The Effectiveness of a Multidisciplinary, Protocol-based Approach to Patients of Different Age Groups with Lower Back Pain in Bloemfontein, Gqeberha, Polokwane, and Johannesburg

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Research proposal submitted to the Faculty of Health Sciences; University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Masters in the branch of Biokinetics

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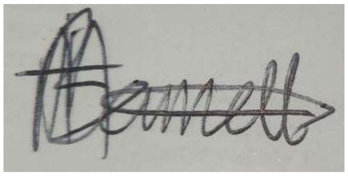
Johannesburg

2024

DECLARATION

I Matthew Bennett declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in the branch of Biokinetics at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.



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28th day of February 2024
Date

ABSTRACT

Introduction: Lower back pain is a chronic worldwide condition experienced by many individuals. In Africa specifically, it has been reported that the average lifetime prevalence of lower back pain is 36% within adolescence, and 62% within adults. Although exercise interventions exist there are many gaps in terms of efficacy across age groups; a lack of multidisciplinary approach; as well as, a lack of a reproducible standardised protocol. Furthermore, there is a lack of interventions focusing on pain scale improvements and ROM simultaneously. In the early 90's, a Documentation Based Care (DBC) multidisciplinary protocol was developed in Finland which aimed to bridge this gap by reducing low back pain, Subsequently it was adapted, and implemented in South Africa, however no information exists as to whether it has been effective in the South African context in terms of improving back pain, as well as improving ROM in individuals.

Objectives: To determine whether the current South African adaptation of the Finnish DBC lower back protocol is effective in reducing pain levels and improving range of motion over multiple age groups.

Methods: A retrospective analysis of 1499 data sets, of individuals who participated in a standardised 6-week lower back intervention, using the adapted version of the Finnish DBC lower back programme was conducted. Data was extracted from a collated database from 5 Biokinetics practices using the adapted DBC protocol. Data included: age, pre-post intervention visual analogue scale (VAS) pain scale data and lumbar thoracic ROM including flexion, extension, lateral flexion and rotation. Descriptive statistics were used for the demographic data, student T-tests were used for pre-post ROM and pain scale data. The use of Statistical version 14.0 was used for the analysis and p value of <0.05 was deemed significant.

Results:

Pain: This study found that for 91.9% of individuals participating in the intervention (n=1377), there was a reduction in lower back pain measured on the VAS pain scale, while for 5.2% (n=78) there was no change in pain, and for only 2.9% there was an increase in pain (n=44).

ROM: All age groups were found to have increase range of motion in all movements from pre-intervention to post-intervention.

Conclusion: The South African adaptation of the DBC protocol over the last 3 years has been successful in reducing pain and increasing ROM in all age group categories pre-intervention to post-intervention.

ACKNOWLEDGEMENTS

I would like to thank my loving wife for her support, wisdom, and continual encouragement, and to my family for their assistance and understanding. a big thanks to Natalia Neophytou for supervising and assisting with the writing up of this research report. Thanks to The University of the Witwatersrand and the Department of Exercise Science and Sports Medicine for their many different roles provided for the completion of this study. Thanks to Lam, Mconcoza and partners medical services for providing the data for the study, and the work they put in during Covid to allow for this study to continue.

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LIST OF ABBREVIATIONS

ADLs – Activities of Daily Living

AF – Annulus Fibrosus

ALL – Anterior longitudinal Ligament

DBC – Documentation Based Care

FABQ – Fear Avoidance Based Questionnaire

GDP – Gross Domestic Product

GP - General Practitioner

HREC – Human Research Ethics Committee

LDH – Lower Disk Herniation

LF – Ligamentum Flavum

LTE - Lumbar Thoracic Extension

LTL - Lumbar Thoracic Lateral Flexion

LTR - Lumbar Thoracic Rotation

NP – Nucleus Pulposus

NSCLBP – Non-Specific Chronic Low Back Pain

PLL - Posterior longitudinal Ligament

RBDS – Ribbons and Beck Depression Scale

RLC – Rotter's Locus of Control

ROM – Range of Motion

VAS – Visual Analog Scale

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CHAPTER 1: PROBLEM IDENTIFICATION

1.1 Introduction

Lower back pain is a chronic condition experienced throughout the world and is becoming increasingly more prevalent as an individual gets older[1]. Lower back pain can result in a decreased physical ability and working capability,[2] lower back pain has also shown to extend time before an individual is able to return to work[3].

The primary function of rehabilitation is to restore function and rectify physical disabilities[3]. Once this is achieved patients can return to work and function more effectively[4]. Lower back pain is often targeted through interventions such as physiotherapy and physical therapy/exercise[5], pharmacological interventions[6], surgical[7] and psychological/cognitive functional therapy[8].

A systematic review and meta-analysis have been conducted to observe the efficacy of such interventions such as strengthening, resistance, coordination, stabilisation, power and functional type exercises. Of the 45 trials that were considered, the conclusion was that exercise interventions were successful in reducing chronic lower back pain with specific mention to the strengthening/resistance trial[9].

Although numerous exercise interventions exist there are many gaps in terms of their efficacy and many limitations still exist, these include for example small sample sizes, efficacy across age groups not being reported, non-standard protocols being readily used and clinicians often working in silos as opposed to using the multidisciplinary approach.

With regards to small sample sizes, a meta-analysis conducted on 249 studies reported on exercise therapy interventions for individuals with chronic low back pain, it was shown that interventions were conducted in samples ranging from 42 participants to 125 participants, with the majority of studies consisting of less than 100 participants[10]. Although the majority of interventions generally reduced back pain, interventions performed in larger samples may have provide more conclusive information on the efficacy of the varied interventions.

Furthermore, in terms of exercise interventions, the efficacy across age groups is not readily reported. In general studies are carried out within specific age groups and not across age categories. For example, studies identified data being collected between the ages of 20 – 65 and 30 – 50 respectively, however neither study considered the efficacy of the intervention across age groups[11-12]. It is imperative that when one carries out an intervention that age is considered as there may be no change or adaptation within a certain age group, yet a large change in another age group. Furthermore, the use of a control group needs to also be considered to determine efficacy more effectively. The exception can be made for studies specifically identifying certain age groups.

In addition, when applying interventions, a multidisciplinary approach needs to be considered. A systematic review and a meta-analysis looking at multidisciplinary biopsychosocial approach to rehabilitation of chronic lower back pain and considered this approach to be one of the most effective interventions to reduce pain and disability within chronic lower back patients[12]. It was noted although multidisciplinary interventions may be more expensive in the short term, they may lead to better outcomes long term[13]. Nonetheless, the cost effectiveness of an intervention needs to be considered especially within developing countries such as South Africa[14].

However, within all the above-mentioned studies no standardised treatment/approach or clarity on which clinicians were involved, were stated in the interventions[8-12]. We have been made aware that Multidisciplinary, protocol-based approaches to rehabilitation is ideal, yet not specifically which exercises, clinicians, measures performed on specific age groups and on significant sample sizes has been defined, this study will attempt to bridge the gap between these variables to create a standardised, protocol.

This study will make use of a relatively large sample, across age groups using a multidisciplinary standardised protocol - the DBC programme. The DBC (Documentation Based Care) protocol which was designed and created in Finland has incorporated 4 major focuses within their design (Figure 1), The focus areas include: functional capacity, in which the protocol attempts to rectify the loss of function within the individuals; secondly, lifestyle improvement where the focus is to restore the daily activities of the individual allowing them to perform tasks and duties which are considered essential to perform; thirdly, to reduce pain levels; and finally, the restoration of range of motion (ROM) which has often been used as an indicator for the likelihood of lower back pain[14]. The addition of ROM exercises to the protocol has shown to be beneficial in reducing pain in those who participate[15].

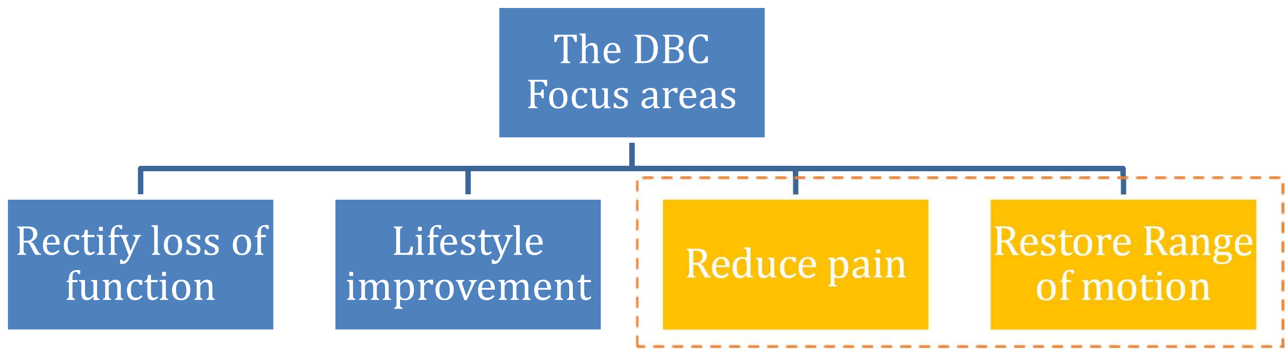

Figure 1: The DBC 4 major focus areas[16]

The former two focuses will not be considered within this study. The focus of this study will therefore be determining the efficacy of the DBC protocol nationally within South Africa in terms of pain reduction and the restoration of ROM- as indicated by figure 1.

The DBC programme is unique in that there is emphasis placed on their uniquely designed lower back rehabilitation equipment (Figures 2-5) which focuses on the improvement of ROM and the restoration functional movement[16]

<u>Equipment used in the intervention for lower back rehabilitation</u>[16]

Figure 2: Lumbar thoracic lateral flexion

Figure 3: Lumbar thoracic rotation

Figure 4: Lumbar thoracic extension

Figure 5: Lumbar thoracic flexion

Although the original DBC programme was standardised in Finland, and made use of only the rehabilitation equipment, it was then adapted after being introduced into South Africa due to the medical aid structures within the country, whereby a more multidisciplinary approach was followed. The addition of physiotherapy (mobilisation, manipulation, massage, and acupressure), doctor consultations (assessment for contra-indications, medication and x-rays.) and Biokinetics (facilitates the exercises on the machines and home stretching programme). Was included into the programme.

This study will explore how effective the multidisciplinary, DBC protocol-based approach has been in helping rehabilitate people struggling with chronic lower back pain in terms of pain and ROM, and to also determine whether the efficacy of the intervention is similar across age groups in the South African context.

1.2 Motivation of the study

Research considering multidisciplinary, protocol-based approaches to rehabilitation and their efficacy across different age groups is severely lacking, to the researcher's knowledge. This intervention used in this study therefore may help bridge the knowledge gap in terms of effectiveness of the intervention as well as investigating the effects of treating patients by providing a multidisciplinary, protocol-based approach, which can be reproduced anywhere to obtain consistent results across age groups. Furthermore, incorporating an intervention which could possibly provide positive results among different age groups in terms of pain reduction and restoration of range of motion, may not only benefit the individual but may reduce the economic burden of disease in South Africa[13]

1.3 Research question

Can the Finish DBC protocol, adapted for South Africa be used to effectively reduce back pain, and improve lumbar range of motion effectively?

1.4 Aims of the study

This study aims to determine the effectiveness of an adapted 6 weeks Finnish DBC lower back protocol in reducing pain and improving the range of motion in South African adult patients with lower back pain.

1.5 Objectives

1. To determine the effectiveness of the 6-week DBC programme in a South African population in different age groups (18-29 / 30-39 / 40-49 / 50-59 / 60-69 / 70-79 / 80-90 years old), taken over the last 3 years (2018-2020) in terms of pain and range of motion.
2. To determine the effectiveness of the 6-week DBC protocol in terms of pain.
3. To determine the effectiveness of the 6-week DBC protocol in terms of ROM.

1.6 Hypothesis

The null hypothesis is that the adapted DBC lower back programme carried out in a South African population over the last 3 years has not been effective in reducing pain or increasing range of motion, within the 7 different age groups. The Alternative hypothesis is that the protocol has been effective in both pain reduction and improved range of motion amongst all age groups.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This study will be interpreting the changes in range of motion and pain as the result of the completion of a 6-week protocol based, multidisciplinary approach to rehabilitation in patients from different age groups, suffering from low back pain. This section will help identify any gaps within the existing literature and build a theoretical framework around the topics within this study. Firstly, information regarding the anatomical structures involved in lower back pain will be introduced, and the review of intervention will be presented to provide insight into what is available for the population affected. Throughout the literature, review gaps in the literature will be highlighted and a means to bridge this gap will be presented.

2.2 The anatomy of the lower back

Non-specific and / or unknown pathoanatomical lower back pain has been identified as the most prevalent[17] type of lower back pain in individuals. Lower back pain is associated with the structures involving the five lumbar vertebrae (L1 - L5) which comprise of a nucleus pulposus (NP), annulus fibrosus (AF), vertebral body, pedicles and associated processes. The three main ligaments are the anterior longitudinal ligament (ALL), posterior longitudinal ligament (PLL), and ligamentum flavum (LF), which are utilised for joint stability. The neural structures of the spine consist of the L1 – L5 nerve roots and the sciatic nerve consisting of the L4 and L5 nerve roots as well as the sacral nerve roots. The lumbar spine consists of four muscle groups responsible for extension, flexion, lateral flexion, and rotation[18].

2.3 Pathologies of the lower back

The different types of lower back pain may fall into the categories of radicular pain, sacroiliac joint pain, facet joint syndrome, lumbar spinal stenosis and discogenic pain[19]. The risk factors associated with lower back pain have been divided up into the three categories of poor general health, physical stress and psychological stress determined by an umbrella review, in which poor health is associated with obesity, dieting etc. Physical stress includes activities such as bending, squatting, kneeling etc. and the effect of psychological stress involves the social, economic and financial pressures of the individuals at risk[20]. The world prevalence of lower back pain has been shown to increase as one gets older, with as much as a 60% - 85% lifetime prevalence[1], within Sub-Saharan Africa having a low back pain prevalence in adolescents of 12% and in adults a prevalence of 50% with an overall life time prevalence of 62%[21]. The Lifetime prevalence within the South African context has specifically been reported as 73.2%[22], The greatest issue affecting one's life, as a result of back pain has been reported as large amounts of pain, which may lead to decrease in function, reduced ADL's (Activities of daily living) and the inability to work[4].

2.4 Pain

Pain within the lower back has been identified for 3 different categories, namely nociceptive pain (e.g., myofascial low back pain), neuropathic pain (e.g. lumbar radiculopathy), and central sensitization pain (Hypersensitivity)[23]. Pain can be measured using a variety of different methods, namely the numerical rating scale (NRS), Visual Analog Scale (VAS), Verbal Rating Scale (VRS), and/or Face Pain Scale - Revised (FPS-R) etc[23,25]. A study determined that the VAS measurement was least affected by non-pain related factors, making it one of the most specific tools to measure pain[23].

In addition in terms of the application of pain scales, a meta-analysis performed determine which exercises would assist in the reduction of generalised body pain most effectively, found that pilates, stabilisation/motor control, resistance and aerobic exercise training were able to improve levels of pain most efficiently[24]. and that visual analog scales were the preferred measuring tool.

2.5 Lumbar range of motion

It has been generally accepted that a reduced range of motion (ROM), has often been used as an indicator for the likelihood of lower back pain, in both hypo-mobile and hyper-mobile individuals[14/26]. This movement is measured in degrees (^{0}). Furthermore studies have shown that restrictions in certain muscles such as the hamstrings and lumbar lateral flexors are associated with the development of lower back pain[14/15].

I terms of treatment, the addition of ROM exercises has shown to assist in the rehabilitation process and to reduce pain in individuals with lower back pain[7]. For example, a study using a 2-week exercise based rehabilitation programme found that ROM improved in association with pain, when an improvement general activity dysfunction was targeted[29]. Another study found a significant improvement in ROM when compared to the control group of the protocol associated with a decrease in pain intensity[30]. Interestingly there have also been a study showing no correlation between range of motion within the spine and chronic lower back pain[28]. This study was performed on only 34 participants and thus may need further investigation. The current study will be considering a much larger number of participants, as well as identifying multiple ranges around the lumbar thoracic joint[27]. To the researcher knowledge there are limited studies in South Africa that have considered the effect that ROM has specifically had on lower back pain, this study will attempt to provide a clearer picture within a South African context.

2.6 Age and gender relating to lower back pain.

Since lower back pain can occur throughout an individual's life, it is imperative to consider the prevalence of back pain in different age groups as well as consider how interventions may need to change accordingly, Studies have shown the prevalence of non-specific lower back pain to be more predominant within the third decade of life onwards until the age of 60, as well as an increased prevalent in female participants[31]. This relates to the rate at which degenerative changes affect people as they grow older, both in muscular degeneration such as multifidus and paraspinal muscles[32], disc degeneration[33] as well as loss of mobility[34]. The ideal course of action would be to focus on the prevention of lower back pain from a young age[33], and secondly manage lower back pain within the latter third of one's life, through conservative treatment, surgeries and fall risk preventative programs [35]. On of the gaps in the literature is a lack of age group specific data with regards to low back injuries and appropriate age specific intervention.

This study will stratify its data into age groups to determine whether there may be an age-related component to the effectiveness of the programme. This may assist the gap between preventative treatment in the early stages of life as well as management of pain within the latter third of one life.

2.7 Lower back pain and exercise

There have been many studies in which physical exercise has had a significant improvement on patients suffering with non-specific, as well as specified lower back disorders[24]. Even in cases with lower back disc herniations, there have been great improvements to pain when following interventions targeting pain[24]. Specifically exercise was found to have moderately certainty in terms of being more effective in treating chronic low back pain than no treatment at all, usual care or placebo interventions. It has also been reported that exercise improved pain scores and functional limitations in terms of daily living for patients suffering from low back pain[10]. In addition a study which considered the level of exercise intensity in the rehabilitation of chronic non-specific low back pain and found high intensity treatment to be well tolerated and effective in pain reduction and improvement on disability[37].

Conversely, it is a known fact that inactivity may lead to lower back pain or worsen already existing lower back pain. It has also recently been shown that sitting frequently, and desk jobs have increased dramatically and that there is a strong correlation between sitting for long period of time and lower back pain[38]. Although interventions have produced positive results in terms of improving back pain levels. It should be noted that a patient suffering with lower back pain are less likely to adhere to physical activity recommendations[39]. This therefore may be a barrier to low back pain reduction through intervention and should be considered and monitored when implementing interventions or protocols.

2.8 Protocol based approaches to back pain rehabilitation.

Following on the concept behind a protocol-based approach is to achieve a universally understood and reproducible programme that has been proven to aid in rehabilitation, regardless of location or external factors based on empirical evidence[33]. The efficacy of a protocol can easily be measured due to the standardised nature of the intervention, performed on specific subjects, when individuals are compliant and engage appropriately with interventions and protocols developed.

It has been proven that following the set structured exercise based protocol has been beneficial in the reduction of non-specific lower back pain[38-39]. Studies have also shown that there is a decrease in employee sick days being taken due to programme-based rehabilitation, specifically with the addition of a cognitive-behavioural approach[40].

One of the things that needs to be considered with intervention and proposed protocols is length of intervention.

A meta-analysis on 374 studies considered the timeframes of different protocols [10]. These studies were categorised as short term, medium term and long-term, where short-term protocols were implemented over a period of 6 – 12 weeks, medium term was implemented over 13 – 47 weeks and long term protocols were implemented for 48 weeks and longer. Majority of these studies were considered short term studies (n = 184). Overall as reported by the meta-analysis, the length of intervention didn't seem to have a direct correlation to benefit of the patient or in pain reduction[10].

Protocol-based programmes have been proven to be beneficial:[35/36] however, the negative sides to protocol-based approaches are namely two-fold. Firstly, the unique nature of an individual patient's disability is key to rehabilitation; a therapist needs to understand that not all patients fall perfectly into a specific category. Secondly, most protocol-based programmes require specific, specialised equipment that may be expensive or difficult to acquire in certain settings, thus limiting the reach of the protocol. Protocols also need to be constantly evolving and adapting to improve on the possible outcomes based on empirical research. This study will be considering the framework set out by the Finnish DBC protocol, however it will also explore the effects of a multidisciplinary involvement and the efficacy around the inclusion of other clinicians to bridege gaps in the literature. (See next section).

2.9 The DBC protocol (Finland)

The DBC protocol was designed in Finland as an active rehabilitation programme to target low back pain in low back patients. The programme is run within private practices in which only the physiotherapist attends to patients by giving them the exercises on the DBC machines, the machines comprise of a set of 5 pieces of unique equipment namely the LTL (Lumbar Thoracic Lateral Flexion), LTF (Lumbar Thoracic Flexion), LTR (Lumbar Thoracic Rotation), LTE (Lumbar Thoracic Extension) and the HLP (Horizontal Leg Press) These devices were developed, manufactured and validated by the DBC company[16]. Patients enrolled onto the programme perform all the prescribed exercise every session (twice a week) for 6 weeks. Individuals also complete a self-reported questionnaire to track progress.

In terms of efficacy , a study was conducted in Finland using the Finnish DBC Protocol, [16] and it was found that there was a significant reduction in pain was seen, from an initial average score of 62 mm to an outcome average score of 31mm in which pain ranging from 0-4mm is considered no pain, 4-44mm is considered mild pain, 45-75mm is considered moderate pain and 75-100mm is sever pain)[16], within a population of 125 chronic/recurrent lumbar pain patients. This study also found a significant gain in lumbar mobility within all lumbar thoracic movements The Finnish study also noted a marked improvement in depression and perceived competence as part of their self-assessment questionnaires [16].

In the Finnish version of the DBC protocol, the patients do not receive manual manipulation, dry needling, or any other “typical” physiotherapy treatments.

In Iran, a study conducted by the Iran university of medical sciences named the Effects of six-week exercise training protocol on pain relief in patients with lumbar disc herniation, it was shown that the Finnish DBC had a positive pain outcome, The study utilized the Finnish DBC protocol and equipment to observe the amount of lumbar thoracic pain decrease over the 1st to 6th session (first 3 weeks) and 1st to 12th session (Total 6 weeks of intervention). Their findings were as follows: amount of lumbar thoracic pain decreased between 1st to 6th session on the VAS scale, female (n=51) 1.60 ± 1.17 and males (n=13) 2.00 ± 2.15, amount of pain decreased between 1st to 12th session, female (n=51) 1.90 ± 2.41 and males (n=13) 1.90 ± 3.65. It was concluded that the training programme reduced the greater amount of lumbar thoracic pain in male's compared to females with lumbar disc herniation[16].

The study was conducted on 13 males and 51 females, ranging from the ages of 20 – 50 years old. The inclusion criteria were that of individuals suffering from lumbar disc herniation for more than 5 months[36]. This study conducted by the Iranian university has many of the same components the present study of the South African DBC protocol is identifying and thus would be a great comparison.

With that being said, one of the gaps in the literature is being able to effectively compare exercise interventions effectively to one another

In a study entitled, "Consensus on Exercise Reporting Template (CERT): Explanation and Elaboration Statement"[40] was published in 2016, a model was provided in which to effectively communicate, report and rate on findings of exercise intervention-based studies. The researcher has used this model below to report on the Finnish DBC used in the above study (Table 1) and the South African adapted programme (Table 2).

Table 1 below rates the DBC protocol studied by the Iranian university as reported in the study entitled "Effects of six-week exercise training protocol on pain relief in patients with lumbar disc herniation"[16]. Since there is no South African data this table will provide further context for the current study. The pros of the Iranian study (Reporting on DBC) were that details were given as to the measurements taken and the exercise intervention delivered, however the cons were that it was unclear as to the type of exercises prescribed, whether there was a home program provided, or whether there were any non-exercise components, thus making it very difficult to be reproduce the study.

Table 1: CERT report, "Effects of six-week exercise training protocol on pain relief in patients with lumbar disc herniation", Table copied from the CERT report template[40]

		Location		
		Primary Paper	Yes (1)	
Item	Description	Page, Para.	No (0)	Reason for rating
1	Detailed description of the type of exercise equipment		0	No details provided
2	Detailed description of the qualifications, expertise and/or training		0	Unclear imporatnt details provided (Specialist, not specified)
3	Describe whether exercises are performed individually or in a group		0	No details provided
4	Describe whether exercises are supervised or unsupervised; how they are delivered		0	No details provided
5	Detailed description of how adherence to exercise is measured and reported		1	
6	Detailed description of motivation strategies	Pg 2, Col 2, Para 3	1	Timeframe, completion of protocol
7a	Detailed description of the decision rule(s) for determining exercise program		0	No details provided
7b	Detailed description of how the exercise program was progressed		0	No details provided
8	Detailed description of each exercise to enable replication		0	No details provided
9	Detailed description of any home programme component		0	Images shown, unclear as to reps/sets, timeframe
10	Describe whether there are any non-exercise components		0	No details provided
11	Describe the type and number of adverse events that occur		0	No details provided
12	Describe the setting in which the exercises are performed		0	No details provided
13	Detailed description of the exercise intervention	Pg 2, Col 2, Para 3-	1	
14a	Describe whether the exercises are generic (one size fits all) or tailored	Pg 2, Col 2, Para 4	1	
14b	Detailed description of how exercises are tailored to the individual		0	No details provided
15	Describe the decision rule for determining the starting level		0	No details provided
16a	Describe how adherence or fidelity is assessed/measured	Pg 2, Col 2, Para 4	1	Completion of protocol
16b	Describe the extent to which the intervention was delivered as planne		0	No details provided

Table 2 rates this South African rolled out iteration of the DBC protocol. The pros of this study are detailing the specifics on type of exercise, specialist and qualifications involved in the study, the adherence to the protocol, home programmes involved and non-exercise related components, intentionally trying to highlight the criteria and guidelines provided by the CERT template. However, the cons where that the study never tracked the number of adverse events adequately, or how the exercises were progressed and how starting levels were determined. Furthermore, the researcher had no information on the compliance of participants.

Table 2: CERT report, "The Effectiveness of a Multidisciplinary, Protocol-based Approach to Patients of Different Age Groups with Lower Back Pain in Bloemfontein, Gqeberha, Polokwane, and Johannesburg", Table copied from the CERT report template[40]

		Location		
		Primary Paper	Yes (1)	
Item	Description	Page, Para.	No (0)	Reason for rating
1	Detailed description of the type of exercise equipment	Pg 6, Para 1	1	
2	Detailed description of the qualifications, expertise and/or training	Pg 9, Para 2	1	Emploment of Biokineticists, Training from Licenced entity provided
3	Describe whether exercises are performed individually or in a group	Pg 11 Para1,3	1	
4	Describe whether exercises are supervised or unsupervised; how they are delivered	Pg 11 Para1,3	1	
5	Detailed description of how adherence to exercise is measured and reported	.	1	Data capture sheet
6	Detailed description of motivation strategies	Pg 10, Para 4	1	Specified timeframe
7a	Detailed description of the decision rule(s) for determining exercise program	Pg 11, Para 4	1	
7b	Detailed description of how the exercise program was progressed		0	Progress was based entirely on a case by case bases
8	Detailed description of each exercise to enable replication	Pg 11, Para 4	1	Specified set of equipment
9	Detailed description of any home programme component	Pg 11, Para 2	1	
10	Describe whether there are any non-exercise components	Pg 11, Para 5	1	
11	Describe the type and number of adverse events that occur		0	Specific situations of adverse events were not documented
12	Describe the setting in which the exercises are performed	Pg 11, Para 4	1	
13	Detailed description of the exercise intervention	Pg 11, Para 2-5	1	
14a	Describe whether the exercises are generic (one size fits all) or tailored	Pg 11, Para 4	1	
14b	Detailed description of how exercises are tailored to the individual		0	Patients adhere to fixed protocol, no specific additions documented
15	Describe the decision rule for determining the starting level		0	
16a	Describe how adherence or fidelity is assessed/measured	Pg 12 Para 1 & 3	1	Completion of protocol (12 Weeks)
16b	Describe the extent to which the intervention was delivered as planne		0	Data on drop out rate was not provided

2.8 Multidisciplinary approaches to reducing lower back pain.

Multidisciplinary approaches have been proven to be of greater benefit to the patient, especially in the cases of chronic lower back pain[41]. However, multidisciplinary approaches involve a higher cost, due to the need for multiple specialists. In the case of most developed countries where large portions of the Gross Domestic Product (GDP) gets put into health and wellness, this is less of a burden[42]. In developing countries however, most of the cost generally falls on the patient[35]. This study and its finding may provide a cost effective, evidence-based protocol, which can be adopted to obtain successful outcomes at a reduced cost to the individual and certainty of success to the payer should the intervention be found to be effective.

In terms of evidence based practice, a systematic review performed, suggested that multidisciplinary approaches that followed a more intensive approach with the inclusion of functional restoration to be the most effective in alleviating pain and reducing disability in individuals suffering with low back pain[46]. A multidisciplinary approach therefore needs to be considered when targeting individuals with low back pain.

CHAPTER 3: METHODOLOGY

3.1 Study Design

This study was a quantitative retrospective record review study.

3.2 Study Population

Data from South African patients aged 18 years and older, suffering with lower back pain, who had participated and completed the full DBC protocol with all data sets completed were used for the study.

3.3 Sampling and recruiting

A sample of convenience was used with data from patients suffering with lower back pain who had participated and completed the DBC programme. The initial sample consisted of 1511 data sets, from 2 practices within Johannesburg (Roodepoort and Kempton Park) and practices in Gqeberha, Bloemfontein and Polokwane. All practices had followed the same methodology and data collection procedures. The method of original data collection and the procedures followed is discussed below in the DBC protocol design. Data sets from the years 2018 to 2020 were utilised as this is when the practices had begun to use the DBC protocol. No recruiting was necessary due to the nature of a retrospective study. Permission to use the data was obtained from the clinical owners of the practices who run the DBC protocol (Appendix A).

The following inclusion and exclusion criteria were followed:

3.4 Inclusion/Exclusion criteria

3.4.1 Inclusion:

- Data sets of patients 18 years and older.
- All data sets of participants completing the DBC protocol between the years 2018-2020.
- Data sets including Age, Pain scale and Range of motion.

3.4.2 Exclusion:

- Incomplete data sets that are relevant to the study.
- Data sets with unclear/ or deemed to be incorrectly captured information.
- Data sets with pain scales below 3/10 on initial assessment.

3.5 Testing and procedures: The DBC Protocol

The purpose of this section is to better understand the process and methods followed by all 5 practices, in capturing data from patients participating in the programme, thus aiding in the reproducibility of the study and a better understanding of the process. A summary of the protocol has been added to the appendices (Appendix B)

The DBC protocol was a programme overseen by the Medscheme medical aid group. Ensuring all practices and practitioners adhered to the same process and protocols, the aim was to restore range of motion, restore muscle coordination and movement control, improve muscular endurance, improve general conditioning, re-educate patients in the difference between normal physical loading and pain, reduce fear avoidance behaviour and address the psychological/social/occupational obstacles of return-to-work[16].

a) **Pre-screening**

The patient began by signing an indemnity form, filling out personal information forms identifying their name, date of birth, medical aid etc. Then they completed a medical history form (Appendix C) identifying any underlying medical conditions either for themselves or their immediate family. The patient then completed a STarT (Appendix D) back screening tool to determine their risk level in terms of requiring further surgery.

b) Baseline data/ pre intervention testing:

1. The patient completed forms relating to their fear avoidance behaviour (FABQ) (Appendix E), Locus of control (RLC) (Appendix F), Depression scale (RBDS) (Appendix G), a back disability index scale to gather information on how these related to their Lower back pain.

2. The patient was then seen and assessed by a Biokineticist, who began with a subjective assessment in which the patient's history of injury was assessed. Questions including things like injury onset, location of pain, type of pain, occupational environment, aggravating and relieving factors.

3. As an objective assessment the visual analogue scale (VAS) was taken in which the patient was shown a pain scale (Appendix H) and asked to rate their level of pain according to the scale.

4. The patient's range of motion (ROM) was assessed next and measured in degrees. The patient was made familiar with the DBC machines and set up by the Biokineticist using anatomical landmarks to ensure accurate and standardised measurements. Forward flexion and extension were measured on the Lumbar Thoracic Extension machine (LTE); Lateral flexion was measured on the Lumbar Thoracic Lateral Flexion machine (LTL); and lastly Lumbar rotation was measured on the Lumbar Thoracic Rotation machine (LTR). Once on the machines, the patient was instructed to perform the relevant movement to their maximal/end range once without causing themselves pain or serious discomfort.

5. The patient was then assessed by the General Practitioner (GP). The GP considered the x-rays and/or other imaging techniques and performed special tests. The GP provided insight into any medication used and, if needed, provided prescriptions for any additional medication. The doctor excluded patients who had any contra-indications or red flags (e.g., compression fractures, cauda equina, etc.) in terms of exercise participation.

Those who were deemed good candidates for the programme were enrolled for 12 treatment sessions. Patients enrolled into the programme were then given a general overview as to what would be expected of them throughout the programme, namely that the protocol consists of 12 sessions performed over 6 weeks, and that each session would consist of treatment from both the Biokineticist and Physiotherapist for 30 minutes each per session. Patients found unsuitable for the protocol were given further education on their diagnosis and referred to a relevant practitioner at the discretion of the GP. For example, individuals with more severe/complicated injuries such as compression fractures; patients suffering with multiple injuries and/or injuries where machinery was not appropriate (e.g., Parkinson's); and patients that were less than 8 weeks post-surgery were generally referred to another specialist.

Those who were less than 8 weeks post-surgery were encouraged to come back once clearance to exercise was provided by their specialist. Data for all patients deemed unsuitable for the protocol was not considered for this study.

c) Six-week intervention

1. On the first treatment session, the patient had a one-on-one session with the Biokineticist, in which the patient was guided through exercises to be performed at home, exercise included stretching and transverse abdominis activation exercises (Appendix I).

2. During the patients first physiotherapy session, the Physiotherapist assessed the patient, both subjectively (medical history, socioeconomic stress, history of condition etc.) and objectively (palpation of the area, special tests, observation of function). Once the assessment was completed the physiotherapists provided symptomatic relief treatment, this treatment was not standardised but individualised at the discretion of the physiotherapist.

3. Biokineticists sessions 2 to 12, the patients performed the DBC exercises on the equipment, supervised by the biokineticist within a gym environment, where no more than two patients were seen by a biokineticist. The exercises were performed at 30 repetitions per side/movement at a varying resistance, determined by the biokineticist. The treatment page that was used has been attached (Appendix J). Patents were all progressed from session to session, determined individually by the biokineticist, the intention was to progress the resistance of the exercises at minimum, once per week while the repetitions were always maintained at 30 reps. However clinical reasoning and judgment took precedence.

4. In the Physiotherapists Sessions 2 to 12, the physiotherapists focused on symptomatic relief treatment throughout the programme, individualised to the patients, using techniques including but not limited to, dry needling, myofascial release, electrotherapy (TENS etc.), postural education, strapping and thermal therapy (hot, cold packs).

d) Post intervention testing

Post intervention testing followed the same procedures as the pre-intervention testing and was carried out in the same order within the same practice and same clinicians. It included the forms relating to the patients fear avoidance behaviour (FABQ), Locus of control (RLC), Depression scale (RBDS), a back disability index scale, the range of motion tests on the machines and the Biokineticists and GP assessments.

e) DBC Data collection

The pre-screening, pre-intervention and post intervention data collected (FABQ, RLC, RBDS, pain scale and ROM) got totalled and handwritten onto the records page (Appendix K) of the patient's personal file and then the data was uploaded onto a data spreadsheet on Microsoft Excel by the practice administrator. This data was verified by Medscheme monthly to ensure adherence to the protocol.

3.6 Data Collection for study

Using the inclusion and exclusion criteria, data collected during the pre-assessment and post-assessment within the 3 years was compiled into one spreadsheet provided by the practice owners and within the structures of the ethical guidelines. Data were collected from 5 practices within South Africa over the period 3 years, all adhering to the same protocol and multidisciplinary processes as determined and prescribed by Medscheme. The data were collected and collated by the practice administrators and verified by the medical scheme monthly to ensure accuracy and adherence to the protocol. All the data were saved onto a Microsoft Excel spreadsheet which was shared via email for the completion of this study. This was done once ethical clearance had been approved.

3.7 Statistical analysis

Descriptive statistics were used for the demographic data. Categorical data such as pre/post pain data was interpreted using a one-way ANOVA. A T-test was used to interpret the change in pre-intervention to post-intervention mean for ROM and pain to determine effectiveness. The data was then used to determine the effectiveness of the DBC protocol, by observing whether there was a reduction in pain and increase in ROM amongst the different age groups. The use of Statistica version 14.0 was used for the analysis, a P value of <0.05 constituted a significant result. A change in ROM or pain score was also considered to be clinically significant depending on percentage changes.

3.8 Ethical considerations

Ethical clearance was granted by the Wits Human Research Ethics Committee (Appendix L: M (220212). The DBC centres obtained a signed consent form from each patient before their assessment, allowing for their data to be used anonymously for research. All data was kept anonymous, whereby the spreadsheet only contained age, sex, pain scale, ROM, and date of protocol completion. Data relevant to the study was disclosed with no identifiable information attached to the data sets to ensure anonymity of the participants. The data for the study was obtained from the clinical owners of the practices who facilitate the DBC protocol. Permission forms are attached in Appendix A. Only the researcher and the researcher's supervisor had access to the data. All data was assessed as a group and no individual reports were generated.

CHAPTER 4: RESULTS

4.1 Introduction

Results will be presented under two main sections: in section A, demographic information will be presented; in section B, the objectives for the study and the results corresponding to each objective will be presented, after which a discussion of the results follows.

4.2 Results

Section A: Sample data and demographics

- **Sample**

The data for the study was obtained from the clinical owners of the practices who run the DBC protocol in South Africa. The sample consisted of 1511 data sets, from 2 practices within Johannesburg (Roodepoort and Kempton Park) and one practice in Gqeberha, Bloemfontein and Polokwane, thus a total of 5 practices. The data was received on an excel spreadsheet and checked for nonsensical data, by the principal investigator. (e.g., nonsensical values such as ROM of 501 degrees) Of the 1511 data sets, 2 were excluded due to missing information of either age, range of motion or pain scores (Figure 6). A further 10 data sets were excluded due do invalid/errors in capturing of data. (i.e., a pain score of 15 out of 10. A final number of 1499 of data sets were used for the analysis of this study.

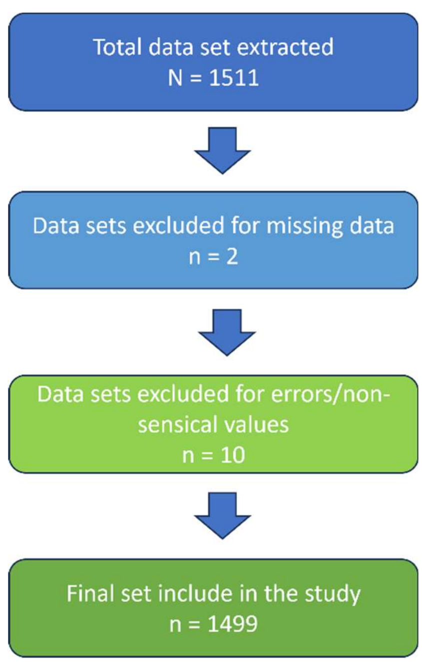

Figure 6: Data sets included in this study.

- **Demographic Information**

Table 3 below shows the ages per gender group of the study population. For the age group 18 - 29, there was a mean age of 26 ± 2.94 years , the age group between 30 - 39, had a mean age of 36 ± 2.72 years, the age group between 40 - 49, had a mean age of 45 ± 2.88 years, the age group between 50 - 59, had a mean age of 55 ± 2.8 years, the age group between 60 - 69, had a mean age of 66 ± 2.84 years, the age group between 70 - 79, had a mean age of 75 ± 2.73 years, the age group between 80 - 90, had a mean age of 84 ± 2.52 years.

Table 3: Mean age per age category, and number and percentage of males and females per category of individuals with LBP (n=1499)

	Female		Male		Total	
Age Categories	**Mean age ± SD**	**No. (%)**	**Mean age ± SD**	**No. (%)**	**Mean age ± SD**	**No.**
18 – 29	26 ± 3.57	32 (57.1)	25 ± 6.39	24 (42.9)	26 ±2.94	56
30 - 39	37 ± 6.40	117 (60.3)	36 ± 6.42	77 (39.7)	36 ±2.72	194
40 - 49	45 ± 6.39	237 (64.9)	46 ± 2.14	128 (35.1)	45 ±2.88	365
50 - 59	56 ± 1.39	255 (70.4)	55 ± 4.26	107 (29.6)	55 ±2.8	362
60 - 69	65 ± 2.81	186 (65.5)	65 ± 6.42	98 (34.5)	66 ±2.84	284
70 - 79	74 ± 6.31	113 (56.8)	75 ± 3.56	86 (43.2)	75 ±2.73	199
80 - 90	84 ± 0.68	17 (43.6)	84 ± 6.40	22 (56.4)	84 ±2.52	39

Section B: Results per objective

Objective 1 and 2

To determine the effectiveness of the 6-week DBC programme in a South African population in different age groups (18-29 / 30-39 / 40-49 / 50-59 / 60-69 / 70-79 / 80-90 years old), taken over the last 3 years (2018-2020) in terms of pain and range of motion.

To determine the effectiveness of the 6-week DBC protocol from pre-intervention to post intervention in terms of pain.

Mean pain score per category are presented in Table 4 and Figure 7 below. The youngest age category ranging from 18 - 29 had a total number of 56 participants, this category was the second smallest in terms of participants, with a mean pre intervention pain score of 7.1 ± 1.46 out of 10 and a mean post - intervention pain score of 2.8 ± 2.11 out of 10, the p-value < 0.001 indicating a significant reduction in pain from pre to post intervention. This sample size and pre-intervention pain score was most like that of the oldest age category ranging from 80 - 89 having a total number of 39 participants, with a mean pre intervention pain score of 7.1 ± 1.74 out of 10 and a mean post - intervention pain score of 3.6 ± 2.28 out of 10, which was significant, the p-value < 0.001.

The age category ranging from 30 - 39 had a total number of 194 participants, with a mean pre intervention pain score of 7 ± 1.67 out of 10 and a mean post - intervention pain score of 2.8 ± 2.19 out of 10, with the p-value < 0.001 indicating a significant reduction in pain. This sample size and pre-intervention score again most like that of the age category ranging from 70 - 79 having a total number of 199 participants, with a mean pre intervention pain score of 6.9 ± 1.89 out of 10 and a mean post - intervention pain score of 3.2 ± 2.25 out of 10 with a significant reduction in pain, (p-value < 0.001). However, once again it is noted that the younger of the two categories had a better post-intervention score.

The age category ranging from 40 – 49, 50 - 59 and 60 – 69, had the greatest number of participants each respectively having a total number of 365, 362 and 284 participants. These three categories also had the most similar pre-intervention scores of with a mean pre intervention pain score were 7.2 ± 1.71, 7.2 ± 1.8 and 7.2 ± 1.84 out of 10 respectively, However the mean post - intervention pain score were different for the three categories, the younger of the three categories having a noticeably more reduced post-intervention pain score of 2.9 ± 2.41, while the 50 – 59 age group had a post-intervention score of 3.2 ± 2.45 and the 60 – 69 age category had a post-intervention score of 3.3 ± 2.49 out of 10, (p-value < 0.001), for all these categories the post intervention scores were significantly reduced, indicating a significant reduction in pain for the three age categories.

Overall the samples included a total number of 1499 participants, with a mean pre intervention pain score of 7.1 ± 1.77 out of 10 and a mean post - intervention pain score of 3.1 ± 2.38 out of 10, for all categories there was a significant reduction in pain (p-value < 0.001).

Table 4: Mean pain scores per age group of individuals with LBP pre and post intervention (n=1499)

Age categories (n)	Pain score Pre –Intervention Mean± SD	Pain score Post –Intervention Mean± SD	P Value
18-29 (56)	7.1 ±1.46	2.8 ±2.11	P<0.001*
30-39 (194)	7 ±1.67	2.8 ±2.19	P<0.001*
40-49 (365)	7.2 ±1.71	2.9 ±2.41	P<0.001*
50-59 (362)	7.2 ±1.8	3.2 ±2.45	P<0.001*
60-69 (284)	7.2 ±1.84	3.3 ±2.49	P<0.001*
70-79 (199)	6.9 ±1.89	3.2 ±2.25	P<0.001*
80-90 (39)	7.1 ±1.74	3.6 ±2.28	P<0.001*
Total (1499)	7.1 ±1.77	3.1 ±2.38	P<0.001*

p<0.05 – Significant

Mean pre-intervention, post-intervention and change in pain scores is represented below in Figure 7, its evident that all age group categories experience a similar pain reduction from the multidisciplinary treatment and exercise protocol, most pain reduction occurred within the 18 – 29 age group and the 40 – 49 age group, whereby both age groups had a mean pain reduction of 4.3 units, age group 30 – 39 had the second most pain reduction with a reduction of 4.2 units of pain measured on the VAS scale. Age group 80 – 90 had the least amount of pain reduction, with a pain scale change of 3.5 units on the VAS scale.

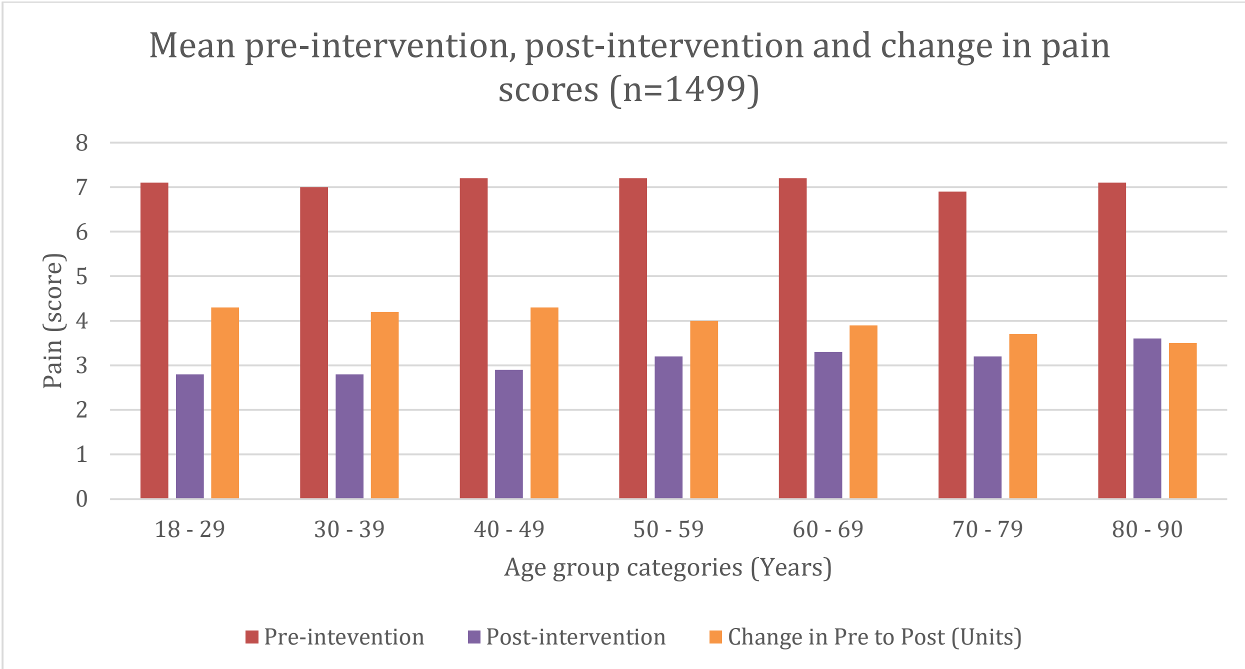

Figure 7: Mean pre-intervention, post-intervention and change in pain scores (n=1499)

Objective 1 & 3

To determine the effectiveness of the 6-week DBC programme in a South African population in different age groups (18-29 / 30-39 / 40-49 / 50-59 / 60-69 / 70-79 / 80-90 years old), taken over the last 3 years (2018-2020) in terms of pain and range of motion.

To determine the effectiveness of the 6-week DBC protocol from pre-intervention to post intervention in terms of ROM.

Mean range of motion (^{0}) in all age categories for lumbar thoracic flexion, extension, rotation and lateral flexion for pre-intervention and post-intervention are shown in Table 5 below. All age groups were found to have an increased range of motion in all movements from pre-intervention to post-intervention.

The youngest age group category had the highest pre-intervention range of motions with the exception of Lateral flexion to the right, in which the age group 80 -90 had the highest pre-intervention values of $41.2^0 \pm 9.28^0$. The biggest difference between the youngest group and the other groups was that of the LTF, the youngest group had a pre-intervention value of $41.7^0 \pm 16.55^0$ with the next closest group being the 80 – 90 age group with $39.2^0 \pm 14.26^0$.

All other pre-intervention values were quite similar between all age groups, with the youngest age group having the most consistently better pre-intervention values and the eldest group having the most consistently worse pre-intervention values.

The majority of the age group categories had pre-intervention values below the norms[17] as provided as a refernce by the DBC framework. However, most age groups had a pre-intervention extension value within the accepted norm of 23^0 [17]- those included the age groups 18 – 29 which had had a mean of $27.1^0 \pm 9^0$, the age group 30 – 39 which had a mean of $25.8^0 \pm 7.86^0$ and the age group 40 – 49 which had a mean of $25.8^0 \pm 8.49^0$.In addition the age group 50 – 59 had a mean of $24.3^0 \pm 7.5^0$ and the age group 60 – 69 had a mean of $23.7^0 \pm 7.66^0$ which fell within the norms. Only the eldest two categories had pre-intervention extension ranges below the norms with age group 70 – 79 having a mean value of $22.1^0 \pm 7.39^0$ and 80 – 90 having a mean of $20.4^0 \pm 7.01^0$. Lumbar thoracic rotation seemed to be the furthest pre-intervention values from the norm.

Mean post-intervention values improved within all the age group categories for all measured range of motions. However, most age groups were unable to achieve the norm of 65^0 to 75^0 [17] for Lumbar thoracic rotation. The highest post-intervention values were found in the youngest age group category in which their mean values were $65.9^0 \pm 14.79^0$ to the left and $67.9^0 \pm 13.85^0$ to the right which were well within the norms. However, every other age group category was unable to achieve the targeted rotation set out by the DBC guidelines. The lowest of which belonged to the eldest age group in which their mean values were $50.7^0 \pm 12.42^0$ to the left and $53.1^0 \pm 11.4^0$ to the right. The age group closest to achieving the norms (without having achieved them) was that of the age group 30 – 39, followed by the second youngest age group category, with mean values of $61.9^0 \pm 16.69^0$ to the left and $64^0 \pm 14.81^0$ to the right.

Lumbar thoracic flexion had only two age groups able to achieve the norms set out by the DBC framework. Age group 18 – 29 and 70 – 79 had mean post-intervention values of $50.6^0 \pm 10.17^0$ and $45.7^0 \pm 12.59^0$ respectively, with the reported norm being 45^0 [17]. The other three age groups were found to be only 1 – 2 degrees short of the norm. All mean ranges of motion (°) for the lumbar thoracic spine, were found to significantly change($p<0.001$) pre to post intervention.

Table 5: Mean range of motion (°) for the lumbar thoracic spine, pre and post intervention groups of individuals with LBP (n = 1499).

	18-29			30-39			40 - 49			50 - 59		
Lumbar spine movement	Pre-Intervention Mean ± SD	Post-Intervention Mean ±SD	P value	Pre-Intervention Mean ± SD	Post-Intervention Mean ±SD	P value	Pre-Intervention Mean ± SD	Post-Intervention Mean ±SD	P value	Pre-Intervention Mean ± SD	Post-Intervention Mean ±SD	P value
Lumbar thoracic extension	41.7 ± 16.55	50.6 ± 10.17	P < 0,001	33.1 ± 13.61	44.2 ± 13.28	P < 0,001	31.9 ± 13.44	43.5 ± 13	P < 0,001	31.4 ± 13.04	44.1 ± 12.21	P < 0,001
Lumbar thoracic flexion	27.1 ± 9	33.3 ± 7.47	P < 0,001	25.8 ± 7.86	32.3 ± 8.61	P < 0,001	25.8 ± 8.49	32.2 ± 8.7	P < 0,001	24.3 ± 7.5	30.9 ± 7.52	P < 0,001
Lumbar thoracic rotation to the left	40.9 ± 15.44	65.9 ± 14.79	P < 0,001	37.8 ± 13.23	61.9 ± 16.69	P < 0,001	38.4 ± 12.08	61.5 ± 16.11	P < 0,001	38.4 ± 13.36	62.7 ± 16.34	P < 0,001
Lumbar thoracic rotation to the right	41.8 ± 15.79	67.9 ± 13.85	P < 0,001	38.2 ± 13.03	64 ± 14.81	P < 0,001	37.2 ± 12.77	62.9 ± 15.84	P < 0,001	37.2 ± 13.43	63.6 ± 15.91	P < 0,001
Lumbar thoracic lateral flexion to the left	41.1 ± 11.01	65.9 ± 9.57	P < 0,001	40.2 ± 10.76	53.5 ± 9.79	P < 0,001	39.4 ± 10.68	52.7 ± 10.32	P < 0,001	38.2 ± 10.68	52.7 ± 10.14	P < 0,001
Lumbar thoracic lateral flexion to the right	40.8 ± 11.87	54.3 ± 9.82	P < 0,001	40.7 ± 11.09	53.6 ± 10.15	P < 0,001	39.6 ± 10.87	52.6 ± 10.42	P < 0,001	38.5 ± 10.79	52.8 ± 9.82	P < 0,001

	60 - 69			70 - 79			80 - 89			Total		
Lumbar spine movement	**Pre-Intervention Mean ± SD**	**Post-Intervention Mean ±SD**	**P value**	**Pre-Intervention Mean ± SD**	**Post-Intervention Mean ±SD**	**P value**	**Pre-Intervention Mean ± SD**	**Post-Intervention Mean ±SD**	**P value**	**Pre-Intervention Mean ± SD**	**Post-Intervention Mean ±SD**	**P value**
Lumbar thoracic extension	33.8 ± 13.56	44.2 ± 11.87	P < 0,001	36.9 ± 13.38	45.7 ± 12.59	P < 0,001	39.2 ± 14.26	44.1 ± 12.33	P < 0,001	33.5 ± 13.62	44.5 ± 12.52	P < 0,001
Lumbar thoracic flexion	23.7 ± 7.66	30.2 ± 7.17	P < 0,001	22.1 ± 7.39	28.6 ± 7.26	P < 0,001	20.4 ± 7.01	27.2 ± 7.3	P < 0,001	24.4 ± 7.98	30.9 ± 7.97	P < 0,001
Lumbar thoracic rotation to the left	39.9 ± 13.75	59.9 ± 17.44	P < 0,001	38.2 ± 13.22	57.2 ± 14.18	P < 0,001	39.1 ± 14.39	50.7 ± 12.42	P < 0,001	38.7 ± 13.16	60.8 ± 16.32	P < 0,001
Lumbar thoracic rotation to the right	39.5 ± 12.95	61.2 ± 16.17	P < 0,001	37.7 ± 13.47	57.7 ± 14.78	P < 0,001	38.7 ± 13.99	53.1 ± 11.4	P < 0,001	38 ± 13.23	62.1 ± 15.7	P < 0,001
Lumbar thoracic lateral flexion to the left	39.5 ± 9.78	51.6 ± 10.56	P < 0,001	38.8 ± 10.02	50.1 ± 8.84	P < 0,001	40.5 ± 8.83	48.2 ± 8.52	P < 0,001	39.3 ± 10.41	52.2 ± 10.08	P < 0,001
Lumbar thoracic lateral flexion to the right	39.2 ± 10.55	51.6 ± 10.37	P < 0,001	38.9 ± 10.07	50.4 ± 9.14	P < 0,001	41.2 ± 9.28	49.3 ± 8.54	P < 0,001	39.4 ± 10.72	52.3 ± 10.07	P < 0,001

Mean degree changes from pre-intervention to post-intervention can be seen in Figure 8 below. The initial trend that can be seen shows a greater change within the youngest age group, with a decline in pre- to post-intervention changes as the categories move towards the older age groups.

Another trend that can be seen is that each age experienced similar changes in all ROMs with the exception of the oldest age group in which their flexion ROM doesn't change like the other age groups (their pre-intervention values were $39.2^0 \pm 14.26^0$ with a post-intervention of $44.1^0 \pm 12.33^0$ with a change of 4.9 degree's). The highest within the flexion ROM in degree change was the 50 – 59 age group, with a pre-intervention ROM of $31.4^0 \pm 13.04^0$ and a post-intervention ROM of $44.1^0 \pm 12.21^0$-with the change being a difference of $12,7^0$.

The group with the least change following the 80 – 90 group was that of the 79 – 79 age group, with pre-intervention values of $36.9^0 \pm 13.38^0$ and post-intervention of $45.7^0 \pm 12.59^0$, with a difference of $8,8^0$, almost double that of the oldest group.

Extension ROM was seen to be the least changing ROM between all the movements in all the age groups. The greatest change was seen in the oldest group of 80 – 90, their pre-intervention values were $20.4^0 \pm 7.01^0$ for ROM, with a post-intervention ROM of $27.2^0 \pm 7.3^0$- with the change being 6.8 degree's. The least change was in the youngest age group of 18 – 29, with pre-intervention ROM values of $27.1^0 \pm 9^0$ and post-intervention ROM values of $33.3^0 \pm 7.47^0$ with a change of 6.2 degree's. It is important to note that most age group pre-intervention movements were well within the norms for extension and therefore no significant change in these values were expected.

Lumbar thoracic rotation had the greatest changes in ROM within all age groups, with an interesting observation in which all age groups had better mobility towards the right side compared to the left. Its also interesting to note the degree's of change diminish as the age groups get older. The greatest changes in rotational ROM was the 18 – 29 age group and the 50 -59 age group having pre-intervention ROM values of $40.9^0 \pm 15.44^0$ to the left and $41.8^0 \pm 15.79^0$ to the right for the younger group and $38.4^0 \pm 13.36^0$ to the left and $37.2^0 \pm 13.43^0$ to the right in the 50 – 59 age group. The changes in ROM were 25^0 to the left and 26.1^0 to the right for the younger age group and 24.3^0 to the left and 26.4^0 to the right in the 50 – 59 age group.

The oldest age group had the most noticeable lowest change in rotation with a pre-intervention ROM value of $39.1^0 \pm 14.39^0$ to the left and $38.7^0 \pm 13.99^0$ to the right with a post-intervention ROM value of $50.7^0 \pm 12.42^0$ to the left and $53.1^0 \pm 11.4^0$ to the right-the change being 11.6^0 to the left and 14.4^0 to the right. Interestingly the youngest four age groups had very similar values, with only the last three age groups varying noticeably.

Lumbar thoracic lateral flexion seemed to be the most consistently changed ROM between all age groups with the exception of the oldest group. The first four age group categories had values varying from 14.5^0 to the left and 14.3^0 to the right in the 50 – 59 age group (the highest) to 13.3^0 to the left and 12.9^0 to the right in the 30 – 39 age group category (Lowest amongst the first four age groups). This showed a relatively small variation between the age groups. However, the oldest two age groups had a change of 11.3^0 to the left and 11.5^0 to the right in the 70 – 79 age group and 7.7^0 to the left and 8.1^0 to the right in the 80 – 90 age group.

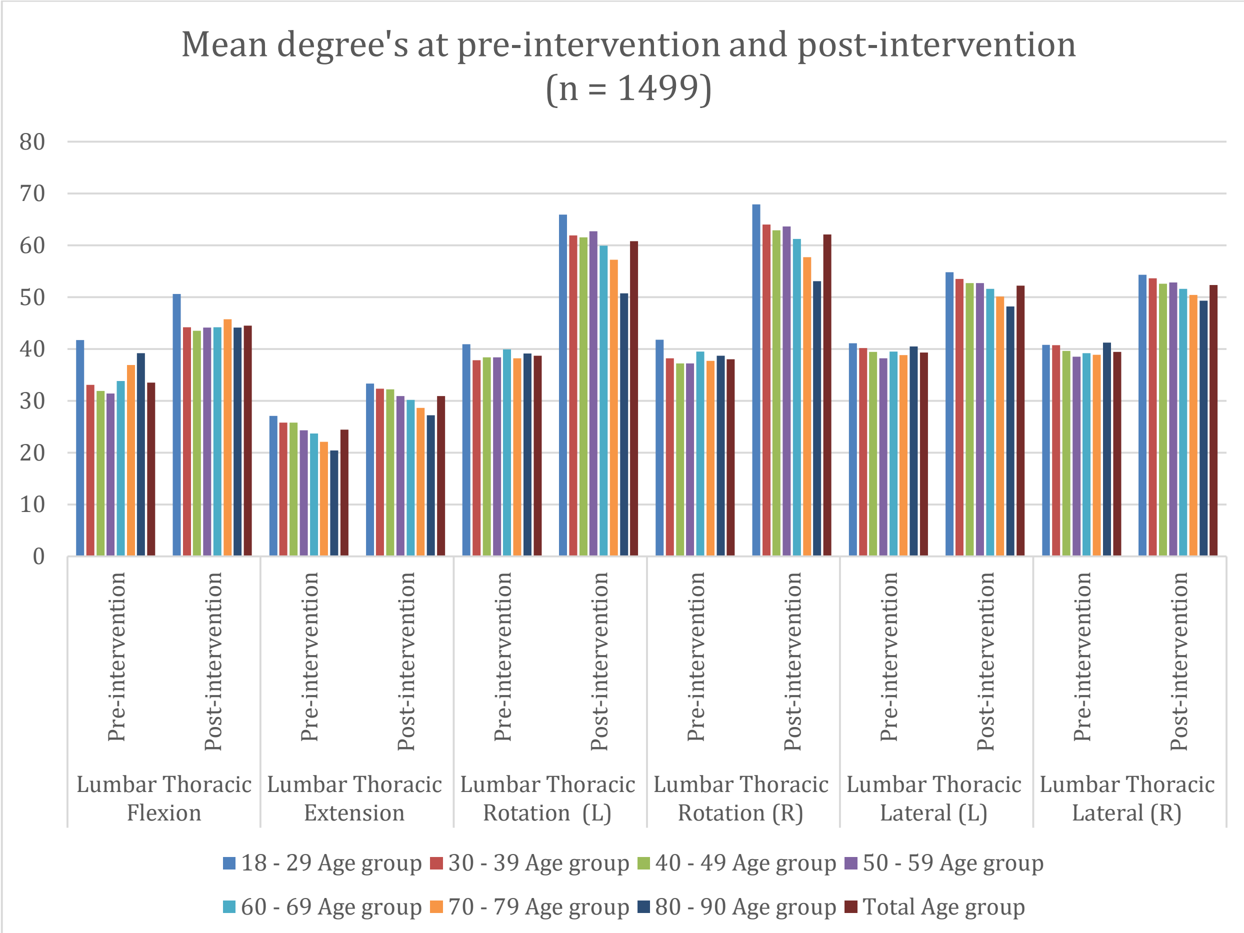

Figure 8: Mean degrees at pre-intervention and post-intervention (n=1499)

CHAPTER 5: DISCUSSION

Demographics

The sample of this study comprised of more females (63.8%) than males (36.2%). There were more females in each age group except for the elderly group of 80 - 90 years of age (43.6% female to 56.4% male). There is a clear trend whereby there is an increase in females up to the 50 – 59 age group category, followed by a decrease to the point of 80-90 years where more males were observed Overall, the youngest age group, 18 – 29, and the oldest age group category, 70 - 79, comprised of the most equally distributed participants with 57.1% females compared to 42.9% males in the younger group and 56.8% female to 43.2% male within the older group, the 30 – 39, 40 – 49 and 60 - 69 age group categories all had a similar distribution comprising of 60.3% females to 39.7% males, 64.9% female to 35.1% male and 65.5% female to 34.5% male respectively. The 50 - 59 age group category had the most unequally balanced ratio of participants comprised of 70.4% female to 29.6% male.

This was like many other studies, for example a meta-analysis in which 249 trials revealed an average of 59% female participants compared to a 41% male participation[42]. This is trend amongst the literature. A systematic review including 35 studies performed on the elderly in which lower back pain conditions were studied and they found that amongst those 35 studies the predominant gender was female participants[44], another systematic review on no specific chronic low back pain (NSCLBP), in which they included 165 studies, also finding the predominant gender being female participants, it was suggested that this may be due to the predominance of women suffering from lower back pain more than men[34]. This however is the first study the researcher is aware of that compares prevalence of injuries across age groups between genders. This therefore provides insight and bridges the knowledge gap in the south African context on gender prevalence rates across age groups in individuals with low back pain.

Pain

This study found that for 91.9% of individuals participating in the intervention (n=1377), there was a reduction in lower back pain measured on the VAS pain scale (appendix G), while for 5.2% (n=78) there was no change in pain, and for only 2.9% there was an increase in pain (n=44). Furthermore out of the 44 patients who experienced an increase in pain, 30 individuals had an increase in pain of 1 unit, 5 patients experienced an increase in pain of 2 units , 6 patients experienced an increase in pain of 3 units, 2 patients experienced an increase of pain of 4 units and one patient experienced an increase of pain of 6 units. These negative outcomes may have been a result of specific diagnosis that may not have responded as well to the treatment, another possibility may be the compliance the patient had to the protocol, However there was no information captured as to how compliant patients were to the programme, this would be a great addition to future studies to ascertain the reasoning behind these specific negative outcomes.

Overall, however, the mean pain scores across all age categories were reported to be 7.1 out of 10 with a standard deviation of only 1.77. Following the intervention, overall mean pain scores reduced to a mean value of 3.1 out of 10 ± 2.38 across the age group categories. This was found to be statistically significant ($p<0.001$) and hence clinically significant.

The highest pre-intervention pain score was reported in the 50 - 59 age group and 60 - 69 age group, with a mean pain score of 7.2 ± 1.8 and 7.2 ± 1.84 respectively. The lowest mean score reported was within the 70 - 79 age group, with a mean pain score of 6.9 ± 1.89. Interestingly, the age groups that achieved the greatest positive change from pre-intervention to post-intervention was that of the 18 - 29 age group and the 40 -49 age group for which both had a reduced mean pain score of 4.3 following the intervention, This was perhaps due to their younger age, the physiological response to the intervention was perhaps more pronounced. The reduction in pain across all age groups indicates that the South African adapted DBC protocol was effective in reducing back pain following the intervention across all age groups. In fact, there was significant change where all age group categories p values were $p<0.001$

In comparison, a study revealed no significant difference in pain relating to age group categories following an exercise intervention, interestingly the study attributed the non-significance to the perceptual component of pain, they found that the older age group categories perceived their physical wellbeing in a more positive mental state[47].

However, the current study has found a trend in which the younger age group categories began the protocol with reduced pre-intervention pain scale levels and finished the protocol with greater pain scale changes. This indicating that perhaps age does influence the efficacy of treatment. Unfortunately, very few studies have documented the effect treatment has on different age group categories, thus it is difficult to corroborate findings

In terms of pain, a review article looking at non-surgical treatments and their effect on pain relief within patients suffering with lower disk herniations (LDH), His finding suggested that within the physical and behavioural modal of treatment, heat therapy, exercise and traction were recommended for lower disk herniation, whereas electrical therapy was found to be inconclusive and bed rest deemed to be not recommended[28]. Once again however no information regarding response differences across age groups was provided. This seems to be a large limitation in this field of research and something that needs to be mitigated in the future.

Since there is s shift towards using standardised protocols and interventions in therapies , there is a need to effectively document patient responses across age groups, and genders so that if adverse effects are found special recommendations can be made.

Range of Motion

Range of motion was assessed pre-intervention to post-intervention in this study, and it was found that for all age groups there was an increase in ROM following the intervention. This indicates that the multi-disciplinary treatment and exercise protocol was effective in improving ROM following the intervention across all age groups. In fact, there was a significant change across all age groups ($p<0.001$). Furthermore, like the change in pain scores across age groups, for ROM (in degrees) the improvement was noticeably reduced within the older age group categories, possibly due to the level of degeneration or lack of ability to heal as effectively as the younger population[46].

Lumbar Thoracic Flexion Range of Motion:

Age group category 18 – 29 had a mean pre-intervention LTF of $41.7^0 \pm 16.55^0$ with a mean post-intervention flexion of $50.6^0 \pm 10.17^0$, this youngest age group had the highest pre and post intervention values, interestingly the eldest age group had the next closest pre intervention values, this may be the result of the natural tendency for the elderly to become more stooped as they become older[52], the age group 80 – 90 had a mean pre-intervention LTF of $39.2^0 \pm 14.26^0$ with a mean post-intervention flexion of $44.1^0 \pm 12.33^0$ followed by the age group 70 – 79 in which the mean pre-intervention LTF was $36.9^0 \pm 13.38^0$ with a mean post-intervention flexion of $45.7^0 \pm 12.59^0$, the 70 – 79 and 80 - 90 age groups were unable to achieve a post-intervention value similar to that of the youngest age group.

Age group category 30 – 39 and 60 – 69 had similar values in which they recorded a mean pre-intervention LTF of $33.1^0 \pm 13.61^0$ with a mean post-intervention flexion of $44.2^0 \pm 13.28^0$ and a mean pre-intervention LTF of $33.8^0 \pm 13.56^0$ with a mean post-intervention flexion of $44.2^0 \pm 11.87^0$ respectively, age group categories 40 – 49 and 50 – 59, both too shared similar values in which the mean pre-intervention LTF was $31.9^0 \pm 13.44^0$ with a mean post-intervention flexion was $43.5^0 \pm 13^0$, and mean pre-intervention LTF was $31.4^0 \pm 13.04^0$ with a mean post-intervention flexion of $44.1^0 \pm 12.21^0$ receptively, Although the 50 – 59 age group experienced the greatest improvement, the 18 – 30 age group achieved the highest mean ROM. Although all age groups achieved an improvement in flexion, it is still evident that most of the age groups (all except age

groups 18 – 30 and 70 – 79) were unable to achieve the lowest range of the norms. the 80 -90 age groups experienced a significantly smaller improvement to flexion.
. Interestingly flexion seemed to be the most consistently changed movement amount all categories

The norm for LTF as mentioned below is between 45^0 - 55^0 [16], all age group categories pre-intervention flexion measurements were below the norms, the 18 – 30 age group had the better mean flexion of the age categories, with only being a mean of 3.3^0 away from the norm, the 50 – 59 age group were furthest from the norms with a mean deficit of 13.6^0, at post-intervention measurement all age group categories improved, with the most significant improvement being in the 50 – 59 age group. Possibly due to the underperformance within the pre-intervention assessment there was greater room for improvement.

A study found a similar trend in which post-intervention lumbar flexion was significantly higher in the younger population in comparison to the elderly population[52]. Another study assessed the lumbar, thoracic ROM of office workers in comparison to forklift drivers; their findings were that in thoracic flexion amongst the office workers the mean ROM was $33.2^0 \pm 8.3^0$ [38], similar to that of this study's findings.

Lumbar Thoracic Extension Range of Motion:

The youngest age group has the best of the pre-intervention and post-intervention values with a mean pre-intervention LTE of $27.1^0 \pm 9^0$ and mean post-intervention extension of $33.3^0 \pm 7.47^0$, interestingly all values within the extension range of motion diminish as the age increases.

The first four age group categories pre-intervention measurements fall within the norm for extension according to the DBC protocol, however age group categories 70 – 79 and 80 – 90 had mean pre-intervention LTE of $22.1^0 \pm 7.39^0$ with a mean post-intervention extension of $28.6^0 \pm 7.26^0$, and mean pre-intervention LTE of $20.4^0 \pm 7.01^0$ with a mean post-intervention extension of $27.2^0 \pm 7.3^0$, both below the suggested ranges. This again could be due the stooping posture associated with elderly individuals.

However, all post-intervention values were well within the provided norms as seen above. A study in which they observed the ROM in participants of different sex and ages, the study found the same trend in which as the age groups move toward a more advanced age their extension ROM diminishes.

The norm for extension is $23^0 – 34^0$ [16]. Age groups 70 – 79 and 80 – 90, were the only two categories that failed to achieve the normal ROM at pre-intervention only by a deficit of 0.9^0 and 2.6^0 respectively. All other age groups were well within the normal ROM for extension from pre-intervention, age groups all experienced a similar increase in extension throughout the protocol varying between 6.2^0 (18 – 30 Age group) – 6.8^0 (80 – 90 age group) mean degrees of change, interestingly the greatest improvement from pre-intervention to post-intervention was seen in the oldest age group.

A study considered the involvement of both lumbar extension and flexion on patients suffering with non-specific chronic low back pain; their findings were that the rehabilitation and increasing of lumbar extension and flexion were statistically relevant in the reduction of pain, they also stated the importance of facilitating the activation of the muscles involved in these two movements, another function that this study focused on[50]. This study found similar findings with an improvement of these two ROM's from pre- to post-intervention measurements, and the subsequent improvement in pain.

Lumbar Thoracic Rotation Range of Motion:

The youngest of the age groups were found to have the better of the pre and post-intervention values, their mean pre-intervention LTR to the left was $40.9^0 \pm 15.44^0$ with a mean post-intervention rotation of $65.9^0 \pm 14.79^0$ and to the right was $41.8^0 \pm 15.79^0$ with a mean post-intervention rotation of $67.9^0 \pm 13.85^0$, with this group being the only age group to achieve a post-intervention of more than 65 degree's.

The age group category of 50 – 59 had the next best post-intervention value with a mean pre-intervention LTR to the left of $38.4^0 \pm 13.36^0$ with a mean post-intervention rotation of $62.7^0 \pm 16.34^0$ and to the right was $37.2^0 \pm 13.43^0$ with a mean post-intervention rotation of $63.6^0 \pm 15.91^0$, The age groups of 30 – 39, 40 – 49 and 50 - 59 were unable to achieve a post-intervention value of over 65 degree's as suggested by the DBC protocol, the age group categories of 30 – 39 had a post-intervention LTR of $61.9^0 \pm 16.69^0$ to the left and $64^0 \pm 14.81^0$ to the right, 40 - 49 age group had post-intervention LTR to the left of $61.5^0 \pm 16.11^0$ and to the right was $62.9^0 \pm 15.84^0$

A study assessed the lumbar, thoracic ROM of office workers in comparison to forklift drivers, the study found that the mean thoracic rotation of office workers was $29.6^0 \pm 7.6^0$ to the left and $31.5^0 \pm 8.1^0$ to the right[53], being slight reduced from the finding of this study.

The norm for LTR was $65^0 – 75^0$ [16], of which the mean pre-intervention total age categories were only able to achieve about 58% of the minimum acceptable rotational degree's, and at post-intervention the mean percentage of total age categories was at 94% of the minimum acceptable norm ranges for rotation, only the age group category of 18 – 30 were able to achieve a mean post-intervention range within the norms, with the 80 – 90 age group category unable to achieve up to 80% of the minimum range required.

There was also a noticeable difference from movement to the right compared to the left in all age group categories. Although rotation was the biggest mean range of improvement it was the only range of motion in which patients were unable to achieve movement within the suggested norm ranges.

A study measured the lumbar rotation of male individuals in different positions; their finding were very much like that of this study, patients diagnosed with non-specific chronic low back pain (NSCLBP) had reduced lumbar rotational ROM within a mean range of 35^0, interestingly similar to what this study has identified, the study also identified a trend in which their lumbar rotation values were asymmetrical, favouring more movement to the right-hand side in patients diagnosed with NSCLBP, as it has been found in this study, the assumption was that movement favouring dominant sides may be the reason although the literature is uncertain as to the reason. Thus, the suggestion is that limited rotation is commonly associated with patients suffering from NSCLBP[51].

Another study also found individuals suffering with lower back pain to have a reduced lumbar regional rotation when assessing lumbar spine kinematics in people with and without low back pain during walking [54].

Lumbar Thoracic Lateral Flexion Range of Motion:

The youngest age group had a mean post-intervention lateral flexion of $65.9^0 \pm 9.57^0$ to the left interestingly showing a significantly large variation in comparison to right in which the mean post-intervention lateral flexion was $54.3^0 \pm 9.82^0$. More than 10 degrees between the left and right lateral movement. The age group category with the second-best pre-intervention values interestingly was that of the age group category 80 – 90 with very little variance between the left and the right post-intervention, in which the mean post-intervention lateral flexion to the left was $48.2^0 \pm 8.52^0$, and the mean post-intervention lateral flexion to the right was $49.3^0 \pm 8.54^0$.

However, the response to lateral flexion as far a post-intervention values were recorded followed a linear pattern in which each subsequent age group had a reduced value compared to the following group. Age group category 30 – 39 had a mean post-intervention LTL to the left of $53.5^0 \pm 9.79^0$, the mean posr-intervention to the right was $53.6^0 \pm 10.15^0$, age group category 70 – 79 had a mean post-intervention LTL to the left of $50.1^0 \pm 8.84^0$, the mean post-intervention LTL to the right was $50.4^0 \pm 9.14^0$. the lateral flexion range of motion had the most consistent measurements between all age groups.

This phenomenon has been observed in other studies, in which they observed the lumbar thoracic ROM in participants of different sex and ages. The study found a similar trend in which all age groups had very similar lateral flexion movements pre-intervention[55].

The norm for LTL is $45^0 – 55^0$ [16], at the pre-intervention stage lateral flexion had a mean percentage of 87% to the lower range of the suggested norms with a small variance between age categories, at the post-intervention stage the patients in all age group categories were able to attain a normal range of lateral flexion, however, more pronounce at the younger age categories decreasing linearly towards the older categories.

A study identified a reduction in lumbar lateral flexion is significantly related to the likelihood of future lower back pain. The study stressed the importance of identifying other lumbar thoracic muscles and their possible involvement in lumbar pain for future studies[56]. This study supports the finding in which lumbar lateral flexion at pre-intervention was assessed at below the normative values and improved throughout the intervention congruently with pain reduction all age group categories. interestingly it can be seen that the age group category with the smallest improvement to Lumbar lateral flexion was similarly the smaller improvement in pre to post intervention pain.

To the researcher's knowledge no single study has identified the effects of rehabilitation on all associated lumbar thoracic movement, this study has attempted to identify how a protocol-based rehabilitation programme can influence lumbar thoracic ROM, and the associated improvement to pain in different age group categories.

CHAPTER 6: CONCLUSIONS, STRENGTHS & LIMITATIONS AND RECOMMENDATIONS

6.1 Conclusion

This study shows the positive effects of a multidisciplinary, protocol-based approach to rehabilitation, performed by Biokineticists and Physiotherapists for patients suffering from lower back pain. With a mean success rate of 91.2% reduction of pain and an improvement of all ROM's, across all age group categories for the participants in this study.

Specifically the Lumbar thoracic flexion, range of motion, in the elderly population seemed to be less improved following the intervention compared with other age groups. Rotational movements were also found to be a problem in all age group categories, although there was improvement in rotation, of all age groups with the except for the 18 - 30 age group who were unable to achieve the norms.

Although the protocol was effective for the majority of the participants , there was an increase in levels of self-reported pain amongst 44 of the 1499 participant, however no post-intervention assessment tool was used to interpret the increase in pain. Therefore, future implementation of the programme needs to consider this and make relevant adaptations to prevent this in future.

Lastly, this study has shown that the DBC can effectively improve pain and ROM in individuals with low back pain and should be considered as a treatment option for those seeking therapy

6.2 Strengths

The study was able to analyse 1511 data sets of which 1499 data sets were used, all practices performed the assessment measures, clinical treatment methods and exercise protocol, over a 6-week period. Thus, allowing for a standardized treatment plan. The protocol was performed on individuals suffering with low back pain ranging from the ages of 18 – 90 years old. Thus, allowing the researcher to make important inferences regarding different age groups and the efficacy of a multidisciplinary treatment and exercise based protocol.

6.3 Limitations

Assessing the efficacy of the protocol between different diagnoses of the lower back would have been insightful, unfortunately there was no captured data on the data base specifying different lower back diagnoses of the patients. This is something that can be included in future research.

A large portion of assessing the efficacy of the protocol is based upon the self-reporting of pain, this however considered an industry norm.

There was an increase in levels of self-reported pain amongst 44 of the 1499 participant, with no indication as to the reason, this is a limitation, as success of the programme cannot be guaranteed even though the majority of patients performed extremely well. In future patients need to be made aware that there is a risk of increased pain. Further research is needed to identify why few individuals experience this adverse effect.

This study never reported on the dominant or non-dominant sides of the participant, thus makes it difficult to interpret the change in ROM, however all participants performed movements and repetitions equally between the left and the right hand-side, under the same load.

The norms for this study were obtained from the Finnish protocol as norms from South Africa do not exist for the DBC protocol.

The research was performed on a pre-existing protocol and data sets, thus certain data points were unable to be assessed.

6.4 Recommendations

- The South African DBC protocol should be prescribed for individuals of all ages suffering with low back pain, the protocol has been proven to both reduce pain and improve ROM in all age groups.
- Future research should consider the elderly population and determine whether the programme needs to be slightly adapted for the age groups of 80 – 89, although this age group had a positive response to the protocol it would be beneficial to determine whether an adaption to the protocol would provide a better outcome.
- Assessing the effect, a multidisciplinary, protocol-based approach to rehabilitation has on the economy of a country could help mitigate financial burden

- DBC protocol specific recommendations :
- Specifically the Lumbar thoracic flexion, range of motion, in the elderly population seemed to be less improved following the intervention compared with other age groups- the recommendation would be to facilitate more flexion in this age group in an attempt to bring them more in line with the norms.
- More rotational movements need to be facilitated in the attempt to achieve the normal ranges across all age groups.
- It would be important to identify the reason behind why individuals had an unsuccessful experience with the protocol to better understand how it may need to be adapted.

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LIST OF APENDICES

APPENDIX A: PERMISSION LETTER FOR DATA US

The Back Clinic

LAM, MCONCOZA
and partners Medical Services

REHABILITY

21/04/2021

To whom it may concern

This letter is to confirm that Cocoa Lam and Silindile Mconcoza as partners of Lam, Mconcoza and partners and The Back Clinic, hereby give permission to Matthew Bennett to use data provided by The Back Clinic for the purpose of his thesis.

Feel free to contact us for any further queries.

Cocoa Lam
Partner

S. Mconcoza
Silindile Mconcoza
Partner

Lam, Mconcoza & Partners – Practice Number: 0507822
Head Office: 110, 11th Street, Parkmore, Johannesburg 2196
email: info@thebackclinic.co.za tel: 0861 101 353
web: www.thebackclinic.co.za | www.rehability.co.za

Appendix B:

- **Assessment day:**
    - Documentation: Indemnity, medical history.
    - Biokineticist assessment: ROM, Pain scale, functional ability.
    - Doctors assessment: Contra-indication to protocol, medication, imaging.
- **First session:**
    - Physiotherapist assessment: Palpation, special test.
    - Biokineticist session: Home program, Stretches and core activation.
- **Session 2 – 5:**
    - Physio treatment: Needling, TENS, ultrasound, myofascial release, manual treatment.
    - Biokinetics treatment: 30 repetitions on each DBC machine.
- **Session 6 (Re-assessment):**
    - Biokineticist re-assessment: ROM, Pain scale, functional ability.
    - Doctor re-assessment: Progress or regression check.
    - Physio treatment: Needling, TENS, ultrasound, myofascial release, manual treatment.
    - Biokinetics treatment: 30 repetitions on each DBC machine.
- **Session 7 – 11:**
    - Physio treatment: Needling, TENS, ultrasound, myofascial release, manual treatment.
    - Biokinetics treatment: 30 repetitions on each DBC machine.
- **Session 12 (Final assessment):**
    - Biokineticist re-assessment: ROM, Pain scale, functional ability.
    - Doctor re-assessment: Progress or regression check.
    - Physio treatment: Needling, TENS, ultrasound, myofascial release, manual treatment.
    - Biokinetics treatment: 30 repetitions on each DBC machine.

APPENDIX C: MEDICAL HISTORY FORM

LAM MCONCOZA
AND PARTNERS

MEDICAL HISTORY

Previous illnesses/conditions ***(Circle relevant description and tick applicable block)***

*Tick family history if any of your children, brothers and sisters, parents, grandparents, have / had the illness / condition

	Yes	No	Family History		Yes	No	Family History
Heart disease (e.g. Angina/Thrombosis/Congenital/Rheumatic fever)				Are you receiving chemo/radiation therapy?			
Blood Pressure HIGH/LOW				Are you pregnant?			
Varicose veins/Thrombosis of veins/Circulatory problems				Are you breastfeeding?			
Asthma/Bronchitis/TB/Other lung disease				Do you smoke?			
Jaundice/Other liver conditions e.g. Hepatitis				Do you have a pacemaker?			
Diabetes Mellitus				Do you have difficulty sleeping?			
Thyroid Overactive/Underactive/Other				Are you usually awake between 23h00 and 02h00?			
Gastric/Duodenal ulcer/Hiatus hernia/Diarrhea				Do have trouble falling asleep?			
Kidney or bladder disease				Does spinal pain wake you?			
Porphyria				Do you have abnormal bladder function?			
Patient or family member				Do you have abnormal bowel function?			
Genetic/Congenital history of pathology (e.g. birth defects)				Does your pain affect your normal sexual function?			
Epilepsy/Other neurological or muscular disorders				Do you have regular headaches?			
Excessive bleeding after extractions, injury or operations				Do you have dizzy spells?			
Back/neck problems e.g. whiplash, scoliosis, extra vertebrae				Does the pain get worse as the day progresses/at night/with? walking			
Rheumatoid disease				Does the pain get worse when coughing/sneezing?			
Other severe joint disease				Have you experienced any unexplained weight loss?			
Increased eye pressure (Glaucoma)				Do you suffer from sensation loss in your saddle region?			
Malignant disease (Cancer)				Do you suffer from night sweats?			
Any recent illness e.g. cough, cold				Do you suffer from abdominal pain in conjunction with back pain?			
Are you taking Steroids/Contraceptives/Cortisone				Do you suffer from Osteoporosis (bone loss)?			

Describe your current complaint / condition / pain:	
List all work mechanical stresses you experience: List all leisure mechanical stresses you experience: List all medication you are currently taking: Do you have any medical conditions you suffer from that we should be aware of? Are you Pregnant or Breast feeding? Name any allergies / sensitivities you have, including allergies you have to any medication: List any previous surgery you have had, and the dates.	
List X-rays / MRI / sonar / other special test in the past 12 months:	
On a scale of 0 to 10, how intense is your pain? (0 = no pain and 10 = most intense pain)?	
How long have you had the current pain?	
What caused your current pain?	
What makes your symptoms worse?	
What makes your symptoms better?	
At what time of day is your pain the worst? Morning ◯ As the day progresses ◯ Afternoon ◯	Evening ◯
At what time of day is your pain better? Morning ◯ As the day progresses ◯ Afternoon ◯	Evening ◯
List any religious/cultural considerations we should be aware of:	

APPENDIX D: STarT BACK SCREENING TOOL

Name: ______________________________________ Date: _________________

The Keele STarT Back Screening Tool

Thinking about the last 2 weeks tick your response to the following questions:

		Disagree	Agree
		0	1
1	My back pain has spread down my leg(s) at some time in the last 2 weeks.		
2	I have had pain in the shoulder or neck at some time in the last 2 weeks.		
3	I have only walked short distances because of my back pain.		
4	In the last 2 weeks, I have dressed more slowly than usual because of back pain.		
5	It's not really safe for a person with a condition like mine to be physically active.		
6	Worrying thoughts have been going through my mind a lot of the time.		
7	I feel that my back pain is terrible and it's never going to get any better.		
8	In general I have not enjoyed all the things I used to enjoy.		

9 Overall, how bothersome has your back pain been in the last 2 weeks?

Not at all	0
Slightly	0
Moderately	0
Very much	1
Extremely	1

Total Score: Add Question 1 - 9	
Sub Score: Add Question 5 - 9	

If Total Score is **3 or less** *patient is scored as*	**LOW RISK**
If Total Score is **4 or more** *use the Sub* **score total:** *Sub score total* **3 or less**	**MEDIUM RISK**
Sub score total **4 or more**	**HIGH RISK**

APPENDIX E: FEAR AVOIDANCE BEHAVIOURAL QUESTIONNAIRE (FABQ)

Initial Assessment

DBC GLOBAL

Name:______________________ Date: ____________

(FABQ)

Listed below are some statements that other patients have conveyed about their pain. Please choose one number for each statement that best describes your situation. Answer as carefully and accurately as possible, keeping in mind that there are no right or wrong answers. Please do not leave any questions blank. Your responses will be kept confidential

	Completely Disagree						Completely Agree
1. My pain was caused by physical activity.	0	1	2	3	4	5	6
2. Physical activity makes my pain worse	0	1	2	3	4	5	6
3. Physical activity might cause harm to my back.	0	1	2	3	4	5	6
4. I should not do physical activities that (may) make my pain worse.	0	1	2	3	4	5	6
5. I cannot do physical activities that (may) make my pain worse.	0	1	2	3	4	5	6
6. My pain was caused by the jobs I do at work or by an accident at work.	0	1	2	3	4	5	6
7. My work aggravated my pain.	0	1	2	3	4	5	6
8. My work is too physically demanding for me.	0	1	2	3	4	5	6
9. My work aggravates my pain or would make my pain worse.	0	1	2	3	4	5	6
10. My work may harm my back.	0	1	2	3	4	5	6
11. I should not do my normal work in my present condition.	0	1	2	3	4	5	6
12. I cannot do my normal work in my present condition.	0	1	2	3	4	5	6
13. I cannot do my normal work until my pain is treated.	0	1	2	3	4	5	6

APPENDIX F: ROTTER'S LOCUS OF CONTROL (RLC)

Initial Assessment

Name:____________________________ Date: _____________

DBC GLOBAL

RLC

Choose one number for each statement that best describes your situation. Answer as carefully and accurately as possible, keeping in mind that there are no right or wrong answers. Please do not leave any questions blank. Your responses will be kept confidential

	Completely Disagree				Completely Agree
1. My future health depends on what other people can do for me.	1	2	3	4	5
2. What I do for myself will determine my future health.	1	2	3	4	5
3. It is up to me to ensure that I make the best possible recovery in my circumstances.	1	2	3	4	5
4. Getting better now is a matter of my own determination more than anything else.	1	2	3	4	5
5. It does not matter how much help you get, in the end it is your own efforts that count.	1	2	3	4	5
6. It is often best just to wait and see what happens.	1	2	3	4	5
7. My own efforts are not very important to my recovery. My recovery really depends on those taking care of me.	1	2	3	4	5
8. My own contribution to my recovery will not effect much.	1	2	3	4	5
9. I have little or no control over my progress from now on. My work aggravates my pain or would make my pain worse.	1	2	3	4	5

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APPENDIX G: RIBBONS BEKKER DEPRESSION SCALE (RBDS)

Initial Assessment

DBC GLOBAL

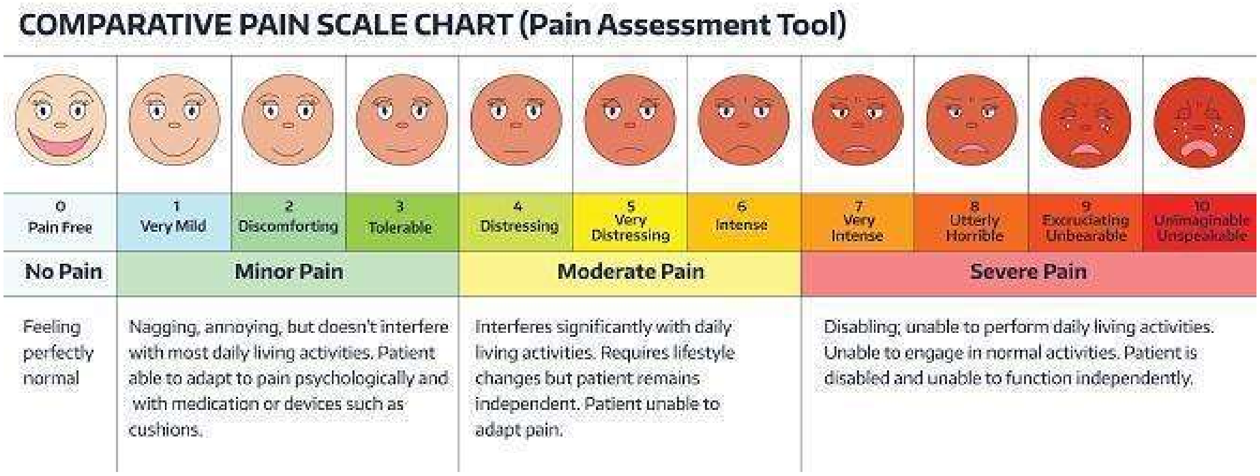
Name:______________________ Date: __________

RBDS

Choose one number for each question that most closely describes your situation. Answer as thoughtfully and accurately as possible, keeping in mind that there are no right or wrong answers. Please leave no question unanswered. Your responses will be kept confidential.

	No	A Little	Moderately	Severely
1. Have you noticed a recent decreased interest in your work and/or hobbies?	0	1	2	3
2. Have you noticed a recent decrease in your ability to make decisions and/or concentrate?	0	1	2	3
3. Have you noticed a recent change in your appetite or general physical well-being (unusually tired, fatigued more easily, etc.)?	0	1	2	3
4. Have you recently noticed any change in your general appearance, or have you experienced an increase in chest pain, gastrointestinal trouble, headache or diminished sexual interest?	0	1	2	3
5. Have you recently increased your consumption of alcohol and/or drugs with the intention of reducing anxiety?	0	1	2	3
6. Have you recently experienced increased self- blame, felt hopeless or had thoughts of not wanting to deal with life or living?	0	1	2	3
7. Have you recently been unusually irritable, tense or had crying spells?	0	1	2	3

APPENDIX H: VISUAL ANALOG SCALE PAIN SCALE



APPENDIX I: DATA COLLECTION SHEET

ESTIONNAIRES	Initial	Interim	Outcome
IOKINETICIST NAME:			
DATE:			
Pain Score			
Disability Index			
Locus of Control (RLC) Score			
Fear Avoidance Behaviour (FABQ) Score			
KEELE Score			
Surgical Risk			
The Patient-Specific Functional (PSFS) Scale			
Rimmons Brief Deppression Scale (RBDS) Score			

F	Flexion
E	Extension
L	Left
R	Right

BACK ROM	Baseline				Interim				Outcome				NORM			
Device	Date:				Date:				Date:							
LTE	F		E		F		E		F		E		F	45–55	E	23–34
LTR	L		R		L		R		L		R		65-75			
LTL	L		R		L		R		L		R		45-55			
Comment:																

BACK EMG: PASSIVE (Optional if PSFS done)	Baseline		Outcome		NORM
	L	R	L	R	
Upright standing					µV
Full flexion					< 10
Hyper extension					< 15
					< 15–20

BACK EMG: ACTIVE (Optional is PSFS done)		Baseline	Outcome		Baseline	Outcome	NORM		
Initial (B)	Left			Right			M: 100–120	F: 90–110	
Delta (D)	Left			Right			M: < 13	F: <15	µV
Time	Baseline			Outcome			90 seconds		%/min
Load	Baseline			Outcome			M: 7KG	F: 5KG	

NECK ROM	Baseline				Interim				Outcome				NORM			
Device	Date:				Date:				Date:							
CEE	F		E		F		E		F		E		F	30-35	E	20–28
C3R	L		R		L		R		L		R		65-80			

NECK EMG: PASSIVE (Optional if PSFS done)	Baseline		Outcome		NORM
	L	R	L	R	
Arms at side					µV
Shoulder retraction					< 30
Shoulder elevation					M: 120–150 F: 80–120
Shoulder depression					< 50
Shoulder contraction					50-80
					80-120

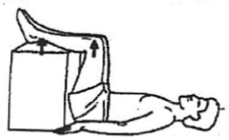
NECK EMG: ACTIVE (Optional if PSFS done)		Baseline	Outcome		Baseline	Outcome	NORM		
Initial (B)	Left			Right			M: 120–200	F: 120–200	µV
Delta (D)	Left			Right			M: < 13	F: <17	%/min
Time	Baseline			Outcome			90 seconds		

APPENDIX J: LOWER BACK STRETCHES (HOME PROGRAMME)

Back Stretches

Choose between 1a) and 1b)

1a

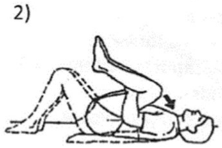


Lie on your back with knees bent or on a chair.
Pull pelvic floor muscles up and in. Hold approximately 10 seconds.
Repeat 10 times.
(Transvers)

1b)

Lie on your back with knees bent or on a chair.
Pull pelvic floor muscles up and in. Hold approximately 10 seconds.
Repeat 10 times.
(Transvers)

2)



Lie with your knees bent and feet on the floor. Lift your knees towards your chest. Place your hands behind both knees and pull them towards your chest. Hold 30 seconds.
Repeat 3 times.
(Back extensors)

Choose between 3a), 3b) and 3c)

3a)

Lie on your back with knees bent. Cross the ankle of the leg to be stretched over the other knee. Put your arms around the thigh as shown. Bring your thigh towards your stomach. Feel the stretch in your buttocks.
Hold 30 seconds.
(Piriformis)

3b)

Sit on a chair with your foot on the opposite knee.
Gently push your knee towards the floor.
Hold 30 seconds.
Repeat 3 times.
(Piriformis)

3c)

Stand with one leg straight and the other one bent on a table. Hold on to the table. Gently bend your straight leg. You should feel the stretch in your buttock (bent leg).
Hold 30 seconds.
Repeat 3 times.
(Piriformis)

Choose between 4a) and 4b)

4a)

Lie on your back with a cushion under your head. Put a band under the sole of your foot and hold onto the band with both hands. Lift your bent leg up. Pull the band flexing the ankle and stretching the back of you thigh. Hold approximately 30 seconds – relax.
Repeat 3 times.
(Hamstring)

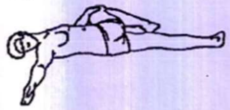
4b)

Stand with the leg to be stretched on a footstool. Flex your ankle and push the heel towards the footstool keeping your knee straight. Bend your upper body forward from your pelvis keeping your back straight. You should feel the stretch behind your knee and thigh. Hold approximately 30 seconds – relax.

These exercises are specific to cater for your needs and should not be use by anyone else.

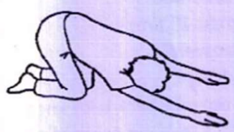
Repeat 3 times.
(Hamstring)

5)



Lie on your back with one leg bent. Bring your bent knee over the other leg and pull your knee towards the floor with the opposite hand. Reach with the other arm to the opposite side looking in the same direction. Feel the stretch in your lower back or bottom. Hold approximately 30 seconds – relax.
Repeat 3 times. (Erector sinae / Gluteus)

7)



Crawl position. Let your arms slide along the floor as far as possible. In this position slide to the right side so that you can feel a stretch on your left side. Hold 30 seconds and repeat to the other side.
Repeat 3 times. (Quadratus lumborum and Latissimus dorsie)

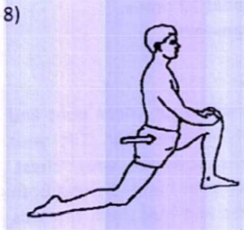
9)

Stand, holding on to a support. Bend one knee and take hold of the ankle. Do not lock the knee of the leg you are standing on. Pull your heel towards your buttock. Tilt your pelvis forwards so that your knee points towards the floor. Feel the stretch in the front of your thigh. Hold 30 seconds
(Rectus Femoris)

6)

Sit on the floor with one leg straight and the other leg crossed over it. Bring your knee towards your opposite shoulder. Feel the stretch in your buttock.
Hold 30 seconds.
Repeat 3 times.
(Gluteus)

8)



Half kneeling. Tighten your stomach muscles to keep your back straight. Rotate the heel behind you outwards while pushing your pelvis forwards.
Hold approximately 30 seconds – relax.
Repeat 3 times. (Psoas)

10)

Stand, facing a wall. Put your foot against the wall keeping your heel on the floor. Bring your pelvis forwards and feel the stretch in your calf.
Hold 30 seconds.
Repeat 3 times.
(Gastrocnemius)

APPENDIX K: TREATEMNET LOGBOOK

BIOKINETICS NOTES

BACK TREATMENT LOG

BIOKINETICIST NAME: ____________

LTE	**LTL**	**LTF**	**LTR**	**HLP**	**SBA**	**MLU**
SEAT ☐	SEAT ☐	SEAT ☐	BR ☐	SEAT ☐	SEAT ☐ GH ☐	☐
FOOT ☐	FOOT ☐	FOOT ☐			CH ☐ GW ☐	
					CD ☐ SW ☐	

EXTRA NOTES

DATE	Ses.	PL	REPS	PL	REPS	PL	REPS	PL	REPS	PL	REPS	PL	REPS	PL	REPS	NOTES
	1															
	2															
	3															
	4															
	5															
	6															
																IH
	7															
	8															
	9															
	10															
	11															
	12															
																HOME PROGRAM
	13															
	14															
	15															
	16															
	17															
	18															
	19															

11

APPENDIX L: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mr Matthew Bennett

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M220212

NAME: (**Principal Investigator**)	Mr Matthew Bennett
DEPARTMENT:	School of Therapeutic Sciences Centre for Exercise Science and Sports Medicine The Back Clinic
PROJECT TITLE:	The effectiveness of a multidisciplinary, protocol-based approach to patients of different age groups with lower back pain in Bloemfontein, Port Elizabeth, Polokwane, and Johannesburg
DATE CONSIDERED:	25/02/2022
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Miss N Neophytou
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	08/04/2022

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions.Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **February** and will therefore be due in the month of **February** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Bennett
Principal Investigator Signature

11/04/2022
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES