiological, immunological and psychological parameters were investigated using a randomised control trial.

2.2. Methodology

2.2.1. Subjects

For this study 6 subjects were recruited, aged 30 to 56 (1 female, 5 male). The main criterion for inclusion in this study was that the subjects had to be HIV+. Due to the nature of this study several exclusion criteria were used. Firstly subjects had to be assymptomatic with a CD4 cell count above 200 cells/ml of blood. This was essential to ensure that exercise would not be harmful to the subjects. In terms of CD4 cells counts and disease status the subjects were assessed by their doctors prior to inclusion in the study. Secondly. The subjects were required not to have exercised regularly for the 6 months prior to the recruitment. The exercise status of the subjects was self-reported. Finally current intravenous drug users were excluded from this study. Their ability to exercise would be impaired by the drugs and the effects of the drugs might have interfered with physiological functions important to this study. However, former drug users were not excluded from the study.

2.2.2. Recruitment procedure

Each hospital gave ethical approval to the study. The risk assessment committee at the university gave approval to the procedures, this was done to protect the HIV+ subjects and the experimenter. Subjects were recruited through their HIV clinics by their HIV doctor at either Ruchill Hospital (Glasgow) or the Glasgow Royal Infirmary. The doctors gave an information sheet about the study to patients suitable for this study then if the subjects agreed to participate they were referred to the researcher. Before talking part in the study subjects read and signed consent forms (The information sheet and consent forms can be found in Appendix K). After the initial baseline measurement testing the subjects were randomly assigned to two groups: the exercise group and the control group. The first, third and fifth subject were

groups: the exercise group and the control group. The first, third and fifth subject were randomly assigned by coin toss to experimental or control group. And the second, fourth, and sixth subjects were then allocated the opposite group.

2.2.3. Pilot testing

Each individual procedure used was tested on pilot subjects who were not HIV+. It was then recognised that one of the strength measurementswas too difficult to set up and for the subjects to perform accurately. This was a 25 isokinetic contractions fatigue test of the quadriceps at a speed of 90 degrees/sec on the Kin Com isodynamometer, the test was omitted from the testing procedure.

2.2.4. General Procedure

The subjects were refered to the researcher by their HIV doctors. An appointment was set up to come to the lab where they performed the baseline testing procedure. The immunological data was released later after the HIV+ doctors were given signed consent forms. The subjects were then randomly assigned to either an exercise group or control group. The exercise group received 12 weeks of strength training (described later), while the control group was told that they would begin exercising after 12 weeks and to continue with their normal routine. After the 12 weeks (stage 1) all the subjects went though the testing procedure again. After that the control group received 12 weeks (stage 2) of the same strength training programme, while the exercise group was given strategies to keep exercising and were released from the study. After the next 12 weeks, all the control subjects went through the testing procedure again. After the last testing of each subject a taped interview was undertaken focusing on the subjects perceptions on exercise.

2.2.5. Instruments

There were three main categories of data collected for this study: physiological, psychological, and immunological.

Physiological

Body weight (kg) and height (cm) were determined before the testing procedure. Body weight was measured on standard scales, with the subject barefooted. Height was measured with the subject barefooted, to the nearest cm using a stadiometer.

Girth (cm) was determined by the circumference of the thigh and the arm, which were measured using anthropometric tape. For the arm the measure was taken halfway between the tip of the acromion and the olecranon. And for the thigh the measurements were taken halfway between the anterior superior iliac spine and the superior aspect of the patella.

Percentage Body Fat was estimated using the skinfold thickness sum method devised and validated by Durnin and Womersley (1974). Skinfold thickness is taken at four sites:

a) triceps: measurement taken halfway between acromion and the olecranon with the arm hanging loosely at the subjects side.

b) biceps: measurement taken at the site of the middle of the muscle belly with the arm supinated.

c) subscapular: the skinfold was taken bellow the inferior angle of the scapula, at the angle of 45 degrees to the vertical.

d) supra-illiac: the skinfold was taken just above the iliac crest on the mid auxiliary line. The skinfold should be vertical unless the subjects are particularly fat in this area, in which case the skinfold should be horizontal.

Three readings were taken at each site with the average value used as the site's skinfold score. Once the four sites had been done the total of the four scored was referred to the table by Dunin and Womersley (1974) for the prediction of percentage body fat. The table gives a prediction for individuals on the basis of their age and sex.

Grip strength (kg x m): was measured using a hand dynamometer (Takei Kiki Koguo). Subjects were asked to exert as much force as they can on the handles with the arm on the side of the body. The right hand was used in all cases. The subject was given a warm-up trial and then performed three trials and the best out of three was used as the measurement.

Abdominal local muscular endurance: was measured by the number of sit-ups completed in 30 seconds. The subject lay on the floor with their legs at a 90 degree angle and their feet were held on the floor. The subjects kept their hands either in front of their chest or in front of their face. A sit-up was counted for each time the subject's chest reached his thighs.

Quadricep isometric strength (Newtons) was measured using a Kin-Com hydraulic system (Chattecx Corporation). Strength was measured isometrically at an angle of115 degrees (vertical being 90 degrees and horizontal being 180 degrees). The subject's right leg was strapped onto the lever and his/her leg is weighed for gravitational correction. The subject was instructed to exert as much force against the lever as possible while the lever was stationary (the system gives a 5 degree movement as a standard). The subject was given one warm-up trial and after a minutes rest performed three maximal trials with a minutes rest between trials. All three efforts were analysed by the computer and peak force was given for each trial. The best of the three trials was used as data.

Psychological

Beck Depression Inventory (BDI) this inventory was developed and validated by Beck *et al.* (1961) for assessing depression. Since then it has been used to measure changes in depression in exercise studies (e.g. McCann and Holmes, 1984). It has also been previously used to examine the effects of exercise on an HIV+ population. It consists of 21 questions relating to mood, somatic symptoms and behaviour. The answers are scores (0-3) and the higher the summed score the higher the overall depression. A score of under 10 is normal, between 10-16 mild depression, between 16-32 moderate depression, and over 32 serious depression. (Appendix A)

The Bi-Polar Profile of Mood States (POMS) Questionnaire consists of 72 adjectives describing moods. The subjects had to assess how they felt during the previous week and rate how well the adjectives relate to how they feel. The scores range from : 0-*feel very unlike this* to 3-*feel very like this*. The adjectives are split into 6 subscales each consisting of 12 items, 6 positive and 6 negative. The 6 subscales are: Composed-Anxious, Agreeable-Hostile, Elated-Depressed, Confident-Unsure, Energetic-Tired, and Clearheaded-Confused. The questionnaire has been tested for reliability and validity on various populations (McNair *et al.,* 1981). It has also been used on studies involving HIV+ patients (LaPerriere et al.,1990; Brown, (1996). The raw scores for each subject were calculated by adding all the positive items and subtracting all the negative ones. A constant of 18 is added to ensure a positive score and then the result is converted into T-scores using a table provided in the POMS manual for normative populations. Higher scores reflect more positive moods, and 50 is considered the population average. (Appendix B)

The Physical Self Perception Profile (PSPP-A). The original form of this questionnaire was developed by Fox (1989), based on his hierarchical model of global self-esteem using student populations. That questionnaire was found to be population specific so for the purposes of this study a new form was used especially modified for an elderly population called PSSP-A, which was devised by Chase (1991). The PSPP-A consists of five subdomains: Physical Self-Worth, Perceived Body Attractiveness, Sports Competence, Perceived Functional Capacity, and Perceived Health and Disease. These subdomains are more relevant for a clinical population than the original form which was devised with a young population in mind.

This adapted form has been used on an HIV+ population in Brown (1996). Subjects chose a positive or a negative statement and then decide whether this is 'sort of true' for them or 'really true' for them. Scores for each item range from 1 to 4. Each subdomain has 6 items yielding a minimum score of 6 and a maximum of 24. (Appendix C)

Immunological

CD4 and CD8 cell counts were provided by the subjects' HIV+ clinics. Measurement values came from the subjects routine screening at the hospital. The cell counts are reported as cells/ ml of blood. The data used were taken within 1-4 weeks from the first lab visit (baseline) and were obtained from the patients medical records. And for the follow up measures, the closest measurements to the testing date were taken(1-4 weeks). This means that any effects of exercise on the immunological data maybe less precise, since they could not coincide precisely with the dates of the exercise regime.

All the CD4 and CD8 cell count measurements were analysed in the Western Infirmary Immunology Laboratory. Lymphocyte counts (CD4 and CD8 included) and proportions were measured by flow cytometry (B.D.FACscan, simulset software), by a lysed whole blood method (Gale and Henry, 1992), using directly conjugated monoclonal antibodies against:

CD14/CD45 (for white cell differentials),
CD19 (for B-lymphocytes),
CD3/CD4 (for T-helper subset),
CD3/CD8 (for T-cytoxic subset),
CD3/CD56+CD16 (for NK cells)
+isotype control.

Viral Load: There are not expectations as to what changes would occur. All viral load measurement were done at the Gartnavel Hospital Virology Laboratory, using the NASBA technique (Mas *et al.*, 1998). This technique involves generation of a template from which RNA copies of the target sequence can be made. This is accomplished with the use of three enzymes: reverse transcriptase, Rnase H, and RNA polymerase, in a reaction containing two primers at a constant temperature of 41

degrees Celsius. This produces a single stranded RNA which can be detected by electrophoresis, hybridisation and colorimetry. Readings bellow 400 cells/ml cannot be detected and are reported as undetectable (UD).

2.2.6. Testing Procedure

When the subjects came into the exercise physiology lab they read the consent form. Once they read the form and confirmed that they clearly understood it's contents they signed it. They then completed a health/safety form and signed it. This is a requirement for anyone who is going to be tested on the laboratory equipment. Afterward the subjects had their weight and height measured. Then their circumference was measured, as described previously. Afterwards the subjects had their body fat percentage was estimated by measuring their skinfold thickness, as described.

The subjects then completed the three questionnaires in the following (arbitrary) order: PSSP-A, POMS, and BDI. Then they warmed up on a bicycle ergometer for 5 minutes at 60 Watts. Following warm-up the subjects performed the grip strength test. After that the subjects performed the quadricep isometric test on the Kin-Com machine. Then the subjects performed as many sit -ups as they could in 30 seconds, as described. After that the subjects were instructed to cool down doing simple stretching exercises.

There were two considerations when designing the testing procedure. One was to keep the whole procedure as short as possible. Motivation plays an important factor in strength and local muscular endurance tests. These three strength tests were chosen from a variety of possible tests, because they are easy to do and short in duration. Given that the subjects were asked to complete three questionnaires before hand, one would want to avoid mental fatigue which would deteriorate motivation, so the number of strength tests was kept to a minimum. The other consideration was that the psychological questionnaires had to be done before warming up to avoid any acute effects of exercise on the psychological parameters measured.

2.2.7. Qualitative Data

At the end of the exercise stage, after the completion of the laboratory testing subjects were asked to do a semi-structured interview. The questions for this interview were structured in order to gain the subjects personal view in certain matters. The questions were mainly dealing with issues investigated in this study, i.e. the effects of the exercise programme on psychological and immunological function of the subjects. Some questions, however, asked more about general effects of the exercise programme on the general quality of life prompted by comments made (and recorded) by the subjects during the exercise programme. The interview was piloted on an HIV+ person who was not part of the study. One question regarding effects of exercise on appetite was added as a result of this piloting. The questionnaire has 23 questions with answers provided, subjects were asked to circle the answer they felt described them better and then comment on it. After the 23 questions subjects were asked for open comments on the exercise program and the procedures in general. The interview was taped then transcribed and analysed. The questions used in the interview can be found in the Appendix D.

2.2.8. The exercise programme

When designing a strength training programme certain parameters need to be considered: the needs of the exerciser, time available, facilities (space and equipment) choice of exercises, and choice of repetitions. This programme was designed to increase muscular strength and endurance (Feigenbaum and Pollock, 1997).

In terms of facilities the programme had to be done in a space were HIV+ patients felt comfortable. The programme was done at an centre for HIV+ people in Glasgow, and was instructed by the researcher. The instrument used was the Xor-tube, which was provided by Forza UK. The Xor-tube is a band (like a bicycle inner tube) with handles (Forza UK prospectus). It works on the elastic properties of the band, the more you pull the band the more resistance is experienced. Resistance can also be modified by changing the length of the tube the force is applied to. The Xor-tube used the handles and limbs to create resistance to the muscle trying to lengthen the band. In this way most of the muscles of the body can be trained. For an example of an exercise see appendix E.

The exercise programme consisted of three parts: warm-up , resistance training, and stretching/relaxation. The warm-up was approximately 5 minutes and used body movements used in aerobic programmes to increase heart rate and body temperature.

The resistance programme lasted about 20 minutes. It started with upper body, then abdominals, then push-ups, and then lower body exercises, but the order was reversed for variety. The order and choice of exercises was dictated by the equipment itself and constraints of time. All exercises were done in sets of 12 repetitions (Feigenbaum and Pollock, 1997). The subjects were instructed to do as many as they could out of the 12, aiming to do at least 8. There were also shown how to vary resistance by adjusting the length of the tube. There was a gradual increase in volume in the course of the 12 weeks. The sets were increased from 1 to 2 in some cases and some new exercises were gradually introduced, according to the progress of the individual.

The subjects then did 5 minutes of stretching exercises of the muscles they had used in training. They were also instructed how to slow down their breathing. After the subjects got familiar with the stretches a one minute relaxation period ended the routine. The subjects lay on the floor and were asked to slow down their breathing rate, relax and focus their attention on their breathing. The programme was done to music and was done 3 times a week. If subjects were unable to make all three exercise sessions a set of written instructions was provided with an X-or tube so that a home-based session could be conducted. Examples of the initial and advanced exercise programmes can be found in Appendix E.

2.2.9. Data handling and analysis

Because the number of subjects was very low (n=3, for each group), any results analysed statistically will have to be interpreted with caution. Results are analysed in two ways: descriptively and statistically. In terms of statistical analysis the results are presented in the following order: i) Baseline measures, ii) Within group changes for stage 1, iii) Experimental vs. control group (**stage 1 inter-group comparison**) iv) Control group stage 1 vs. stage 2. (**control group inter-stage comparison).** Results

for iii) and iv) are presented under descriptive results and presented by variable. Statistical tests were analysed using the Minitab statistical package.

Stage 1: refers to the first period, where the experimental group received the exercise programme, and the control group did not. (from baseline measurements to stage 1 measurements).

Stage 2: refers to the second period, during which the control group received the exercise programme (from stage 1 measurements to stage 2 measurements)

2.3. RESULTS

2.3.1. Subject attendance

The subjects had a potential 36 sessions to attend (3 x 12 sessions). The average attendance was 27 session which is 75% of the full programme. The lowest attendance was 23 sessions (63%) and the highest was 33 sessions (91%). Four out of the six subjects had to take some time off the programme due to illness, typically 3-5 sessions. However, one of these four had to take a month off due to illness, in this case 3 further weeks of exercise were added to his routine.

2.3.2. Baseline Measures

The experimental and control groups were compared at baseline to see whether there were any significant differences between the groups at baseline. An **independent two-sample T-test** was performed comparing the two groups at baseline. There was no significant results which means that we can assume that the two groups were similar at baseline. Results in Appendix F.

2.3.3. Within group subject change during stage 1

Both the groups were analysed for changes between baseline measures and after stage 1 scores, this was done by a **paired T-test.**

Experimental group. There were three significant changes, the quadriceps isometric strength shown an increase in strength measures, the total POMS suggesting improved mood, and the energetic-tired scale scores of the POMS questionnaire, suggesting an increase in energy. **Control group.** The control group received no exercise in stage 1. A significant decrease was found for skinfolds sum. The changes in means within each group between baseline and stage 1 are presented in Table 1.1 along with the p-value of the **paired-T-test.**

Table 1.1. T-tests on within group changes between baseline and stage 1.

Variable	Mean Scores Exercise Group			Mean Scores Control Group		
	Baseline	Stage 1	p-value			
skinfold sum (mm)	30.7	31.6	0.8	36.8	30.6	**0.018***
thigh circumference (cm)	50.3	50.3	1	53	53	1
arm circumference (cm)	28.8	28.5	0.53	25.6	29	0.33
grip pull (kg x m)	45.5	44.3	0.80	40.5	42.1	**0.06**
sit ups (number is 30 seconds)	15.3	18.6	0.13	11.6	13.6	0.18
quadriceps isometric strength (N)	730	1072	**0.016***	690	775	0.47
Beck depression Inventory	11.3	5	0.14	9.3	7.6	0.37
composed-anxious-POMS	56	65.3	0.27	61	59	0.58
agreeable-hostile -POMS	56.3	65	0.13	53	51	0.71
elated-depressed -POMS	58	66.3	0.18	55	52.6	0.40
confident-unsure -POMS	57.3	59.6	0.74	52	54.6	0.48
energetic-tired -POMS	50.3	62.3	**0.04***	52	49	0.58
clearheaded-confused -POMS	57.7	66.3	**0.065**	59	57.3	0.42
total POMS	334.3	375	**0.044***	331.3	323.6	0.49
sports competence -PSSP	10	13.6	**0.09**	10	11.3	0.27
perceived body attractiveness -PSSP	14.6	16.6	0.32	12	12.3	0.67
physical self-worth -PSSP	14.6	17.3	0.32	13.6	14	0.42
perceived functional capacity -PSSP	19	20.3	0.18	18.3	17.6	0.8
perceived health/disease -PSSP	15.3	17.6	0.34	15.3	15.6	0.42
CD4 cell count (cells/ml)	432	421	0.75	477	534	0.79
CD4/CD8 ratio	0.24	0.27	0.62	0.48	0.6	0.18

Note * denotes significant difference between baseline and stage 1 within group.

Bold denoted nearly significant results.

2.3.4.Descriptive Results for stage 1 and stage 2

Body measurements

Sum of skinfolds.

Stage 1. The changes for sum of skinfolds are inconclusive, for stage 1: experimental group one subject increased in score, one decreased, and one did not change. For the control group (still in stage 1) all subjects decreased in sum of skinfolds.

Stage 2. The results for sum of skinfolds are not suggestive of any trend. For stage 2: group C had one subject decreased, one increased and one did not change. All changes shown in Table 1.2. Results from t-tests done to compare, experimental versus control group for stage1 and control group stage1 versus stage 2 showed no differences. Results can be found in Appendix F.

Table 1.2. Sum of skinfolds changes (mm).

Subject	baseline	stage 1	stage 2
1	19.33	29.72	
2	38.86	31.85	
3	33.91	33.25	
4	25.5	20.53	17.93
5	49.25	43.45	46.12
6	35.67	27.85	27.06

(1-3: experimental, 4-6: control subjects)

Thigh circumference.

Stage 1. Thigh circumference changes were not conclusive, for stage 1: the experimental (E) group had two subjects decrease while one increased. The control (C) group had one subject increase while two decreased. **Stage 2.** Group C had two subjects decrease and one subject increase. All changes shown in table 1.3. Statistical analyses on the data, did not show any significant changes.

Table 1.3. Thigh circumference changes (cm).

Subject	baseline	stage 1	stage 2
1	47	50	
2	51	49	
3	53	52	
4	44	48	45.5
5	62	59	64
6	53	52	50.5

(1-3: experimental, 4-6: control subjects)

Arm circumference.

The results for arm circumference are not conclusive or suggestive.

Stage 1. The changes were minimal but for subject 6 (group C) whose scores increased. **Stage 2**, in group C, one subject decreased while one increased slightly and the other remained the same. Individual changes shown in Table 1.4. Statistical analysis did not reveal and significant changes.

Table 1.4. Arm circumference changes (cm).

Subject	baseline	stage 1	stage 2
1	47	50	
2	51	49	
3	53	52	
4	24	24.5	23.5
5	33	34	30
6	20	28.5	29

(1-3: experimental, 4-6: control subjects)

Conclusion for Body measurements.

For body measurements the data does not reveal any meaningful changes, which could be associated with the exercise programme. Statistical t-test results can be found in the Appendix F.

Muscle performance measurements

Grip strength.

The data are not suggestive of any trends. Changes were small and could be explained by normal variation and the error range of the test, shown in Table 1.5 . Statistical t-test also indicate no significant changes. (The control group had a nearly significant increase during stage 1, Table 1.1)

Table 1.5. Grip strength score changes (kg x m)

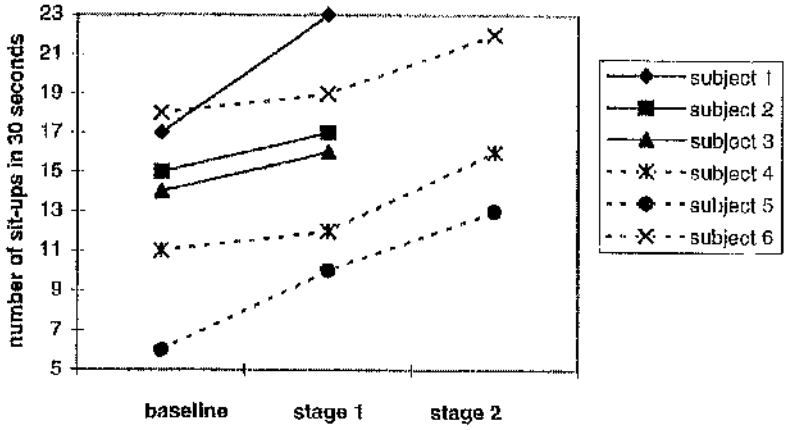
Subject	baseline	stage 1	stage2
1	41	38	
2	44.5	46	
3	51	49	
4	29.5	32	29.5
5	43	44	48.5
6	49	50.5	50.5

(1-3: experimental, 4-6: control subjects)

Sit-ups.

For sit-ups there seems to be a slight trend for increased scores associated with the exercise programme. However, these changes did not reach significant levels. **Stage 1.** The control group increased by a mean of 2 (sit-ups in 30 seconds), while the experimental group increased by a mean 3.3 (sit-ups in 30 seconds). **Stage 2.** In this stage the control group increases a mean 1.33 (sit-ups in 30 seconds) over and above increases in stage 1. This slight trend is shown in figure 1.3.

Figure 1.3 Changes in number of sit-ups.



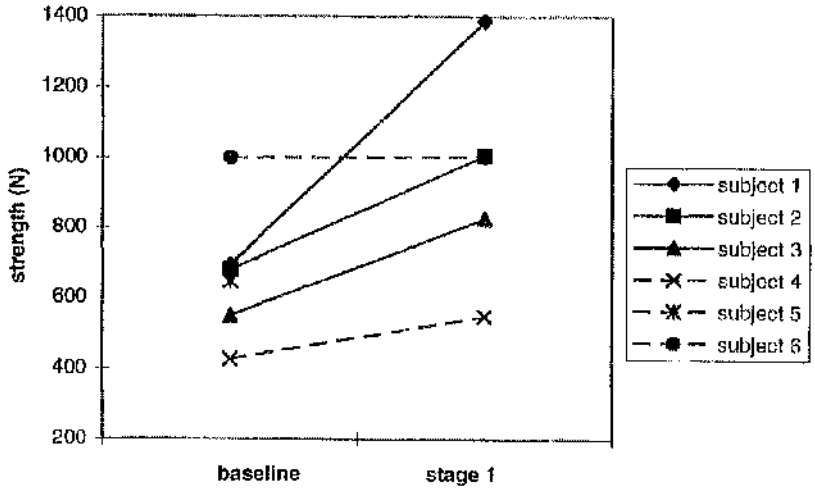
(Note: experimental group: straight lines, control group: dotted lines)

Quadriceps isometric strength.

There is some evidence for implying that the exercise intervention tends to increase quadriceps strength. **Stage 1.** In the experimental group all three subjects increased (Mean=342 N), while for the control group one increased , one stayed the same and one subject was not able to give a reading (Mean=63.5). This difference in mean changes between the two groups reached statistical significance. The **two sample t-test** gave a p-value of **0.029.** The changes for stage 1 are graphed in figure 1.4.

Stage 2. The changes in this stage for the control group do not follow the changes of the experimental group in stage 1. Subjects in stage 2 did not seem to change and statistical analysis agrees with this.

Figure 1.4. Quadriceps isometric strength changes between baseline and stage 1.



(Note: experimental group: straight lines, control: dotted lines)

Conclusion.

There is some evidence that the strength training programme is associated with improved quadriceps strength. Changes in stage 1 reached statistical significance for the experimental group. However, the trend of increased strength was not replicated with the control subjects.

Beck Depression Inventory (BDI)

Stage1. There is a trend for BDI scores to reduce with exercise intervention more so than without it (a reduction in BDI scores means a reduction in depression). The level of depression is classified according to scores:

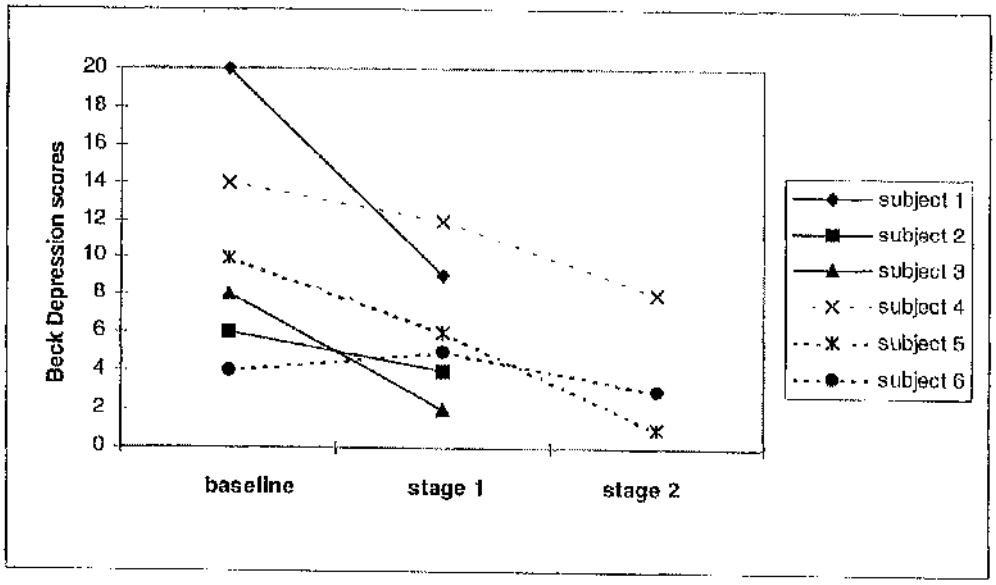
above 32: high depression, **16-32:** moderate depression, **10-15**: mild depression, **bellow 10:** normal levels. For most subjects depression was at normal or mild levels. It is interesting, however, that subject 1 had moderate depression and after the exercise he went down to normal levels as shown in Figure 1.5. The rest of the subjects experienced minor changes. The changes were not significantly different between the

two groups, but there was a trend for the experimental group having on mean a greater reduction (details in appendix F), probably caused by subject dropping from 20 to 10.

Stage 2.

The control group had all the subjects decrease, and by a mean : -2.0 (more so than the decrease in stage 1). This reached a p-value of : **0.074** (change in stage 1 versus change in stage 2), which was near significance levels. It should be also noted that scores are normal and not indicative of clinical depression. The trend in decrease in BDI scores with the exercise intervention is shown graphically in Figure 1.5.

Figure 1.5. Beck Depression score changes.



(Note: experimental group: straight lines, control: dotted lines)

Conclusion.

From the data, there is a trend of a slight depression reduction associated with the exercise programme. This was pronounced in subject 1 who decreased from mild depression to normal levels with the exercise programme. The other subjects had smaller changes, and none of the exercisers became more depressed.

Profile of mood states

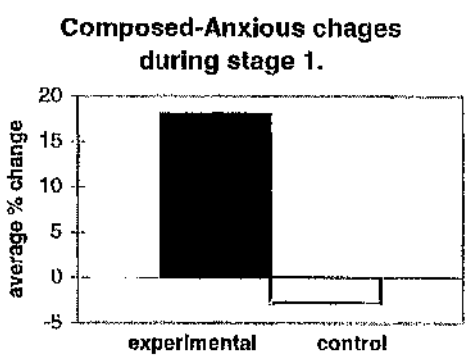
Stage 1. The profile of mood states subscales showed trends of improved mood with exercise as compared to no exercise, and so did the total mood score. This trend is illustrated in Figure 1.6 where the average mean % changes for each group can be compared to the other for stage 1. The experimental group seems to increase while the control remains unchanged for all subscales apart from Confident-Unsure.

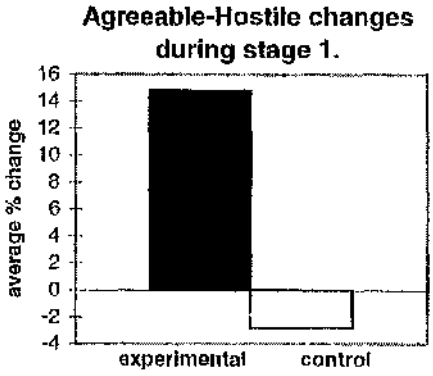
When looking at the changes in each subject from baseline to stage one the trend is less apparent, but still evident. In general, 2 out of 3 subjects increased in score, while in the control group subjects got worse or did not increase. This is illustrated in Figure 1.7, (Confident-Unsure scale not included, as there appeared to be no difference between groups)

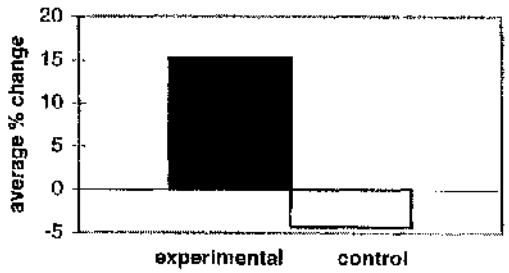
Independent t-tests performed on the changes from baseline to stage 1 between experimental and control group, also supported the trend of increased scores for the experimental group compared to scores for the control group (excluding Confident-Unsure scale). This trend reached statistical significance for the Energetic-Tired scale, with mean for group Experimental (E): 12 $\pm$.(4.58) and for group control (C): -3 $\pm$ (1.67), p-value = **0.047** and for the Clearheaded-Confused scale, mean for group E : 8.67 $\pm$ (4.04) and for group C:-1.67$\pm$ (2.89), with p-value = **0.023**. (Full table of results in appendix F).

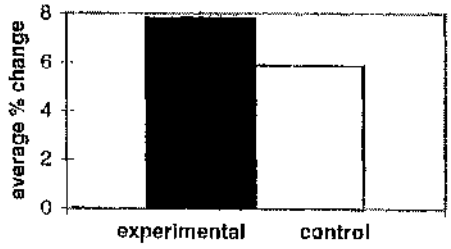
Also the total POMS score (all subscales) showed a significant increase for the experimental group: group E mean: 40.7 and group C mean: -7.7, p-value=**0.019.**

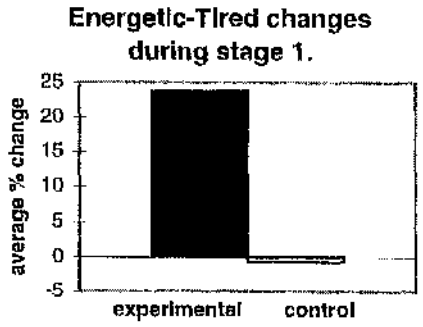
Figure 1.6. Charts of average percentage change in POMS scores between baseline and stage 1.

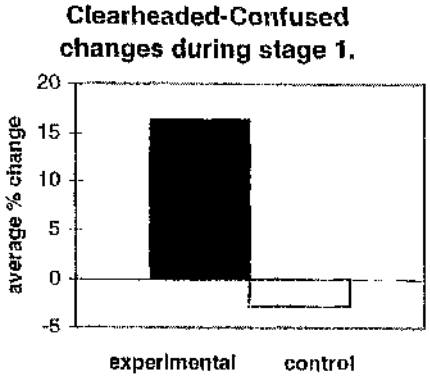






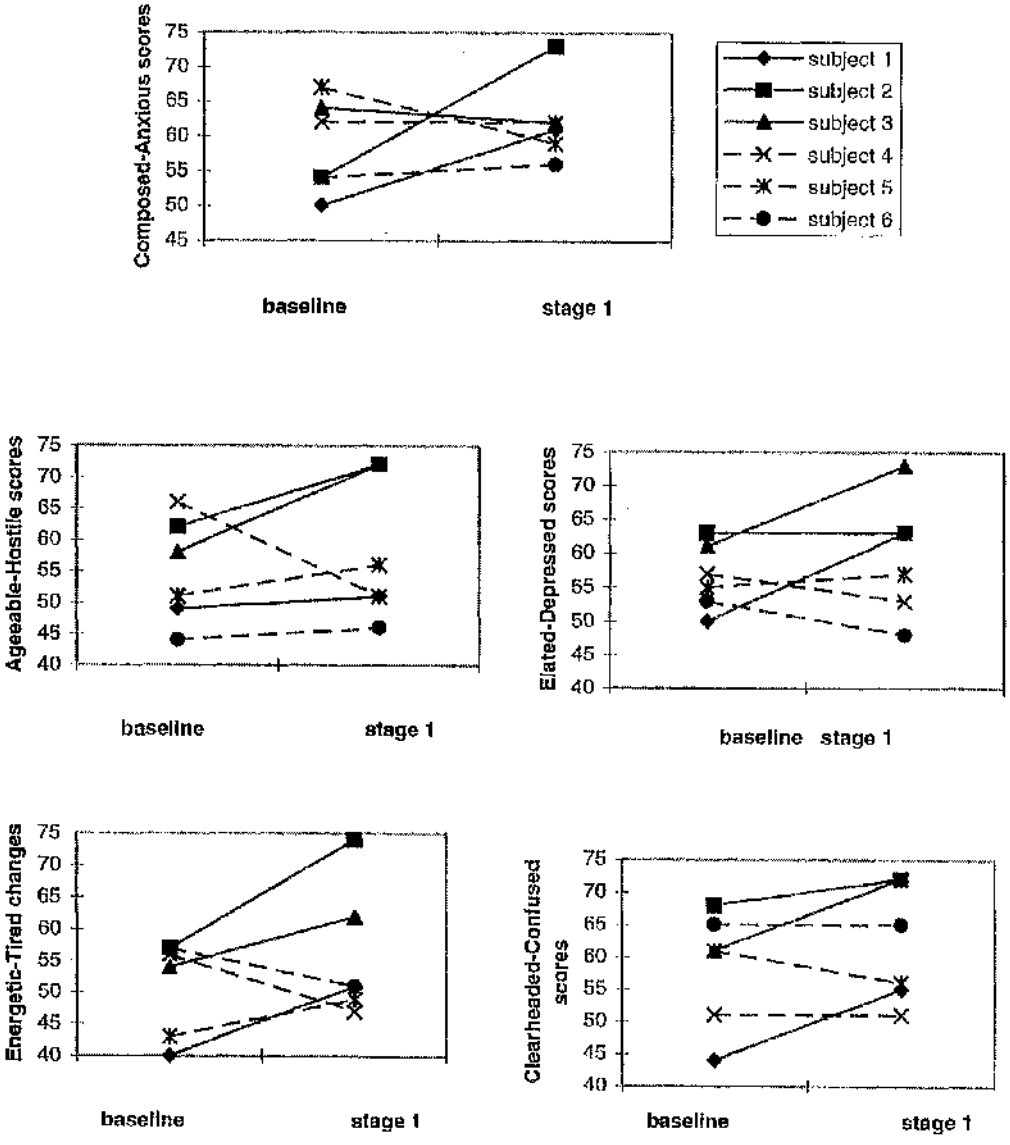






(Note: the scales on each graph are not the same)

Figure 1.7. Changes for individual subjects in subscales of POMS for stage 1.



Note: experimental group: straight lines, control group: dotted lines.

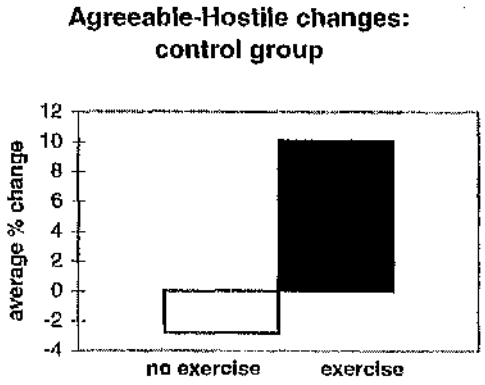
Stage 2. Having received the exercise programme the control group in stage 2 showed similar changes to those of the experimental group in stage 1.
In Figure 1.9, the average % changes are charted for the control group over the two stages. The charts indicate that exercise showed trends of increased mood scores. Changes shown in Figure 1.8 follow the same pattern as those in Figure 1.6.

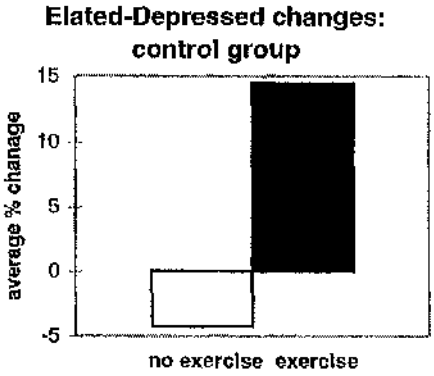
Changes for individual subjects also indicate this trend, with subjects showing little or no change in stage 1 and increases in stage 2 as shown in Figure 1.9

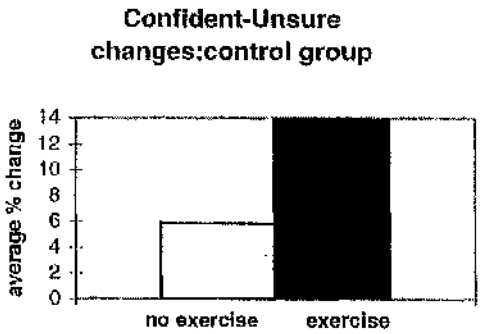
A **paired-T-test** was performed between the means of the changes for each stage. Although the mean differences between the changes were positive suggesting an increase in mood scores, none reaches significance levels. Two subscales were near significance the composed-anxious with a p-value of **0.062**, and the confident-unsure with **0.074.**

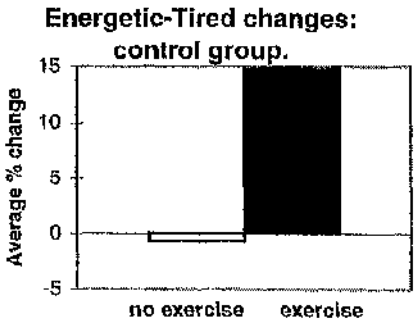
For the total POMS score the control group increased in stage 2 over stage 1 by a mean 52.4 (increase comparable to that of the exercise group during stage 1). However, this increase did not reach statistical significance.

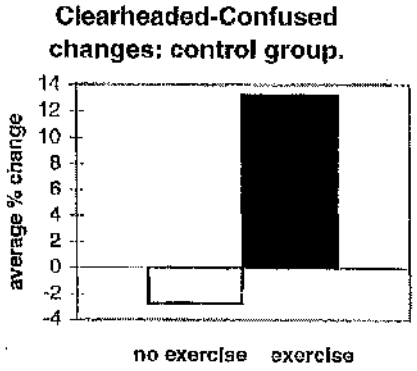
Figure 1.8. Average percentage change differences between stage 1 and 2 in control group.





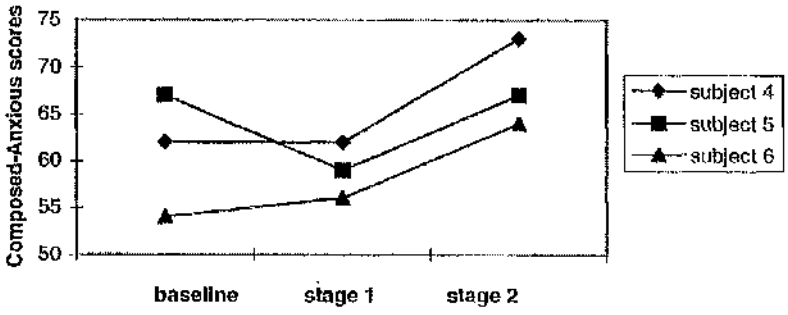


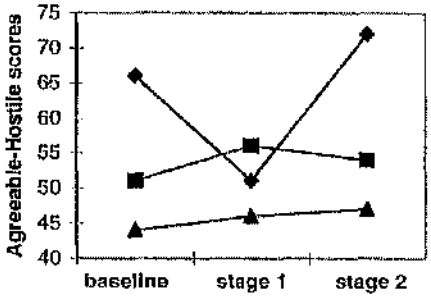


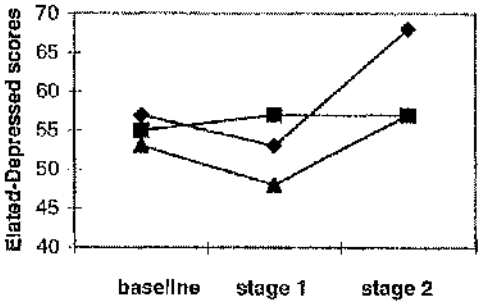


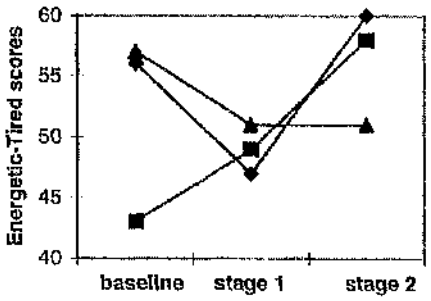
(Note: the scales on each graph are not the same)

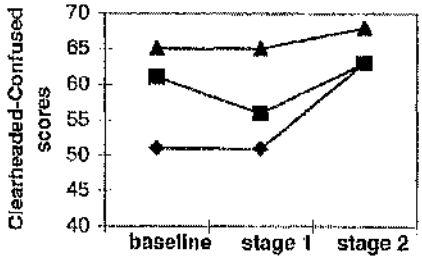
Figure 1.9. Changes of individuals for control group in scales of POMS.











Conclusion.

The trends in changes of mood scores experienced by the experimental group during stage 1 and then later by the control group during stage 2 seem to follow the same pattern of improved mood as a result of exercise. In addition, the total POMS score and two subscales reached statistical significance during stage 1. In conclusion

there is a suggestion from the data that the exercise programme improved mood, but there were too few subjects to show this statistically.

Physical Self Perception Profile-Adult

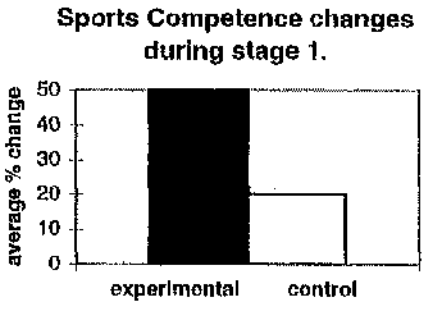
Stage 1. There was a slight trend for scores of the subscales to improve for the experimental group, with little change for the control group, between baseline and stage 1. This was more evident when expressed as average percentage changes, and shown in Figure 1.10. None of the differences between changes in the two groups reached significant levels (details in Appendix F).

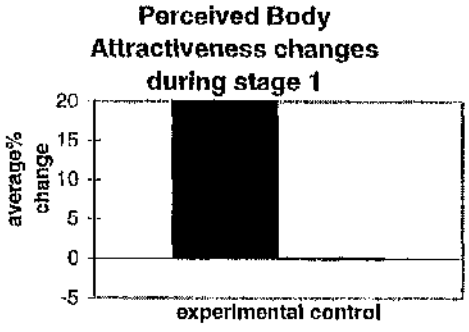
Stage 2. There was a slight trend for increased scores at stage 2 for the control group compared to stage 1. However, this trend did not reach significant levels (results in Appendix F). Average percentage (%) changes for this stage follow this trend but are less pronounced than at stage1, as shown in Figure 1.11.

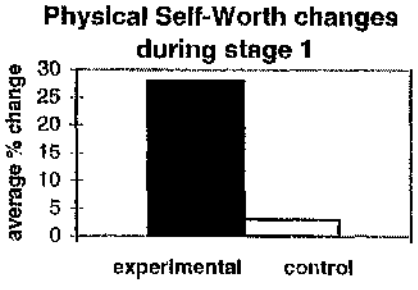
Conclusion.

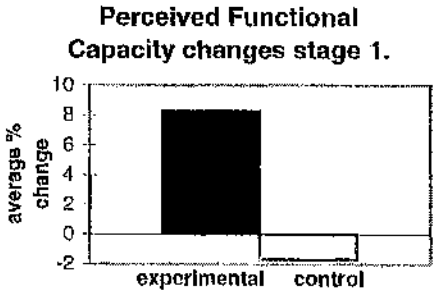
There is some evidence to suggest that exercise improved Physical Self Perception, but it is not strong. Statistical analysis did not support this trend.

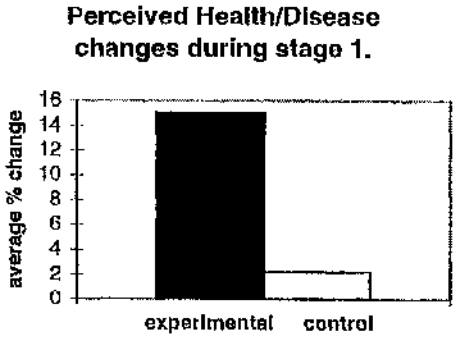
Figure 1.10. Average percentage change in PSSP-A scores during stage 1.





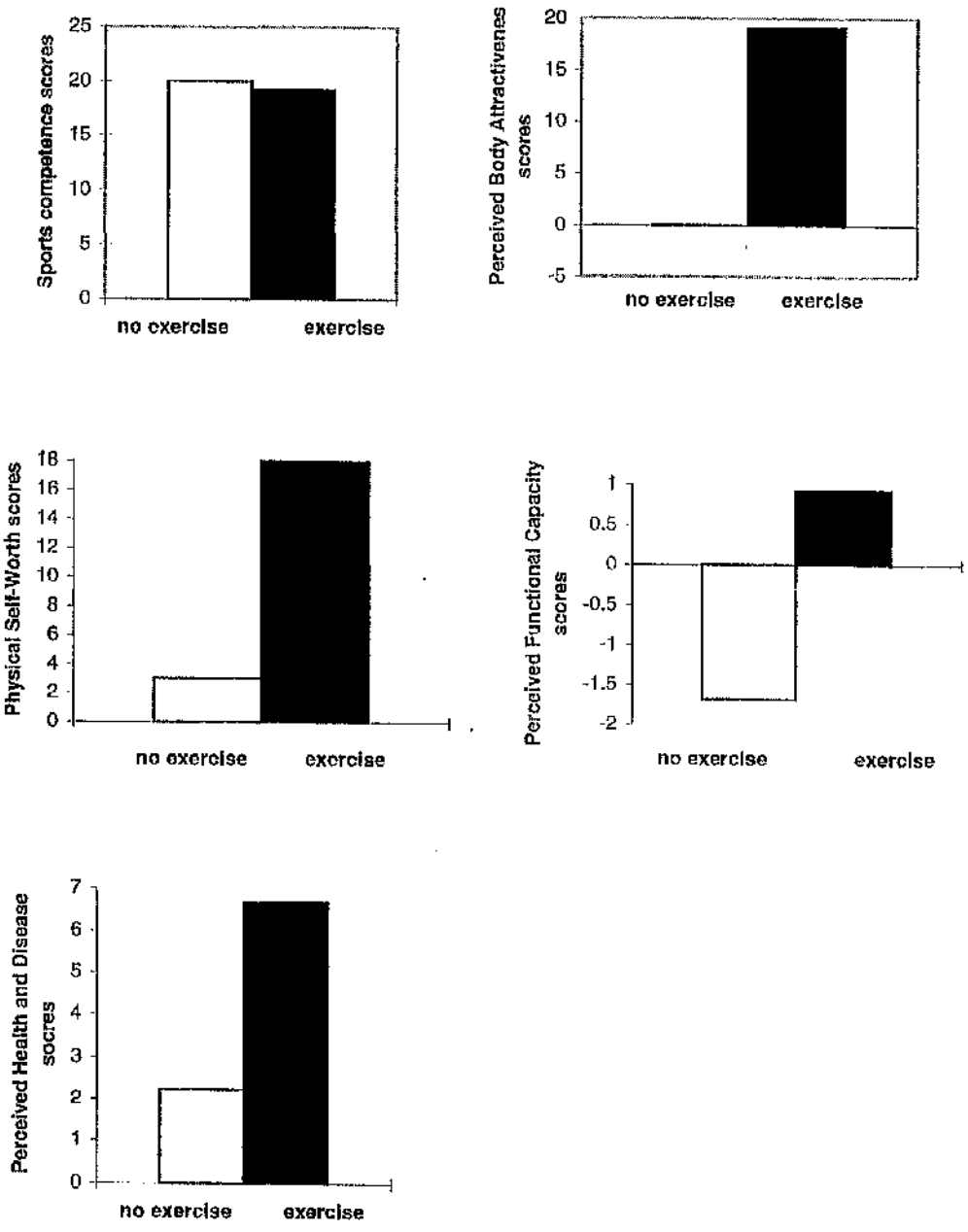






(Note: the scales on each graph are not the same)

Figure 1.11. Average percentage change for control group in PSPP-A.



(Note: the scales on each graph are not the same)

Immunological Data

CD4 cell count.

Stage 1. From the data between baseline and stage 1, there is no trend present for CD4 cell counts changes with any condition. There were no real changes apart from subject 3 decreasing and subject 5 increasing. An increase in CD4 cell count would mean an increase in immune function. As shown in table 1.6, changes overall do not indicate any trends, and this was verified by the statistical analysis. It is also important to note that immunological measures do not match the dates of baseline and stage 1 measurements exactly. There is a difference of a few days in some cases up to a month in some cases. Therefore any indicative results would have to be treated with caution.

Table 1.6. CD4 cell count changes between baseline and stage 1.

Subject	baseline	stage 1
1	718	710
2	323	363
3	256	190
4	542	483
5	670	860
6	218	259

(Note: Subjects 1-3: experimental group, 4-6: control)

Stage 2. Comparing CD4 cell counts for the control group during stages 1 (no exercise) and stage 2 (exercise) does not indicate any trends. As shown in table 1.7, CD4 cell counts for the control group did not follow any meaningful patterns, and differences were not significant. Again it should be noted that these scores do not follow the dates for the stages closely.

Table 1.7. CD4 cell counts for control group comparison.

Subject	baseline	stage 1	stage 2
4	542	483	335
5	670	860	285
6	218	259	219

Conclusion.

The data from this study did not reveal any trends for CD4 cell count with the exercise programme.

CD4/CD8 ratio.

Stage 1. The result were inconclusive with no meaningful trends, as shown in table 1.8. An increase in the ratio would mean improved immune function. Statistical analysis of the data did not result in any significant differences between the groups.

Table 1.8. CD4/CD8 ratio changes between baseline and stage 1.

Subject	baseline	stage 1
1	0.41	0.33
2	0.21	0.29
3	0.11	0.14
4	0.76	0.82
5	0.46	0.71
6	0.22	0.29

(Note: Subjects 1-3: experimental group, 4-6: control)

Stage 2. Similarly CD4/CD8 ratios for the control group inter-stage analysis does not indicate any meaningful trends with the exercise intervention, as shown in table 1.9.

Note that a healthy ratio is about: 2. Statistical analysis of the results also revealed no trends.

Table 1.9. CD4/CD8 ratio for control group comparison.

Subject	baseline	stage 1	stage 2
4	0.76	0.82	0.82
5	0.46	0.71	0.648
6	0.22	0.29	0.423

Conclusion.

There was not meaningful trend for CD4/CD8 ratio with the strength training programme.

Viral Load.

Viral Load is the presence of the virus in the blood measured in copies of the virus DNA per ml of blood. For any change to be meaningful it would have to be on a logarithmic scale (e.g. from 1.000 to 10.000). Also the test is not sensitive enough to detect any differences for loads under 400, so everything under that is considered "undetectable" (UD).

Stage 1. The data for viral loads is not indicative of any trends as shown in table 1.10.

Results were not analysed statistically as they were not numerical.

Table 1.10. Viral Load changes between baseline and stage 1.

Subject	baseline	stage 1
1	UD	UD
2	1300	1600
3	3200	9300
4	2600	1600
5	UD	UD
6	6300	UD

(Note: Subjects 1-3: experimental group, 4-6: control, UD= undetectable <400)

Stage 2. The results were again not indicative as most subjects have undetectable levels of viral load (under 400 copies of the virus per ml). Subjects 5

and 6 showed no meaningful change, while subject 4 increased during stage 2, as shown in table 1.11.

Table 1.11. Viral load for control group comparison.

Subject	baseline	stage 1	stage 2
4	2600	1600	150.000
5	UD	UD	UD
6	6300	UD	UD

Conclusion.

The data from this study did not reveal any effects of the strength training programme on viral load

2.3.5.Qualitative Results

Data gathered during the semi-structured interviews is incorporated in the discussion of relevant sections. A full set of results from the interviews can be found in Appendix G.

2.4. Discussion

2.4.1. Low subject numbers

The major consideration when discussing the results is the low subject numbers. The number of people recruited to this study was 6 (3 in the control group and 3 in the experimental group). When this experiment was being designed, it was seen as realistic (in discussion with clinical staff) that around 20-30 people would participate, with 10-15 people in each group. This would have provided with 80% power to detect a .5 effect size (Thomas and Nelson, 1996) The experimenter did 20 visits to the HIV-clinics, with a 20-30 people attending in each clinic. The doctors and nurses recommended people who would meet the study criteria (above 200 CD4 cell count, assymptomatic), which greatly reduced the number of people the experimenter could speak to. Regular attendees of the clinic are usually low in CD4 cell count and some of the people suitable, where already exercising 3 times a week which would exclude them. After about 20 visit, the experimenter had about 30 personal contacts with suitable people, and collected 25 phone numbers of people intending to start. Eight subjects completed the consent form, however, only 7 people completed the baseline measurements (1 subject completed half the testing procedure and then dropped out). Of those 7 subjects only 6 subjects made it to the last stage of the experiment. One subject never showed up for testing after the exercise programme.

With only 6 subjects therefore the statistics had very little power (at best 40%). However, despite the fact that there were only 6 subjects some of the results were significant and descriptive analysis of the results revealed patterns of changes with specific trends. The results will be discussed separately.

2.4.2. Body Measurements

In terms of sum of skinfolds and arm and thigh circumference the result were not indicative at all. So we can not conclude on any effects of the exercise programme on body fat, arm and thigh circumference, from the data collected .

2.4.3. Muscle Performance

For the muscle performance tests the results were suggestive of improvements in muscle performance with the exercise intervention. This was especially true for sit ups and the quadriceps isometric test.

For the grip strength the results do not support an improvement in strength after the exercise programme.

For the sit ups , there was a small tendency for a greater improvement with exercise. For the **stage 1 inter-group comparison,** the experimental and control group improved slightly in the number of sit ups, however the experimental tended to improve more than the control, this was not significant (p-value:0.48, Appendix D), For the **control group inter-stage comparison** there was a positive mean which implies an increase in the number of sit ups with exercise, however this was not significant (p-value: 0.38, Appendix D). So there was tendency for sit up number to increase with exercise .

For the quadriceps isometric test an initial analysis of the experimental group showed that quadriceps isometric strength had increased after exercise and this was significant (p-value: 0.016, Appendix D). When this change was compared to the change in the control group for the same period, the difference between the changes was still significant (p-value: 0.029, Appendix D). Descriptive results and graphs also support the notion that the exercise programme increased quadriceps isometric

scores. Therefore there is evidence to believe that if the number of subjects was greater and the power of the study was greater this trend would be more clear.
For **Control group inter-stage comparison** the results were not significant.

A number of factors could have influenced the results apart from the exercise programme. The mode of muscle activity: the type of training used in the exercise programme would be described as concentric, the grip strength and quadriceps tests were isometric, therefore they might have not been sensitive to the physiological alteration that could have occurred.
Familiarity of the exercise could also have influenced the results. In the initial test the subjects were given only one familiarity trial, but on the second stage test scores might improved for the control group because they are more familiar with the test than in the first test. It is advisable that subjects should familiarise with the protocol and procedures. Another issue which might have influenced results was motivation. Maximal strength measurements require a great amount of motivation. Motivation could have been lower the second and third time subjects were tested.

Other studies that have used strength training in HIV+ patients have managed to show an increase in strength measurement after resistance training. So given the positive results from the quadriceps isometric test, the potential for strength increases with resistance training should not be disregarded because of the low numbers of subjects in this experiment.

2.4.4. Depression

Depression was assessed in two ways in this experiment: by the Beck Depression Inventory and the Elated-Depressed subscale of the POMS test.
The results of both these measures seem to indicate that the exercise programme did tend to lower depression.

For the Beck Depression Inventory

a) **Stage 1 inter-group comparison:** the experimental group reduced their score more than the control group, however this was not significant (p-value:0.22),

b) **Control group inter-stage comparison:** the exercise stage did tend to reduce BDI scores more and this was near significant (p-value:0.074)

The elated-depressed subscale of POMS exhibited similar trends (note that an increase in score here means less depression, while a decrease means more depression)

a) **Stage 1 inter-group comparison.** The experimental group increased their score by a mean 8.33 (an average of 15.22%), while the control group decreased their score by a mean -2.33 (an average of -4.27%). These differences were not significant (p-value:0.11)

b) **Control group inter-stage comparison** The exercise stage caused a mean increase of 10.33 (stage 1 caused a change of -4.27% on average and the stage 2 increased it by 14.43%). This was not significant (p-value:0.24) (all p-values in Appendix D)

Notice how in the elated-depressed subscale the increase in score during the exercise stage of the control group (stage 2) matches in size the increase caused in the experimental group (stage 1). Mean changes, 10.33 (for group C-stage 2) and 8.33 (for Group E-for stage 1).

Other experimenters have also found a decrease in depression scores Schlenzig *et al.*, (1989) and Florijn and Geiger (1991) both found a decrease in depression scores in the exercise groups (significance and method of assessment are not know). Rigsby *et al.*, (1991) randomly assigned 37 individuals into a exercise and a counselling control group. He found that after 12 weeks of exercise the exercise group decreased in BDI scores significantly and these decreases were comparable to those in the counselling group. LaPerrierre et al., (1994) noted that in these studies the exercise

sessions were done in a group which implies a strong social support component, which may influence depression scores. In this study the exercise sessions were done individually, so group interaction did not influence the results.

In the semi-structured interviews subjects responded very positively to questions relating to depression or symptoms of depression.

Do you think you appetite has improved since starting this exercise program ?

This question was included after piloting the interview questions, the pilot subject indicated that his appetite increases with exercise and that appetite is an issue for a lot of HIV+ people who are on medication. Appetite is also included in the Beck Depression Inventory as a reduction of appetite can be a symptom of depression . Half of the subjects felt that it did improve it, and half said that it made no change. From this information, we can suggest that exercise could perhaps help increase appetite but further research is needed.

Do you think you are coping any better with your life?

Four subjects answered yes and two no change. So it seems that exercise can help with coping ability. One subject said: " I was on a tablet for depression, I have since come off it, when I was doing my exercises"

Do you think the exercise programme improved the quality of you sleep?

Having trouble with sleeping is a symptom of depression, it is generally associated with negative mood affect, and is included in the Beck Depression Inventory. Four subjects said it helped them sleep better and two said it made no change. One of the subjects came off sleeping tablets.

Conclusion

Once again the number of subjects limited the strength of the results, and also perhaps the fact that these specific subjects were not particularly depressed at baseline (by either method, only one subject exhibited mild depression), which could have caused a floor effect. It has been suggested that exercise induced depression reduction will be more noticeable, the higher the initial depression (North *et al.*, 1990) . However, data gathered in this study (quantitative and qualitative) suggest that the exercise programme had an effect of reducing depression.

2.4.5. Profile Of Mood States (POMS)

For the profile of mood states the results were more positive, since a pattern emerged. The total POMS score increased significantly during stage 1 for the experimental group and so did two of the subscales. In general the means were positive which tends to support the notion that the exercise programme improved mood.

a) Stage 1 inter-group comparison. The total POMS score (all subscales) showed a significant increase for the experimental group: group E mean: 40.7 and group C mean: -7.7, p-value=**0.019.** The energetic-tired and clearheaded-confused results were significant (p-values: **0.047** and **0.023** respectively, Appendix D). The elated-depressed subscale results were near significant as shown above (p-value: 0.086, Appendix D). And the rest of the subscales were not significant. When looking at figures of the average % change of each subscale for each group (Figure 1.6), one notices that (disregarding the confident unsure subscale) the changes for the rest of the subscales were similar. For the experimental group scores increased in a range of: 14.78% to 23.75, while for the control group scores decreased in a range of: -4.27% to

-2.73% . Taking into account the pattern of changes for most subscales indicates a trend for increase in positive mood scores after the exercise intervention.

b) Control group inter-stage comparison. For this analysis none of the results were significant. They were near significant for the following three subscales: composed-anxious (p-value:0.062, table 44 of results), confident-unsure (p-value:0.074, table 44 of results), clearheaded-confused (p-value: 0.095). Similarly to the **Stage 1 inter-group comparison** case, disregarding the confident-unsure subscale, the rest of the subscales show a pattern of responses: a decrease for stage 1: -0.70% to -4.27 and an increase for stage 2: 10.05% to 14.83%.(Illustrated graphically in Figure 1.8)

Also worthy of noticing is the fact that the increases in scores for the experimental group are similar to the increases in the control group in stage 2 (again disregarding the confident-unsure subscale). Comparing figure 1.6 with figure 1.8 makes the similarity apparent. This supports the trend for increased mood scores with exercise intervention.

The subjects also responded favourably to questions relating to POMS in the semi-structured interview.

Do you think the exercise programme improved your mood generally?

While some subjects were more enthusiastic "yes there is absolutely no doubt about that" than others "Yes it has probably, generally, overall", all six subjects answered yes.

Have you noticed any differences in your energy levels with the exercise programme?

All subjects said that they had more energy now. This was in accordance with an increase in energetic-tired subscale scores. Subjects felt more awake and alert after doing the exercises.

In a study done by Lox et al. (1995) an aerobic training, a weight training and a control group were compared pre and post 12 weeks of intervention. For mood measurements the Positive and Negative Affect Schedule (PANAS) was used. Both the aerobic and weight training groups had a significantly higher positive mood and a significantly lower negative mood when compared to the control group.

Conclusion

The evidence from this experiment indicate that especially for the energetic-tired subscale, and clearheaded-confused subscales we can suggest that the exercise intervention is associated with increases in mood scores. Whether this is a result of the physiological benefits of the exercise programme or of environmental factors associated with it (e.g. experimenter-subject interactions, music), is not clear. What is important is that the subjects had a better mood as measured by POMS and they reported so themselves in the personal interviews.

2.4.6. Physical Self Perception Profile-Adult

It was a hypothesis of this experiment that the exercise regime would improve physical self perception as measured by PSPP-A. However, the results do not support this hypothesis very strongly. This has to be attributed to the small number of subjects used in this experiment. Some of the subjects were very near the top of the scale in their baseline measurements, so maybe a ceiling effect did limit the results for the PSPP-A.

There was a small trend for experimental group to have higher increases than the control group in **stage 1**, which was similar in all the subscales (Figure 1.10). This trend was existent but much less evident in **control group inter-stage comparison** (Figure 1.11).

The researcher feels that these changes were not very strong because of the ceiling effect and low numbers rather than the exercise not affecting physical self-perception. In addition to the suggestions of the data, qualitative data supports an increase in physical self-perception.

Do you feel more at ease with your body after the exercise programme?

All subjects answered yes to this question. One subject said he was "happy about my physical condition". This related to the perceived body attractiveness and physical self-worth scales of the PSPP-A and indicates that the subjects perceive that they have improved.

Do you feel better about yourself after doing the exercise programme?

Do you have a sense of achievement after the completion of the exercise programme?

All subjects answered yes to both questions. These question relates to a the achievement and mastery theory of increased self-efficacy and self-esteem. It seems that all of the subjects did get a sense of achievement and feel better about themselves, and this is important because it can affect mood and self-esteem. Although measures by the PSPP-A failed to show an increase in subscales like sports competence and physical self-worth, it seems that the subjects did feel an improvement after the intervention in term of those issues.

Do you feel more positive about your health now?

All subjects answered yes. However they were not as enthusiastic in that as in the mood question. To paraphrase one of the subjects, it was felt that health was better in general, however, he was not confident that this reflected in an increased ability to fight the HIV infection. This question relates to the perceived health and disease scale of the PSPP-A.

Has the exercise programme helped you with you everyday practical tasks? And how?

Four out of six subjects said yes, while two said it made no change. This question relates to the perceived functional capacity subscale of the PSPP-A. Subjects mention increased flexibility, feel generally more active, walking up and down hills. In one subject the exercise made a great difference, since leg pains he had gone away and he was able to go back to work, he said: "I can go to Safeway on foot, I used to take the car even though it was across the street."

Conclusion

The qualitative and quantitative data seem to support the notion that exercise could improve physical self-perception. Large scale studies would be required to prove so statistically.

2.4.7. Immunological parameters

The data generated no clear trends for immunological measures following exercise intervention. This was mainly a result of large variation. In fact studies with more subjects (e.g. Rigsby *et al.*, 1992) using up to 30 subjects have also failed to show a significant increase in CD4 cell count with exercise, citing variance of CD4 cell count as the reason for that.

2.4.8. Qualitative Data

Some of the questions asked in the interviews related to the objective data collected and was reported in the relevant sections. The rest of the questions are grouped in those relating to the programme itself, those relating to motivational issues, and other questions. A full set of the qualitative results can be found in Appendix E.

Questions relating to the exercise programme

These questions are not directly useful to our hypothesis, but could direct further research and exercise promotion.

How did you find the exercise?

What did you think on the length of the exercise sessions?

Did you find the exercises easy to perform?

How did you manage with the sessions at home?

How would you improve the sessions at home?

What would you like to change about this exercise session?

From answers to these questions we can see that the subjects felt that the exercise programme was enjoyable, and that 30 minutes is just about right for it. Any longer and would interfere with peoples schedules. The exercises were though of as easy in general apart from a few which were perceived as a bit hard. This became more apparent at home were everybody felt they did OK, apart from one subject who thought he did bad. Subjects felt that motivation at home was a little more difficult. Strictet monitoring, a friend, and a tape or video with instruction were felt would improve the sessions at home. Also subjects thought the programme did not really need any changes, only perhaps a shorter warm-up period.

Questions relating to motivational issues

Did exercise in anyway help you adopt and/or maintain a healthier lifestyle?

Did you get what you expected out of the exercise programme?

Would you recommend the exercise programme to other HIV+ people?

Has your attitude towards exercise in general changed after the exercise programme?

Do you intend to keep exercising?

How are you going to make sure you will keep exercising?

It was felt that this programme had given some subjects the "kick" to go out and do some more. Subjects were generally surprised from the benefit they perceived they got from this exercise programme, which means that exercise is not valued that much. They also said that their attitude towards exercise has greatly changed, people emphasised again that it was enjoyable and they didn't expect that. Most people said they would recommend the programme to other HIV+ people without hesitation, this question was put there to validate that there were positive effects from the programme great enough for the subjects to recommend this to others. "I wish everybody could do it!", was an enthusiastic response, other said it would be of benefit to appropriate individuals, referring to the fact he was thought exercise would be more beneficial in the initial stages of the infection. All subject said they intended to keep exercising. Some said they would get friends to do it with, and one said his shower in the evening was his trigger for doing it. Others were less ready in finding ways to motivate themselves to keep exercising.

Other data gathered

Do you think the exercise programme has helped you at all with any side effects of your medication, and which?

Most subjects did not have any side effects, one was not on any medication. But one subject reported that pains in his legs, a side effect of AZT went away with exercise. This is perhaps a finding worthy of further research, since AZT (and similar drugs) are commonly used in drug therapy, and myalgia is a common side-effect (Miller et al., 1991).

2.4.9. General Conclusions

From all the evidence presented, it would seem that the exercise programme did improve strength and mood in the subjects.

The quantitative results are not so suggestive about physical self-esteem measures, but the qualitative data suggested that the subjects perceived benefits in this area. In terms of immunological data no positive conclusions could be made. However, exercise was perceived to have helped the subjects in many different ways, and no one reported any negative effects.

It seems therefore that exercise is to be recommended for HIV+ people not just to keep fit, but to prevent or/ improve their condition on many associated problems like anxiety, depression, appetite, and reduced physical capacity.

2.4.10. Future research

A similar experimental study with larger numbers of subjects (above 30 subjects in total) would provide more concrete evidence. For this to happen in Glasgow, the recruitment drive would need to rely on more than just the good will of the subjects, a financial reward would ensure more subjects. Perhaps a joint effort with Edinburgh would provide a sufficient number of subjects. If numbers permit it would be a good idea to get groups of subjects in different disease stages and examine the effects of exercise for each stage. Also, in addition to larger numbers used in such studies, perhaps longer studies are required too. Perhaps for exercise to have an effect on the immune system more time than 12 weeks is required.

The low recruitment drive and qualitative data collected suggest there is a motivational issue with exercise in the HIV+ population, the second study which follows examines these issues.

Another possible topic of research could be to investigate the possible alleviation of drug related myalgias (muscle soreness/pain) with exercise. The researcher suggests that better circulation or increased flexibility should be investigated as some of the possible mechanisms.

Finally, basic research into the mechanisms of immunological and psychological benefits from exercise in general, would provide more information and credibility for studies in the HIV+ population. More research into the differences between acrobic and resistance training would help in the understanding of the mechanisms involved in the benefits of exercise. The literature reviewed suggests that the effects of catecholamines (adrenaline/nor-adrenaline) and cortisol levels on immune and psychological function associated with exercise are the best candidates for aerobic exercise, while glutamine levels are proposed for strength training. Research should investigate associations of levels of such substances in the blood and brain with measured benefits from exercise.

CHAPTER 3.

SECOND STUDY: A SURVEY OF EXERCISE BEHAVIOUR IN THE HIV+ POPULATION.

3.1 Introduction

3.1.1. Recruitment rate during study 1

After 20 visits to the HIV clinic at the Ruchill hospital, and several personal contacts at Body Positive, and an announcement of the study in the Body Positive newsletter (distributed to virtually all HIV+ patients in the Glasgow area), there were only 25 people who showed an intention of participating in the study 1. Of those 25, only eight subjects made it to the first visit at the University. This is a drop out rate of about 70%, in terms of adoption. Of these eight subjects, one dropped out straight after the baseline measurement tests, for personal reasons. And another one dropped out after having completed nearly all of the 12 weeks of the program. The drop out rate after the study began was therefore 25%. This means that only 6 subjects' data was completed. Considering there are about 210 HIV assymptomatic patients in Glasgow, the recruitment to this study was quite low.

One possible reason for low recruitment could be that the HIV population, has a negative attitude towards exercise. Chronically ill patients often have little no interest in exercising (Lapman, 1997). It was also noted that in the HIV and exercise literature there was no indication of levels of habitual exercise in this population. It was therefore, decided to examine exercise levels and attitudes towards exercise for the Glasgow HIV population.

It is therefore an aim of this study to investigate possible differences in the four transmission groups. It is also possible that in general the HIV population will have different physical activity levels and different motivations and barriers to the general population. So the results will also be compared to those of the general population.

3.1.2. Background to the HIV population

As a patient population the HIV population is quite particular as it composed of very different subgroups. The four main ways of HIV transmission are : a) sex between men (whether homosexual or bisexual), b) heterosexual contact, c) intravenous drug users, d) haemophiliac transmission (although the latter is becoming less common, with proper blood screening), e) other minor groups (like blood transfusion, resident in Africa etc.). Therefore, in terms of physical activity levels and motivations and barriers to exercise, each group could paint a different picture.

3.1.3. The exercise adherence problem

There is a widely recognised lack of exercise in the normal population. Population estimates in North America show that 30% to 60 % are sedentary in their leisure time (Stephens, 1987). Studies in the Scotland report that up to 70-80% of the population fail to meet the minimum levels of exercise as defined by ACSM, 1990, with three session of vigorous exercise per week (Health Education Board for Scotland, 1995). According to the Health Education Population Survey of 1996 in HEBS (1997), about 62% of the population fail to meet the new regular moderate or vigorous activity levels, (26% percent doing irregular moderate exercise and 36% being sedentary). With the health benefits associated with exercise, public health and exercise scientists have been trying to understand what makes people start exercising and maintaining that behaviour.

Up until the 1980s research on adherence to physical activity was mainly atheoretical, with the information gathered being general and descriptive (Godin, 1994). Since then a number of theories have emerged that try to explain (and/or

predict) exercise adherence. Examples of these models include: Health-Belief model (Becker & Maiman,1975; Jans & Becker, 1984), Protection-Motivation theory (Rogers,1975), Self-Efficacy theory (Bandura,1977), the Theory of Reasoned Action (Fishbein & Ajzen,1975), the Theory of Interpersonal Behaviour (Triandis,1977), Theory of Planned Behaviour (Ajzen 1985, 1988) , the Schema Theory based on (Lewin 1947), and the Transtheoretical Model (Prochaska and Marcus, 1994).

There is still great debate as to which is the best theory in predicting exercise adoption and adherence. Research is conflicting when determining the usefulness of these theories in terms of predicting exercise behaviour (e.g. Smith and Biddle 1999). However most of the theories above seem to include in one form or another the concept of a decisional balance. There is a role for the value a person places on the outcomes expected from a behaviour and/or barriers that a person perceives as obstacles to that behaviour.

In the Health Belief Model, a person is likely to start a preventative behaviour (like exercise) depending on the perception of a health threat of a disease. The perceived efficacy of the recommended preventative action depends on: a) the personal evaluation of the perceived benefits of the behaviour (in terms of reducing the health risk, or severity of the disease) and b) the real or perceived barriers to the adoption and maintenance of this proposed behaviour. Therefore in this model the likelihood of adoption and adherence to exercise as a preventative behaviour for disease would be partly explained by expected-outcomes and perceived barriers.

In the Protection Motivation Theory (Rodgers, 1975), similar to the health belief model, the intention to protect oneself depends on four factors (as described in Godin 1994):

a) the perceived severity of a threatened event (e.g. heart attack)

b) the perceived probability of the occurrence

c) the efficacy of the recommended preventive behaviour (e.g. exercise)

d) the perceived self -efficacy (in terms of undertaking recommended action)

In this model therefore, the perceived outcomes expected from exercise are a major factor in determining likelihood of undertaking exercise.

In the Self-Efficacy theory Bandura (1977) states that self-efficacy is the common cognitive mechanism mediating behavioural changes. Self-efficacy can determine whether an individual attempts a given task/behaviour (e.g. exercise), how much he/she is likely to persist in the face of difficulties, and the ultimate success of adopting and maintaining the task/behaviour. Bandura introduces the idea that "the conviction that one can successfully execute the behaviour required to produce outcomes" (Bandura 1977, p.193) will influence likelihood of action, and he also considers that the "estimate that a given behaviour will lead to certain outcomes" (Bandura 1977, p.193), always plays an important role.

Therefore according to the Self -Efficacy Theory attempts to increase exercise behaviour will depend on a personal assessment of the expected benefits of regular exercise, as well as in the perceived ability of the individual to exercise regularly.

In the Theory of Reasoned Action, Fishbein and Ajzen (1975) believed that intention (I), and consequently the behaviour (B) will depend on the individual's attitude about performing the behaviour (Aact) and the influence of social factors upon the behaviour, such as spouse's beliefs (SN). The basic model can be represented by the following mathematical equation:

$B \approx I = (Aact)\, w_1 + (SN)\, w_2$,

where w_1 and w_2 are weighting coefficients which should show intersituational and interindividual differences. The personal attitude towards the behaviour (Aact) is a function of the beliefs regarding the perceived consequences of carrying out that behaviour, and a personal evaluation of those consequences. Therefore, the perception and evaluation of expected outcomes of exercise would play a role in determining intention to exercise according to the Theory of Reasoned Action.

In the Theory of Interpersonal Behaviour, Triandis (1977) wrote that the likelihood of undertaking a given behaviour is a function of:

a) the habit of performing the behaviour

b) the intention to perform the behaviour

c) the conditions facilitating or discouraging performance of the behaviour.

As part of the intention to perform the behaviour Triandis identifies, among other components, the perceived consequences and the value attributed to them, and he terms this the cognitive component.

Although conditions discouraging performance of the behaviour could refer to perceived barriers, they are not specified in this model. The theory of Planned Behaviour (Ajzen 1988) is one that incorporates perceived barriers. Ajzen presented this theory as an improvement on the Theory of Reasoned Action where in addition to personal attitudes (Aact) and the subjective norm (SN), what would also influence intention and thus behaviour is perceived behavioural control (PCB), as shown in model below:

$B \sim I = (Aact)\ w_1 + (SN)\ w_2 + (PCB)\ w_3$

The first two components are defined exactly as they are in the theory of reasoned action model. The third component (PBC) was defined by Ajzen as the perceived presence or absence of required resources and opportunities and of anticipated

obstacles, and the perceived control to facilitate or inhibit the behaviour. And perceived barriers to a behaviour were used as a means of measuring PCB.

So most of the theories that are trying to explain exercise adoption and adherence have elements that identify expected-outcomes and perceived barriers as predictors of exercise behaviour. (The transtheoretical model was left out as it will be explained below). Moreover, research has shown that the balance between the perceived pros and cons of a behaviour, exercise in this case, can have predictive associations with adoption and maintenance of exercise (Dishman *et al.*,1985) .

3.1.4. Stages of change

The concept of stages for readiness to adopt exercise behaviour was introduced in the transtheoretical model of behaviour change by Prochaska and Marcus (1994). The stages of behaviour change came about from research with smokers but can be applied for understanding behavioural change in other chronic behavioural risk factors such as: obesity, high-fat diets, and sedentary lifestyles. Marcus adapted the model for exercise behaviour from the original model for smoking (Prochaska and Diclemente, 1983). The concept of stages of change "falls somewhere between traits and states" (Prochaska and Marcus, 1994). Stages of change of high risk behaviour are stable over time yet open to change. The stages have been named:

- pre-contemplation
- contemplation
- preparation
- action
- maintenance, and

- termination

In pre-contemplation individuals do not intend to change their high-risk behaviour in the future (usually 6 months), e.g. I do not intend to start exercising in the following 6 months. In terms of exercise this is not a very stable stage for those alternating between sedentary and active lifestyles. As a group, pre-contemplators evaluate the pros of the risk behaviour (e.g. sedentary lifestyle) as greater than the cons (Velicer, *et al.*, 1985).

Contemplation is the next stage in which people intend to change in the next six months. However, they tend to stay in this contemplation stage for at least 2 years, as they substitute taking action with thinking about changing their behaviour. As a group they evaluate the pros and cons of their risk behaviour as about equal, therefore being more ambivalent about changing (Prochaska and Marcus, 1994).

Preparation is when individuals intend to take full action in the near future. They typically have a plan of action, made some behavioural changes but not enough to meet a criterion, in this instance doing come exercise but not enough to meet the description of physically active. People in this stage people perceive the cons of the risky behaviour greater than the pros, and are therefore more likely to advance to the next stage than precontemplators or contemplators.

The stage which behavioural change has occurred within the last 6 months is called action. It is the least stable stage and there is a higher risk of relapse. The criterion for the behaviour has to be specific. An example for exercise behaviour can be found in the Scottish Physical Activity Questionnaire (Loughlan & Mutrie, 1995): **Exercise**: e.g. weight training, aerobics etc. for 2-3 times per week, hill walking for at least two hours/once per week

or

Sport: e.g. golf, hockey, football, netball, etc. for 2-3 times per week

or

General Activity: e.g. walking, gardening, etc. accumulating to at least 30 minutes/4-5 times per week

Maintenance is defined as the period from 6 months after the criterion has been reached until the risk of returning to the risky behaviour has been terminated, in which case we get the termination stage. In termination, there is "no temptation to engage in the old behaviour and 100% self-efficacy in all previously tempting situations." (Prochaska and Marcus, 1994, p.163). Termination as a stage in exercise is questionable, since there is always risk of relapse, therefore in exercise people are either in the maintenance stage or relapse to lower stages.

The stages of exercise behaviour have been used to examine different populations is Scotland (Mutrie, *et al.*, 1997). Since the subjects of this study are in Scotland, data from these studies will serve as useful comparison levels. This study compiled data from four separate surveys who used the stages of exercise behaviour questionnaire, as developed by Loughlan and Mutrie (1995). The populations were: (study 1) NHS nursing staff in two hospitals, (study 2) nursing staff from another hospital, (study 3) insulin dependent diabetics from four hospital clinics, and (study 4) students at a further education college. Table 2.1 shows the percentages of subjects in each stage of exercise behaviour for each study (adapted from Mutrie, *et al.*, 1997).

Table 2.1. Distribution of subjects (%) to stages of exercise behaviour change.

	Study 1 N=1494	Study 2 N= 94	Study 3 N=983	Study 4 N=242
Pre-contemplation	3	4	27	10
Contemplation	13	18	15	19
Preparation	36	34	26	32
Action	7	10	4	8
Maintenance	41	33	28	32

As one can see in Table 2.1, the clinical population of diabetics has a higher percentage of people in the pre-contemplation stage, and less people in the action and maintenance stages, when compared to the "general" populations of nurses and students.

3.1.5. Decisional Balance

The notion of a decisional balance is also found in the transtheoretical model. The pros and cons of specific behaviours have been measured using an instrument developed by O'Connel & Velicer (1988) and Velicer *et al.*, (1985). From these studies it was shown that the pros and cons played an important role in predicting transitions between the first three stages of change, while during action and maintenance they were less relevant.

The pattern of pros and cons across stages is consistent across a variety of problem behaviours, as a study of twelve behaviours by Prochaska, *et al.*, (1994) revealed. Predictably, in the precontemplation stage the cons of changing behaviour outweighed the pros,while the opposite happened at action and maintenance. The

cross-over in relative importance of pros and cons takes place during the contemplation and preparation stage, depending on the behaviour.

3.1.6. Measuring expected-outcomes and perceived barriers

As shown above there is a case for measuring expected-outcomes and perceived barriers when trying to predict exercise adoption and adherence. Although the strength of prediction from these measurements is still questionable, there is still a case in using them (Brawley, *et al.*, 1998). In the case of exercise and HIV, there have been no studies examining the adherence issue, therefore a study measuring expected outcomes and perceived barriers would provide a valuable baseline for future studies and exercise intervention projects.

There were two questionnaires considered for the motivations and barriers part of this survey. The Exercise Motivation Inventory (Markland and Hardy, 1992) was examined but not used because it only contained questions on motivation. The Expected Outcomes and Barriers to Exercise Questionnaire developed by Steinhardt and Dishman (1989) was adopted. Two versions of the questionnaire have been reported (Steinhardt and Dishman, 1989). The first version was designed for a college population while the second version was designed for a workplace site population. In the second version the number of items was expanded based on results from the first study and descriptive studies of work-site populations. The second version was chosen for this study as the HIV+ population was more likely to resemble the work site population rather than the college population. College students are generally younger and may have different activity patterns than older adults.

3.1.7. Aims of this study

The aim of this study was to investigate the levels of physical activity in the HIV+ population in Glasgow by categorising each person to a stage of exercise

behaviour. In addition, the motivations and barriers of this population towards physical activity were examined.

Questions that were examined in this study were:

1) Does HIV+ diagnosis affect activity levels?
2) How do activity levels in the HIV+ population compare to those of other populations?
3) Are activity levels influenced by method of contraction?
4) How do the motivations and barriers compare to other populations?
5) Do factors like disease progression as measured by CD4 cell count, method of contraction, Body Mass Index and activity levels influence motivations and barriers?

The questionnaire used for measuring outcome-expectancy and perceived-barriers did not allow direct comparison between the two. Therefore, decisional balance could not be investigated in this study.

3.2. METHODS

3.2.1. Subjects

The main criterion for inclusion in the study was HIV+ status dated at least 6 months prior to the completion of the questionnaire. This was done to ensure that HIV status had been there long enough to perhaps make a contribution to exercise behaviour. (Only one potential subject was excluded for this reason).

Fifty seven subjects from the Brownlee outpatients clinic (Gartnavel Hospital) volunteered to participate in this survey. Recruitment was done on the HIV clinic day for a period of 2 months. The mean age was 35.2 years. Forty six of them were men and 11 of them were women. In terms of transmission of the HIV virus, twenty seven (27) were classified as homosexual contact, 15 as intravenous drug users, 10 as heterosexual contact, and 5 were classified as other (no data recorded).

3.2.2. Procedure

Subjects were recruited from the Brownlee centre at Gartnavel hospital, at the HIV clinic. Patients were asked to participate in the survey by the staff nurse or doctors. If they agreed, after their session with the doctor, they were taken into a quiet room with the experimenter. The experimenter then explained the purpose of the study and gave the patient an information sheet with a consent form (Appendix J). If the patients agreed to take part in the survey they signed the consent form. Then they filled in the questionnaire with instructions from the experimenter. The questionnaire (approved by the hospital's ethical committee, Appendix J) took on average 5 to 10 minutes to be completed, with intravenous drug users taking considerably more time to finish. When the questionnaire had been completed the experimenter obtained medical data from the patients records via the staff nurse.

(Note: The experimenter was not allowed access to the patients medical files.) Most subjects present at the HIV+ clinic completed the questionnaire. Only a few subjects were missed due to time constraints and only one refused to complete the questionnaire. Therefore there is reasonable confidence that the recruitment was random and that the subjects would be representative of the HIV+ population.

3.2.3. Instrument

The questionnaire was in four parts (Appendix H). The first part had a description of regular physical activity (Loughlan and Mutrie, 1995). The question invited the subject to answer: "Do you consider yourself to be physically active now?" with the choice of : Yes or No. If the subjects answers NO, Then there were invited to answer the same question for 3 months ago, 6 months ago and before HIV diagnosis.

Part two of the questionnaire invited the subject to classify themselves as one of the 5 stages of exercise behaviour as modified by Marcus *et al.*, (1992) from Prochaska and DiClemente (1983) and further adapted by Loughlan and Mutrie (1995) to include general activity in the description of physical activity.

Part three is an Expected Outcomes and Barriers to Exercise Questionnaire developed by Steinhardt and Dishman (1989). All items have graded answers from 1: strongly disagree to 5: strongly agree. Part one refers to expected outcomes of exercise and has 19 items. The second part refers to barriers to exercise and has 15 items.

Part four of the questionnaire was for medical data, which were given to the experimenter by the staff nurse. These were: CD4 cell count, Age, Sex, Height, Weight, and method of transmission.

3.2.4. Pilot Testing

The full questionnaire in its final form was piloted on two people (non subjects) for duration and understanding. Both subjects went through the questionnaire without any problems in about 5 minutes. No adjustments were made after piloting.

3.2.5. Data Analysis

Data were transferred anonymously to a Minitab worksheet by the researcher. Then the distribution of subjects in stages of exercise behaviour was calculated and also analysed by method of contraction. Stages of exercise behaviour change were not statistically analysed, they were just compared to results from other populations descriptively.

Data from the outcome-expectancy values were analysed, scores for total outcome-expectancy and five factors identified by Steinhardt and Dishman (1989) were calculated. The factors being: psychological, body image and health, competition, fun, and social. Scores were also calculated for barriers total score and four factors identified: effort, time, limiting health, and obstacles. Details of the items each factor contains can be found in Appendix G. The scores obtained by the above analysis were descriptively compared to results from the worksite population in Steinhardt and Dishman (1989). The data was also examined statistically by one-way ANOVA using as factors CD cell count and method of contraction. Analysis of the results by Body Mass Index and activity levels were done using two-sample-t-tests.

All data was analysed using the MINITAB statistical package.

3.3. Results

3.3.1. Population Statistics

The total number of people attending the Outpatients Clinic at Brownlee Centre in 1998 were 217. The analysis by method of contraction of the HIV virus is given in Table:2.2.

Table 2.2. HIV patients attending in 1998 by method of contraction.

Method of Contraction	Number of patients	Percentage
Homosexual contact	100	47.1
IVDA	67	30.9
Heterosexuals	35	16.1
Others	13	5.9
Total	217	100

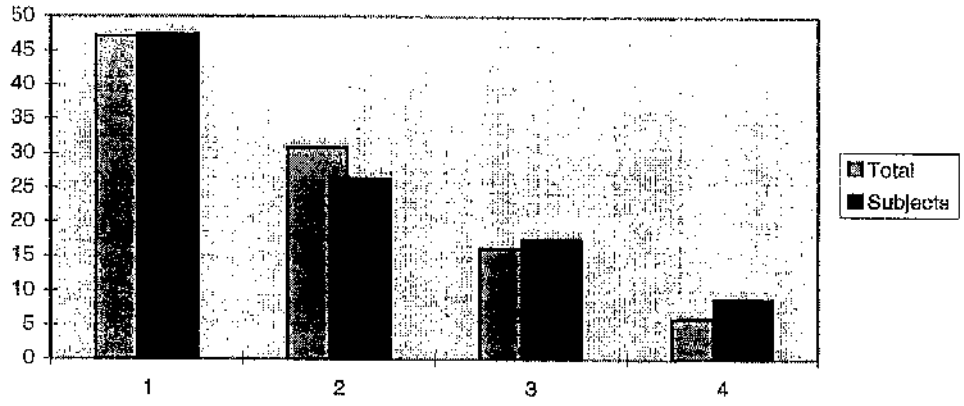
(Data obtained from Brownlee centre)

The total number of patients who completed the physical activity questionnaire was 57, this was 26.3% of the total clinic population. The analysis of subjects by method of contraction is given in the Table 2.3.

Table 2.3. Subjects by method of contraction.

Method of Contraction	Number of patients	Percentage
Homosexual contact	27	47.4
IVDA	15	26.3
Heterosexuals	10	17.5
Others	5	8.8
Total	57	100

Figure 2.1 Comparison of percentages of subgroups of Total and Subject HIV population.



It is interesting to note that the percentage of the different methods of contraction in the target population is very similar to the that of the subjects as illustrated in figure 2.1. This suggests that the subjects were representative of the HIV+ population targeted.(1=homosexual, 2=drug users, 3=heterosexual, 4=other)

3.3.2. Descriptive Statistics

Descriptive data of the subjects are summarised in Table 2.4.

Table 2.4 Descriptive Statistics of subjects.

Variable	N	Mean	SD	Median	Min	Max
Age (years)	57	35.8	7.38	35	19	56
Height (cm)	55	173.8	9.5	175	148	194
Weight (kg)	57	68.3	14.51	66.2	46.4	117.8
B.M.I. (kr/m^2)	55	22.5	4.03	21.8	16.1	40.7
CD4 (cells/ml)	57	369.8	269.4	305	7	1219

It can be seen from Table 2.4 the subjects mean age was 35.78 (SD=7.38). The mean Body Mass Index was 22.5 (SD=4.03) which is within normal levels. Their CD4 cell count mean was 369.8 (SD=269.4), which would be categorised as mildly immunocompromised, but subjects ranged from 7 cells/ml of blood (Severely immunocompromised-AIDS) to 1219 cells/ml of blood (normal cell count). It should be noted, however, that none of the subjects had a major symptoms related to HIV that would keep them hospitalised.

3.3.3. Reported activity levels

In the questionnaire subjects read the definition of physical activity and then responded to the question "Do you consider yourself to be physically active now?". Results are tabulated in the Table 2.5 and graphed in Figure 2.1.

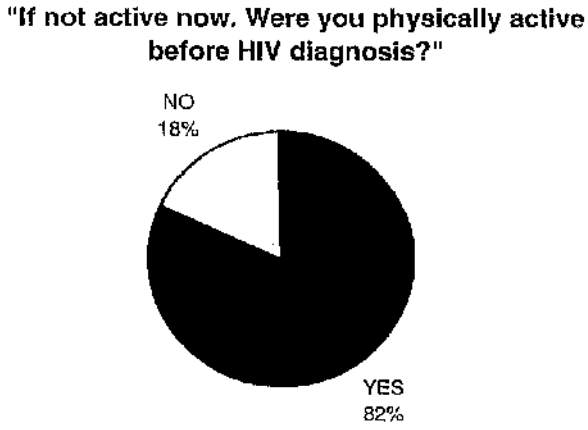
Table 2.5. Self reported activity status.

Do you consider yourself to be physically active now?	Yes	No
Number of subjects	35	22
% of total	61.4	38.6

From this percentage of people who answered yes in response to this question (61.4%) only about 38% of the subjects was in action or maintenance, therefore actually physically active.

It is interesting to note that of those 22 who answered no to the above question: 18 said that they were active before diagnosis (81.9%), and 4 said that they were not active before diagnosis (18.1%), as shown in Figure 2.2

Figure 2.2. Activity status before HIV+ diagnosis of inactive subjects.



3.3.4. Stages of exercise behaviour change

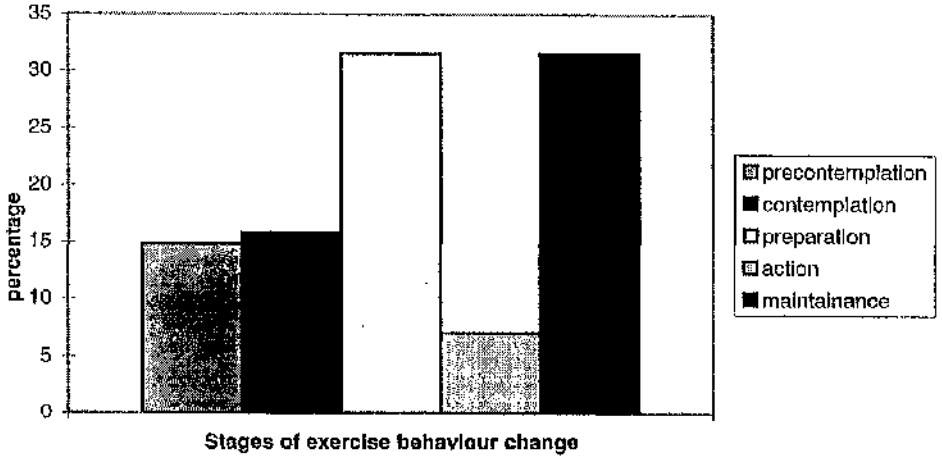
Results for stages of exercise behaviour are found in Table 2.6 and Figure 2.3.

Table 2.6. Stages of exercise behaviour for subjects.

Stage of behaviour	Number	Percentage
Pre-contemplation	8	15%
Contemplation	9	16%
Preparation	18	31%
Action	4	7%
Maintenance	18	31%
Total	57	100%
Non regularly active	35	62%
Regularly active	22	38%

From Table 2.5 it can be seen that 38% of the subjects were physically active (i.e. action and maintence) while 62% were either inactive or not doing enough physical activity to meet the recommendations (i.e. pre-contempation, contemplation, and preparation).

Figure 2.3. Percentage of population at each stage of exercise behaviour.



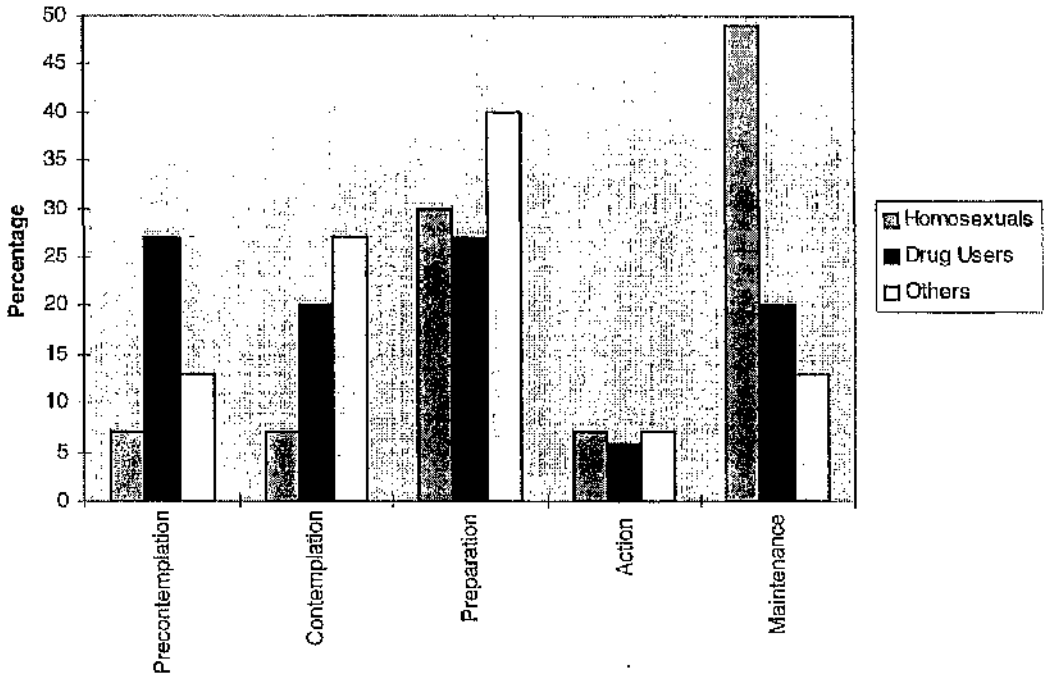
The stages of exercise behaviour were also analysed by method of contraction to see differences between groups and are shown in Table 2.7 and Figure 2.4. Because of the low numbers of the heterosexual and "other" groups, the two groups were combined to form a new "others" group. Results were also summarised as Non-regularly active including pre-contemplation, contemplation, and preparation stages, and regularly active containing: action and maintenance stages.

Table 2.7. Analysis of stages by method of contraction.

Method of contraction	Homosexual	Drug Users	Others
Pre-contemplation	2 (7%)	4 (27%)	2 (13%)
Contemplation	2 (7%)	2 (20%)	4 (27%)
Preparation	8 (30%)	4 (27%)	6 (40%)
Action	2 (7%)	1 (6%)	1 (7%)

Maintenance	13 (49%)	3 (20%)	2 (13%)
Total	27 (100%)	15 (100%)	15(100%)
Non-regularly active	12 (44%)	11(74%)	12 (80%)
Regularly active	15 (56%)	4 (26%)	3 (20%)

Figure 2.4. Stages of exercise behaviour by method of contraction.



From Table 2.7 and Figure 2.4 it can be seen that different methods of contraction have different distributions in the stages of exercise behaviour. Homosexuals have a higher percentage of 56% physically active people (maintenance and action stages), while drug users and others have 26% and 20% respectively.

3.3.5. Outcome-Expectancy and Perceived Barriers

Outcome-Expectancy . The first section of this part of the questionnaire related to perceived benefits of exercise: "a major benefit of physical activity for me is:" . This 19 item section gives a total score of outcome-expectancy and can also be divided into five factors. The mean for total outcome-expectancy values was 64.18 with SD= 14.01 (N=55). The possible range of scores for the total outcome-expectancy score are : 19 to 95. The scores for the five factors are given in Table 2.8.

Table 2.8. Outcome-Expectancy Values.

Variable	N	Mean	SD
Psychological	57	21.36	5.10
Body image Health	55	18.80	4.30
Competition	57	11.33	3.81
Fun	57	7.33	2.27
Social	57	5.59	2.29
Total	55	64.18	14.01

(Note that because the five factors are not equal in the number of items direct comparison is not possible)

The individual outcome-expectancy values were ranked by mean score in order of importance, in Table 2.9. The range of scores for each item range from 1: strongly disagree to 5: strongly agree.

Table 2.9. Ranked means on outcome-expectancy values.

Variable	N	Mean	SD
1.Improved health	57	4.14	0.99
2.Positive psychological effect	57	3.87	1.07
3.Release of Tension	57	3.86	1.076
4.Stay in shape	57	3.84	1.13
5.Sense of accomplishment	57	3.84	1.15

6.Enhancing self-image	57	3.74	1.09
7.Enjoyment of the activity	57	3.71	1.13
8. Fun and enjoyment	57	3.61	1.26
9.Cope with life's pressures	57	3.56	1.15
10.Maintain or lose weight	56	3.55	1.34
11. Improved mental alertness	57	3.45	1.28
12.Improved physical attractiveness	56	3.41	1.17
13. Respect of my athletic ability	57	3.19	1.20
14. The thrill of victory	57	3.05	1.35
15.Time spent with close friends	57	2.93	1.37
16.Feeling younger	57	2.77	1.33
17.Time spent with family	57	2.66	1.41
18.Competition	57	2.57	1.26
19.Sense of being member of team	57	2.50	1.22

Perceived Barriers. The second section of this part of the questionnaire related to perceived barriers to physical activity: "A major reason when I do not exercise is:" . The 15 items of this section give a total score and also give four factors. The total score for perceived barriers was a mean of 39.13 with SD=8.81 (N=54). The possible range being 15 to 75. The analysis of the four factors are given in Table 2.10.

Table 2.10. Perceived Barriers Values.

Variable	N	Mean	SD
Effort	57	12.19	3.95
Time	54	8.96	3.51
Limiting Health	57	8.47	3.59
Obstacles	56	9.67	3.21
Total	54	39.13	8.81

(Note that because the four factors are not equal in the number of items, direct comparison is not possible)

The individual perceived barriers were ranked by mean score in order of importance, in Table 2.11. The range of scores for each item range from 1: strongly disagree to 5: strongly agree.

Table 2.11. Ranked means of perceived barriers values.

Variable	N	Mean	SD
1.Lack of motivation	57	3.35	1.43
2.Too tired	57	3.08	1.24
3.Limiting health reasons	57	3.03	1.46
4.Too lazy	57	2.94	1.50
5. Illness	57	2.80	1.50
6.Too fatigued	57	2.80	1.39
7.Too busy	56	2.64	1.47
8. Physical disability	57	2.63	1.53
9.Lack of facilities	57	2.57	1.33
10. Not enough time	55	2.56	1.19
11.Too inconvenient	56	2.46	1.19
12.Too boring	57	2.40	1.45
13.Bad weather	57	2.29	1.46
14.Family obligations	57	2.05	1.39
15.Interferes with my work	57	1.86	1.21

3.3.6. Analysis of expected-outcomes and barriers by factors

The five factors of the expected-outcomes and total expected-outcome values and the fours factors of barriers and total barriers values were analysed using ANOVA, by the following variables: CD4 cell count, , method of contraction, Body Mass Index,

CD4 Cell count (cells/ml of blood)

CD4 counts were grouped into three categories:

1 (very low immunity) = below 200 (N=16),

2 (moderate immunity) = between 200 and 400 (N=22),

and **3 (moderate to normal immunity)** = above 500 (N=19)

A **one-way ANOVA** was computed on each of the outcome-expectancy and barriers factor values by CD4 cell count, (Tables 2.12, 2.13). The F-value from the ANOVA on obstacles reached significance **p= 0.019**, therefore a follow up test was done. **Two-Sample T-tests** were done between all three groups for obstacle scores, and it was seen that the only significant difference was between the moderate immunity mean = 8.32, and normal immunity mean=11.11 with a **p-value** of 0.006. This means that patients with normal immunity had a higher perception of obstacle than those with moderate immunity.

However, it is recognised that there is no apparent pattern to this data and this single significant difference may be a type I error as a result of repeated testing.

Table 2.12. Differences in outcome-expectancy scores by CD4 cell count category.

Variable	CD4 count	Mean	SD	p-value of ANOVA F
Psychological	1(low)	19.93	5.61	
	2(mod)	23.31	4.05	
	3(normal)	20.31	5.30	0.069
Body image/Health	1	16.93	5.61	
	2	20.13	3.31	
	3	18.72	3.72	0.082
Competition	1	11.37	3.72	
	2	12.18	4.59	
	3	10.31	2.68	0.301
Fun	1	7.06	2.01	
	2	8.00	2.26	
	3	6.78	2.41	0.205
Social	1	6.00	2.58	
	2	5.27	2.31	

	3	5.63	2.08	0.635
Total Outcomes	1	60.67	16.02	
	2	68.91	12.12	
	3	61.33	13.50	0.122

Table 2.13. Differences in perceived-barrier scores by CD4 cell count category.

Variable	Group	Mean	SD	p-value of ANOVA F
Effort	1(low)	11.25	4.46	
	2(mod)	12.54	3.98	
	3(normal)	12.57	3.51	0.539
Time	1	8.53	2.41	
	2	9.13	3.85	
	3	9.11	3.99	0.861
Limiting health	1	8.31	3.24	
	2	9.50	3.86	
	3	7.42	3.38	0.179
Obstacles	1	9.93	3.15	
	2	8.31	2.76	
	3	11.11	3.25	**0.019***
Total Barriers	1	60.67	16.02	
	2	68.91	12.12	
	3	61.33	13.50	0.122

(* denotes significant value $p<0.05$)

Method of contraction

Data was also analysed by method of contraction, with the categories being:

1 = homosexual (N=27), **2 = Drug users (IVDU)** (N=15), **3 = Others** incorporating heterosexuals and others (N=15)

Data was analysed using a **one-way ANOVA** and results are shown in Tables 2.14 and 2.15. None of the F values reached significance.

Table 2.14. Differences in outcome-expectancy scores by method of contraction.

Variable	Group	Mean	SD	p-value of ANOVA F
Psychological	1(homo)	21.85	4.185	
	2(drugs)	21.40	4.98	
	3(other)	20.46	6.76	0.70
Body image/Health	1	19.28	3.73	

	2	17.93	4.92	
	3	18.86	4.68	0.63
Competition	1	10.55	2.77	
	2	13.06	4.48	
	3	11.00	4.40	0.11
Fun	1	7.37	2.00	
	2	7.33	2.35	
	3	7.26	2.78	0.99
Social	1	5.33	2.40	
	2	6.46	2.10	
	3	5.20	2.21	0.23
Total Outcomes	1	63.80	11.21	
	2	66.20	15.01	
	3	62.80	17.59	0.79

Table 2.15. Differences in perceived-barriers scores by method of contraction.

Variable	Group	Mean	SD	p-value of ANOVA F
Effort	1(homo)	12.07	4.02	
	2(drug)	13.53	3.73	
	3(other)	11.06	3.88	0.23
Time	1	9.61	3.09	
	2	7.78	3.59	
	3	8.92	4.06	0.29
Limiting health	1	8.00	3.28	
	2	9.13	3.56	
	3	8.66	4.23	0.60
Obstacles	1	9.48	3.08	
	2	9.86	3.85	
	3	9.85	2.93	0.91
Total Barriers	1	39.15	8.554	
	2	39.92	8.95	
	3	38.28	9.71	0.88

Body Mass Index

A similar analysis was done for body mass index this time using a **two-sample T test.** Subjects were split into two groups using the median score as point of reference, which was 21.8 kg/m^2. Anyone above the median was assigned to **group 1**: high BMI and anyone below the median was assigned to **group 2**: low BMI.

Results are shown in Tables 2.16 and 2.17. No significant differences between high and low BMI groups were noted.

Table 2.16. Differences in outcome-expectancy scores by Body Mass Index.

Variable	BMI	Mean	SD	p-value
Psychological	1 (high)	20.89	5.03	
	2 (low)	21.89	5.01	0.46
Body image/Health	1	19.33	3.92	
	2	18.19	4.77	0.35
Competition	1	11.00	3.42	
	2	11.61	4.30	0.57
Fun	1	7.74	1.97	
	2	7.00	2.4	0.22
Social	1	5.33	2.35	
	2	5.79	2.33	0.48
Total Outcomes	1	64.3	12.8	
	2	64.0	15.2	0.94

Table 2.17. Differences in perceived-barriers scores by BMI.

Variable	BMI	Mean	SD	p-value
Effort	1(high)	12.00	4.07	
	2(low)	12.43	3.99	0.69
Time	1	8.67	3.23	
	2	8.92	3.75	0.79
Limiting health	1	7.96	3.93	
	2	8.96	3.37	0.31
Obstacles	1	9.74	3.41	
	2	9.56	3.15	0.84
Total Barriers	1	38.37	8.67	
	2	39.56	9.30	0.64

3.3.7. Analysis by activity levels

Data on expected-outcomes and barriers were also analysed by physical activity levels. Those patients not meeting the requirements of regular physical activity (pre-contemplation, contemplation, preparation) were called **group 1**, while patients meeting the requirements (action, maintenance) were called **group 2.**

Two-sample T-tests were computed to compare the two groups, results shown in Table 2.18, and 2.19.

Table 2.18. Differences on outcome-expectancy scores by activity levels.

Variable	Group	Mean	SD	p-value
Psychological	1 (non-exercisers)	20.37	5.18	
	2 (exercisers)	22.95	4.67	**0.062**
Body image/Health	1 (non-exercisers)	17.88	4.28	
	2 (exercisers)	20.29	3.99	**0.043***
Competition	1 (non-exercisers)	11.00	4.07	
	2 (exercisers)	11.86	3.41	0.73
Fun	1 (non-exercisers)	6.66	2.40	
	2 (exercisers)	8.41	1.59	**0.0038***
Social	1 (non-exercisers)	5.60	2.44	
	2 (exercisers)	5.59	2.11	0.99
Total Outcomes	1 (non-exercisers)	61.2	14.1	
	2 (exercisers)	69.0	12.7	**0.044***

(bold type denotes near significance, * denotes significant difference, $p<0.05$)

Results show that exercisers had greater total outcome scores, and specifically, the body image/health and fun components were higher than the scores of non-exercisers. The psychological scale was also near significance. It should be noted that there is a possibility of rejecting the null hypothesis while it is true (Type I error), with the number of repeated tests being made.

Table 2.19. Differences in perceived barriers values by activity levels.

Variable	Group	Mean	SD	p-value
Effort	1 (non-exercisers)	12.77	3.90	
	2 (exercisers)	11.27	3.94	0.17
Time	1 (non-exercisers)	8.24	3.67	
	2 (exercisers)	10.10	3.00	**0.058**
Limiting health	1 (non-exercisers)	9.23	3.66	
	2 (exercisers)	7.27	3.19	**0.044***
Obstacles	1 (non-exercisers)	10.26	3.14	
	2 (exercisers)	8.77	3.19	0.09
Total Barriers	1 (non-exercisers)	40.30	8.37	
	2 (exercisers)	37.29	9.38	0.22

(bold type denotes near significance, * denotes significant difference $p<0.05$)

Results show that regularly active subjects in general do no differ from non-regularly active subjects in total barrier scores. However, looking at individual factors non-regularly active perceived limiting health as a bigger barrier than regular exercisers (**p-value: 0.044**). In terms of time, there was a tendency ($p=0.058$) for regular exercisers to view time as a barrier more than those classified as not regularly active.

3.4.Discussion

3.4.1. Self reported physical activity levels

The percentage of people who answered "yes" to the question "Do you consider yourself to be physically active now?" was 61.4. Of those 34 who answered yes to this question, only 22 were in maintenance or action stages, the other 13 were in preparation or contemplation which meant they were not doing enough activity to meet the requirements of being physically active according to the definition in the questionnaire. Therefore, the percentage of yes answers cannot be used as a true representation of levels of physical activity in the subject population. This illustrates how difficult it can be to get good measures in a complicated issue like exercise behaviour. The stages of exercise behaviour change results are assumed to be more accurate since they have been validated (Marcus *et al.*,1992).

However, it is very interesting to note that of those 22 who answered no to the above question 18 said that they were active before diagnosis (81.9%). It would seem therefore that diagnosis and perhaps treatment could have affected activity levels in this subject population. This is interesting because research findings (e.g. Rigsby, 1992) and findings from study 1, indicated that exercise does not have any negative effects on the health of asymptomatic HIV+ patients, and it will possibly have positive effects. Therefore, if diagnosis with the HIV virus is perceived as a contra-indication to exercise by HIV+ patients, this should become a discussion topic by health workers dealing with HIV+ populations.

3.4.2. Stages of exercise behaviour change

From the results it can be seen that 38% of the subjects were regularly physically active while 62% were either inactive or not doing enough physical

activity to meet the recommendations. This is in line with general population statistics which indicate that about 62% of the Scottish population fail to meet their minimum recommendations of moderate or vigorous exercise (HEBS, 1997). These recommendations are the same used in this study as set by Loughlan and Mutrie (1995). It would therefore seem that although 62% of the subjects were failing to be physically active, this does not constitute a special problem of the HIV+ population as inactivity levels are similar to the general population.

However under closer analysis of the results by method of contraction, it seems that there is a particular problem with subgroups of the HIV+ population. Drug users and the "others" group (heterosexuals, blood transfusion, etc.) are particularly low in activity, with 72% of drug users and 80% of others failing to meet recommendations of physical activity. It seems therefore that although the total subject population (HIV) is similar to general population numbers, subgroups of drug users and "others" resemble more activity levels of diabetic patients populations in Mutrie *et al.*,(1997). The cause for total HIV+ results resembling the general population while drug users and "others" being more inactive is probably explained by the high number of homosexuals who are physically active. This is made clearer in Table 2.20, which incorporated data from this study with two studies from Mutrie *et al.*, 1997. Results from this study can be compared to the NHS population who are most representative of the general population (from Mutrie *et al.*, 1997)

Table 2.20. Comparison of % in stages of exercise change of different populations

Method of contraction	Homosexual N=27	Drug Users N=15	Others N=15	Total HIV N=57	NHS staff N=1494 Mutrie *et al.*, 1997	Diabetics N=983 Mutrie *et al.*, 1997
Pre-contemplation	7%	27%	13%	15%	3%	27%
Contemplation	7%	20%	27%	16%	13%	15%
Preparation	30%	27%	40%	31%	36%	26%
Action	7%	6%	7%	7%	7%	4%
Maintenance	49%	20%	13%	31%	41%	28%

It seems therefore that different subgroups of the HIV+ population have different activity levels, with homosexuals having higher levels of physical activity and drug users and "others" having lower levels. This should be taken into account when trying to promote physical activity in the HIV+ population. It seems that drug users and "others" will be more resistant to starting exercise as they have more people in the pre-contemplation and contemplation stages. It should be noted that the numbers in this study are quite small, but appear to be representative of the Glasgow HIV+ population. Therefore, we could generalise results from this study to the Glasgow HIV+ population.

3.4.3. Outcome-expectancy values

The means of the total and the five factor scores from this study can be compared to the worksite values from the Steinhardt and Dishman (1989) study, in Table 2.21. (The items each factor contains can be found in Appendix I).

Table 2.21. Outcome-Expectancy Values Comparison.

Variable	HIV+ Mean N=57	Worksite Mean N=968 Steinhardt and Dishman (1989)
Psychological	21.36	23.11
Body image/Health	18.80	20.70
Competition	11.33	10.46
Fun	7.33	7.55
Social	5.59	5.28
Total	64.18	67.06

(Note: factor scores are not inter-comparable)

Table 2 might suggest a trend of the HIV+ population possibly having a lower perception of exercise having beneficial outcomes, but it seems that this difference is not large. It would seem therefore reasonable to conclude that the HIV+ population does not differ in the way they perceive benefits from exercise from the general population.

3.4.4. Perceived Barriers to exercise

In general the subject population did not have a different total score of perceived barriers than those of the worksite study of Steinhardt and Dishman (1989). However, a closer look at the four factors of perceived barriers might indicate that some differences exist. The effort, time and obstacles factors have the same amount of items making their scores directly comparable. In the worksite population time rates first then effort and finally obstacles. In the subject population of this study effort rates first with obstacles second and time third, as shown in Table 2.22.

Table 2.22. Perceived Barriers Values Comparison.

Variable	HIV Mean N=57	Worksite Mean N=968 Steinhardt and Dishman (1989)
Effort	12.19	11.42
Time	8.96	13.68
Limiting Health	8.47	6.76
Obstacles	9.67	6.67
Total	39.13	40.87

It seems from Table 2.22, that in the HIV+ subject population, time rates lower than the "general" population, this is a very interesting result because time is a common major barriers to exercise (Gullop Organisation, 1985; Canada Fitness Survey, 1983; Steinhardt and Dishman, 1989). It is also interesting to note that limiting health and obstacles (e.g. lack of facilities, too inconvenient) are higher in the HIV+ population than in the worksite sample. Although there is no statistical evidence to back these differences, they are important issues that those involved in promoting physical activity for HIV+ patients should be aware of. Another piece of evidence would be to compare individual barriers in the order of importance. The order of importance of each barrier from this study and Steinhardt and Dishman (1989) worksite sample are shown in Table 2.23.

Table 2.23. Ranking of perceived barriers values.

HIV subject population	Worksite population Steinhardt and Dishman (1989)
1.Lack of motivation	1. Too busy
2.Too tired	2. Not enough time
3.Limiting health reasons	3. Family obligations
4.Too lazy	4. Lack of motivation
5. Illness	5.Interferes with my work
6.Too fatigued	6. Too lazy
7.Too busy	7. Too tired
8. Physical disability	8. Bad weather
9.Lack of facilities	9. Illness
10. Not enough time	10. Too boring
11.Too inconvenient	11. Too inconvenient
12.Too boring	12. Too fatigued
13.Bad weather	13. Physical disability
14.Family obligations	14. Limiting health reasons
15.Interferes with my work	15. Lack of facilities

As can been seen in Table 2.23, in the worksite population items for time rate among four of the top five reasons for not exercising, in the HIV+ subjects it comes in at numbers: 7, 10, 14, 15. This may be self-evident because in the experience of the experimenter a high percentage of HIV+ patients do not work. So when compared to a worksite population will seem to have more time available to exercise, but that in itself is important in terms of exercise promotion. The top five reasons for the HIV+ subjects not exercising are items of effort and limiting health. (Shading shows position of 3 top reasons for HIV in worksite population). This evidence is very important in terms of health and exercise promotion: targeting time limitations of exercise with effective time management may be very relevant to the general population. However, as time is less of a barrier to HIV+ patients, time management

need not take a great part of exercise promotion. On the other hand effort seems to be the most major barrier to exercise in the HIV+ subjects, and therefore more emphasis should be given to minimising perceptions of effort rather than time management in exercise promotion campaigns.

In terms of health limiting factors HIV+ patients perceive them more as a barrier, this is to be expected as illness is more common in this population. However, the role of perceived health limiting factors and real health limitations could be a future area of research.

Obstacle scores in HIV+ patients seem to be a bit higher than 'worksite' population, in particular the lack of facilities items rates much higher in the HIV subjects than in the worksite population. During the completion of the questionnaire complaints about lack of facilities for HIV patients were common, subjects reported feeling intimidated and scared to use public facilities, saying that they were ashamed of their own body or of their HIV status.

3.4.5. Analysis of expected-outcomes and barriers by factors

The data from expected-outcomes and barriers was also analysed by the following three factors: CD4 cell count, method of contraction and Body Mass Index (BMI). It was expected that disease progression (measured here as CD4 cell count) would have an effect on expected-outcomes and barriers. However, data does not support this hypothesis. With the exception of the obstacles barrier-factor (e.g. lack of facilities, bad weather) where moderate to normal immunity (above 500 cells/ml) patients perceived more obstacles than did the moderate immunity(between 200-500 cells/ml). This result is unexpected, and could be a type I error.

Method of contraction was also hypothesised to have an effects on perceived motivations and barriers since, as shown, different methods of contraction have different distributions across the stages of exercise behaviour change. Again the data did not support this hypothesis.

Body Mass Index is not a major disease progression indicator, although people in more advanced stages will tend to be more thin, and perhaps have a lower physical self-image, which could be exhibited as lower scores on outcome-expectancy and higher scores on barriers. The data, however, was not supportive of this hypothesis.

One of the reasons for the ANOVA not giving significant results could come from the subject numbers, which may not have been large enough to detect the effect. The experimenter feels more confident that this is the case for method of contraction, as data from this study indicate that method of contraction made a difference in the subject distribution across the stages of exercise behaviour change, as seen Table 2.7 and Figure 2.4 (p132-3). This issue should be examined in future studies.

3.4.6. Analysis of expected-outcomes and barriers by activity levels

Additional analysis of expected-outcomes and barriers was done by physical activity levels. Subjects who did not meet the requirements of physical activity (as defined by Loughlin and Mutric, 1995) were termed **non-regularly** active, and those who did meet the criterion were termed **regularly** active. Regularly active subjects had higher expected-outcomes in general than non regular exercisers, as expected. But more specifically non-regular exercisers viewed health/body image and fun as less of an expected-outcome than did the regular exercisers. Therefore it seems that when targeting the non regular exercisers of this population to start exercising health/body image and fun might be useful motivators.

In terms of total barriers we can't conclude that the two groups differ. However, when looking more closely, non-regular exercisers perceived limiting health as a more major barrier to exercise than regular exercisers. This is possibly more of a perceived barrier for non regular exercisers rather than a real one (meaning it could be more of an "excuse" rather than a real problem). In analysis done by disease progression, more advanced patients (who theoretically should have more symptoms, i.e. more limiting health) did not perceive limiting health barriers any differently than the less advanced patients. Therefore, there is a case for reassuring HIV+ patients that being HIV+ (at least in the assymptomatic phase) is not a contra-indication to exercise.

3.4.7. Conclusions

The results of this study have shown that a large number of HIV+ assymptomatic patients are not exercising enough to meet the requirements of regular physical activity. It was also shown that this problem was accentuated in drug users and people contracting the virus though heterosexual sex and other causes apart from homosexual contact. Since the benefits of exercise could make a difference to these patients' general quality of life, as indicated by study 1, and other studies (Lox *et al.*, 1995), it seems logical that this population should have a more specific exercise promotion strategy. Data from the barriers scales have shown that HIV+ patients have different barriers than those of the general population, with increased limiting health and obstacle problems and lower time management problems. These issues would be important to be raised when promoting exercise to HIV+ patients. When targeting the non-exercisers, the results showed that health is a very important issue as it distinguished exercisers from non-exercisers in both motivations and barriers. The results showed that promoting the health benefits of exercise and reassuring that HIV+

status is not a contra-indication to exercise would be beneficial. Also promoting the fun elements of exercise might be a good motivator, as it distinguished regular from not regular exercisers.

3.4.8. Future research

Larger scale research of motivations and barriers in the HIV+ population would give more conclusive results. This should be done both by quantitative and qualitative methods. Investigating differences in the different groups of HIV+ patients (homosexuals, drug users, heterosexual) would also provide useful guiding points for research and exercise promotion. Processes of change as described in Prochaska and Diclemente (1995), would also provide good information, about how this population becomes more active.

Qualitative research into settings where HIV+ exercise programmes have been set up would give invaluable information (e.g. Body Positive Strathclyde fitness centre). Adherence and drop out rates along with information on promotion strategies and other parameters (e.g. supervision, settings encouragement) would indicate effectiveness of different promotional approaches.

Research into the beliefs of medical staff and health professionals involved with HIV+ patients and its effects on levels of activity would also be a very fruitful area of investigation. The influence of the staff's attitudes to exercise on the beliefs of their patients could be very important. And finally a good exercise promotion strategy should be devised, used and then evaluated, using all the findings coming from previous research. A good exercise promotion strategy would involve information on the benefits of exercise for HIV+ patients (via doctors, nurses, leaflets, posters, etc.) being readily available at HIV+ clinics. It would also involve doctors referring

patients to exercise programs tailored to HIV+ patients, like exercise programmes in HIV+ self help centres.

3.4.9. Conclusions on recruitment rate during study 1

Study II was conducted partly to gain information on the low recruitment drive in study I. It was hypothesised that the HIV+ population would have negative attitudes towards exercise. In general the results did not confirm that the HIV+ population has lower motivations and higher barriers than the general population. Therefore, generally the results do not explain the low recruitment drive in study I. However, under closer analysis issues of health and obstacles were more important in the HIV+ population.

So perhaps these issues can partly explain the lower recruitment drive.

Another explanation comes from data from this study and experience of the experimenter. In study one, an inclusion criterion was lack of regular physical activity in the previous 6 months. Verbal communication with nurses and doctors indicated that drug users were not reliable in terms of appointments, treatments and being subjects in experiments. Analysis of sub groups in this study showed that homosexuals had higher percentages of regularly active people while drug users had low percentages of regularly active people. Thus the drug users were a more suitable pool of subjects for study one, however, that group was not reliable. In fact, none of the subjects used in study I were drug users, and drug users that did show an interest in the study did not meet their appointments or dropped out. Homosexuals were a more reliable subgroup in terms of study recruitment but had higher percentages of regularly active people, therefore making it more difficult for recruitment.

Other explanations for the low recruitment in study one include issues of heavy subject demands and confidentiality. The HIV+ population is a heavily studied

population, as the disease in less that 20 years old. During study two, the experimenter was aware of at least another two studies being undertaken. Another big issue with study one was confidentiality, as part of the experiment was conducted at the university, and potential subjects may have felt intimidated and afraid of disclosure of their HIV+ status. Even during the exercise programme conduction, because it involved personal contact with the experimenter 3 times a week, issues of personal communication outside the HIV+ centre made it really difficult in terms of confidentiality. For example, phone calls and letters to the subjects' home addresses were restricted.

All of the above reasons are expected to have contributed to the low subject recruitment in study one.

3.4.10 Overall conclusion

From the first study, we can conclude that exercise and in particular strength training can have positive effects on HIV+ patients. The data, qualitative and quantitative, support improvements in strength and mood. While physical self-esteem was only supported by qualitative data. No positive conclusions could be made on immunological data. Also no negative effects of exercise were reported.

It seems, therefore, that exercise is an ideal complimentary therapy for HIV+ patients, as it has more holistic benefits. Exercise can help not only with the physical side of HIV+ patients, but can also improve on may associated problems like depression, anxiety, appetite, perceived physical competence, and energy levels.

From the second study several conclusions can be made. First, there is still a large number of HIV+ assymptomatic patients who are not exercising enough to meet the current recommendations, and this is more pronounced in non-homosexual patients. Secondly, in terms of motivations to exercise the HIV+ population does not differ from the normal population. In terms of barriers to exercise, we can conclude that HIV+ patients view limiting health and obstacles more of barriers than the normal population. Also time management issues seem to be less important. It was also seen that fun and health distinguished non-exercisers from exercisers in the HIV+ population. It seems therefore, that when targeting HIV+ patients in exercise promotion the health benefits of exercise and the fact that an HIV+ diagnosis is not a contra-indication to exercise are important issues that should be addressed by health promoters.

Appendix A

Beck Depression Inventory

Please tick the response that best describes how you feel at the moment. e.g ( ).

A.
( ). I do not feel sad.
( ). I feel sad or blue.
( ). I feel sad or blue all of the time and can't snap out of it.
( ). I am so sad or unhappy that it is painful.
( ). I am so sad or unhappy that I can't stand it.

B.
( ). I am not particularly pessimistic or discouraged about the future.
( ). I feel discouraged about the future.
( ). I feel I have nothing to look forward to.
( ). I feel that I won't get over my troubles.
( ). I feel that the future is hopeless and that things cannot improve.

C.
( ). I do not feel like a failure.
( ). I feel I have failed more than the average person.
( ). I feel I have accomplished very little that is worthwhile or that means anything.
( ). As I look back on my life, all I can see is a lot of failure.
( ). I feel I am a complete failure as a person (parent, partner, etc.)

D.
( ). I am not particularly dissatisfied.
( ). I feel bored most of the time.
( ). I don't enjoy things the way I used to.
( ). I don't get satisfaction out of anything anymore.
( ). I am dissatisfied with everything.

E.
( ). I don't feel particularly guilty.
( ). I feel bad or unworthy a good part of the time.
( ). I feel quite guilty.
( ). I feel bad or unworthy practically all of the time.
( ). I feel as though I am very bad or worthless.

F.
( ). I don't feel I am being punished.
( ). I have a feeling that something bad may happen to me.
( ). I feel I am or will be punished.
( ). I feel I deserve to be punished.
( ). I want to be punished.

G.
( ). I don't feel disappointed in myself.
( ). I am disappointed with myself.
( ). I don't like myself.
( ). I am disgusted with myself.
( ). I hate myself.

H.
( ). I don't feel any worse than anyone else.
( ). I am critical of myself for my weaknesses or mistakes.
( ). I blame myself for my faults.
( ). I blame myself for everything bad that happens.

I.
( ). I don't have any thoughts about harming myself.
( ). I have thoughts of harming myself but I would not carry them out.
( ). I feel I would be better off dead.
( ). I feel my family would be better off if I were dead.
( ). I have definite plans about committing suicide.
( ). I would kill myself if I could.

J.
( ). I don't cry any more than usual.
( ). I cry more than I used to.
( ). I cry all of the time now. I can't stop it.
( ). I used to be able to cry, but now I can't cry even though I want to.

K.
( ). I am no more irritated now than I ever am.
( ). I get annoyed or irritated more easily than I used to.
( ). I feel irritated all of the time now.
( ). I don't get irritated at all at the things that used to irritate me.

L.
( ). I have lost interest in other people.
( ). I am less interested in other people than I used to be.
( ). I have lost most of my interest in other people and have little feeling for them.
( ). I have lost all of interest in other people and don't care about them at all.

M.
( ). I make decisions about as well as ever.
( ). I try to put off making decisions.
( ). I have great difficulty making decisions.
( ). I can't make decisions anymore at all.

N.
( ). I don't feel I look any worse than I used to.
( ). I am worried that I am looking old and unattractive.
( ). I feel that there are permanent changes in my appearance and they make me unattractive.
( ). I feel that I am ugly or repulsive looking.

O.
( ). I can work about as well as before.
( ). It takes extra effort to get started at doing something.
( ). I don't work as well as I used to.
( ). I have to push myself very hard to do anything.
( ). I can't do any work at all.

P.
( ). I can sleep as well as usual.
( ). I wake up more tired in the morning than I used to.
( ). I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
( ). I wake up early every day and can't get more than 5 hours sleep.

Q.
( ). I don't get any more tired than usual.
( ). I get tired more easily than I used to.
( ). I get tired from doing nothing.
( ). I get too tired to do anything.

R.

( ). My appetite is no worse than usual.
( ). My appetite is not as good as it used to be.
( ). My appetite is much worse now.
( ). I have no appetite at all.

S.

( ). I haven't lost much weight, if any lately.
( ). I have lost more than 5 lbs.
( ). I have lost more than 10 lbs.
( ). I have lost more than 15 lbs.

T.

( ). I am no more concerned about my health than usual.
( ). I am concerned about aches and pains or upset stomach or constipation.
( ). I am so concerned about how I feel that it's hard to think of much else.
( ). I am completely absorbed in how I feel.

U.

( ). I have not noticed any recent change in my interest in sex.
( ). I am less interested in sex now than I used to be.
( ). I am much less interested in sex now than I used to be.
( ). I have no interest in sex anymore.

You have now completed all of the questionnaires. Thank-you for taking the time to help me with this project.

Appendix B

The POMS Questionnaire

Below are words that describe feelings and moods people have. Please read every word carefully then fill in one circle under the answer which best describes how you are feeling now.
For example, suppose the word is *happy*. Mark the one answer that is closest to how you feel right NOW.

The numbers refer to these phrases:

0 = much unlike this
1 = slightly unlike this
2 = slightly like this
3 = much like this

	much unlike this	slightly unlike this	slightly like this	much like this
1 Composed	0	1	2	3
2 Angry	0	1	2	3
3 Cheerful	0	1	2	3
4 Weak	0	1	2	3
5 Tense	0	1	2	3
6 Confused	0	1	2	3
7 Lively	0	1	2	3
8 Sad	0	1	2	3
9 Friendly	0	1	2	3
10 Tired	0	1	2	3
11 Strong	0	1	2	3
12 Clearheaded	0	1	2	3
13 Untroubled	0	1	2	3
14 Grouchy	0	1	2	3
15 Playful	0	1	2	3
16 Timid	0	1	2	3
17 Nervous	0	1	2	3
18 Mixed-up	0	1	2	3
19 Vigorous	0	1	2	3
20 Dejected	0	1	2	3
21 Kindly	0	1	2	3
22 Fatigued	0	1	2	3
23 Bold	0	1	2	3
24 Efficient	0	1	2	3
25 Peaceful	0	1	2	3
26 Furious	0	1	2	3
27 Lighthearted	0	1	2	3
28 Unsure	0	1	2	3
29 Jittery	0	1	2	3
30 Bewildered	0	1	2	3
31 Energetic	0	1	2	3
32 Lonely	0	1	2	3
33 Sympathetic	0	1	2	3
34 Exhausted	0	1	2	3
35 Powerful	0	1	2	3
36 Attentive	0	1	2	3
37 Serene	0	1	2	3
38 Bad tempered	0	1	2	3
39 Joyful	0	1	2	3
40 Self-doubting	0	1	2	3
41 Shaky	0	1	2	3
42 Perplexed	0	1	2	3
43 Active	0	1	2	3
44 Downhearted	0	1	2	3
45 Agreeable	0	1	2	3
46 Sluggish	0	1	2	3
47 Forceful	0	1	2	3
48 Able to concentrate	0	1	2	3
49 Calm	0	1	2	3
50 Mad	0	1	2	3
51 Jolly	0	1	2	3
52 Uncertain	0	1	2	3
53 Anxious	0	1	2	3
54 Muddled	0	1	2	3
55 Ready-to-go	0	1	2	3
56 Discouraged	0	1	2	3
57 Good-natured	0	1	2	3
58 Weary	0	1	2	3
59 Confident	0	1	2	3
60 Businesslike	0	1	2	3
61 Relaxed	0	1	2	3
62 Annoyed	0	1	2	3
63 Elated	0	1	2	3
64 Inadequate	0	1	2	3
65 Uneasy	0	1	2	3
66 Dazed	0	1	2	3
67 Full of pep	0	1	2	3
68 Gloomy	0	1	2	3
69 Affectionate	0	1	2	3
70 Drowsy	0	1	2	3
71 Self-assured	0	1	2	3
72 Mentally alert	0	1	2	3

Appendix C

The Physical Self-Perception Profile

THE PHYSICAL SELF-PERCEPTION PROFILE (PSPP)

What am I like?

These are statements which allow people to describe themselves. There are no right or wrong answers since people differ a lot.

First, decide which one of the two statements best describes you.

Then, go to that side of the statement and check if it is just "sort of true" or "really true" **For You.**

	Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
			Example				
	☐	☒	Some people are very competitive	**BUT**	Others are not quite so competitive	☐	☐
			Remember to check only **one** of the four boxes				
1.	☐	☐	Some people feel that they are not very good when it comes to playing sports	**BUT**	Others feel that they are really good at just about every sport	☐	☐
2.	☐	☐	Some people feel they have an attractive body	**BUT**	Others feel that compared to most, their body is not quite so attractive	☐	☐
3.	☐	☐	Some people feel extremely proud of who they are and what they can do physically	**BUT**	Others are sometimes not quite so proud of who they are physically	☐	☐
4.	☐	☐	Some people feel very alert and alive	**BUT**	Others feel listless and distracted	☐	☐
5.	☐	☐	Some people do not usually have a lot of medical problems	**BUT**	Others always have medical problems	☐	☐
6.	☐	☐	Some people feel that they are among the best when it comes to athletic ability	**BUT**	Others feel that they are not among the most able when it comes to athletics	☐	☐

	Really True for Me	Sort of True for Me			Sort of True for Me	Really True for Me
7.	☐	☐	Some people feel that they have difficulty maintaining an attractive body	**BUT**	☐	☐
8.	☐	☐	Some people are sometimes not so happy with the way they are or what they can do physically	**BUT**	☐	☐
9.	☐	☐	Some people feel that they occasionally need to rely on others to accomplish every-day tasks	**BUT**	☐	☐
10.	☐	☐	Some people feel that compared to most, their general physical health is not so good	**BUT**	☐	☐
11.	☐	☐	Some people are not quite so confident when it comes to taking part in sports activities	**BUT**	☐	☐
12.	☐	☐	Some people feel embarassed by their bodies when it comes to wearing few clothes	**BUT**	☐	☐
13.	☐	☐	When it comes to the physical side of themselves, some people do not feel very confident	**BUT**	☐	☐
14.	☐	☐	Some people feel they have all of the physical capabilities to do the tasks required for daily living	**BUT**	☐	☐

Really True for Me	Sort of True for Me				Sort of True for Me	Really True for Me
☐	☐	Some people feel they must visit the doctor very often in order to care for their physical health	**BUT**	Others are physically healthy and rarely visit a doctor's office	☐	☐
☐	☐	Some people feel that they are always one of the best when it comes to joining in sports activities	**BUT**	Others feel that they are not one of the best when it comes to joining in sports activities	☐	☐
☐	☐	Some people feel that they are often admired because their physique or figure is considered attractive	**BUT**	Others rarely feel that they receive admiration for the way their body looks	☐	☐
☐	☐	Some people always have a really positive feeling about the physical side of themselves	**BUT**	Others sometimes do not feel positive about the physical side of themselves	☐	☐
☐	☐	Some people feel confident in their physical ability to care for themselves	**BUT**	Others feel uneasy about their physical ability to care for themselves	☐	☐
☐	☐	Some people are not very confident about their level of physical health	**BUT**	Others feel confident that they always maintain excellent physical health	☐	☐
☐	☐	Some people are some times a little slower than most when it comes to learning new skills in a sports situation	**BUT**	Others have always seemed to be the quickest when it comes to learning new sports skills	☐	☐
☐	☐	Some people feel that compared to most, their bodies do not look in the best shape	**BUT**	Others feel that compared to most, their bodies always look in excellent physical shape	☐	☐

	Really True for Me	Sort of True for Me			Sort of True for Me	Really True for Me
23.	☐	☐	Some people wish that they could have more respect for their physical selves	**BUT**	☐	☐
24.	☐	☐	Some people are confident in their ability to get around their home and neighbourhood	**BUT**	☐	☐
25.	☐	☐	Some people always have a really positive feeling about the physical side of themselves	**BUT**	☐	☐
26.	☐	☐	Given the chance, some people are always one of the first to join in sports activities	**BUT**	☐	☐
27.	☐	☐	Some people are extremely confident about the appearance of their body	**BUT**	☐	☐
28.	☐	☐	Some people feel extremely satisfied with the kind of person they are physically	**BUT**	☐	☐
29.	☐	☐	Some people feel that, compared to most, they are physically able to do for themselves extremely well	**BUT**	☐	☐
30.	☐	☐	Some people feel confident about their ability to be free from illness and medical problems	**BUT**	☐	☐

			Others always have great respect for their physical selves
			Others are not confident in their ability to get around their home and neighbourhood
			Others sometimes do not feel positive about the physical side of themselves
			Other people sometimes hold back and are not usually among the first to join in sports
			Others are a little self-conscious about the appearance of their bodies
			Others sometimes feel a little dissatisfied with their physical selves
			Others feel that, compared to most, they are not physically able to do for themselves very well
			Others are not so confident about their ability to remain free from illness and medical problems

APPENDIX D

Semi-structured interview questions

Semi-structured interview questions

1. How did you find the exercise? Enjoyable / Not enjoyable / Other

2. Do you think the exercise programme improved you mood generally?

   Yes / Made it worse/ Did not affect my mood.

3. Do you feel more at ease with your body after the exercise programme?

   Yes / No change / Feel less at ease.

4. Do you feel better about yourself after doing the exercise programme?

   Yes / No change / Feel worse.

5. Do you think you appetitte has improved since starting this exercise program ?

   Yes/No Change/ Made it worse.

6. Do you have a sense of achievement after the completion of the exercise programme?

   Yes/ No

7. Do you feel more positive about your health now?

   Yes/ No change / Worse

8. Do you think you are coping any better with your life?

   Yes/ No change/ Worse.

9. Has the exercise programme helped you with you everyday practical tasks? And how?

   Yes / No change/ Made it worse

10. Did exercise in anyway help you adopt and/or maintain a healthier lifestyle?

    Yes / No/ Made it worse

11. Do you intend to keep exercising?

    Yes/ No

12. Did you get what you expected out of the exercise programme?

    Less than what I expected / Just what I expected / More than.....

13. What did you think on the length of the exercise sessions?

Too short / Just right / Too long

14.Did you find the exercises easy to perform?

Very easy/ Simple/ A bit hard/ Difficult

15.Would you recommend the exercise programme to other HIV+ people?

Without hesitation/ Yes / No

16. Do you think the exercise programme improved the quality of you sleep?

Yes / No change / Made it worse.

17.How did you manage with the session at home?

Very well/ OK/ Bad

18.How would you improve the sessions at home?

19.Has your attitude towards exercise in general changed after the exercise programme?

20. Do you think the exercise programme has helped you at all with any side effects of your medication, and which?

21.What would you like to change about this exercise session?

22.How are you going to make sure you will keep exercising? (If answer was yes to Q10)

23.Have you noticed any differences in your energy levels with the exercise programme?

24.Open Comments.

Appendix E

Exercise Programmes and sample photo

Beginners Exercise Programme

Warm Up (5 minutes)

Jog/Walk
Knees Up
Heels Up
Punching in the air
Four steps forward/back

Strength Resistance (20 minutes)

2 x 12 shoulder raises side (one for each arm)
1 X12 biceps curl (both arms)
2 x 12 triceps curl (one for each arm)
1 x 12 "bench press"

1 x 12 sit up/crunches
1 x 12 crunches with a twist
1 x12 push ups

2 x leg extension (one for each leg)
2 x leg curl (one for each leg)
2 x calf raises (one each leg)

Stretching (5 minutes)

Shoulder Stretch
Neck Stretch
Calf Stretch
Quadriceps Stretch
Hamstring Stretch

Advanced Programme

Warm Up (5 minutes)

Jog/Walk
Knees Up
Heels Up
Punching in the air
Four steps forward/back

Strength Resistance (20 minutes)

2 x 12 shoulder raises side (one for each arm)
2 x 12 shoulder raises front(one for each arm)
1 X12 biceps curl (both arms)
2 x 12 triceps curl (one for each arm)
1 x 12 "bench press"
1 x 12 "bench press incline"

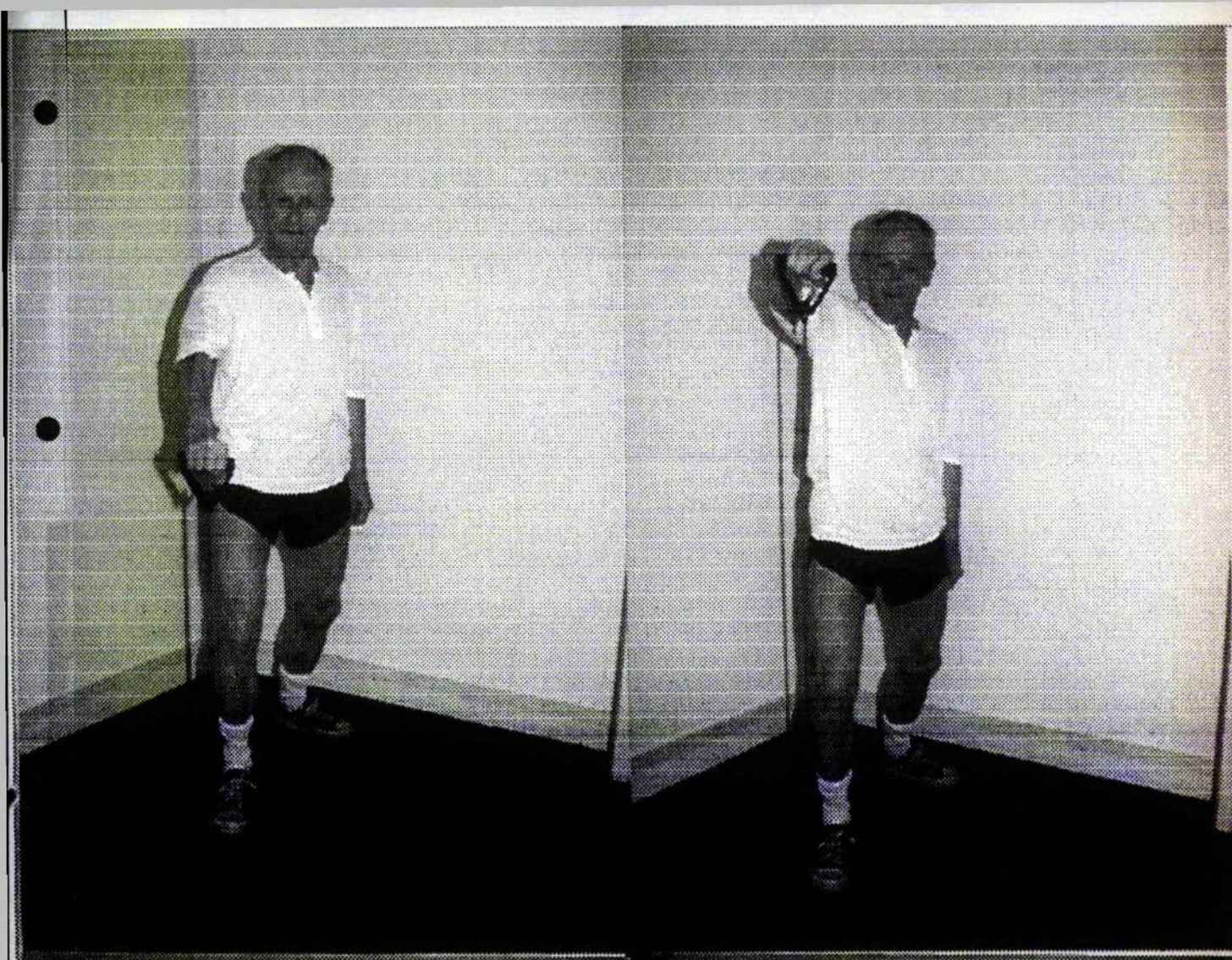
2 x 12 sit up/crunches
1 x 12 crunches with a twist
1 x 12 combination crunch
1 x12 push ups

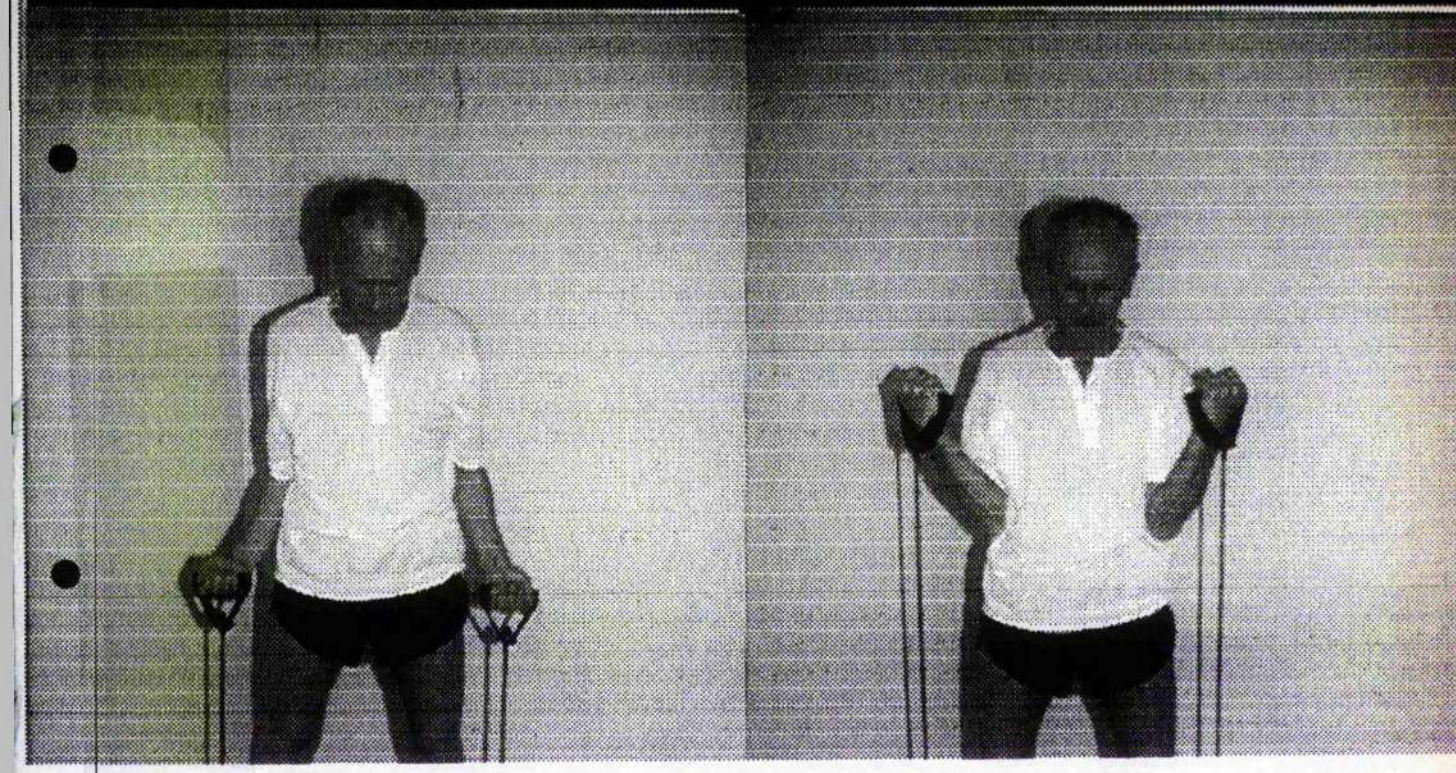
2 x leg extension (one for each leg)
2 x leg curl (one for each leg)
2 x calf raises (one each leg)
2 x 12 hip abductors

Stretching/Relaxation (5 minutes)

Shoulder Stretch
Neck Stretch
Calf Stretch
Quadriceps Stretch
Hamstring Stretch
+ 1 minute relaxation.

Photographic examples of shoulder raise front and biceps curl follow in the next page.





Appendix F

Statistical Results

Baseline measures comparison between exercise and control group.

Variable	Mean Scores Exercise Group	Mean Scores Control Group	P-value
skinfold sum (mm)	30.7	36.8	0.54
thigh circumference (cm)	50.3	53	0.65
arm circumference (cm)	28.8	25.6	0.46
grip pull (kg x m)	45.5	40.5	0.48
sit ups (number in 30 seconds)	15.3	11.6	0.36
quadriceps isometric strength (N)	730	690	0.85
Beck depression Inventory	11.3	9.3	0.72
composed-anxious -**POMS**	56	61	0.42
agreeable-hostile -**POMS**	56.3	53	0.74
elated-depressed -**POMS**	58	55	0.51
confident-unsure -**POMS**	57.3	52	0.69
energetic-tired -**POMS**	50.3	52	0.82
clearheaded-confused -**POMS**	57.7	59	0.88
Total **POMS**	344.3	331.3	0.70
sports competence -**PSSP**	10	10	1
perceived body attractiveness -**PSSP**	14.67	12	0.65
physical self-worth -**PSSP**	14.67	13.67	0.86
perceived functional capacity -**PSSP**	19	18.3	0.85
perceived health/disease -**PSSP**	15.3	15.3	1
CD4 cell count (cells/ml)	432	477	0.79
CD4/CD8 ratio	0.245	0.48	0.25

Exercise versus Control group during stage 1.

Variable	Group	Mean (SD)	P-value
sum skinfolds (mm)	Exercise	0.91 (8.81)	
sum skinfolds (mm)	Control	-6.20 (1.47)	0.24
thigh circumference (cm)	Exercise	0 (2.65)	
thigh circumference (cm)	Control	0 (3.61)	1.0
arm circumference (cm)	Exercise	-0.33 (0.76)	
arm circumference (cm)	Control	3.33 (4.48)	0.23
grip strength (kg x m)	Exercise	-1.17 (2.36)	
grip strength (kg x m)	Control	1.667 (0.76)	0.12
sit ups (number in 30 seconds)	Exercise	3.33 (2.31)	
sit ups (number in 30 seconds)	Control	2.00 (1.7)	0.47
quadriceps isometric strength (N)	Exercise	342 (74.8)	
quadriceps isometric strength (N)	Control	63.5 (82.7)	**0.029***
Depression scores	Exercise	-6.33 (4.51)	
Depression scores	Control	-1.62 (2.52)	0.19
composed-anxious scores-**POMS**	Exercise	9.3 (10.6)	
composed-anxious scores-**POMS**	Control	-2 (5.9)	0.17
agreeable-hostile scores-**POMS**	Exercise	8.67 (6.11)	
agreeable-hostile scores-**POMS**	Control	-2.7 (10.8)	0.19
elated-depressed scores-**POMS**	Exercise	8.33 (7.23)	
elated-depressed scores-**POMS**	Control	-2.33 (3.79)	0.086
confident-unsure scores-**POMS**	Exercise	2.3 (10.6)	
confident-unsure scores-**POMS**	Control	2.33 (4.76)	1.0
energetic-tired scores-**POMS**	Exercise	12 (4.58)	
energetic-tired scores-**POMS**	Control	-3 (-1.67)	**0.047***
clearheaded-confused scores-**POMS**	Exercise	8.67 (4.04)	
clearheaded-confused scores-**POMS**	Control	-1.67 (-2.89)	**0.023***
total **POMS**	Exercise	40.7(15.31)	
total **POMS**	Control	-7.7((15.63)	**0.019***
Sports Competence-**PSSP**	Exercise	3.67 (2.08)	
Sports Competence -**PSPP**	Control	1.33 (1.53)	0.19
perceived body attractiveness scores-**PSPP**	Exercise	2.00 (2.65)	
perceived body attractiveness scores-**PSPP**	Control	0.33 (1.55)	0.37
physical self-worth-**PSPP**	Exercise	2.67 (3.51)	
physical self-worth-**PSPP**	Control	0.33 (0.57)	0.32
perceived functional capacity-**PSPP**	Exercise	1.33 (1.15)	
perceived functional capacity-**PSPP**	Control	-0.67 (2.33)	0.46
perceived health and disease-**PSPP**	Exercise	2.33 (3.21)	
perceived health and disease-**PSPP**	Control	0.33 (0.57)	0.35
CD4 cell count (cells/ml)	Exercise	-11.3(53.1)	
CD4 cell count (cells/ml)	Control	57 (125)	0.43
CD4/CD8 ratio	Exercise	0.033(0.126)	
CD4/CD8 ratio	Control	0.099(0.106)	0.33

(* denotes significant result p<0.05)

Stage 1 versus Stage 2 for control group.

Variable	Mean (SD)	P-value
skinfold sum (mm)	5.96(3.19)	0.084
thigh circumference (cm)	0.33 (7.29)	0.94
arm circumference (cm)	-4.83 (3.25)	0.12
grip pull (kg x m)	-1 (4.27)	0.72
sit ups (number in 30 seconds)	1.33 (2.08)	0.38
quadriceps isometric strength (N)	-180.5 (21.9)	0.09
Beck depression Inventory	-2 (1)	**0.074**
composed-anxious -**POMS**	11(5)	0.062
agreeable-hostile -**POMS**	9.3(23.3)	0.56
elated-depressed -**POMS**	10.33(10.97)	0.24
confident-unsure -**POMS**	4(2)	**0.074**
energetic-tired -**POMS**	10.33(10.21)	0.22
clearheaded-confused -**POMS**	9(5.20)	0.095
total **POMS**	52.3(46.9)	0.19
sports competence -**PSSP**	0.33(1.52)	0.74
perceived body attractiveness -**PSSP**	1 (3.46)	0.5
physical self-worth -**PSSP**	1.67(2.08)	0.3
perceived functional capacity -**PSSP**	1.33(9.71)	0.83
perceived health/disease -**PSSP**	0.677(1.18)	0.42
CD4 cell count (cells/ml)	-180 (164)	0.20
CD4/CD8 ratio	-0.106(0.190)	0.44

(highlighting denotes near significant result)

Appendix G

Results from interview

Question 1: How did you find the exercise programme?

Enjoyable: 6 Not enjoyable:0 Other: 0

quotes from interviews: " thoroughly enjoyable", " very enjoyable"

Question 2: Do you think the exercise programme improved your mood generally?

Yes: 6 No: 0 Did not affect my mood:0

Quotes: " yes there is absolutely no doubt about that", "Yes it has probably, generally, overall", "Greatly",

Question 3: Do you feel more at ease with your body after the exercise programme?

Yes: 6 No:0 Feel less at ease: 0

quotes: "I am happier about my physical condition, if that is in it I would say YES.", "Yes, I do, it is capable of more than I thought it was...", " I feel better"

Question 4: Do you feel better about yourself after doing the exercise programme?

Yes: 6 No: 0 Feel worse: 0

quotes: "Oh yes, that too.", "Yes, generally.",

Question 5: Do you think you appetite has improved since starting this exercise program ?

Yes: 3 No change:3 Made it worse:0

quotes: "It has made no change.", "Yes, it has improved"

Question 6: Do you have a sense of achievement after the completion of the exercise programme?

Yes: 6 NO: 0

quotes: "Oh yes, I want to do more", "Yes, definitely.",

Question 7: Do you feel more positive about your health now?

Yes:6 No change:0 Worse:0

quotes: "About my health, more positive about my mental health, more positive about my physical health, ...but by ability to produce C-cell counts, I don't think there is a difference at all. On balance, if you take all these three components, I would have to say yes.", "I suppose I do"

Question 8: Do you think you are coping any better with your life?

Yes: 4 No change: 2 Made it worse:0

quotes: "No change.", "Yes I am, but there are a lot of reasons for that.", "Yes, probably", "Yes, the time I started the exercise, I was actually on a tablet for depression, I have since come off it, when I was doing my programme."

Question 9: Has the exercise programme helped you with you everyday practical tasks? And how?

Yes:4 No change: 2 Made it worse:0

quotes: "Yes it has, it has given me a bit more flexibility. I am less still than I was before.", "Yes it has, it has made me more active in doing things.", "Yes, overall, just getting about has improved, walking up and down the hills.", "I am not longer scared

of pains, and I know how to get rid of the tension, with stretching.....I am able to go back to work now, because the pain in my hips went away..... because I couldn't walk and my work involved steps..... I can go to Safeway on foot, I used to take the car even though it was across the street"

Question 10: Did exercise in anyway help you adopt and/or maintain a healthier lifestyle?

Yes: 4 **No:2** **Made it worse:0**

quotes: "Apart from actually doing the exercises, NO", "Yes it has without a doubt.", "It has probably given me the kick start to go and do more.'," It did, I can go out and do swimming and do things I enjoy doing. I can do them now."

Question 11: Do you intend to keep exercising?

Yes: 6 **No:0**

quotes: "Of course.", "I intend to try.", "Certainly"

Question 12: Did you get what you expected out of the exercise programme?

Less than:0 **Just what: 2** **More than:4**

quotes: "If I go back to the beggining probably more... I realised there would be a mood improvement and getting fit, but I didn't realise how big that effect was going to be.", "I didn't no what to expect. I was so painful and sore that I thought anything is better than this. Until the pain disappeared....more than what I expected"

Question 13: What did you think on the length of the exercise sessions?

Too short: 1 **Just right: 5** **Too long:0**

quotes: "Just right, it could be 5 minutes longer, but any longer it would interfere with how you fit it in the day...", "Definitely not too long, probably just about right.", "Too short, I felt I could have gone on longer."

Question 14: Did you find the exercises easy to perform?

The options were: Very easy/ Simple/ A bit hard/ Difficult

All **six** answered some were simple and others were a bit hard.

Quotes: "Some of them were easy, but as we went on some of then got a little more difficult. I would say a bit hard."

Question 15: Would you recommend the exercise programme to other HIV+ people?

Without hesitation: 4 **Yes:2** **No:0**

quotes: "...if the CD 4 and viral load were fine then yes, it wouldn't be a case of without hesitation, but I would recommend it for the appropriate individuals.", "I wish everybody could do it!"

Question 16: Do you think the exercise programme improved the quality of you sleep?

Yes: 4 **No change:2** **Made it worse:0**

quotes: " No change, it was bad anyway, so it hasn't made a dramatic change...", "A lot. I sleep very well now, I don't need tablets anymore. I tend to do the exercises in the evening and then have a shower and then I go to bed."

Question 17: How did you manage with the session at home?

Very well: 2 **OK:3** **Bad:1**

quotes: "Variable, OK", "OK when I remembered to do them.", " Oh just terrible, I couldn't do it on my own"

Question 18: How would you improve the sessions at home?

Quotes: "A little bit of you asking how did you get on and monitoring. You made it easy for me not to do anything at home, you didn't make me feel guilty. Make it a bit more guilty.", "I would have somebody else to do it with me", "A complete tape with instructions, sometimes you forget.", "Video tape or instruction tape, it is difficult to do it on your own."

Question 19: Has your attitude towards exercise in general changed after the exercise programme?

Quotes:" Yes, I found it a lot more enjoyable than I thought I would.", "yes, because it was an enjoyable programme, where as before I used to think god I can't be bothered doing that. But it's been really good, it's been fun.", "yes I was bit more cynical before.", " No"

Question 20: Do you think the exercise programme has helped you at all with any side effects of your medication, and which?

Quotes: "No", " I am not on medication.", "I don't really have any side effects.", "It was the major thing that made the pains go away. (from AZT). If I miss my exercises the pain creeps back in."

Question 21: What would you like to change about this exercise session?

Quotes: "I would cut out the warming up session, and not carry out the full relaxation, I am not convinced of its benefit.", "Maybe shorter warm up period.", "Nothing"

Question 22: How are you going to make sure you will keep exercising? (If answer was yes to Q10)

Quotes: "I am going to try and encourage my friends to get into it.", "I hope to be able to keep doing it in the house.", ": I will probably try and take up something, swimming or something.", "I do my exercises before my shower in the evening, that is my trigger."

Question 23: Have you noticed any differences in your energy levels with the exercise programme?

Quotes: "Aha, yes, I have a lot more energy than I had before", No not really", "After doing the programme I feel so invigorated, I feel really awake and alert.", "Yes, probable a big difference, I was getting tired by the end of the day, but now I feel I can get around , no problems.", "Has increased my levels brilliantly. And I have increased my fluid intake which I needed to do.", " Yes"

Open comments

"Thank you."

"It has been a great programme. It has done me the world of good. And hopefully it will help other people."

"All I can say thanks very much. It has given me loads and made me feel much better."

"I think in generally it has been quite good for me, because I was needed to do exercise for a long while."

"..... a blessing in disguise. I couldn't walk the stairs anymore, and I though that was it, but now I run those stairs with a bag in my hands."

APPENDIX H

Survey Questionnaire

In the following questionnaire please circle the answer that describes you the most.

Regular physical activity relates to:

Exercise: e.g. weight training, aerobics etc., for 2-3 times per week; hillwalking for at least 2hours/week
OR

Sport: e.g. golf, hockey, football, netball, etc., for 2-3 times per week
OR

General Activity: e.g. walking, gardening, etc., accumulating to at least 30 minutes/4-5 per week

1) Do you consider your self to be physically active now? YES NO

If NO. Were you physically active,

3 months ago? YES NO
6 months ago? YES NO
before diagnosis of HIV status? YES NO

2) Please read through the categories below and circle the number of the category which best describes how physically active you have been over the past six months.

i) I am not regularly physically active and do not intend to be so in the next six months
ii) I am not regularly physically active but I am thinking about starting to do so in the next six months
iii) I do some physical activity but not enough to meet the description of regular physical activity given above
iv) I am regularly physically active but only began in the last six months
v) I am regularly physically active and have been so for longer than six months

3) Please circle the number that currently describes you the best:	**Strongly disagree**				**Strongly agree**
A major benefit of physical activity for me is:					
1) being able to cope with life's pressures	1	2	3	4	5
2) enhancing my self image and appearance	1	2	3	4	5
3) the thrill of victory	1	2	3	4	5
4) the enjoyment of activity	1	2	3	4	5
5) the time spent with family members	1	2	3	4	5
6) improved mental alertness	1	2	3	4	5
7) improved physical attractiveness	1	2	3	4	5
8) the competition	1	2	3	4	5
9) the fun and enjoyment	1	2	3	4	5
10) the time spent with close friends	1	2	3	4	5
11) the positive psychological effect	1	2	3	4	5
12) to maintain or lose weight	1	2	3	4	5
13) other respect of my athletic ability	1	2	3	4	5
14) the release of tension	1	2	3	4	5
15) to stay in shape	1	2	3	4	5
16) the sense of being a member of a team	1	2	3	4	5
17) feeling younger	1	2	3	4	5
18) the improved health	1	2	3	4	5
19) the sense of accomplishment	1	2	3	4	5
A major reason when I do not exercise is :					
1) the lack of motivation	1	2	3	4	5
2) I am too busy	1	2	3	4	5
3) limiting health reasons	1	2	3	4	5
4) that it is too inconvenient	1	2	3	4	5
5) I am too lazy	1	2	3	4	5
6) there isn't enough time	1	2	3	4	5
7) physical disability	1	2	3	4	5
8) the lack of facilities	1	2	3	4	5
9) I am too tired	1	2	3	4	5
10) that exercise interferes with my work	1	2	3	4	5
11) illness	1	2	3	4	5
12) that exercise is boring	1	2	3	4	5
13) that I am too fatigued to exercise	1	2	3	4	5
14) family obligations	1	2	3	4	5
15) bad weather	1	2	3	4	5

For staff nurse and researcher to complete:

Study ID:_____

CD4:_____

Age:_____

Sex:_____

Height:_____

Weight:_____

Group:_____

Appendix I

Items of factors of expected-outcomes and perceived-barriers.

Expected-Outcomes

I) Psychological:
Cope with life's pressures
Improved mental alertness
Positive psychological effect
Release of tension
Feeling younger
Sense of accomplishment

II) Body image/Health:
Enhancing self-image and appearance
Improved physical attractiveness
Maintain or lose weight
Stay in shape
Improved health

III) Competition:
Thrill of victory
Competition
Other's respect of my athletic ability
Sense of being a member of a team

IV) Fun:
Enjoyment of the activity
Fun and enjoyment

V) Social
Time spent with family members
Time spent with close friends

Perceived-Barriers

I) Effort:
Lack of motivation
Too lazy
Too tired
Too fatigued by exercise

II) Time:
Too busy
Not enough time
Exercise interferes with work
Family obligations

III) Limiting Health:
Limiting health reasons

Physical disability
Illness

IV) Obstacles:
Too inconvenient
Lack of facilities
Exercise is boring
Bad Weather

(From: Steinhardt and Dishman, 1989)

Appendix J

Information Sheet, Consent Form, and Ethics Approval

UNIVERSITY
of
GLASGOW

A post-graduate student at Glasgow University called Menelas Siafakas is doing a study examining the benefits of exercise on asymptomatic HIV+ people. He is also a volunteer at Body Positive, on two counts he is therefore bound by strict rules of confidentiality. If you have not exercised regularly for at least six months, we would like you to consider taking part in this study.

At first the subjects will be assessed for strength and complete three easy questionnaires. Don't worry if you think you are not strong enough, you don't need to be fit for this study! He will also with your permission request access to your CD cell counts and viral load, done as routine measurement by your HIV doctor at the Glasgow Royal or Ruchill Hospital, but he will not be allowed access to your records. After that you will be split into two groups. One will do a simple exercise programme which he will conduct at Body Positive Strathclyde. The programme lasts about 30 mins and will be done three times a week for 12 weeks. If you can't make it 3 times a week, you will be able to do one of the three sessions at home with the help of an instruction tape and instructions. The other group will start the programme, when the first one is finished. Subjects will do the same tests they did before the exercise programme at the end of round 1 and at the end of round 2.

The times that the exercise programme will be offered throughout the week will be discussed, and will be done at times suitable for all the subjects. He can assure you that the exercise programme will not do you any harm. Exercise has been previously shown to be beneficial for HIV+ people. No one will be allowed access to your records. All the information collected will be strictly confidential and your name will not be used in any report.

If you are interested in doing the study, please leave your name and number at Body Positive Strathclyde: 0141-332 5010, 3 Park Quadrant, Glasgow, G3 6BS, and Menelas will get back to you. Or, please let your HIV doctor or nurse know. If you don't want to take part in the study, but are worried about how exercise affects you as an HIV+ person, do not hesitate to contact Menelas through Body Positive. (or at 0141-337 6981)

We do hope that you can help us with the study.

Institute
of Biomedical
and Life Sciences

West Glasgow Hospitals University NHS Trust

WEST ETHICS COMMITTEE
Western Infirmary
Dumbarton Road
Glasgow G11 6NT

Direct Line: 211 6238
Fax: 211 1920

Our Ref: AHT

Your Ref:

Please reply to: Mrs A H Torrie
SECRETARY - WEST ETHICS COMMITTEE

24 July, 1998

Mr Menelas Siafakas
64 Oakfield Avenue
IBLS
University of Glasgow
Glasgow

Dear Mr. Siafakas,

98/112(2) Menelaos Siafakas et al. - A survey into the motivations and barriers towards exercise of an HIV+ population.

The Committee at the meeting held on 21st July, 1998 discussed your letter dated 6th July, 1998 but were of the opinion that you should be asked to contact Dr. A Pithie as most of the patients intended to be entered into this study will be Dr. Pithie's patients and as such, should be discussed with him. It was agreed to pass Dr. Pithie's telephone number to you in order that you may contact him.

Yours sincerely,

Andrea H Torrie
SECRETARY - WEST ETHICS COMMITTEE

Footnote: Dr. A Pithie, Tel No. 211 1086

West Glasgow Hospitals University NHS Trust

WEST ETHICS COMMITTEE
Western Infirmary
Dumbarton Road
Glasgow G11 6NT

Direct Line: 211 6238
Fax: 211 1920

Our Ref: AHT

Your Ref:

Please reply to: Mrs A H Torrie
SECRETARY - WEST ETHICS COMMITTEE

16 June, 1998

Mr Menelaos Siafakas
IBLS
64 Oakfield Avenue
Glasgow

Dear Mr. Siafakas,

98/112(2) Menelaos Siafakas et al. - A survey into the motivations and barriers towards exercise of an HIV+ population.

The Committee at the meeting held today discussed the above study and felt that this should be re-designed to ensure that it was scientifically sound i.e. that the end points were clear etc. The Committee also felt that the numbers involved were very optimistic and it was agreed that you should speak to Dr. Pithie, Consultant Physician in the Brownlee Centre, Gartnavel General Hospital who may be able to assist you with what is required by the Committee. The amended study should come back in time for the next meeting.

Yours sincerely,

Andrea H Torrie
SECRETARY - WEST ETHICS COMMITTEE

Accredited by the
King's Fund Organisation Audit

THE WEST ETHICAL COMMITTEE

FORM OF CONSENT FOR PATIENTS/VOLUNTEERS IN CLINICAL RESEARCH PROJECT

Brief title of project

A survey into the motivations and barriers towards exercise of an HIV+ population.

Patient's Summary (purpose of study, nature of procedure, discomfort and possible risks in terms which the patient or volunteer can understand).

We would like to invite you to participate in our survey, which should take less than 5 minutes to complete. The questionnaire is on the beliefs you have towards exercise. In addition to the questionnaire I will, with your permission, get your latest CD4 cell count along with your age, sex, weight, height, and method of transmission from your medical records via the staff nurse. All the information gathered will be strictly confidential, and no names will be used in the questionnaire or in the report. I will also not have any access to your medical records.
Thank you for your co-operation

By signing this form you give consent to your participation in the project whose title is at the top of this page. You should have been given a complete explanation of the project to your satisfaction and have been given the opportunity to ask questions. You should have been given a copy of the patient information sheet approved by the West Ethics Committee to read and to keep. Even though you have agreed to take part in the research procedures you may withdraw this consent any time without the need to explain why and without any prejudice to your care.

Consent

I, ... of

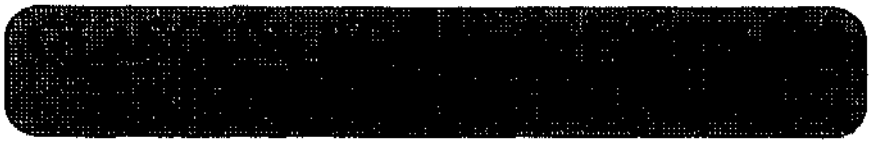
.....

give my consent to the research procedures described above, the nature, purpose and possible consequences of which have been described to me

by .....

Signed ..... Date .....

FORM 3



RESEARCH ETHICS COMMITTEE
COMPLETION OF PATIENT INFORMATION AND CONSENT FORM

TITLE OF PROJECT: The effects of strength training on the immune and psychological function of an HIV+ population.

PATIENT'S SUMMARY

The purpose of my study is to investigate the effects of strength training on the immune and psychological function of HIV+ people. Subjects will either do a strength training programme three times a week for 12 weeks, which last about 30 mins which will take place at Body Positive, straightaway or they will start the exercise after 12 weeks.
Subjects will be measured for CD4 and CD8 cell count and viral load.
This will be done by their doctor at the hospital they attend.
Subjects will also be asked to complete 3 very simple questionnaires and do a few very simple strength tests. They will also be measured for weight and body fat. This will happen in one laboratory visit at the sport science lab at Glasgow University.
All these measurements will be done before and after the exercise
Subjects will need consent from their doctors to take part in the study.
This exercise should not put you in any risk as long as you are asymptomatic.
Subject should feel confident that they can drop from the study at any time they desire so without any consequences.
If you have any questions do not hesitate to contact me at:0141-3376981 or at Body Positive.

CONSENT:

I, (Name) ..... of (Address) .... agree to take part in the Research Project/Study Programme described above.

Dr/Mr ..... has explained to me what I have to do, how it might affect me and the purpose of the Research Project/Study Programme.

Signed ..... **Date** .....
Witness ..... **Date** .....

THE WEST ETHICAL COMMITTEE

FORM OF CONSENT FOR PATIENTS/VOLUNTEERS IN CLINICAL RESEARCH PROJECT

Brief title of project

The effects of strength training on the immune and psychological function on an HIV + population.

Patient's Summary (purpose of study, nature of procedure, discomfort and possible risks in terms which the patient or volunteer can understand).

We would like to invite you to take part in this study.The purpose of my study is to investigate the effects of strength training on the immune and psychological function of HIV+ people. At first the subjects will be assessed for strength and complete three easy questionnaires. I will also with your permission request access to your CD cell counts, done as routine measurement by your HIV doctor at the Glasgow Royal or Ruchill Hospital, but I will not be allowed access to your records. After that you will be split into two groups. Group one will do a simple exercise programme which I will conduct at Body Positive Strathclyde. The programme lasts about 30 mins and will be done three times a week for 12 weeks. If you can't make it 3 times a week, you will be able to do one of the three sessions at home with the help of an instruction tape and instructions. The other group will start the programme, when the first one is finished. Subjects will do the same tests they did before the exercise programme at the end of round 1 and at the end of round 2.

The times that the exercise programme will be offered throughout the week will be discussed, and will be done at times suitable for all the subjects. I can assure you that the exercise programme will not do you any harm. Exercise has been previously shown to be beneficial for HIV+ people. No one will be allowed access to your records. All the information collected will be strictly confidential and your name will not be used in any report.
You will need consent from your HIV doctors to take part in the study.
This exercise should not put you in any risk as long as you are asymptomatic.
You should feel confident that you can drop from the study at any time you desire so without any consequences.
No one will be allowed access to your records. All the information collected will be strictly confidential and your name will not be used in any report.
If you are, or likely to become, pregnant you should not take part in this study.
Should you become symptomatic during the study, you will be excused from it
Contact number: Menelas Siafakas:0141-3376981, or phone Body Positive:0141-3325010 and leave a message for me.

signing this form you give consent to your participation in the project whose title is at the top of this page. You should have been given a complete explanation of the project to your satisfaction and have been given the opportunity to ask questions. You should have been given a copy of the patient information sheet approved by the West Ethics Committee to read and to keep. Even though you have agreed to take part in the research procedures you may withdraw this consent any time without the need to explain why and without any prejudice to your care.

Consent

I, ... of
.....
.....

give my consent to the research procedures described above, the nature, purpose and possible consequences of which have been described to me

by .....

Signed ..... Date
.....

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