Ergonomics SA, 2014, 26 (2)
ISSN Number: 1010-2728

The incidence of chronic low back pain on employment status in working adults in South Africa

JH Billson *PE Krüger**

Dept Biokinetics, Sport & Leisure Sciences
University of Pretoria
Pretoria
0002

amenhotep@mweb.co.za ernst.kruger@up.ac.za

* Corresponding author

Abstract

Low back pain has become one of the most influential musculoskeletal disorders of modern society. Exercise has been shown to be very effective in the treatment of chronic low back pain. The goal of the study was to test the effect of two exercise intervention programmes (conservative or progressive-aggressive programmes) for 12 weeks on low back muscle strength as well as psychological factors in participants with chronic low back pain. In total 32 participants were recruited for the study and randomly assigned to two exercise groups. However, due to medical and work related reasons a number of subjects dropped out. At the end there were 10 subjects in the conservative exercise group and 11 in the progressive-aggressive group. Statistically significant differences at the 5% level of significance were found at the post-test measurements between the two groups. The results from the present study indicate that both types of programmes have shown to be very effective in the treatment of chronic low back pain, but that an aggressive-progressive exercise programme may be slightly more effective than a more conservative exercises programme.

Keywords: Disability, chronic low back pain, absenteeism, working status

1 Introduction

Chronic pain often persists long after the tissue trauma that triggered a painful response has healed and may be present in the absence of any recognized ongoing tissue damage (Holdcroft and Jagger, 2005). It has thus been recognized as a dysfunctional response. Chronic pain has always been classified having lasted for more than six months, but in recent times, an attempt has been made to define chronic pain by its characteristics rather than its duration (Schaible & Richter, 2004). Meyer (2007) provides an accepted definition of chronic pain as stated by the International Association for the Study of Pain (IASP): "*...pain that persists for longer than the time expected for healing, or pain associated with progressive, non-malignant disease, usually taken to be three months*". This response mostly does not warn the individual of underlying disease or injury that will trigger an aversion response, and has thus accordingly been widely acknowledged as a disease in its own right (Meyer, 2007; Niv and Devor, 2007). Burton (2005) reported that in most cases, pathology cannot be directly linked to pain and the tendency then is to make either a diagnosis that is descriptive of symptoms or a diagnosis of nonspecific low back pain (Deyo, 1994). This painful response can then cause secondary consequences, such as disability and high financial cost, which are more problematic than the pain itself (Staal *et al.*, 2005). For example, in South Africa around R1.2 billion is spent each year on back related problems (SAPA, 2009).

Physical deconditioning plays a large part in the development of chronic low back pain. Leboeuf-Yde (2004) reported that a sedentary lifestyle is probably one of the most causative factors for low back pain, as lack of physical activity can lead to reduced muscle strength and flexibility, as well as having an undesirable effect on proprioception. All of these factors can contribute to a maladapted and weakened spine, and therefore more prone to injuries (Leboeuf-Yde, 2004). Empirical research has demonstrated that physiological changes such as muscle dysfunction occur in the lumbar spine in conjunction with an initial episode of pain. These changes remain after the pain episode has subsided (Hides *et al.*, 1996). Individuals with low back pain often have declining muscle strength and endurance, along with greater atrophy of the back muscles.

Western societies tend to be more influenced by worker absenteeism and disability, which results in the largest amount of related economic costs (Andersson, 1999). Burton (2005) reported that the greatest number of people with back pain episodes usually return to work in due time (Phelps *et al.,* 2004), but recurrent and chronic low back pain are considered to be responsible for a large portion of the total number of work absenteeism. Burton (2005) reported that days lost from work due to back pain is for a short period of time and return to work in less than 7 days is very likely. The other 15% accounts for days missed and absences from work lasting longer than 30 days duration. This has important economic implications, in that patients who are absent from work for more than six months have a 50% chance of returning to work. This number becomes lower the longer the person is away from work. There is a 25% chance of returning to work following absence for more than one year, and absence for longer than two years infers less than 5% chance of returning to work (Bergquist-Ullman and Larsson, 1977).

An important recommendation suggests that patients should resume normal daily activities as soon as possible and the patients should also be assured of the safety and necessity of it (Waddell, 1996). It has further been recommended that treatment should not focus primarily on pain, but rather on the consequences of pain, such as a loss of function, physical inactivity and being absent from work (Staal *et al.*, 2005). These goals are considered more important during the course of treatment, rather than pain itself, and that the reduction of pain should not be seen as the primary goal of treatment. Secondary goals should be actively pursued, even if a drastic reduction in pain does not occur initially (Sullivan, 2004). Furthermore, it has been reported that complete relief from pain is not necessary to return to work after a bout of sick leave due to low back pain (Van Tulder *et al.*, 2000), since there seems to be no additional risk to aggravate low back problems when normal daily activities are resumed (Staal *et al.*, 2005). Those who resume normal activities tend to show less work absenteeism (Hagen *et al.*, 2000).

Several guidelines recommend that exercise therapy for chronic low back pain is very effective (Van der Velde and Mierau, 2000; Hayden *et al.*, 2005; Friedrich *et al.*, 2005; Krismer & Van Tulder, 2007; Abdulrahman *et al.*, 2010). It is also mentioned that one mode of exercise is not necessarily better than another one. For example, it hasn't been established that resistance exercise is better than aerobic exercise (Van Tulder *et al.,* 2000). The authors mention that more research is needed to establish what type of exercise and what intensity, frequency and duration is needed to be effective. Chronic low back pain seems to share a close relationship with impaired trunk muscle function (Shirado *et al.*, 1995). Full-time workers with recurrent low back pain and associated disability have shown a reduction in short-term and long-term disability as well as a reduction in short-term pain with remedial exercise programmes (Rasmussen-Barr *et al.*, 2009; Oesch *et al.*, 2010). Rainville *et al.* (2000) reported that exercise can have a multitude of beneficial effects. An altering of pain attitudes and beliefs as well as an improvement of pain intensity and disability through a desensitization of fear are possible psychological benefits. Therapeutic benefit includes the improvement of physical function. The prevention of work related fatigue and muscle pain are important factors that need to be prevented and this can be achieved by sufficient levels of muscle strength and good physical capacity (Oldervoll *et al.*, 2001). Cognitive intervention and exercise seem to help patients overcome their psychological barriers to pain and be more physically active (Keller *et al.*, 2003), as well as having a positive effect on patients' ability to cope with pain (Arnold, 2008). This follows the principles of the much recommended bio-psycho-social approach, which views pain as a dynamic interaction between physical, psychological and social factors. More realistic treatment goals for patients include: (a) the reduction, rather than elimination, of pain; (b) improvement in physical and social function, such as increased range of motion; (c) standing and walking; (d) improvement of vocational/disability status such as return to work and commencement of job training; (e) improvement of general functional status such as increased activities of daily living; (f) social recreational activities and domestic activities; (g) improvement in mood and associated symptoms such as sleeping patterns; (h) increased self-management of pain; (i) development of active coping style and self-management skills; (j) reduction or elimination of opiate and sedative-hypnotic medications; (k) reduction in utilization of medical services; and (l) finally, addressing misunderstandings about the meaning of pain and associated anxieties towards pain (Simmonds & Dreisinger, 2003; Sanders *et al.*, 2005).

The purpose of the study was therefore to investigate the effect of two structured, separate (one conservative and one progressive-aggressive) exercise intervention programmes on disability due to chronic low back pain.

2 Methodology

2.1 Participants

Thirty-two subjects (n=32) between the ages of 20 and 55 years voluntarily participated in the study. Advertisements were placed in the local newspaper as well as on local radio. Some subjects were also referred by medical doctors. All subjects consulted a medical doctor within the last two years which confirmed their back pain status. A medical specialist screened all participants before participation to confirm their back problems. Male and female subjects were used and no distinction between and women was made, as this falls outside of the scope of study, although it is recognized that there could be a substantial difference between men and women. All subjects were full-time employed. All subjects were fluent in English. Back pain had to be present for longer than 12 weeks and subjects were excluded who had previous spinal surgery, discogenic disease and subjects who suffer from neurological symptoms. Current pregnancies as well as disability claims were also excluded. Subjects were given an informed consent form to sign that explained all of the procedures involved. The study was approved by the Ethics Committees of the Faculty of Humanities at the University of Pretoria.

2.2 Methods and materials

Pain and disability were used as dependent variables and were measured by means of specific questionnaires. The selected questionnaires have been used extensively in low back pain and physical therapy studies, because they are valid, reliable, repeatable, sensitive to change and correlate well with other instruments (Linton *et al.*, 2005; Heymans *et al.*, 2006; Kääpä *et al.*, 2006; Goldby *et al.*, 2006). The specific instruments were explained to the subjects in the informed consent form. These tests were:

2.2.1 Visual Analogue Scale (VAS) for Pain

The VAS consists of a single 100 mm line across the surface of a page. On the left side of the line no pain is indicated, while maximal amount of pain is indicated on the right hand side of the line. Subjects indicated how they would rate their own pain by pointing to the scale (Ostelo and De Vet, 2005). A score is presented out of a 100. The VAS is a subjective measurement of the intensity of low back pain (Kankaanpää *et al.*, 2005). The VAS pain scale has a high test-retest reliability of $r>0.95$, has high criterion related validity with established pain measuring instruments and is well suited to measure pain intensity (Wewers & Lowe, 1990).

2.2.2 Oswestry Disability Index (ODI)

The Oswestry disability index is used to assess subjects with low back pain to determine its impact on the activities of daily living (Fairbank and Davies, 1980). This instrument is a self-administrated questionnaire and one of the most commonly recommended condition-specific outcome measures for spinal disorders, which are not life threatening (Carreon *et al.*, 2008; Mehra *et al.*, 2008). The ODI is also used to measure condition-specific outcomes, and it includes 10 sections of low back pain induced disability in daily functions and leisure time activity. It also assesses limitations in activities of daily living (Fairbank and Davies, 1980; Ostelo and De Vet, 2005; Mehra *et al.*, 2008). Each section is scored on a 0-5 scale, with 5 representing the greatest disability and 0 representing no disability (Ostelo and De Vet, 2005; Mehra *et al.*, 2008). The Oswestry Disability Index has been found to be reliable, valid and sensitive to change (Fisher & Johnston, 1997).

2.2.3 Functional rating index (FRI)

The functional rating index is an instrument purposely designed to quantitatively measure the subjective perception of function and pain of the spinal musculoskeletal system in a clinical setting. It was developed to provide an assessment instrument that has clinical value and quantifies the patient’s current state of pain and dysfunction. The FRI contains 10 items that assess both pain and function of the spine. Of these 10 items, 8 refer to activities of daily living and 2 refer to two different attributes of pain. The use of both pain and the loss of function in spinal conditions are better to use in combination, since many spinal conditions contain a combination of the two factors. By using a 5-point scale for each item, the patient ranks his/her perceived ability to perform a specific task and/or the quantity of pain at the present time ("right now, at this very moment") by selecting one of the five response points that are anchored by polarized statements (0 = no pain or full ability to function; 4 = worst possible pain and/or unable to perform this function at all). For scoring purposes, the 10 items of the FRI were totalled according to the responses given, divided by the total possible points available and then multiplied by 100 to produce a percentage value. The range of possible scores is zero percent (no disability) to 100 percent (severe disability). The higher the score, the higher the perceived pain and dysfunction (Feise and Menke 2001).

The questionnaires were completed pre- and post-test by both groups.

2.2.4 Exercise Programmes

The intervention used in this study consisted of two separate exercise programmes. The first was the control group. This group participated in an exercise protocol that was considered to be conservative. The subjects completed the programme twice per week lasting for approximately 35-40 minutes. The exercises remained unchanged throughout the 12-week intervention timeframe. The experimental protocol was considered more aggressive in terms of the exercises performed as well as the intensity of the protocol. The intensity was increased every four weeks. Sessions were also completed twice per week lasting for approximately 45-60 minutes. Stretching and gymnasium-based exercises were performed on the resistance exercise equipment for functional muscle groups of the upper back, hips, arms and legs. Every exercise session was recorded and participants had to complete the intervention in 12 to 16 weeks, a total of 24 sessions. All sessions were supervised by the principle investigator who is a qualified rehabilitation specialist (Biokineticist). As duration formed part of the intensity of the intervention, this differed between groups. All participants performed exactly the same exercise programme. Participants were requested to not perform any other types of exercise as it could interfere with the rehabilitation exercises. Both groups received an information booklet to read before the start of the programme.

2.2.4.1 Control Group (Conservative Exercise Programme)

Resting time between sets was 20 seconds.

Exercise	Sets	Reps
Cycling: This was performed on a recumbent cycle, model Vision Fitness R2150. Subjects cycled for five minutes at Level 2 (43-55 watt) at an RPM (revolutions per minute) of 60-70.	5 min.	
Both Knees to Chest Stretch: Performed with the subject in supine position. Subject started by pulling both knees up towards the chest, lifted to the position of mild discomfort, held for 12 seconds	2	12 sec.
Hamstring Stretch: Performed with subject in supine position. The subject lifted up one leg, placed hands at the back of the knee, pulling the leg up with knee slightly bent, stretching the hamstring. The leg was lifted to a position of mild discomfort. The opposite leg was placed flat on the ground. The position was held for 12 seconds.	2 sets each leg	12 sec.
Piriformis Stretch: Performed with subject in supine position. Ankle of leg was placed on knee of opposite leg, hands behind the knee. The knee was pulled towards the chest. Held position for 12 seconds.	2 sets each leg	12 sec.
Roll Both Knees to Side: Performed with subject in supine position. Arms were placed outstretched to assist with stability. Knees were bent and placed together. Both feet were lifted off the ground about 10 cm. Knees were then kept together and rolled from side to side, slowly and with control, to the point of comfort.	2	10 to each side
Sit on Stability Ball: Performed with subject sitting on a 75 cm stability ball. Hands were placed on hips. Subjects were then asked to lift one leg at a time about 5 cm off the ground, balance in the position for a couple of seconds and repeat with the other leg. Subject had to keep upright without counterbalancing due to altered stability position.	3	30 sec.
Alternate Superman on All-fours: Subject started in the all-fours position with the hands under the shoulders and the knees under the hips. The opposite arm and leg were raised simultaneously and only up to horizontal level. The position was then held for 5 seconds. Arm and leg then returned to starting position and the other opposites were raised and held. Subject maintained neutral spine.	2	4 each side
Hip Lifts (Feet Flat on Floor): Subject started in the supine position with knees bent and feet flat on the floor. The arms were kept next to the sides. The hips were then lifted until they were fully extended. The position was held for 5 seconds. The hips were lowered and the exercise repeated.	2	10
Prone Alternate Leg Lifts: Subject started in the prone position with a pillow under the abdomen to help maintain neutral spine. One leg was lifted until the foot was about 10 cm off the ground with the leg kept straight. The position was held for 5 seconds. The leg was lowered and exercise repeated with the other leg.	2	6 each leg
Prone Alternate Arm and Leg Lifts: Subject started in the prone position with a pillow under the abdomen to help maintain neutral spine. The opposite arm and leg were lifted simultaneously approximately 10 cm off the ground. Both the arm and the leg had to be kept straight. The position was held for 5 seconds. The arm and the leg were lowered and repeated on the other side.	2	6 each side

2.2.4.2 Experimental Group (Progressive-Aggressive Programme)

The exercises performed in this group were changed every four weeks. The programme was made more difficult by including more exercise in number and difficulty.

ISSN Number: 1010-2728

Programme 1:

This programme was performed from the start of the testing period to the end of Week 4.

Exercise	Sets	Reps
Cycling: This was performed on a recumbent cycle, model Vision Fitness R2150. Subjects cycled for 5 minutes at Level 2 (43-55 watt) at a RPM (revolutions per minute) of 60-70.	5min	
Hamstring Stretch with Foot Flexion: Performed with subject in supine position. Lifted up one leg, placed hands at the back of the knee, pulled leg up with knee slightly bent until the hamstring was stretched. Subject then performed 20 plantar/ dorsiflexion step-off movements with the foot. Opposite leg was placed flat on the floor.	3 each leg	20
Side Lying Quadricep Stretch: Subject lay on her side. The top leg was bent and the foot grasped with the hand. The heel of the foot was pulled towards the buttocks to stretch the quadricep muscle. Position was held for 12 seconds.	3 each leg	12 sec.
Lat Pulldown to the Front: Subject was seated in a standard lat pulldown machine. The bar was grasped with both hands slightly wider than shoulder width. The bar was pulled down towards the chest and in front of the face. This enhanced the role of several spinal extensors, particularly the latissimus dorsi (McGill, 2002). Weight selection: men = 3 plates (12 kg); women = 2 plates (7 kg).	3	15
Side Bridging (on Knees): Subject lay on her side with the knees bent 90°, supported on the elbow and hip. The free hand was placed on the hip. The torso was then straightened until the body was supported on the elbow and the knee. Held position for 15 seconds.	3 each side	15 sec.
High Cable Horizontal Adduction (Downwards): Subject stood in a cable pulley machine and gripped the handle with one hand in an extended abducted position. The arm was kept straight throughout the movement. The arm was then adducted towards the midline of the body and in line with the navel, and then slowly released back to the starting position. Torsion forces had to be resisted by keeping the body straight.	3 each arm	15
Hip Lifts with Feet on Bench: Subject started in the supine position with the feet on a 46 cm bench in a 90° angle with the arms next to the sides. The hips were raised off the floor until the hips were in full extension. The hips were then slowly lowered and the exercise was repeated.	3	15
Alt Superman on Stability Ball: Subject started in a prone position with a 75 cm stability ball under the abdomen, with hands and feet placed on the ground. The alternative arm and leg were raised until horizontal. The position was held for 5 seconds. Both limbs were slowly lowered until on the ground again. The other pair of opposites was then raised. This had to be done while maintaining balance on the ball.	3	6 each side (12 total)
Abdominal Crunches (Feet on Bench): Subject started in the supine position with the feet on a 46 cm bench at a 90° angle with the hands behind the head. Eyes had to be kept on the ceiling throughout the entire exercise. The shoulder blades were then raised off the floor, with hands supporting the head and neck. The body was then lowered and the movement repeated.	3	20

Programme 2:
Exercises from the first programme progressed to increased difficulty level. Programme 2 was performed from Week 4 to Week 8.

Exercise	Sets	Reps
Cycling: Intensity was increased as follows: Level was increased to 3 (65-75 watt) and the RPM was increased to 65-75.	5 min.	
Hamstring Stretch with Step-off: Subject started in the supine position. Leg was held up with rope or towel, stretched for 12 seconds. The subject performed 12 plantar/dorsiflexion step-offs with leg in extended position. After the 12 step-offs the leg was pulled slightly further back and held for another 12 seconds. The non-involved leg lay flat on the ground.	3 each leg	12;12; 12
Side Lying Quadriceps Stretch: Stayed the same as in the first programme.	3 each leg	12 sec.
Lat Pulldown to Front: Subject was seated in a standard lat pulldown machine. The bar was grasped with both hands slightly wider than shoulder width. The bar was then pulled down towards the chest and in front of the face. This enhanced the role of several spinal extensors, particularly the latissimus dorsi. The intensity of this version of the exercise was increased by adding more repetitions. Subjects now performed 25 repetitions. The weight stayed the same.	3	25
One arm DB Row: Subject stood with the same arm and same leg placed on a 46 cm bench. The other leg was placed on the floor to give a wide balance position. The other arm held a hand-weight. The weight was raised to the iliac crest with the elbow raised towards the ceiling. Torsion was resisted by bracing the abdominal muscles. The weight was then lowered and the movement repeated. The upper back had to be kept straight and parallel to the floor. The following weight selection was used: men → 5 kg, women → 2 kg.	3 each side	15
Side Bridging (on Feet): Progression of this exercise entailed balancing on the feet and the elbow instead of the knees. The position was still held for 15 seconds.	3 each side	15 sec.
Low Cable Shoulder Flexion (Straight Arm): The subject faced away from a cable pulley machine and gripped a handle in one hand. The shoulder was then flexed to 45° in the sagital plane. The arm was then returned to the starting position and the movement was repeated.	3 each arm	15
Ball Squat Against Wall: Subject leaned against a wall with a 75 cm stability ball placed in the lower back. Feet were placed forward from the vertical position of the hips, slightly apart. Hands were placed on the hips. The knees were bent to simulate a squat movement. Subject squatted no lower than 45° of knee flexion. Subject then rose back up to the starting position and the movement was repeated.	3	15
Hip Lifts (Feet on Ball): This exercise was performed exactly as in the first programme, except that the feet were placed on a 75 cm stability ball and not on a bench. The subject performed 15 repetitions.	3	15
Alt Superman (Sweeping Hand on Floor Upon Return and Up Again): This exercise was performed exactly as in the first programme, except that instead of alternating the arm and leg combination, the arm and leg just swept the ground upon return and were extended again. No weight was placed back onto that side. One arm and leg combination first finished its repetitions; then the other side was used.	3	6 each side (12 in total)
Abdominal Crunches (Feet on Stability Ball): Exactly as in the first programme, except that the feet were placed on a 75 cm stability ball. The repetitions were also increased to 25 per set.	3	25

Programme 3

This programme was designed to be the most challenging programme and was performed from Week 8 to the end of the programme at Week 12.

Exercise	Sets	Reps
Cycling: This exercise was progressed by increasing the level to Level 4 (75-94 watt) and the RPM to 70-80.	5 min.	
Piriformis Stretch: Performed with subject in supine position. Ankle of leg was placed on knee of opposite leg, hands placed behind knee. The knee was pulled towards the chest. The exercise was held for 30 seconds.	2	30 sec.
Rotation Stretch: Subject started in the supine position. One leg was bent and placed over the knee of the other leg. The opposite hand in relation to the bent leg was placed on the knee. The bent leg was pulled over to the side to stretch the buttocks. Shoulders had to be kept down on the ground. Position was held for 30 seconds.	2	30 sec.
Side Lying Quadriceps Stretch: This exercise was performed exactly as in the previous programmes; only it was now held for 30 seconds and not 12 seconds.	2	30 sec.
Lat Pulldown to Front: This exercise was performed exactly as in the previous programmes. Intensity was increased by means of adding more weight. One plate was added. Men now exercised with 4 plates (15 kg) and women with 3 plates (12 kg). Repetitions were again 15.	3	15
High Cable Pulldown to Opposite Hip with Both Arms: The subject stood in cable pulley machine and gripped the handle with both hands. The hands were then pulled across the body towards the opposite hip. Controlled torsion forces were encouraged to teach the subject control in the torsional plane.	3 each side	15
Seated Cable Row: Subject was seated in a standard cable row pulley machine. A V-handle was used. Subject sat upright with feet on the support plates and slightly bent at the knees. The back had to be kept upright during the movement, no flexion or extension was allowed at the hips. The handle was then pulled towards the navel while keeping upright. It was then slowly lowered and the movement was repeated. Men used 2 plates (10 kg) and women used 1 plate (5 kg).	3	15
Ball Squat Against Wall (With Weight): This exercise was performed exactly as in the previous programme, except that the subject held onto a set of hand-weights. Men used 3 kg dumb bells and women used 1.5 kg dumb bells.	3	15
Side Bridging (on Feet, Lifted Side): The starting position was exactly the same as for the previous version of this exercise but was no longer a holding exercise. Instead, the hips were raised in an up and down motion. The subject was instructed to raise the hips towards the ceiling, while keeping the hips extended.	3 each side	12
Hip Lifts With One Leg at a Time (Feet on Bench): The starting position for this exercise is the same as in the previous versions. Intensity is increased by performing the exercise in the same way as previously, but only with one leg at a time. This also increased the volume of the exercise by ensuring that double the amount of sets were completed.	3 each leg	10
Alt Superman: The starting position for this exercise was exactly the same as for the other versions. Intensity was increased in the following manner: The arm and leg were held at end range of motion. The subject performed 5 flexion/extension movements with the hand and foot, while the arm and leg were held at the end range of motion.	3	6 each side (12 in total)
Abdominal Crunches (Lying on Ball): This exercise was performed with the same technique as for the other versions in that the hands supported the head and the eyes looked up at the ceiling. Intensity was increased by having the subject lie on a 75 cm stability ball that required more effort to maintain balance. More repetitions were performed. Subjects performed 30 repetitions instead of 25.	3	30

2.2.5 Statistical Analysis

Descriptive statistics were used for the minimum and maximum scores, mean scores and standard deviations. Statistics were measured by means of the Mann-Whitney test and the Wilcoxon signed-rank test (Babbie, 1992). Statistical analysis showed that there was no significant difference in experienced pain levels at the pre-test between groups.

Table 1. Descriptive Statistics per Group on Pre-test Measurements

Group		n	Minimum	Maximum	Mean	Std Dev
Experimental	Age	18	18	57	33.00	10.35
	Weight (kg)	18	50	131	85.56	26.99
	Height (cm)	18	155	195	175.17	12.90
	BMI (kg/m^2)	18	19	36	27.17	5.97
	Hrs worked / day	18	5	15	10.19	2.57
	Time spent driving (min)	18	0.4	1800.0	169.19	494.97
	Valid N (listwise)	18				
Control	Age	14	22	56	37.43	11.02
	Weight (kg)	14	59	106	79.11	14.37
	Height (cm)	14	152	190	170.57	10.76
	BMI (kg/m^2)	14	20	36	27.14	3.94
	Hrs worked / day	14	3	16	9.07	2.79
	Time spent driving (min)	14	0.0	1800.0	129.76	480.73
	Valid N (listwise)	14				

A statistically significant difference was found at the 5% level of significance between the experimental and control groups for pre-test transport/driving time (Table 1). The transport/driving time for the experimental group was significantly higher than that of the control group. No statistically significant differences were found between the pre-test of the experimental and control groups for any of the other measurements.

The bigger difference in driving time could be explained by the fact that one respondent in the experimental group worked very far from home, while some of the respondents in the control group worked from home; thus increasing the difference between the two groups.

3 Results

There were significant improvements for the VAS, Oswestry disability index (ODI) as well as for the Functional rating index (FRI) in the control group (Table 2). Lower mean scores indicates an improvement in these values. The goal of the VAS pain scale is to get the scores as close as possible to 10 (Wewers & Lowe, 1990).

Table 2. Results of the pre-test and post-test in the control group

		Mean	Standard deviation	Asym. Sig (2-Tailed)
VAS	Pre-test	52.57	19.35	0.005
	Post-test	13.40	11.46	
ODI	Pre-test	20.07	7.73	0.008
	Post-test	11.00	6.20	
FRI	Pre-test	32.29	7.56	0.005
	Post-test	13.80	6.23	

Table 3. Results of the pre-test and post-test in the experimental group

		Mean	Standard deviation	Asym. Sig (2-Tailed)
VAS	Pre-test	54.44	18.23	0.004
	Post-test	17.00	18.75	
ODI	Pre-test	23.72	8.57	0.006
	Post-test	8.00	8.00	
FRI	Pre-test	34.61	13.23	0.003
	Post-test	10.64	8.69	

There were significant improvements for the VAS, Oswestry disability index (ODI) as well as for the Functional rating index (FRI) in the experimental group (Table 3). This shows that the experimental group can also achieve significant improvements from baseline to outcome.

Table 4. Post-test results between both groups (CT = Control group; Exp = Experimental group)

	Mean		Standard deviation		Asym. Sig (2-Tailed)
	CT	Exp	CT	Exp	
VAS	13.40	17.00	11.46	18.75	0.944
ODI	11.00	8.00	6.20	8.00	0.305
FRI	13.80	10.64	6.23	8.69	0.415

There were no significant differences between the control (CT) and experimental (Exp) groups for any of the values at the post-test. For VAS pain levels, the control group performed better, but this difference was not significant (Table 4). Likewise, for the ODI and FRI scores, the mean scores for the experimental groups were better than the control groups, but not significantly. It has to be noted that a lower score with these tests indicates an improvement.

4 Discussion

Of the 32 subjects that started the study, 11 fell away for different reasons. All of the 21 subjects that completed the study were fully employed at the time of the study. All of the subjects reported being affected by their back pain but were still able to work full-time despite their discomfort. The mean score for the Oswestry Disability Index in the experimental group was only at pre-test 23.72 and 20.07 for the control group. This is classified as being only 'moderate disability' (Fairbank & Davies, 1980; Fairbank & Painsent, 2000). Individuals can still function and perform daily tasks, but are affected by pain. At post-test both groups improved significantly on the Oswestry disability index to score only 'minimal disability'. Pain levels according to the VAS score also improved significantly. This would suggest that disability decreased as pain decreased, inferring improved quality of life.

It has been suggested that pain levels should not be the determining factor when treating low back pain, but rather the focus should be on functional status (Sullivan, 2004; Staal *et al.*, 2005). However, pain levels for the subjects are of primary concern, as this was the main reason for them to seek treatment for their low back pain. The subjects reported in open-ended questionnaires at the post-test that they feel that their functional status will improve if their pain levels decrease and that they feel that they could then partake in more activities of daily living (ADL) as well as recreational activities. Further research is needed to determine if there will be a reduction in disability levels even if pain levels do not decrease accordingly following a functional strengthening programme, especially in a South African working environment. Thus, the question remains as to whether an increased level of strength in muscles weakened by low back pain will in fact affect functional status negatively.

The research project has demonstrated that a more progressive-aggressive exercise programme can be as effective, or even better, than more traditional conservative exercise programmes, as those described by Richardson *et al.* (1999) and Hides *et al.* (2001). There is a definite need for the further investigation of these types of programmes. As stated by McGill (2002), in order to attempt to restore functional capacity and provide tissue with enough strength to sustain loads applied to the body, it is necessary to include aggressive types of exercises not only to strengthen the muscles of the lower back, but also to strengthen the muscles used for functional tasks in a safe and effective way (McGill, 2002). In order to fully restore functional capacity and provide tissue with enough strength to sustain loads applied to the body, it might be necessary to include more aggressive types of exercises to not only strengthen the muscles of the low back, but also to strengthen the muscles used for functional tasks in a safe and effective way (McGill, 2002). The important part will be to select exercises that are safe, yet effective.

As seen in Table 1 and 2, both types of exercise programmes showed significant improvement ($p<0.05$) when they were compared with their own control groups. Both pain and self-reported disability improved significantly. This suggests that either programme can be effective for chronic low back pain. The implication of this for employers can be to have their employees partake in some form of remedial exercise, even if it is very basic exercises, because they will have improvement in their pain and disability levels. The challenge for future research will be to establish if more progressive-aggressive exercise programmes will be even more effective.

5 Conclusion

In conclusion, the results from the present study indicate that both types of programmes can be very effective in the treatment of chronic low back pain, but that an aggressive-progressive exercise programme may be more effective than a more conservative approach. However, the present study only used basic questionnaires to measure the efficacy of these protocols. To fully investigate the relationship between chronic low back pain, disability (including working status) and more intensive remedial exercise therapy, more detailed measures would be required.

References

Abdulrahman, M., El-Sayed, B.S., Hadley, C., Tessema, F., Tegegn, A., Cowan, J.A. and Galea, S. 2010. Back and neck pain and psychopathology in rural sub-Saharan Africa: Evidence from the Gilgel Gibe Growth and Development Study, Ethiopia. *Spine*, **35**(6): 684-689.

Andersson, G.B.J., 1999, 'Epidemiological features of chronic low back pain, *Lancet,* **354**: pp 581-585.

Arnold, L.M., 2008, Management of fibromyalgia and comorbid psychiatric disorders. *The Journal of Clinical Psychiatry,* **69**(2): 14-19.

Babbie, E., 1992, *The Practice of Social Research*, (6th Edition). California, USA: Wadsworth Publishing Company.

Bergquist-Ullman, M. and Larsson, U., 1977, 'Acute low back pain in industry: a controlled prospective study with special reference to therapy and confounding factors'. *Acta Orthopaedica Scandinavica*, **170**: 1-117.

Burton, A.K., 2005, 'How to prevent low back pain: on behalf of the COST B13 Working Group on European guidelines for prevention in low back pain, *Best Practice & Research: Clinical Rheumatology,* **19**(4): 541-555.

Carreon, L.Y., Glassman, S.D. and Howard, J., 2008, Fusion and non-surgical treatment for symptomatic lumbar degenerative disease: a systematic review of Oswestry disability index and MOS short form-36 outcomes. *The Spine Journal,* **8**: 747-755.

Deyo, R.A., 1994, 'Magnetic resonance imaging. Terrific test or tar baby?' *New England Journal of Medicine,* **331**: 115-116.

Fairbank, J.C.T. and Davies, J.B., 1980, The Oswestry low back pain disability questionnaire. *Physiotherapy,* **66**: 271-273.

Fairbank, J.C.T and Pynsent, P.B. 2000, The Oswestry Disability Index. *Spine,* **25**(22): 2940-2953.

Feise, R.J. and Menke, J.M., 2001, Functional rating index: a new valid and reliable instrument to measure the magnitude of clinical change in spinal conditions. *Spine,* **26**(1): 78-87.

Fisher, K. & Johnston, M. (1997). Validation of the Oswestry Low Back Pain Disability Questionnaire, its Sensitivity as a Measure of Change following Treatment and its Relationship with other Aspects of the Chronic Pain Experience. *Physiotherapy Theory and Practice.* 13: 67-80.

Friedrich, M., Gittler, G., Arendasy, M. and Friedrich, K.M. 2005, Long-term effect of a combined exercise and motivational program on the level of disability of patients with chronic low back pain, *Spine,* **30**(9): 995-1000.

Goldby, L.J., Moore, A.P., Doust, J. and Trew, M.E., 2006, A randomized control trail investigating the efficiency of musculoskeletal physiotherapy on chronic low back pain disorders. *Spine,* **31**(10): 1083-1093.

Hagen, E.M., Eriksen, H.R. and Ursin, H., 2000, Does Early intervention with a light mobilization program reduce long-term sick leave for LBP. *Spine,* **25**: 1973-1976.

Hayden, J.A., Van Tulder, M.W., Malmivaara, A.V. & Koes, B.W., 2005, Meta-analysis: exercise therapy for non-specific low back pain, *Annals of Internal Medicine*, **142**: 765-775.

Heymans, M.W., De Vet, H.C.W., Bongers, P.M., Knol, D.L., Koes, B.W. and Mechelen, W., 2006, The effectiveness of high-intensity versus low-intensity back schools in an occupational setting. *Spine,* **31**(10): 1075-1082.

Hides, J.A., Richardson, C.A. & Jull, G.A. (1996). Multifidus Muscle Recovery is Not Automatic after Resolution of Acute, First-Episode Low Back Pain. *Spine*. 21: 2763-2769.

Hides, J.A, Jull, G.A. & Richardson, C.A. (2001). Long-Term Effects of Specific Stabilizing Exercises for First Episode Low Back Pain. *Spine,* 26: E243-248.

Holdcroft, A. and Jagger, S., 2005, *The chronic pain patient* in *core topics in pain,* (Cambridge University Press), 117-120.

Kääpä, E.H., Frantsi, K., Sama, S. and Malmivaara, A., 2006, Multidisciplinary group rehabilitation versus individual physiotherapy for chronic non-specific low back pain: a randomized trial. *Spine,* **31**(4): 371-376.

Kankaanpää, M., Colier, W.N., Taimela, S., Anders, C., Airaksinen, O., Kokko-Aro, S.M. and Hänninen, O., 2005, Back extensor muscle oxygenation and fatigability in healthy subjects and in low back pain patients during dynamic back extension exertion. *Pathophysiology,* **12**: 267-273.

Keller, A., Brox, J.I., Gunderson, R., Holm, I., Friis, A. and Reikerås, O., 2003, Trunk muscle strength, cross-sectional area, and density in patients with chronic low back pain randomized to lumbar fusion or cognitive intervention and exercise, *Spine,* **29**(1): 3-8.

Krismer, M. and Van Tulder, M., 2007, Strategies for prevention and management of musculoskeletal conditions. Low back pain (non-specific), *Best Practice & Research. Clinical Rheumatology,* **1**: 77-91.

Leboeuf-Yde, C. (2004). Back Pain – Individual and Genetic Factors. *Journal of Electromyography and Kinesiology,* 14: 129-133.

Linton, S.J., Boersma, K., Jansson, M., Svärd, L. and Botvalde, M., 2005, The effect of cognitive behavioural and physical therapy preventive intervention on pain-related sick leave: a randomized control trail, *Clinical Journal of Pain,* **21**: 109-119.

McGill, S.M. (2002). *Low Back Disorders: Evidence-Based Prevention and Rehabilitation.* Campaign, IL: Human Kinetics.

Mehra, A., Baker, D., Disney, S. and Pynsent, P.B., 2008, Oswestry disability index scoring made easy. *Annals of the Royal College of Surgeons of England,* **90**: 497-499.

Meyer, H.P., 2007, 'Pain management in primary care – current perspectives', *South African Family Practice,* **49**(7), 20-25.

Niv, D. and Devor, M., 2007, 'Position paper of the European Federation of IASP Chapters (EFIC) on the subject of pain management', *European Journal of Pain,* **11**, 487-489.

Oldervoll, L.M., Rǿ, M., Zwart, J.A. and Svebak, S., 2001), Comparison of two physical exercise programs for the early intervention of pain in the neck, shoulder and lower back in female hospital staff. *Journal of Rehabilitation Medicine,* **33**: 156-161.

Ostelo, R.W.J.G. and De Vet, H.C.W., 2005, Clinically important outcomes in low back pain. *Best Practice & Research: Clinical Rheumatology,* **19**(4): 593-607.

Phelps, G.L., Vogel, R. and Shellenberger, S. 2004, 'Treatment and outcomes in occupational low back pain: a practice evaluation and comparison with national and international guidelines, *Journal of Agromedicine*, **7**: 67–78.

Oesch, P., Kool, J., Hagen, K.B. and Bachmann, S., 2010, Effectiveness of exercise on work disability in patients with non-acute non-specific low back pain: systematic reviews and meta-analysis of randomized controlled trails, *Journal of Rehabilitation Medicine,* **42**: 193-205.

Rainville, J., Carlson, N., Polatin, P., Gatchel, R.J. and Indahl, A., 2000, Exploration of physicians' recommendations for activities in chronic LBP. *Spine,* **25**: 2210-2217.

Rasmussen-Barr, E., Äng, B., Arvidsson, I. and Nilsson-Wikmar, L., 2009, Graded exercise for recurrent low back pain. a randomized, controlled trail with 6-, 12- and 36-month follow-ups, *Spine,* **34**(3): 221-228.

Richardson, C., Jull, G., Hodges, P. Hides, J. 1999. *Therapeutic Exercises for Spinal Segmental Stabilization in Low Back Pain*. London, UK: Churchill-Livingstone.

SAPA 2009, Counting the cost of back pain. *Pretoria News, Tuesday March 10.*

Sanders, S.H., Harden, R.N. & Vicente, P.J. 2005. Evidence-Based Clinical Practice Guidelines for Interdisciplinary Rehabilitation of Chronic Nonmalignant Pain Syndrome Patients. *Pain Practice.* 5(4): 303-315.

Schaible, H.G. & Richter, F. 2004. Pathophysiology of Pain. *Archives of Surgery,* 389: 237-243.

Staal, J.B., Rainville, J., Fritz, J., Van Mechelen, W. & Pransky, G., 2005, Physical exercise interventions to improve disability and return to work in low back pain: Current insights and opportunities for improvement, *Journal of Occupational Rehabilitation,* **15**(4): 491-505.

Shirado, O., Ito, T., Kaneda, K. and Strax, T.E., 1995, Concentric and eccentric strength of trunk muscles: influence of test postures on strength and characteristics of patients with chronic low back pain, *Archives of Physical Medicine and Rehabilitation,* **76**(7): 604-611.

Simmonds, M.J. & Dreisinger, T.E. 2003. Low Back Pain Syndrome. In: Durstine, J.L. & Moore, G.E. (2003). *ACSM's Exercise Management for Persons with Chronic Diseases and Disabilities***.** Champaign, IL: Human Kinetics.

Sullivan, M.D., 2004, *What are the goals of pain treatment?* In: Dworkin, R.H. and Breitbart, W.S., (eds.) Psychosocial Aspects of Pain: A Handbook for Health Care Providers. **(**Seattle, WA: IASP Press): 215-230.

Van Der Velde, G. and Mierau, D. 2000, The effect of exercise on percentile rank aerobic capacity, pain, and self-rated disability in patients with chronic low back pain: a retrospective chart review, *Archives of Physical Medicine and Rehabilitation,* **81**: 1457-1463.

Van Tulder, M., Malmivaara, A., Esmail, R. and Koes, B., 2000, Exercise therapy for low back pain: a systematic review within the framework of the Cochrane Collaboration back review group. *Spine,* **25**: 2784-2796.

Waddell, G., 1996, 'Low back pain: a twentieth century health care enigma', *Spine***, 21**, 2820-2825.

Wewers, D.A. & Lowe, N.K. (1990). A Critical Review of Visual Analogue Scales in the Measurement of Clinical Phenomena. *Research in Nursing & Health*. 13: 227-236.