CHAPTER 1

INTRODUCTION:

Low back pain (LBP) is a major cause of disability in many societies (Waddell 1998) and is the most common diagnosis for patients treated in outpatient physiotherapy settings (Jette and Davis 1991). Approximately 10-20% of sufferers of LBP develop chronic LBP (CLBP), which is described as pain and disability persisting for more than three months (Maher et al 1999). Persons with CLBP pose a major health problem with significant economic and social costs. They use more than 80% of healthcare costs for back pain with a variety of therapeutic interventions with varying success rates (Waddell 1998).

Exercise is an intervention that has been shown to play a major role in the successful management of CLBP (Maher 2004, van Tulder et al 1997). One exercise approach, referred to as Pilates, has in recent years become a popular trend in rehabilitation, with over five million registered practitioners in the United States (Chang 2000). The late Joseph Pilates created a repertoire of exercises to optimise musculoskeletal performance, and today the claimed benefits are numerous. "Building lean musculature, correction of postural abnormalities, increasing core stabilisation, low impact on joints, enhancing athletic performance in sporting activities and improving coordination and balance" are just a few benefits mentioned by the Meritthew Corporation (2004a). The focus of Pilates is lumbar stabilisation through the transversus abdominus muscle, pelvic floor and multifidus activation, and includes pelvic and shoulder girdle stabilisation, neutral postural alignment and precise breathing (Anderson 2000). Although frequently used in the clinical situation, the value of Pilates in the treatment of CLBP has still not been established (Maher 2004).

In more conventional rehabilitation, supervised exercise programmes have proven to be beneficial. According to Maher (2004), exercise programmes are one of the few clearly effective treatments for chronic low back pain. In the long term, sufferers of chronic low back pain who undergo an exercise intervention have sustained periods of relief (O'Sullivan et al 1997a) and were found to overcome the fear of physical activity and develop more confidence in the use of their spines. (Frost et al 1995, Frost et al 1998).

Instability of the lumbar spine is thought to be a significant contributing factor to low back pain (Friberg 1987). It has been hypothesized that the abdominal muscles may function to increase the stability of the spinal column (Tesh et al 1987). The literature suggests that the transversus abdominus muscle has a vital role to play in this stabilisation (O'Sullivan et al 1997a). It is believed that people suffering from low back pain have a significant dysfunction of the motor control of the transversus abdominus muscle. According to Richardson and Jull (1995), specific training of the stability muscles of the lumbar spine decreases pain and functional disability in low back pain sufferers. O'Sullivan et al (1997a) found that in a group of patients with lumbar spine instability, an intervention of specific exercises for the lumbar spine stabilisers was more effective than other conservative approaches used.

Hodges (1999) advocates that during the training of the transversus abdominus muscle as part of the management of lumbar instability and low back pain, several factors should be considered. These factors include the initial independent activation of the transversus abdominus muscle, followed by the incorporation of the diaphragm and the pelvic floor muscles due to their functional interaction with the transversus abdominus muscle. Hodges (1999) also identified breathing as an important component of stability training. These factors form the basis of some of the main principles of Pilates.

Pilates, as a form of exercise that combines the concepts of lumbar spine stability with a general exercise programme should, according to the principles described in the above literature, be beneficial in the rehabilitation of chronic low back pain patients. However, the scientific literature concerning Pilates is very limited, and as yet, there appear to be no studies in the English research literature investigating the effects of Pilates on chronic low back pain. Anecdotally, in the clinical setting, feedback from patients and therapists has been encouraging. Reported improvements in pain and daily functioning need to be scientifically supported. Considering its growing popularity and the various myths concerning the effects and benefits of Pilates, it is important that research be conducted into the role that Pilates has to play in the rehabilitation of patients with chronic low back pain, and in so doing, add to the existing body of scientific evidence.

Research Question:

What is the effect of a Pilates programme in reducing pain and improving function in patients suffering from chronic low back pain?

Aim:

The aim of this study was to establish the effectiveness of a Pilates programme in firstly reducing pain and secondly improving function in patients suffering from chronic low back pain.

Objectives:

The primary objective was to assess pain levels of low back pain at baseline, three weeks and following the completion of the intervention in both a Pilates group and a control group.

The secondary objective was to evaluate the level of functional disability at baseline, three weeks and following the intervention in both a Pilates group and a control group.

CHAPTER 2

LITERATURE REVIEW:

In this literature review the relevant literature concerning chronic low back pain and its causative factors, and current treatment regimes used for CLBP, especially exercise will be reviewed. The existing literature on Pilates will also be reviewed. Evidence for the study design, selection criteria and outcome measures used in this study will be discussed. The main search engine used in this review was Pubmed as well as Pedro, both with a search of articles post 1980.

Chronic low back pain

Chronic low back pain has been described as pain and disability with a duration of three months or more (Maher et al 1999). The origins and predisposing factors of chronic low back pain are unclear, but it appears that muscular dysfunctions have an important role to play in the aetiology of low back disorders (Kirkaldy-Willis and Farfan 1982). The muscle system of the trunk provides major support to the loaded spine during normal function (Panjabi et al 1989), and the spine is therefore more vulnerable to injury in the presence of poor muscular control (Richardson et al 1992). Low back pain has been related to stress and undue load on the joints and ligaments of the spine caused by the dysfunction of the muscles of the trunk (Hides et al 1994, Panjabi 1989, Gracovetsky et al 1985). It is important to investigate the mechanism of poor muscular control and instability in order to fully understand why specific treatments assist in this disorder.

The spinal motion segment is made up of two synovial joints and the intevertebral disc, surrounded by an intricate network of ligaments and both deep and superficial muscles (Mooney 1987). Clinically it is known that excessive motion beyond the normal physiological limits (instability) in this spinal motion segment may result in chronic low back pain (Kirkaldy-Willis and Farfan 1982). Friberg (1987) also suggested that instability in the lumbar motion segments is a significant factor in patients suffering from CLBP. Panjabi (1992a) described spinal instability in terms of a region of laxity around the neutral resting position of a spinal segment called the "neutral zone". Panjabi (1992b) considers the spinal segment's neutral zone to be the sensitive region. Subtle movement in this region may increase with disc degeneration, injury, and weakness of muscles, while the neutral zone has been found to be smaller with simulated muscle forces across a motion segment, which increases spinal stability (Panjabi et al 1989).

The local muscle system acting on the lumbar spine has been found to be primarily responsible for segmental stability (Richardson and Jull 1995). The deep muscle groups of the spine, which connect to adjacent vertebrae close to the centres of rotation are aligned so that their direction of force facilitates joint compression and hence stability. These muscles are therefore important contributors to the neuromuscular control system for fine-tuning spinal stability (Panjabi et al 1989), while the muscles of the anterolateral abdominal wall increase the stability of the vertebral column in the lumbar region by increasing the intra-abdominal pressure and by increasing the tension in the thoracolumbar fascia (Tesh et al 1987). Both of these groups of muscles are part of the local muscle system and multifidus and the transversus abdominus muscle are the most important muscles.

In the paraspinal muscles, emphasis has been placed on the role that multifidus has to play in the stability and movement of the vertebral column. It is the largest and most medial of the lumbar muscles and consists of separate bands with separate innervation. The bands attach in the midline to the spinous process of the vertebrae and spread caudolaterally to attach to the vertebral arches (spanning one to three vertebrae), the iliac crest and the sacrum (Moore 1992). Multifidus is regarded as an important muscle in the dynamic control of the motion segment in its neutral zone (Panjabi et al 1989, Kaigle et al 1995). Hides et al (1994) found that marked asymmetry of multifidus was seen in patients with unilateral low back pain with the smaller muscle being on the side ipsilateral to the symptoms. Multifidus was also found to not recover spontaneously following the resolution of acute, first-episode low back pain. This finding may explain why there is such a high recurrence rate of low back pain after this acute episode, probably due to a deficiency in the muscular stabilising mechanism of the lumbar spine (Hides et al 1996).

The function of the transversus abdominus muscle and its role in lumbo-pelvic stability has attracted considerable interest (Hodges 1999). the transversus abdominus muscle, the deepest of the abdominal muscles, attaches to the iliac crest, lower six ribs, the lateral raphe of the thoracolumbar fascia and the lateral portion of the inguinal ligament and passes medially to the linea alba, pubic crest and pecten pubis. The horizontal orientation of the fibres results in the increase of thoracolumbar fascia tension and an increase of intra-abdominal pressure when contracted (Moore 1992). The functioning of this deep, stabilising muscle with specific regard to CLBP has been investigated in various EMG studies, described below.

In an EMG study, Hodges and Richardson (1996) investigated the temporal sequence of trunk muscle activity associated with arm movement and whether a dysfunction of this sequence was present in patients with LBP. They found that movement of the arm in flexion, extension and abduction resulted in contraction of the trunk muscles before or shortly after the deltoid in the control subjects, and that the transversus abdominus muscle was first to contract. This finding supports the hypothesis of the transversus abdominus muscle enhancing the stabilisation of the spine and limiting intersegmental translation and rotational forces. Furthermore, Hodges and Richardson (1996) identified that the contraction of the transversus abdominus muscle was significantly delayed in patients with LBP, implying that this element of spinal stability is deficient. The delay in transversus abdominus muscle activation in LBP patients is reported to be significant in the stabilisation of the lumbar spine (Hodges and Richardson 1996), as during an action, without the immediate contraction of the transversus abdominus muscle, the forces are translated to the lumbar spine resulting in intersegmental rotation. Since only two degrees of intersegmental rotation is required to produce micro trauma to the structures of the lumbar spine (Gracovetsky et al 1985), this delay can be seen as significant.

O'Sullivan et al (1997b) investigated the patterns of abdominal muscle recruitment during an abdominal drawing in manoeuvre in patients with lumbar instability and CLBP. (The abdominal drawing in manoeuvre in a neutral alignment of the lumbar spine was found by Richardson et al (1992) to be a sound technique for activating the spinal support musculature.) In the presence of CLBP and a dysfunction in the deep abdominal muscles, the pattern of activation of the different groups of abdominal muscles was altered. Rectus abdominus, which is part of the global muscle system responsible for balancing external loads and producing large torque, and with a limited ability to stabilise the lumbar spine was found to substitute for the deeper stabilising muscles. This was described as an alteration in the neural pathways controlling recruitment (O'Sullivan et al 1997b).

Edgerton et al (1996) suggested that pain leads to inhibition of specific muscle groups, producing these alterations, and that this results in compensatory recruitment of other motor units from synergists or the global muscle system (such as rectus abdominis). The importance of such findings in the re-education of stabilising muscle groups in patients with compromised lumbar stability and CLBP is clear and the focus of this rehabilitation is therefore on the activation of the local muscle system and the application of techniques to prevent unnecessary activation of the global muscle system (Richardson and Jull 1995). O'Sullivan et al (1997) emphasized that without the regard for the quality of the muscular contraction, activation of unwanted synergist muscular activity may be re-enforced. From these and other studies, Hodges (1999) was able to compile specific points that should be considered when training the transversus abdominus muscle.

- The transversus abdominus muscle should be trained independently due to the fact that it is controlled independently and is the principle muscle affected in LBP.
- There is a functional interaction between the transversus abdominus muscle, the diaphragm and pelvic floor muscles, and this should be considered.

O'Sullivan (2000) was also able to highlight several points for training lumbar stability and progressing the rehabilitation through different stages.

- The first stage concentrated on the awareness and co-contraction of the local muscle system (the transversus abdominus muscle) progressing to maintaining the contraction without global substitution and with controlled respiration and a neutral spine alignment.

- The second stage consisted of training central and lateral costal diaphragm breathing control.
- The emphasis in the third stage was on maintaining a neutral spine alignment while facilitating the contraction of the pelvic floor and transverus abdominus muscle with controlled diaphragm breathing in non-weight bearing and then weight bearing positions. The techniques of focusing on pelvic floor contraction, lateral costal diaphragm breathing and optimal postural alignment in weight bearing are suggested to help inhibit global muscle substitution.
- Activation of lumbar multifidus in co-contraction with the transversus abdominus muscle is facilitated in stage four.
- In stage five, co-contractions in sitting and standing with postural correction are the focus.

These points have been incorporated into the basic principles of Pilates, and will be discussed further in the review.

Current treatment regimes

The treatment goals used in LBP are to relieve pain, reduce muscle spasm, improve range of motion and strength, correct postural problems, and ultimately improve functional status (Philadelphia Panel 2001). Many treatment options for CLBP are available, but little is known about the optimal treatment strategy (van Tulder et al 1997). Numerous systematic reviews concerning treatment and rehabilitation interventions for LBP exist. Two of these reviews that are referred to in this section are by van Tulder et al (1997) and van Tulder et al (2000), and included the following methodologic quality criteria:

- “Concealment of treatment allocation
- Withdrawal or drop-out rate

- Co-interventions avoided or equal
- Blinding of patients
- Blinding of assessor
- Intention-to-treat analysis
- Compliance
- Similarity of baseline characteristics
- Blinding of care provider"

(each criterion was weighted differently in each of the reviews)

The levels of evidence used were the same in both reviews.

- "Level 1: Strong evidence was provided by generally consistent findings in multiple high-quality RCTs.
- Level 2: Moderate evidence provided by generally consistent findings in one relevant, high quality RCT and one or more relevant, low quality RCTs.
- Level 3: One relevant, high quality RCT or multiple relevant, low RCTs.
- Level 4: Only one relevant, low quality RCT or no relevant RCTs or contradictory results."

High quality studies were defined as RCTs that fulfilled five or more of the validity criteria (van Tulder et al 2000) or that scored fifty points or more in the methodologic assessment (van Tulder et al 1997). In the review by van Tulder et al (2000) 41% of the RCTs reviewed were considered to be high quality studies, while only 25% of the RCTs involving CLBP were considered to be high quality in the earlier review by van Tulder et al (1997).

Various aspects of treatment for CLBP will now be discussed using evidence from the systematic reviews, and where possible, an analysis of a high quality study for a specific intervention will also be made.

Medical treatment of CLBP ranges from analgesics, muscle relaxants and non-steroidal anti-inflammatories (NSAIDs) to anti-depressants and epidural steroid injections. Three high quality and three low quality studies investigating the use of NSAIDs were assessed by van Tulder et al (1997) and the conclusion was drawn that there is moderate evidence (level 2) to support the use of NSAIDs for CLBP and strong evidence that various types of NSAIDs are equally effective in treatment (level 1). In the same review, the effectiveness of epidural steroid injections was assessed using four high quality and two low quality RCT's. It was reported by van Tulder et al (1997) that moderate evidence (level 2) exists to support the use of steroid injections over placebo in the short-term, but contradictory results of trials comparing epidural steroid injections and injections of local anaesthetic or muscle relaxants were found, nullifying the evidence supporting its use over other drugs.

Deyo (1996) reviewed various studies relating to various drug therapies used in low back pain. The conclusions drawn for the use of drug therapies in CLBP support the evidence found by van Tulder et al (1997). The efficacy of NSAIDs, muscle relaxants and narcotic analgesics remains largely unclear, and the value of anti-depressants for those patients with chronic pain who are not depressed is unproven. Deyo (1996) also raises the important controversy in the use of chronic narcotic analgesics in patients with chronic pain, as the duration of therapy may extend for many years and the potential for addiction and tachyphalaxis is great. Side effects particularly in the elderly are a concern. Deyo (1996) reports that NSAIDs are associated with higher rates of gastrointestinal bleeding and renal impairment, and opiates provide a risk of constipation and cognitive impairment in this group. Seager and Hawkey (2001) reported that NSAIDs are ulcerogenic to the stomach and duodenum and lead to a three to ten fold increase in ulcer complications, hospitalisation and death from ulcer disease.

It appears therefore that drug therapy used for CLBP remains a controversial area of treatment due to the unclear efficacy and potential harmful effects.

Spinal manipulative therapy (SMT) for the treatment of CLBP is widely used in the clinical setting by physiotherapists and chiropractors. In a review of the effect of SMT on CLBP, Ferreira et al (2002) found that it was more effective than placebo, but that the pooled effect size for pain reduction at one month was probably too small to be clinically worthwhile. In another recent review on the effect of SMT for low back pain relative to other therapies, Assendelft et al (2003) found the long term effect size for pain reduction using SMT was clinically worthwhile. Van Tulder et al (1997) found strong evidence (level 1) in support of the use of SMT compared to placebo treatment, while there was moderate evidence (level 2) that SMT is more effective for CLBP than care by a general practitioner, bed-rest, analgesics and massage. Although SMT seems to be an effective treatment for CLBP, the effect appears small.

Triano et al (1995) conducted a RCT to compare the effectiveness of SMT and an education programme in the treatment of CLBP. A greater improvement in pain was noted in the SMT group after two weeks of treatment and after a two-week treatment interval. Although the protocol of this study was rigorous, downfalls in the methodology were found to be a failure to describe the drop-outs for each study group and more than 20% of the population were lost at final follow-up. The lack of control of other interventions during the study period and the lack of a blinded outcome assessment were also problems in the design. It should also be noted that the definition of CLBP used in this study was pain for more than seven weeks only.

Giles and Muller (2003) conducted a well constructed and executed RCT to compare medication, acupuncture and SMT for the management of chronic spinal pain. Overall short-term results showed SMT to be most beneficial, but long-term conclusions could not be drawn as there was no long-term follow-up. Obvious lack of blinding and the lack of a control group were downfalls in the design, but the sample size fulfilled the power calculation and all the drop-outs were accounted for. The sample had a wide age range from a broad socio-economic background, which allowed the results to be generalised.

Acupuncture is an intervention where contradictory results exist. Van Tulder et al (1997) found that due to the contradictions in the RCT's assessed, there is no evidence to prove that acupuncture is an effective treatment for CLBP. Maher (2004), on analysing the Cochrane review and three other systematic reviews on the topic, revealed that each concluded that no convincing scientific evidence exists to support acupuncture as an effective treatment for CLBP. In the study by Giles and Muller (2003) acupuncture was found to improve neck disability with a decrease in the VAS score, but did not show any positive effect on the score for CLBP.

Other interventions found to have unknown value are those of lumbar supports and orthoses (van Tulder et al 1996, Maher 2004) and therapeutic ultrasound (Philadelphia Panel 2001). The Philadelphia Panel formulated evidence-based clinical practice guidelines on selected rehabilitation interventions (which included the above) for LBP using systematic reviews of RCTs and observational studies. Identification and synthesizing methods defined by the Cochrane Collaboration were used as a basis for the guidelines.

Good evidence has been found to show that the clinically important benefit with regards to pain relief using Transcutaneous Electrical Nerve Stimulation (TENS) is lacking. In fact, this treatment modality shows contradictory results in the treatment of CLBP (van Tulder et al 1997). This is supported by Maher (2004) who reported that four systematic reviews found TENS to not have a clinically important effect or one of unknown value in the treatment of CLBP.

The content of back schools seems to vary greatly, but the inclusion of group education and exercises are common elements. The curriculum taught, the type of exercises performed and the programme duration are not consistent (Maher 2004). Van Tulder et al (1997) found that of the RCTs reviewed, there was strong evidence to support an intensive back school programme in an occupational setting over no treatment, but limited evidence exists to show that a back school programme is more effective than other conservative treatments. Maher (2004) reported however, that although several systematic reviews of back schools found the treatment to be effective, the reviews used the levels of evidence approach which was found to bias the results. The conclusion concerning the effect of back schools on CLBP therefore was that of unknown value.

Generally the above interventions appear to be of limited or little value in the treatment of CLBP.

<u>Exercise as a form of treatment</u>

Exercise is one of the few clearly effective treatments for CLBP. The four most recent systematic reviews of exercise therapy and CLBP have all concluded that it is an effective therapy (Maher et al 1999, Philadelphia Panel 2001, van Tulder et al 2000, Bekkering et al 2003). The Philadelphia Panel (2001) found therapeutic exercises to have clinically important benefits for pain relief and functional status. Methods of exercise were not differentiated in the analysis, but based on good evidence, the panel recommended that an exercise programme should include stretching, strengthening and mobility exercises. Maher et al (1999) and Maher (2004) also found the effect of exercise to be sufficiently large and clinically important. Although optimal implementation of exercise as a treatment is unknown, Maher et al (1999) recommended that the evidence shows that more intensive programmes, run from one to six months, incorporating whole body exercise are probably most beneficial. Van Tulder et al (1997) supported the effectiveness of therapeutic exercise from various RCTs, but stated at the time that there was no evidence in favour of one type. In a Cochrane review of 39 RCTs, van Tulder et al (2000) found that exercises were as effective in reducing pain and improving functional status as conventional physiotherapy treatment, and more effective than usual care by general practitioners. Strong evidence was found to show that strengthening exercises are not more effective than other forms, but there is no distinction made between specific stabilisation and strengthening exercises (van Tulder et al 2000).

The approaches to exercise therapy can be generally classed into two approaches. One approach to exercise therapy focuses on a general exercise programme modelled on the Back to Fitness programme (Klaber Moffet and Frost 2000). The patients are treated in a group situation throughout. An initial pre-programme assessment and orientation session is performed before embarking on ten more sessions consisting of "(1) warm up and stretching, (2) exercise stations with varying degrees of difficulty, (3) cool down, (4) tip of the day, and (5) a relaxation session." Daily exercise or activity is encouraged at home. In the final session a plan is developed by the therapist and patient to increase and maintain activity levels.

Another approach focuses on a specific spinal stabilisation exercise programme based on the treatment approach reported by O'Sullivan et al (1997a). During the initial session patients are assessed individually and exercises are prescribed for improving the function of specific low back stabilising muscles. Multifidus, the transversus abdominus muscle and the pelvic floor are the most common muscles requiring retraining. Once these muscles are contracting correctly during simple exercises, the complexity of tasks is increased and the exercises become more functional, including co-ordinated movement of the limbs and trunk (Maher 2004).

This method of training was used in a RCT by O'Sullivan et al (1997a) evaluating the effectiveness of specific stabilising exercises in the treatment of patients with CLBP whose symptoms were based on the diagnosis of spondylolysis or spondylolisthesis. The results revealed that both pain and functional disability were reduced in the group that underwent the ten week exercise therapy programme, while that of the control group who underwent a ten week period of treatment directed by each patient's medical practitioner showed no significant or clinically important changes. The conclusion could then be drawn that specific spinal stabilising exercises directed at the deep abdominals and multifidus are effective in the treatment of this group of CLBP patients. Whether the results can be generalised to other groups of CLBP sufferers with more non-specific low back pain is questionable. The study, which was well designed and implemented, having a sample size sufficient to give significant results, all drop-outs accounted for and baseline characteristics well defined, could have been improved by the control group having more specified management and any other interventions avoided.

Pilates

Pilates combines both the above current approaches to exercise therapy, and focuses on stabilisation exercises in a general exercise programme. It is possible that the integration of approaches makes it an appropriate treatment for CLBP. Although it has become a popular trend in various areas of rehabilitation, no RCT to date has been conducted into its effectiveness as a therapy for CLBP.

Pilates, a mind-body exercise system, was pioneered by Joseph Pilates (1880-1976), a German expatriate, in England during World War I. The series of exercises was developed to help prisoners of war regain strength and mobility. Later, in New York, Pilates' conditioning techniques were discovered by professional dancers to help prevent injury and improve strength while maintaining long, even muscle tone (Merrithew 2004a). Various methods of Pilates training exist, but for the purpose of this review and study, the "STOTT" method of Pilates will be used. The focus of "STOTT Pilates" is to develop optimal strength, flexibility, endurance and posture. It is an anatomically-based approach to the original method that emphasizes neutral alignment, core or trunk stability and peripheral mobility. Optimal neuromuscular performance is developed while focusing on core stability and balancing both muscular strength and flexibility. Modern theories of exercise science and spinal rehabilitation have been incorporated through five basic biomechanical principles (Merrithew 2004b).

The following principles are re-inforced in every exercise, increasing the mind-body awareness and hence the precision and control of the exercise programme.

(1) Breathing is co-ordinated with movement and the focus of the "breath" is the engagement of the transversus abdominus muscle. It is emphasized that the "breath" and awareness of stabilisation of the spine and pelvis through the transversus abdominus muscle, multifidus and pelvic floor activation precedes any actual movement.

(2) Pelvic placement and the stabilisation of the pelvis and lumbar spine in neutral alignment and imprint (a slight posterior tilt of the pelvis) is emphasized.

(3) Attention is paid to the placement and stabilisation of the rib cage through abdominal muscle engagement. Indirectly the correct alignment of the thoracic spine is maintained.

(4) Scapular stabilisation is emphasized in order to prevent the muscles around the neck and upper quadrant overworking.

(5) Correct head and cervical spine placement ensures that the superficial cervical spine flexors and extensors do not overwork. (Merrithew 2004b)

These principles can be related to other literature confirming why the method of Pilates should be beneficial in providing increased stability of the lumbar spine. Relating to principle (1), Hodges (1999) emphasized that contraction of the diaphragm and pelvic floor muscles is essential to prevent displacement of the abdominal contents and permit the transversus abdominus muscle to develop sufficient tension to increase intra-abdominal pressure and fascial tension. As discussed previously, this is an important mechanism in increasing vertebral stability (Tesh et al 1987). O'Sullivan (2000) also confirmed the importance of controlled lateral costal diaphragm breathing and activation of the pelvic floor with the transversus abdominus muscle contraction in a neutral spine alignment in order to train the local stabilisers effectively. Relating to principle (2), in a study comparing three techniques for active lumbar stabilisation, Richardson et al (1992) found that a neutral lumbar spine alignment with abdominal bracing and abdominal hollowing with slight lumbar flattening (imprint), promoted a better muscular contraction pattern for lumbar spine stability than a posterior pelvic tilting position where the loading on spinal intevertebral discs is increased and multifidus is less able to contract optimally.

In general the emphasis of Pilates on the quality of contraction and sequencing of movement is supported by O'Sullivan et al (1997b) who suggests that without regard for the quality of the muscular contraction, activation of unwanted muscle activity may be re-inforced. The view of O'Sullivan et al (1997b) of facilitating a change in the neural control of the muscular system during rehabilitation instead of simply strengthening muscles relates strongly to the technique used in the Pilates method of training. During mat work exercises attention is paid to the pattern and quality of muscular contractions, with emphasis on activating the local muscular system without substituting with the global muscles. Correct sequencing of movement is also developed. Richardson and Jull (1995) described how during progression of exercises patients should be able to hold a co-contraction of the deep local muscles during dynamic functional movements of the trunk. This principle is fulfilled while working through a Pilates regime as the exercises are progressed by increasing the range of motion, reducing the base of support and increasing endurance, balance and co-ordination (Anderson 2000). It appears therefore, that theoretically, Pilates addresses all the components of an exercise programme that should benefit patients with CLBP.

A study by Segal et al (2004) investigated the effects of Pilates training on (1) flexibility; using fingertip-to-floor distance, (2) body composition; using BMI, body mass, segmental fat and lean body mass, and (3) health status; using the American Academy of Orthopaedic Surgeons outcomes questionnaire on a VAS. The study was observational, prospective in design and included all adults who presented to an athletic club for Pilates (participants were excluded if they were pregnant or if they had an implanted metallic device). Forty-five out of 47 participants were female and 32 completed the study (31 female). Improvements for flexibility were statistically significant, but scores for body composition and health status did not change significantly. The study would have benefited from a more controlled design with an intervention and control group to create comparisons and eliminate bias. The base-line status of the participants in terms of physical disabilities or pain is not known, so it is difficult to generalise the result to any other population.

Study design, outcome measures and selection criteria

With the above study in mind, an appropriate design was chosen for this study. The RCT is regarded as the gold standard of evidence and the only ‘scientific’ method of providing evidence of effective intervention and management (Mawson 2002). The importance of a strict control group within the RCT has been illustrated in the study by O’Sullivan et al (1997a). The reviewed studies all showed a sufficiently powered sample size to ensure that significant differences in outcome measures could be detected. The selection of clinically appropriate, functionally relevant, valid and reliable outcome measures has been emphasized by Bardin (2002). The Visual Analogue Scale (VAS) (Jensen et al 1986) for pain and the Roland Morris Disability Questionnaire (Roland and Morris 1983) for functional disability are both recommended by Bardin (2002) as outcome measures that fulfill the above criteria.

The VAS for pain, as described by Jensen et al (1986), has been used in numerous studies that have investigated how specific interventions affect low back pain (O’Sullivan et al 1997a, Triano et al 1995, Mannion et al 1999). Significant differences in scores were detected. In a study to contrast the effectiveness of manipulation, a manipulation mimic and a back education program, Triano et al (1995) found that the VAS was the only measure to reveal significant reductions in scores over a two week period and to show statistically different results between the three groups. In a study comparing various pain intensity scales, Jensen et al (1986) found the VAS to yield similar results to the other scales in terms of the number of correct responses and the predictive validity.

The Roland Morris Disability Questionnaire was developed as a sensitive measure of disability in low back pain to show the difference in improvement between a treatment and control group. During the study which lead to the development of the questionnaire, patients from all social classes between the ages of 16 to 64 were included and the responses to the questionnaire were found not to be related to age, sex or social class. The characteristics of the questionnaire showed that it acted as a discriminating outcome measure in low back pain and that it could be used in treatment trials (Roland and Morris 1983). Stratford et al (1994) compared the ability of the Roland Morris, Oswestry and Jan van Breemen Institute pain and function questionnaires to detect change over time in patients with mechanical low back pain. It was found that the Roland Morris Disability Questionnaire was the preferred instrument for assessing this change over time. It has been used in several studies that have shown significant differences in scores (Moseley 2002, Mannion et al 1999).

Conclusion:

Dysfunctions in the stabilising muscular system of the lumbar spine appear to be strongly related to CLBP. RCTs investigating treatment interventions for CLBP seem to show that many are of little or no value having either a small treatment effect or only a short-term positive effect. Due to the large number of poor quality studies, evidence is also limited or weak. Exercise, however, appears to stand out as a method of treatment that more consistently produces positive results in the reduction of pain and disability, although its most beneficial implementation appears to be largely unknown. Pilates, as a specific method of exercise with specific principles and well defined exercises, incorporates certain techniques that have been shown to be important in the rehabilitation of CLBP. It is the effects of the regime of Pilates on pain and disability in CLBP that have been investigated in this study.

CHAPTER 3

METHOD:

In this chapter the study design, selection of subjects and criteria for inclusion or exclusion, apparatus, procedure and statistical analysis will be discussed.

Study design: The study was a randomised controlled trial, consisting of an intervention and control group. The dependent variables were the VAS for pain and Roland Morris Disability Questionnaire. The independent variable was a twelve-week Pilates intervention. The assessor was blinded as to which group the participants were in.

Ethical clearance: Ethical clearance was provided by the Human Research Ethics Committee of the University of the Witwatersrand on the 25 June 2004. Protocol number: M040606 (Appendix 6)

Subjects: The subjects were a sample of convenience from a private physiotherapy practice in the northern suburbs of Johannesburg.

Sample size: There were16 subjects per group as calculated by a power calculation.

(See Statistical Analysis)

Selection of the sample: The subjects volunteered to be part of the study. Those who complied with the selection criteria were randomly allocated to the Pilates or control group using a process of concealed random allocation.

Inclusion criteria:

- Recurrent low back pain for longer than three months with no sign of abating.
- With or without pain into the lower limbs.
- The subjects fell into the age group of 20 to 65 years.

Exclusion criteria: Subjects were excluded for the following reasons:

- Previous spinal surgery
- Diagnosed inflammatory joint disease
- Red flag signs and symptoms. These patients were sent for further investigations.
- Motor or sensory neurological signs
- No informed consent
- Inability to adhere to the exercise programme. These were subjects that were excluded as they anticipated that attendance would be problematic or difficult.
- Previous or current participation in a Pilates or back class programme

Apparatus:

Outcome measures:

1. Visual analogue scale for pain. (Fulfils primary objective) (Appendix 1)
2. Roland Morris Disability Questionnaire. (Fulfils secondary objective) (Appendix 2)

Both the above are validated and reliable measures that are in the public domain and therefore permission to use them was not required.

Pilates programme:

Permission was gained from Joanne Enslin-de Wet of Joanne Enslin- De Wet and Associates Physiotherapy and Riverclub Pilates to use the premises and equipment.

The requirements were as follows:

- Spacious carpeted room with exercise mats.
- Small balls and pillows
- Exercise charts (Appendix 3)
- Qualified Pilates instructor

<u>Procedure:</u>

- Patients who presented to Joanne Enslin – De Wet and Associates physiotherapy practice in Riverclub, Johannesburg were given the opportunity to volunteer for the study.
- The volunteers who satisfied the inclusion criteria were provided with an information sheet (Appendix 4) and an informed consent form (Appendix 5), which had to be signed prior to being included in the study.
- Once informed consent had been given the participants were allocated to either the intervention or control group by a process of concealed random allocation. The research assistant, an employee of Joanne Enslin-De Wet and Associates, was responsible for overseeing this process.
- Each participant was coded to enable follow-up if necessary. This code appeared on their specific questionnaire sheets. The research assistant was responsible for this procedure.
- Measurements of height and weight were taken and statistics of age and duration of pain were given.
- All participants while at the practice were then asked to complete both questionnaires, confidentially. The questionnaires were administered by the research assistant and were then handed in to the assessor once completed.
- Participants in the control group attended physiotherapy treatment when necessary, and those in the Pilates group could also continue with physiotherapy treatment as necessary. All participants could continue their normal exercise or sports regimes.
- The physiotherapists at the practice were required to do a standard treatment consisting of muscle energy techniques of the lumbar spine and /or pelvis as described by Greenman (1996), myofascial release, massage, unilateral, posterior-

anterior or other Maitland mobilisations as described by Maitland (1986), Mulligan mobilisation techniques as described by Mulligan (1996), ultrasound, interferential, heat or ice, strapping, appropriate postural correction, stretches and strengthening or stabilising exercises. These stabilisation exercises included the re-education of the transversus abdominus muscle, miltifidus and the pelvic floor as necessary. They were asked not to use actual Pilates exercises during treatment or prescribe them for home exercises. Their treatments were fully documented.

- The participants in the Pilates group were required to attend one session every week for twelve weeks. The sessions were taught by a fully qualified Pilates instructor who works at Joanne Enslin-De Wet and Associates Physiotherapy. The participants were not liable for the cost of attending these sessions.
- Each patient was first taught the basic principles of Pilates followed by the warm-up. (Appendix 3)
- Subsequent sessions began with a revision of the basic principles, followed by the warm-up, and the patient was progressed through the repertoire of mat exercises (Appendix 3). The exercises were, where necessary, modified according to the patients' pain and disability and specific known condition.
- The instructor progressed the exercises as she felt appropriate for a specific patient.
- Each session at the practice was approximately an hour long and the exercises completed were comprehensively documented.
- A home Pilates programme was given after the first two weeks. This consisted of prescribed exercises that the instructor felt appropriate for the particular patient. The participants were required to perform the exercises three times per week and the home regime was designed to take no longer than ten minutes to complete.
- The Pilates programme was continued for a total of twelve weeks. Attendance was documented.
- At week three and after the completion of the programme, both the control and Pilates group were required to complete the two questionnaires again.
- The outcome measures were then scored and statistically analysed.

Risks to participants:

There was a very remote possibility of the Pilates aggravating patients' symptoms. Exercises were in these circumstances modified appropriately in order to control and minimise this risk.

Statistical Analysis

Sample size: Sample size was based on the primary objective; an improvement in back pain as assessed on the VAS. From the literature, an improvement of not more than 5 points (10%) was expected in the control group (O'Sullivan et al 1997a) while an improvement of 25 points (approximately 50%) was to be expected in the intervention group. To detect this change a sample of 16 patients per group was required for 90% power when testing at the 0.05 level of significance, assuming a standard deviation of 16.67 points, which is extremely conservative.

Data analysis: For both scales (VAS and RM) groups were compared with respect to change in score from baseline to three weeks and twelve weeks using a two-sample t-test at the 0.05 level of significance. Since change can be dependent on baseline, the results found from the previous analysis were also used in an analysis of covariance (ANCOVA) when comparing groups with respect to change in score of the VAS and RM, using baseline scores as the covariate. This allowed for the assessment of differences between the two groups after three weeks and after the completion of the intervention period. The ANCOVA allows for the consideration of the nature of treatment effects when adjustments are made for differing mean values of the groups that may introduce a source of bias. The precision of tests used to compare groups is also increased by the use of the ANCOVA (Petrie 1987). Differences in VAS and RM baseline scores between the groups were the only factors considered in this study to be possible important sources of bias. It is documented that age has no effect on the responses to the Roland Morris Disability Questionnaire (Roland and Morris 1983) and thus this and other demographic criteria were not included as any source of possible bias in this study.

CHAPTER 4

RESULTS:

In this chapter the demographics, baseline, three-week, and twelve-week results are presented. Various comparisons between groups are also presented.

The sample

32 volunteers were randomized into two groups consisting of 16 patients in each group; Group A (the Pilates intervention group) and Group B (the control group). There were no drop-outs as all 16 patients in each group completed the study.

Demographics

In Table 1 the mean and standard deviation values of height, weight, age and duration of pain of each group are presented.

Table 1: Demographics of the study population

	Group	Height (cm)	Weight (kg)	Age (years)	Duration (months)
Mean (SD)	Pilates	172.4 (8.7)	68.8 (13.0)	33.2 (7.7)	27.0 (22.2)
Mean (SD)	Control	170.8 (6.6)	67.6 (11.7)	46.7 (14.4)	20.4 (19.0)
p value		0.572	0.766	0.002	0.408

The p value for age reveals that the groups differed significantly in this regard. The difference was not considered to be important in this study as discussed in the statistical analysis.

Gender

Group A (Pilates) consisted of twelve females and four males, while group B (Control) consisted of thirteen females and three males.

SCORES

Baseline scores

In Table 2 the mean and standard deviation values for baseline scores (week 0) for the Visual Analogue Scale for pain (/10) and the Roland Morris Disability Questionnaire (/24) are represented.

Table 2: Baseline scores

	Group	**VAS**	**Roland Morris**
Mean (SD)	Pilates	5.13 (2.03)	7.0 (3.11)
Mean (SD)	Control	4.76 (1.68)	7.38 (3.36)
p value		0.579	0.745

There was no significant difference between the two group's baseline scores. The difference in mean baseline scores between the Pilates and Control group is an important factor when comparing future scores and changes in scores, and these differences were used in the ANCOVA.

Three-week scores

In Table 3 the mean and standard deviation values for three-week scores for the Visual Analogue Scale for pain (/10) and the Roland Morris Disability Questionnaire (/24) are represented.

Table 3: Three-week scores

	Group	VAS	Roland Morris
Mean (SD)	Pilates	3.52 (1.82)	4.5 (3.27)
Mean (SD)	Control	3.13 (1.87)	5.06 (2.41)
p value		0.550	0.583

There was no significant difference between three-week scores for the Pilates Group and the Control Group. The three-week scores show an improvement in mean VAS and Roland Morris scores with all mean values having decreased.

Twelve-week scores

In Table 4 the mean and standard deviation values for twelve-week scores for the Visual Analogue Scale for pain (/10) and the Roland Morris Disability Questionnaire (/24) are represented.

Table 4: Twelve- week scores

	Group	VAS	Roland Morris
Mean (SD)	Pilates	1.58 (1.77)	2.44 (2.25)
Mean (SD)	Control	3.15(2.57)	5.06 (4.48)
p value		0.053	0.045

It is notable that after twelve-weeks the mean scores in the Pilates Group had both decreased further since the measurements at three weeks, while those of the Control Group had increased slightly or remained the same. The difference in the two groups VAS scores is marginally significant while the difference in RM scores is significant.

The following figures represent the actual scores that each patient recorded at baseline, three-weeks and twelve-weeks. Patient ID (A1-16 or B1-16) represents the anonymous identification that was allocated to each patient on entry to the study.

Figure 1 represents the actual VAS scores (/10) recorded by patients in Group A (Pilates) at baseline, three and twelve-weeks.

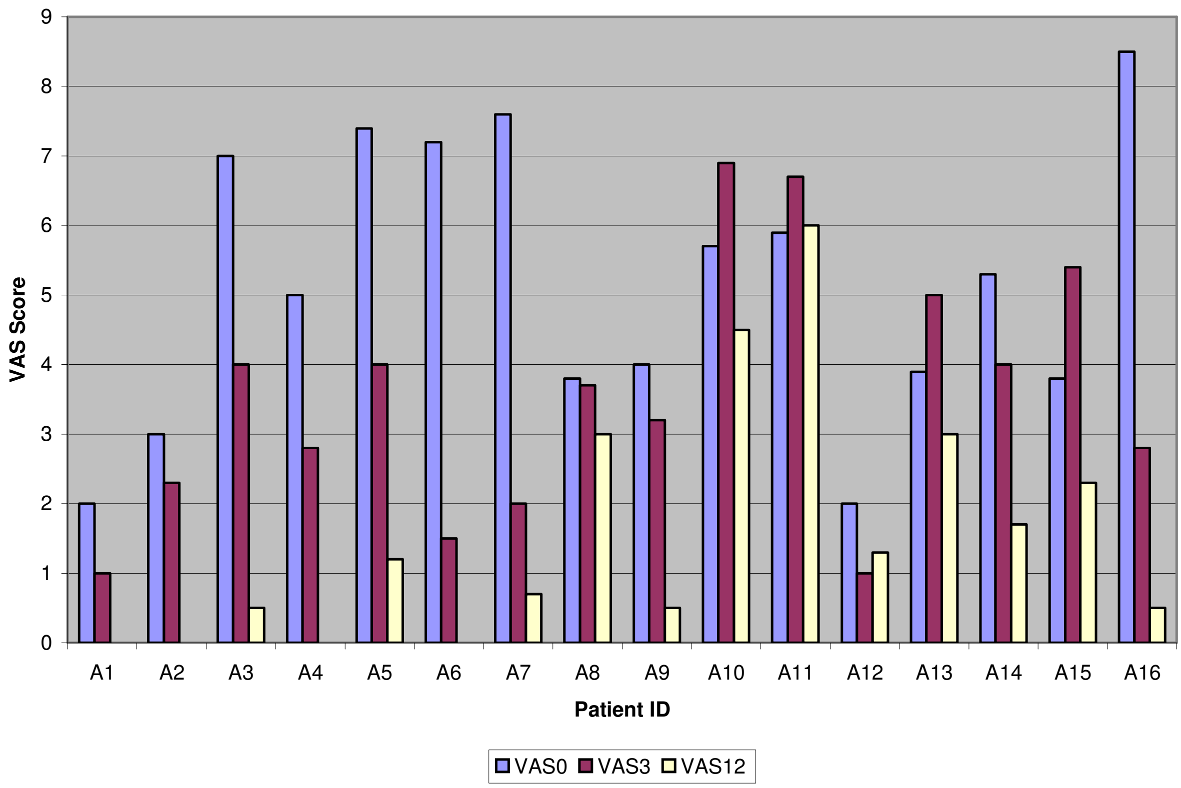
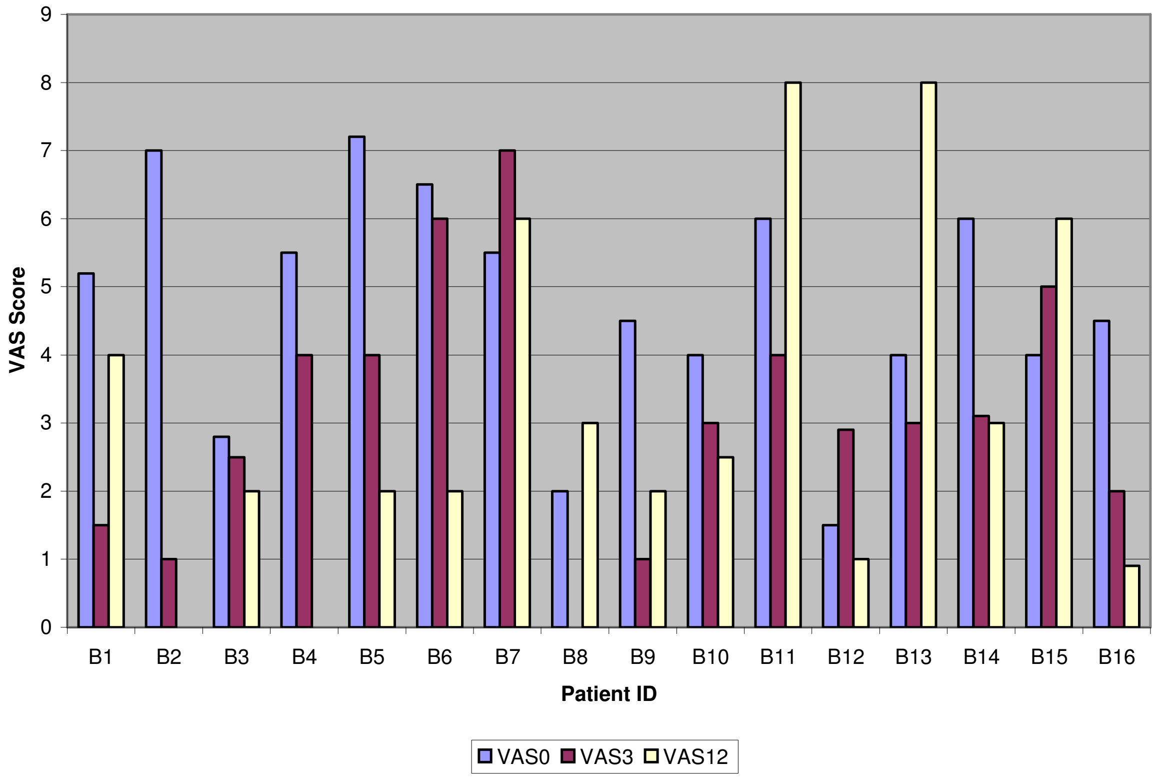


Figure 1: Baseline, three-week and twelve-week VAS scores for patients in Group A

It is clear that over the twelve-week period patients in Group A (Pilates) showed a general trend of a decrease in VAS score, which reflects a decrease in pain.

Figure 2 represents actual VAS scores (/10) at baseline, three and twelve weeks for patients in Group B (Control).



<u>Figure 2: Baseline, three-week and twelve-week VAS scores for patients in Group B</u>

The trend in Figure 1 is not as clear in Figure 2. Some patients showed a decrease in scores over the twelve-week period while others showed an increase in scores.

Figure 3 represents the actual Roland Morris scores (/24) recorded at baseline, three and twelve weeks for patients in Group A (Pilates).

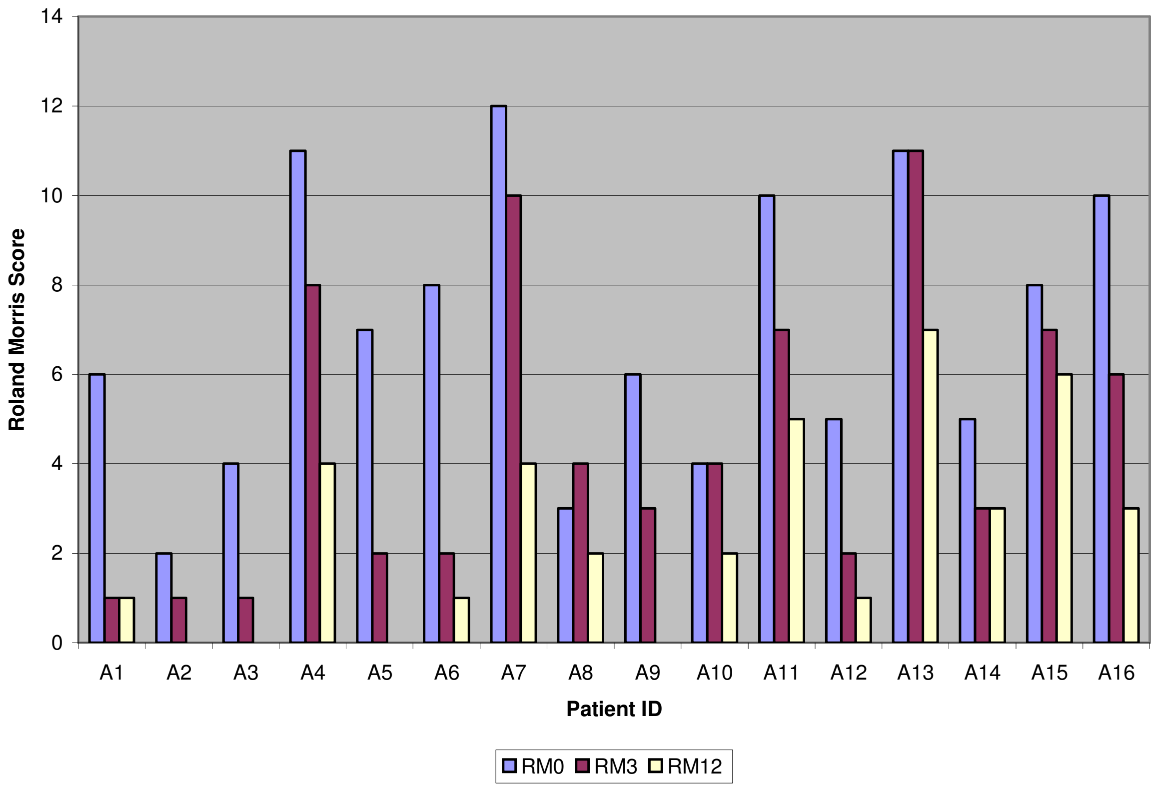


Figure 3: Baseline, three-week and twelve-week RM scores for patients in Group A

The general trend that this figure shows is one of decreasing scores over twelve weeks representing a decrease in functional disability.

Figure 4 represents the actual Roland Morris scores at baseline, three and twelve weeks for patients in Group B (Control).

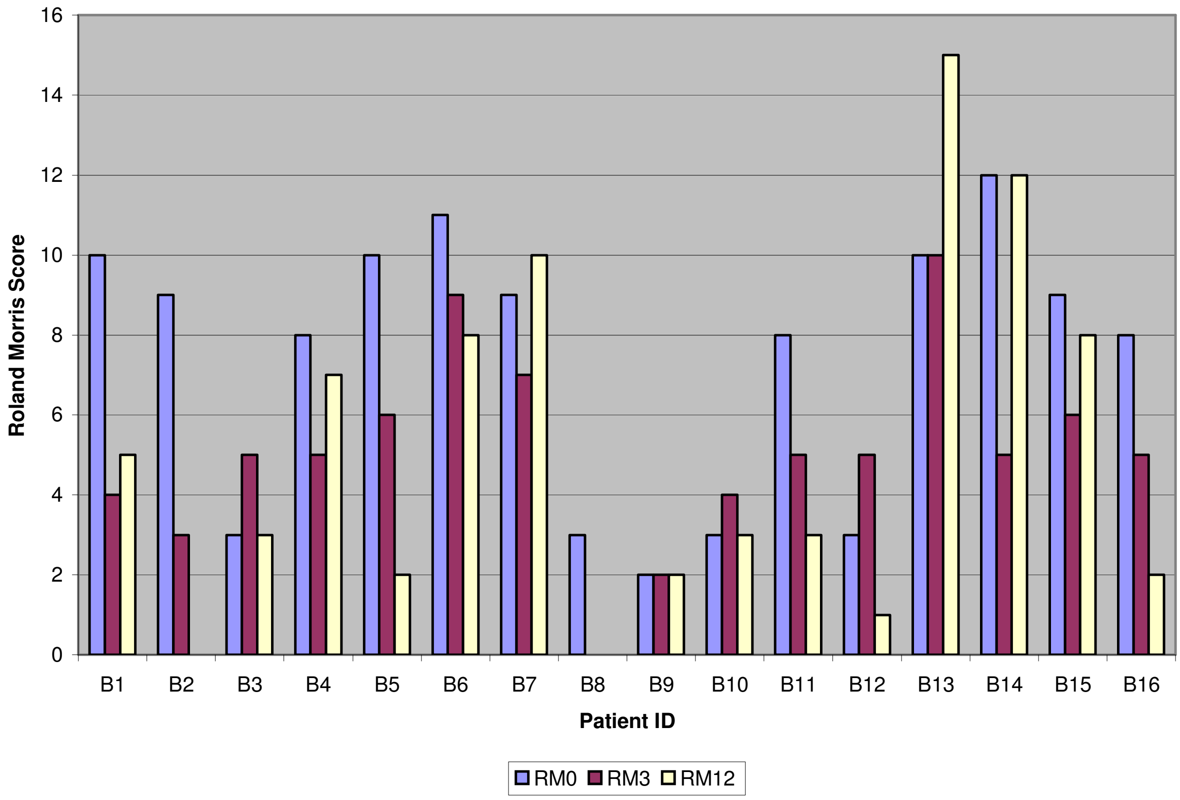


Figure 4: baseline, three-week and twelve-week RM scores for patients in Group B

The general trend in Figure 3 is not as clear in this figure as while the majority of patients have shown a decrease in scores over the twelve-weeks, some have shown an increase from baseline or three-weeks.

COMPARISONS

In comparing the change in scores between the two groups at three and twelve weeks, it was necessary to use the ANCOVA using the change in scores as the dependent variable and the baseline scores as the covariate. The mean scores for change over time could then be adjusted for the two groups and compared for any statistical significance.

Differences between baseline and three-week VAS scores

In Table 5 the mean difference, with the adjusted mean as calculated by the ANCOVA, and standard deviation values, between baseline and three-week VAS scores for both groups are represented.

Table 5: Mean change in baseline to three-week VAS scores and the SD of the change in VAS scores

	Mean change (Adjusted mean)	SD
Pilates Group	1.61 (1.48)	2.46
Control Group	1.64 (1.77)	2.03

Using the adjusted mean values, the mean changes in VAS scores from baseline to three weeks did not differ significantly between the two groups (p=0,646).

Differences between baseline and three-week Roland Morris scores

In Table 6 the mean difference, with the adjusted mean as calculated by the ANCOVA, and standard deviation values, between baseline and three-week Roland Morris Disability Questionnaire scores for both groups are represented.

Table 6: Mean change in baseline to three-week Roland Morris scores and the SD of the change in Roland Morris scores

	Mean change (Adjusted mean)	SD
Pilates Group	2.50 (2.57)	1.97
Control Group	2.31(2.24)	2.75

For changes in Roland Morris score from baseline to three weeks, the adjusted means did not differ significantly (p=0.656)

Differences between baseline and twelve-week VAS scores

In Table 7 the mean difference, with the adjusted mean as calculated using the ANCOVA, and standard deviation values, between baseline and twelve-week VAS scores for both groups are represented.

Table 7: Mean change in baseline to twelve-week VAS scores and the SD of the change in VAS scores

	Mean change (Adjusted mean)	SD
Pilates Group	3.56 (3. 37)	2.72
Control Group	1.61 (1.80)	3.09

Using the adjusted mean values, the changes in VAS scores from baseline to twelve weeks were marginally significantly different (p=0.059).

Differences between baseline and twelve-week Roland Morris scores

In Table 8 the mean difference, with the adjusted mean as calculated using the ANCOVA, and standard deviation values, between baseline and twelve-week Roland Morris scores for both groups are represented.

Table 8: Mean change in baseline to twelve-week Roland Morris scores and the SD of the change in Roland Morris scores

	Mean change (Adjusted mean)	**SD**
Pilates Group	4.56 (4.63)	2.28
Control Group	2.31 (2.25)	3.61

For the changes in Roland Morris score from baseline to twelve weeks, the adjusted means differed significantly (p=0.026).

The following figures represent the number of patients in Group A (Pilates) and Group B (Control) that attained a specific percentage change in VAS and Roland Morris scores from baseline to twelve weeks. The percentage change categories for the VAS were based on the assumption that an improvement of ten percent is expected in the control group while the intervention group can expect a change of 50 percent. This was calculated by using evidence from the study by O'Sullivan et al (1997a). The percentage categories for the Roland Morris were based on an improvement of four points or about twenty percent in the intervention group.

Figure 5 represents the distribution of patients in Group A (Pilates) and B (Control) with a specific percentage change in VAS score from baseline to twelve weeks.

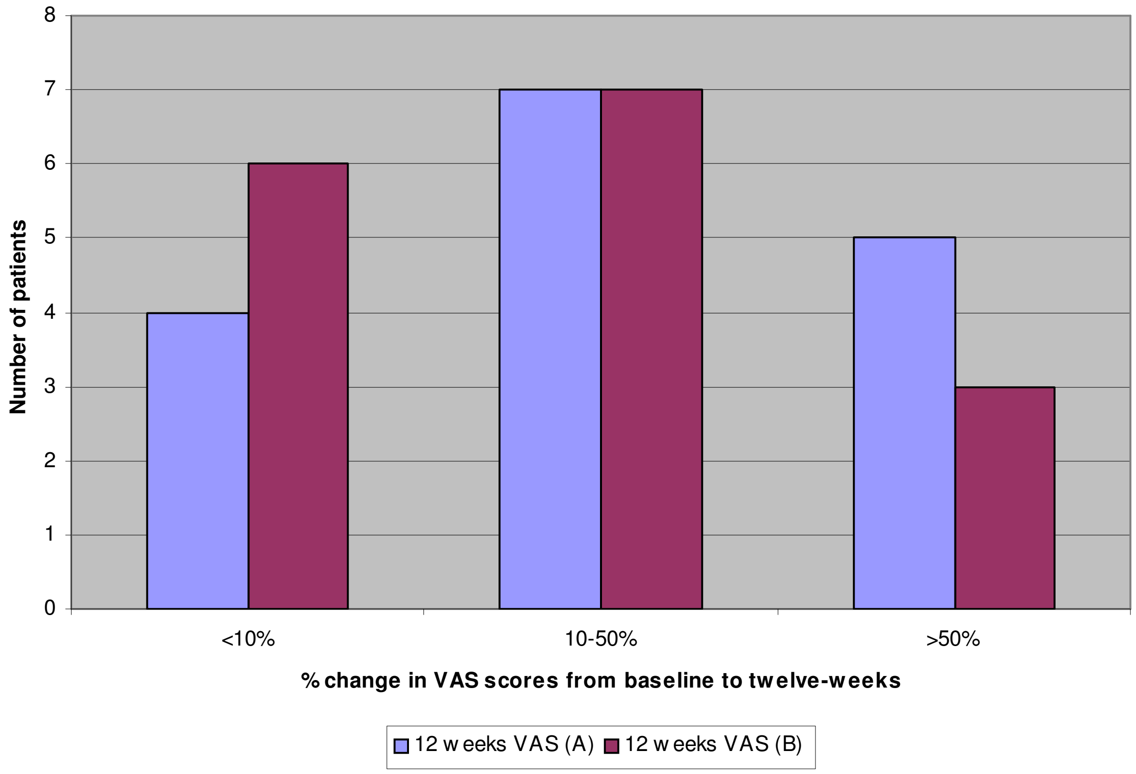


Figure 5: The number of patients in Groups A and B with a percentage change in VAS scores of <10%, 10-50% and >50% from baseline to twelve-weeks

The most notable aspect of this figure is the number of patients in Group A (Pilates) with a greater than 50% change in score (5) versus that in B (Control) (3), and the number of patients in Group B (Control) with a less than 10% change in score (6) versus that in A (Pilates) (3).

Figure 6 represents the distribution of patents in Group A (Pilates) and B (Control) with a specific percentage change in Roland Morris score from baseline to twelve-weeks.

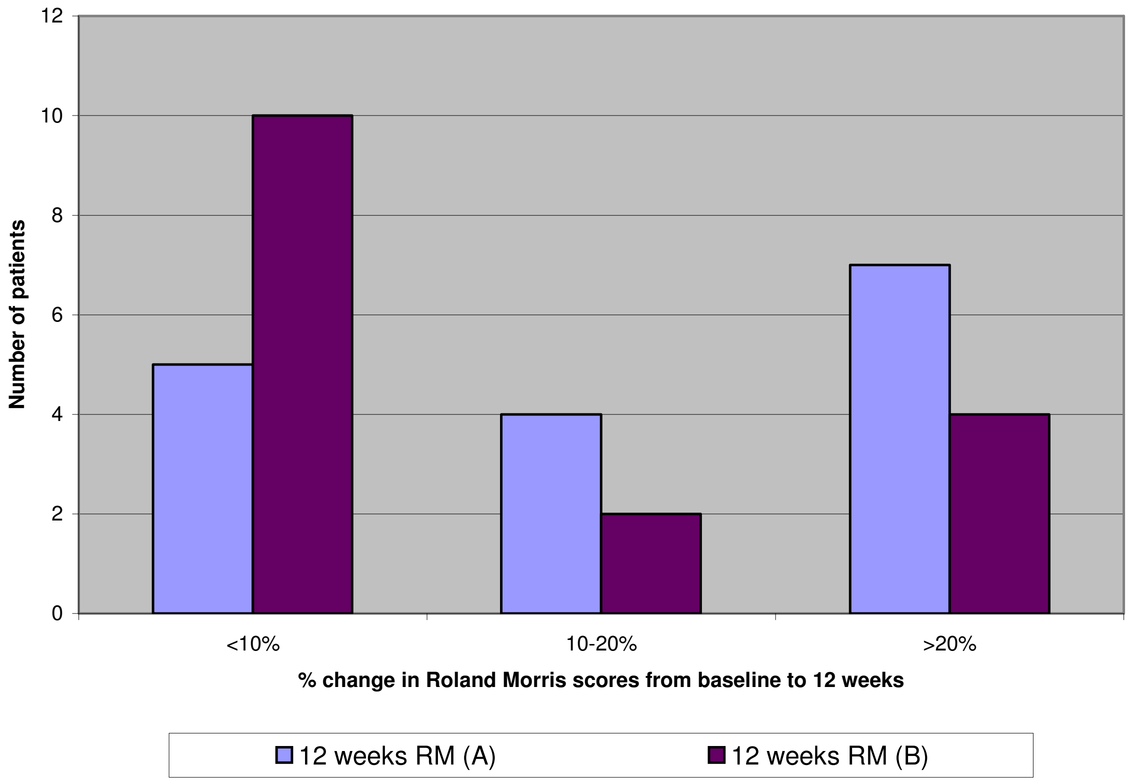


Figure 6: The number of patients in Groups A and B with a percentage change in Roland Morris scores of <10%, 10-20% and >20% from baseline to twelve-weeks

Seven patients in Group A (Pilates) had a greater than 20% change in score while only four in Group B (Control) exceeded a 20% change. Ten out of the sixteen patients in Group B (Control) had a less than ten percent change in score over the twelve weeks.

CHAPTER 5

DISCUSSION:

In this chapter the most important findings of this study will be discussed. Comparisons will be made with similar studies that have been discussed in the literature review and the possible influencing factors of the results will be commented on. The limitations, applicability and relevance of this study will also be discussed and recommendations made for future research. The aim of this pilot study was to determine the effectiveness of a Pilates programme in reducing pain and improving functional disability in patients suffering from CLBP. The subjects in the Pilates (A) and control (B) group were assessed using the VAS for pain and the Roland Morris Disability Questionnaire at baseline, three-weeks, and at twelve-weeks following the completion of the intervention. All participants completed the programme, so there were no drop-outs recorded in either group.

Pain:

The mean change in pain scores from baseline to twelve weeks was marginally significantly different between groups A (Pilates) and B (Control) (p=0.059) with Group A showing more positive results. The results have shown a trend in the improvement of pain intensity over the twelve-week period with Group A showing the greater improvement. The study suggests that a twelve-week Pilates intervention with physiotherapy treatment as necessary, is effective in reducing pain in patients suffering from CLBP and is more effective than physiotherapy treatment alone. It is well documented that exercise is an effective method of treatment for CLBP (Maher et al 1999, van Tulder et al 2000, Bekkering et al 2003). The Philadelphia Panel (2001) found therapeutic exercise to have clinically important benefits for pain relief, and in the study by O'Sullivan et al (1997a) a significant improvement in pain intensity was found in the exercise intervention group. The reduction in pain intensity in the intervention group was also found to be significantly different when compared to that in the control group in the above study (O'Sullivan et al 1997a).

In this study the change in scores from baseline to three-weeks did not differ significantly between the two groups, but the mean scores for Group A and B did decrease with respect to baseline scores, showing an improvement of pain symptoms. A greater number of patients in the Pilates group demonstrated a greater percentage change in score over the twelve-week period when compared to the control group.

The above results can be well explained when considering the mechanisms involved in CLBP. The instability in spinal motion segments and the dysfunction in the muscular control system of the spine have been suggested as important predisposing factors of CLBP (Kirkaldy-Willis and Farfan 1982, Friberg 1987, Panjabi et al 1989). The main muscles responsible for spinal stabilisation are the transversus abdominus muscle and multifidus (Hodges 1999, Panjabi et al 1989). The concept of stabilisation of the spine through the activation of the transversus abdominus muscle together with multifidus is central to Pilates (Anderson 2000). Many studies have confirmed the need for the re-education and training of these muscles in the treatment and further prevention of CLBP (O'Sullivan 2000, Richardson and Jull 1995, Hodges 1999). The other principles that apply directly to Pilates namely, lateral costal diaphragm breathing, activation of the pelvic floor and correct alignment of the spine have also been documented as effective techniques for stabilisation of the spine without global muscular activation (O'Sullivan 2000, Hodges 1999). It is therefore understandable that with increased stabilisation achieved through Pilates there is a decrease in spinal instability and a decrease in pain. It is notable that Maher et al (1999) have suggested that exercise programmes incorporating whole body exercise as opposed to only stabilisation exercises are probably most beneficial for reducing CLBP. The Philadelphia Panel (2001) also recommend that an effective exercise programme for LBP should include stretching, strengthening and mobility exercises. Pilates fulfills the above criteria while applying the principles of stabilisation, hence the effectiveness of the intervention employed in this study in reducing patients' pain.

Functional disability:

The mean change in Roland Morris scores from baseline to twelve weeks was significantly different between the Pilates and Control groups (p=0.026) with Group A (Pilates) showing the greater improvement. Since the Roland Morris Disability Questionnaire is a measure of functional disability related to LBP, a trend in the improvement of function over the twelve-week period thus exists. The Pilates intervention is therefore effective in decreasing disability in CLBP sufferers and more effective than physiotherapy treatment alone. The Philadelphia Panel (2001) also found that therapeutic exercise has important benefits for functional status, and O'Sullivan et al (1997a) found a reduction in functional disability scores in the exercise intervention group that was significantly different when compared to the control group. A decrease in pain and functional disability scores seems to follow similar trends in this and other studies, and the explanation for an improvement in functional status can possibly be explained by a reduction in pain.

The change in scores in this study, from baseline to three-weeks did not differ significantly between the groups, but the mean scores did decrease, demonstrating an improvement in functional disability. More patients in the Pilates group showed a greater change in score over the twelve week period when compared to the control group.

The physiotherapy or control group did show improvements over three and twelve weeks with regard to both the VAS and RM. The physiotherapy treatment approach employed in this study consisted of modalities such as SMT, acupuncture, massage, electrotherapy, postural correction, education and the teaching and prescription of exercises. SMT has been found to be effective in the reduction of pain in CLBP sufferers (Assendelft 2003), but the effect has been described as small (van Tulder et al 1997). Acupuncture, TENS and ultrasound have unknown value in the treatment of CLBP (van Tulder et al 1997, Philadelphia Panel 2001). The stabilisation exercises taught during a physiotherapy session were based on the method described by O'Sullivan et al (1997a) as discussed in the literature review. However, in a physiotherapy session of thirty minutes, time was shared between the above modalities, and only limited time was therefore dedicated to exercise.

The Pilates group was able to benefit from the techniques and modalities used during physiotherapy treatments as well as having an hour session per week of stabilisation training and general exercise during the Pilates sessions. The extended period of time spent focusing on stabilisation, developing body and postural awareness and performing the exercises seems to be more beneficial in the reduction of pain and functional disability.

Other influencing factors:

The undivided attention of the therapist during the hour long Pilates sessions may have influenced the patients' pain levels and functional disability and increased the confidence levels of the patients. The Pilates setting which consists of a large open space that is specifically designed for rehabilitation, may have helped to promote a sense of health and wellness, and may also have created a positive environmental influence for the patients when compared to the more clinical physiotherapy one. The expectations of the patients who were allocated to the Pilates group may have been affected by the vast lay literature that promotes Pilates as a form of therapeutic exercise.

Demographics:

The statistical analysis of the results included a comparison of demographics between the two groups where it was found that the groups showed a significant difference with regard to mean age. This occurred even though the volunteers were randomly allocated to groups, but was not considered important in this study as discussed in the statistical analysis. No literature was found that compared subjects of different ages and their responses to physiotherapy treatment and exercise therapy. Age may be a factor that influenced the effectiveness of the exercise programme or response to the intervention, but should be further investigated to assess this influence and its significance. It is not known if age is an important factor in the effectiveness of other treatment modalities for CLBP, but most studies of this nature have a similar age range to that used in this study (O'Sullivan et al 1997a; Giles and Muller 2003; Roland and Morris 1983).

Comments:

An area that was not measured but became apparent during the intervention period was that of patient's feelings, experiences and responsiveness to Pilates. The most common comments were found to be the following:

"I feel more in control of my back pain"

"I feel less reliant on physiotherapy treatment"

I feel more aware of my posture and body"

"I feel less stressed"

"I feel more relaxed"

"I understand what brings on my pain and I know how to correct it myself"

"I am able to do exercises to ease my pain at home"

These issues appeared to be very important to the patients and could be included in a quality of life assessment in future studies.

LIMITATIONS OF THE STUDY

This study was a pilot study. Considering the important findings that have been revealed, the study could form the basis for further studies. The following points have been identified as the main factors that could be better controlled in future studies.

- Daily fluctuations in pain intensity and therefore disability were not controlled. Due to the patients having to come to the practice for sessions, it was difficult to organise the completion of the questionnaires at the same time of the day at baseline, three and twelve weeks.

- Demographic factors such as the large age range, the differing diagnoses for CLBP and the varying baseline activity levels resulted in a less homogeneous sample. It is important to note that similar studies have included similar demographic criteria that are acceptable for studies of this nature.
- The intervention was only conducted for a period of three months and no long-term follow-up was performed.
- A RCT of this nature cannot be double-blinded as the patients actively participate in either one treatment or another.
- The study population was limited to those who were able to attend the physiotherapy practice. This excluded any CLBP sufferers who for financial, transport, work or other reasons could not attend treatment. This is another factor that is common in other similar studies. The volunteers were generally of a high socio-economic status.

APPLICABILITY OF THE STUDY

It follows from the limitations of this study that the applicability of the findings in this study are limited to non-specific LBP sufferers who have had pain and disability persisting for three months or more. The findings do not apply to any post-surgery patients, pregnant patients or any patients who have inflammatory diseases or any neurological symptoms, but can be generalised to a wide age, sex and severity of condition range of CLBP sufferers. It is, however more applicable to a higher socio-economic population who have access to private physiotherapy and/or Pilates clinics.

Pilates instructors do not have a common board with whom they have to be registered. This has resulted in many different methods of instruction and various levels and expertise of instruction. In the case of this study, the Pilates instructor was an experienced physiotherapist and certified “STOTT” Pilates instructor. The expertise and knowledge of the instructor were likely to be more comprehensive than other instructors who are not physiotherapy trained, but the instructor did follow normal procedure in instructing the specific Pilates method. The possibility that the quality and specific method of teaching may have affected these results cannot be ignored. The applicability of this study to other methods of Pilates is therefore unknown.

RELEVANCE OF THE STUDY

The prevalence of LBP, and the financial implications of the often, prolonged treatment and cost of sick days have created a need for more cost effective treatment for CLBP. In South Africa, where the focus of health care seems to be in the primary health care setting, this study shows the benefit that Pilates in the form of group classes may have in reaching the large number of patients who may not normally have access to any type of management of LBP. Classes would be more financially viable and could also be run in the occupational or community setting, where the focus may also be turned to prevention of initial and further injuries.

The study has also revealed the value of the VAS and Roland Morris Disability Questionnaire in self-assessment of CLBP. Many patients seemed to find the process of completing the questionnaires useful in assessing their progress and formulating treatment goals. The questionnaires were quick and easy to administer and could easily be used in clinical practice.

RECOMMENDATIONS FOR FUTURE STUDIES

The results of this pilot study suggest that it would be worthwhile conducting further research into this method of treatment for CLBP. The following recommendations can be made for future studies:

- A RCT could be conducted comparing the Pilates method of exercise for the reduction of CLBP with other forms of exercise and a control.
- Future studies should attempt to record the frequency of other treatment modalities and drugs used during the study period. These factors could also be controlled.
- A quality of life assessment could be included into a further study on the effectiveness of Pilates as a treatment for CLBP. A questionnaire such as the SF- 36 questionnaire could be used.
- The McGill Pain Questionnaire could also be used in place of the VAS as it is a more comprehensive analysis of pain.

- Translation of questionnaires would enable the sample to be extended to include people of other official South African languages.
- The age range, baseline activity levels and diagnoses could be made more specific in future studies to create a more homogenous group.
- A future study could also be conducted in a community or occupational setting.
- The Pilates intervention could be extended to six months and a long-term follow-up could be included in a future study.

CHAPTER 6

CONCLUSION:

A group of 32 patients suffering from CLBP participated in a randomised control trial where their levels of pain and functional disability were measured over a twelve week period. During this period the patients in the Pilates group showed significant changes in VAS and Roland Morris scores when compared to the control group.

The following conclusions can be drawn from this study:

- A Pilates intervention of twelve weeks appears to be effective in reducing pain in CLBP sufferers and more effective than physiotherapy treatment alone.
- A Pilates intervention of twelve weeks appears to be effective in improving function in CLBP sufferers and more effective than physiotherapy treatment alone.
- It appears that it would be worthwhile conducting further research into this area of exercise therapy for sufferers of CLBP.

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APPENDICES

APPENDIX 1

Visual Analogue Scale for pain

Please mark on the following line with a clear “X” the intensity of your low back pain at present. Note that **0** is no pain at all, and **10** the most severe pain.

0 **10**

APPENDIX 2 ROLAND MORRIS DISABILITY QUESTIONNAIRE

When your back is sore you may find it difficult to do some of the things you normally do. This list contains some of the sentences that people have used to describe themselves when they have back pain. When you read them you may find some stand out because they describe you today. As you read the list think of yourself today. When you read a sentence that describes you today, put a tick against it. If the sentence does not describe you then leave the space blank and go to the next one. Remember only tick the one that describes you today.

- I stay at home most of the time because of my back.
- I change position frequently to try and get my back comfortable.
- I walk more slowly than usual because of my back.
- Because of my back I am not doing any of the jobs I usually do around the house.
- Because of my back I use a handrail to go upstairs.
- Because of my back I lie down to rest more often.
- Because of my back I have to hold on to something to get out of an easy chair.
- Because of my back I try to get other people to do things for me.
- I get dressed more slowly than usual because of my back.
- I only stand for short times because of my back.
- Because of my back, I try not to bend or kneel down.
- I find it difficult to get out of a chair because of my back.
- My back is painful almost all of the time.
- I find it difficult to turn over in bed because of my back.
- My appetite is not very good because of my back.
- I have trouble putting on my socks or stockings because of the pain in my back.
- I only walk for short distances because of my back.
- I sleep less well because of my back.
- Because of my back pain, I get dressed with help from someone else.
- I sit down for most of the day because of my back.
- I avoid heavy jobs around the house because of my back.
- Because of my back pain, I am more irritable and bad-tempered with people than usual.
- Because of my back, I go upstairs more slowly than usual.
- I stay in bed most of the time because of my back.

APPENDIX 3

Warm up								
Breathing								
Imprint and release								
Hip release								
Spinal rotation								
Cat stretch								
Hip rolls								
Scapula isolation								
Arm circles								
Head nods								
Elevation and depression								
Exercises								
Ab prep								
Breast stroke preps								
Shell stretch								
Hundred								
Half roll back								
Roll up								
One leg circle								
Spine twist								
Rolling like a ball								
Single leg stretch								
Obliques								
Slow double leg stretch								
Double leg stretch								
Scissors								
Shoulder bridge								
Roll over								
One leg kick								
Breast stroke								
Shell stretch								

APPENDIX 3 (continued)

Shell stretch								
Saw								
Open leg rocker								
Neck pull								
Obliques roll back								
Jack knife								
Side kick								
Side leg lift series								
Scissors in air								
Bicycle in air								
Double leg kick								
Spine stretch forward								
Teaser series								
Swan dive								
Swimming								
Shell stretch								
Leg pull front								
Leg pull								
Hip twist								
Control balance								
Corkscrew								
Side kick kneeling								
Side bend								
Twist								
Rocking								
Boomerang								
Push up								

APPENDIX 4

<u>Information Sheet for research study</u>

Good day.

You are invited to participate in the following study

Please read the following leaflet carefully.

This research project will form part of a Masters of Science degree in Physiotherapy for which the researcher Leanne Mac Intyre (BSc. Hons. Physiotherapy) is currently registered at the University of the Witwatersrand, Johannesburg.

<u>Research Title: The effect of a Pilates on patients' chronic low back pain. A Pilot study.</u>

<u>Aim of the research:</u> To measure the effectiveness of a Pilates programme in reducing pain and improving functional disability in patients suffering from chronic low back pain.

All patients who present to Joanne Enslin-De Wet and Associates Physiotherapy suffering from chronic low back pain and fulfilling certain criteria will be approached by their physiotherapist to be part of the study. Patients will be given the opportunity to ask the researcher any questions regarding the study and those who decide to volunteer for the study will be asked to sign an informed consent form. Participants will then be randomly allocated to one of two groups. Patients will be requested not to communicate which group they are in to the researcher. Both groups will be asked to complete 2 questionnaires that should take you no longer than 5 minutes to complete. These will be handed in and analysed. One group will be required to attend a Pilates class once a week for 3 months at no cost. They will also be required to perform a 10-minute home exercise Pilates routine three times per week. A qualified Pilates instructor will guide the group through the 3 months. Your attendance at the classes will be encouraged. The second group will not receive any Pilates training. Both groups may continue with standardised physiotherapy treatments, as they feel necessary. The physiotherapist concerned will accurately document these. After 3 weeks and following the 3-month period you will be requested to complete the same 2 questionnaires for analysis.

Those participants who undergo the Pilates intervention may find that their symptoms of chronic low back pain are aggravated while others may find that they improve, and do so to varying degrees. However participants may, according to specific spinal conditions, experience discomfort while performing certain exercises. This should be reported to the instructor immediately so that appropriate modifications may be made to the exercise to alleviate this discomfort. If the discomfort persists they may be advised to withdraw from the study and/or may be further advised to continue with physiotherapy or other medical treatment.

It is important to understand that any information that you supply will be handled confidentially. Your name will not be revealed in any part of this study. You are free to withdraw from the study at any time and you will not be required to give reasons for your withdrawal. There will be no prejudice held against you if you decide to discontinue and you may continue with physiotherapy treatment as usual or resume Pilates sessions at the practice as you wish.

If you require further information about the study or the process, it will gladly be supplied to you. My contact details follow:

Leanne Mac Intyre

Tel: 011 706-9159/60

Fax: 011 706-7259

E-mail: Philip.redshaw@kpmg.co.za

Many thanks

Leanne

APPENDIX 5

<u>Consent Form</u>

<u>For the study:</u>

The effect of Pilates on patients' chronic low back pain. A Pilot study.

I……………………………………….. give consent to participate in the above study. I have read the information sheet and understand the role and responsibilities that I have undertaken, and am clear about the protocol that will be followed. I have been given the opportunity to ask further questions and have them answered.

I reserve the right to withdraw from the study at any time, without providing any reasons. I understand that there will be no prejudice against me for doing so, and that I may continue with physiotherapy treatment or Pilates at the practice as I wish.

I also understand that some spinal conditions may be aggravated by certain Pilates exercises. If I feel any discomfort during the session I will report it to the instructor immediately so that appropriate modifications to the exercise may be made. If this discomfort persists I may be advised to withdraw from the study and seek more physiotherapy or other medical treatment.

All information I give is confidential and all questionnaires will be completed anonymously. I realise that the research may be published, but at no time during the study or publication will my name be revealed.

Signature:

Date:

APPENDIX 6