The effect of Pilates and home-based exercise on pain, disability, and quality of life in people with chronic non-specific neck pain: A randomised controlled trial

Freya Scollay

A research project submitted in partial fulfillment of the requirements for the degree of Master of Osteopathy, Unitec Institute of Technology, 2016
Declaration

Name of candidate: Freya Scollay

This research project entitled The effect of Pilates and home-based exercise on pain, disability, and quality of life in people with chronic non-specific neck pain: A randomised controlled trial is submitted in partial fulfillment for the requirements for the Unitec degree of Master of Osteopathy.

Candidate's declaration
I confirm that:
• This research project represents my own work;
• Research for this work has been conducted in accordance with the Unitec Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the Unitec Research Ethics Committee. Research Ethics Committee Approval Number: 2014-1043

Candidate signature: ………………………….. Date: 11th April, 2016

Student number: 1074644
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<tr>
<td>ACC</td>
<td>Accident Compensation Corporation</td>
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<td>CEQ</td>
<td>Credibility and expectancy questionnaire</td>
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<td>cm</td>
<td>Centimetre</td>
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<tr>
<td>Exercise-only</td>
<td>Home-based exercise only</td>
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<tr>
<td>Kg</td>
<td>Kilogram</td>
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<tr>
<td>MCID</td>
<td>Minimal clinically important difference</td>
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<td>NPQ</td>
<td>Northwick Park pain questionnaire</td>
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<td>NSAID</td>
<td>Non-steroid anti-inflammatory</td>
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<td>Pilates+exercise</td>
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Overview

The following research project is divided into three sections:

1. The literature review, with emphasis on:
   - The prevalence and course of chronic neck pain
   - Causes of chronic neck pain and diagnosis
   - Treatment Guidelines and outcome measures
   - The treatment of chronic neck pain with exercise
   - Pilates as an exercise intervention for chronic neck pain

2. A manuscript in the format specified for submission to the Journal of Bodywork and Movement Therapies.

3. Appendices that include ethics approval, participant information sheet, screening questions, consent form, questionnaires, Equipment Pilates intervention description and guidelines for authors to the Journal of Bodywork and Movement Therapies.
Section 1: Literature Review
Introduction

Equipment Pilates in the treatment of chronic neck pain.

Neck pain causes pain and disability in approximately 30% of the adult population worldwide (O’Riordan, Clifford, Van De Ven, & Nelson, 2014). It brings with it significant financial, physical and psychosocial implications for individuals, for their countries in terms of lost productivity and health care costs, and for clinicians, for whom diagnosis, available treatment options and the outcomes of those treatment options are far from clear. Exercise regimens based upon the Pilates principles are often used to treat chronic lower back pain. The mind-body approach of Pilates is considered beneficial for rehabilitation of chronic pain and thus may assist sufferers of chronic neck pain (Rosenzweig et al., 2010; Wells, Kolt, Marshall, Hill, & Bialocerkowski, 2013). The aim of this literature review is to outline and appraise evidence regarding the causes, course and factors in the chronicity of neck pain, the effectiveness of treatment protocols, particularly exercise, and to explore the potential of Equipment Pilates (a form of Pilates used in rehabilitation, which utilises specialised equipment) in the treatment of chronic neck pain.

The boundaries of neck pain

Neck pain is experienced in the regions of the cervical spine, shoulder girdle and the accompanying muscles in these regions. Pain may also radiate into the head, arms and hands.
Prevalence

Neck pain is a common complaint that may cause substantial disability and a decrease in quality of life (D. Hoy et al., 2014; Walton et al., 2013). In New Zealand, the 12-month prevalence of neck pain is estimated at 30 to 50% of the adult population (Rule, 2009). ACC guidelines (Rule, 2009) state that 50 to 85% of these patients will experience recurrent or persistent symptoms; thus, the condition becomes chronic. Incidence is increased in women, developed countries compared with less developed and third-world countries and high density populations compared with rural areas (Schellingerhout, 2011). The likelihood of experiencing neck pain increases from 35 to 49 years of age, after which the occurrence of neck pain declines (Schellingerhout, 2011).

The course of chronic neck pain, and co-morbidities

With acute neck pain, many cases are self-limiting within the period of 1 to 12 weeks (Cohen, 2015). Acute neck pain can often be attributed to a specific incident, with a defined injury site and local inflammation, episodes often resolve without treatment (Cohen, 2015). However, it is thought that nearly 50% of individuals with acute neck pain will go on to develop chronic pain (pain duration >12 weeks) (Cohen, 2015).

The onset and course of chronic neck pain is varied: traumatic onset, musculoskeletal, postural, environmental and personal factors may all play a role, making diagnosis complicated. Co-morbidities associated with neck pain include headaches, back pain and depression (Cohen, 2015) which may further complicate diagnosis.
The nature of chronic pain

Many researchers believe that chronic pain is a disease, a mixed state involving the peripheral and central nervous system (Clauw, 2015; Falla, Jull, Russell, Vicenzino, & Hodges, 2007; Phillips & Clauw, 2011). Phillips and Clauw (2011) suggest the peripheral and central nervous system play a critical role in determining which inputs are perceived as pain, and that this may be a result of genetically determined sensitivity and/or neoplastic changes within the central nervous system. Phillips and Clauw (2011) stated, “There is not a single chronic pain state where any radiographic, surgical or pathological description of peripheral nociceptive damage has been reproducibly shown to be related to the presence or severity of pain”.

Patients present with neck pain, but the practitioner should be aware of the other symptoms of chronic pain such as pain in other regions, fatigue, cognitive difficulties and signs of depression and anxiety. Chronic pain often presents with pain and sensory amplification, and emotional instability and mood swings (Ablin & Buskila, 2015); studies that identified the epigenetic origins of idiopathic pain syndromes have reported similar attributes (Ablin & Buskila, 2015). This pain-prone phenotype may be triggered by ‘stressors’ such as emotional stress, early life trauma, musculoskeletal trauma (especially to the torso) and viruses. For individuals whose pain changes from acute to chronic, these genetic factors may be predictors.

Individuals with chronic pain may seek treatment from various practitioners, each of whom may give a range of labels to pain occurring in regions of the body at different times, which complicates diagnosis. Overall, the analogy of an increased ‘volume control’ or ‘gain’ setting on pain and
sensory processing is supported by studies from a number of sources (Ablin & Buskila, 2015; Lucas, Leary, Niere, Green & Buchbinder, 2003).

Therapeutic modalities that have been reported to be effective for patients with chronic neck pain include pharmacological interventions such as tricyclic compounds and non-pharmacological interventions involving exercise and cognitive behavioural therapy (Hoy, Protani, De, & Buchbinder, 2010). Equipment Pilates (a form of Pilates used in rehabilitation that utilises a variety of specialised equipment) classes taught by qualified instructors may be of value for chronic pain sufferers, due to the mind-body approach combined with the specific exercises that Equipment Pilates offers.

**Causes of Chronic Neck Pain**

Within the literature there is a diversity of opinion on the causes of chronic neck pain. Rule (2009) suggests that chronic neck pain is caused or exacerbated by poor work place ergonomics, inappropriate posture, sports and overuse from repetitive movements. Childs et al. (2008) state that, “the cause of neck pain may be associated with degenerative processes or pathologies which may be identified during diagnostic imaging, although the tissue that causes a patient’s neck pain is most often unknown”. Ablin and Buskilia (2015) comment that psychological factors such as levels of stress and anxiety, personal factors like catastrophising, and psychosocial factors such as supporting networks, affect the total experience of pain. Dimitriadis, Kapreli, Strimpakos, & Oldham, (2015) agree that stressors such as anxiety, depression, kinesiophobia and catastrophising can indirectly negatively affect patient symptoms due to movement and exercise avoidance or refraining from daily activities. Recent studies suggest that although neck pain may have
originated from trauma or have developed gradually, chronic neck pain is thought to be mediated by the peripheral and central nervous system (D. Falla, 2004; Phillips & Clauw, 2011).

**Diagnosis**

Due to the multifactorial nature of chronic neck pain, diagnosis is complicated. Causes and clinical presentation of chronic neck pain are complex and differ from person to person. Symptoms may occur in the neck, head (headaches), upper extremity and lower back (Frith, 2013). In most patients with neck pain the history and physical examination will not lead to a pathological diagnosis (Ferrari & Russell, 2003). Recommended diagnostic practice for neck pain is to consider blunt trauma, radiculopathy and red flags in order to rule out fracture, neurological causes and other serious pathologies (Anderson-Peacock et al., 2005; Hoy et al., 2014; Schellingerhout, 2011). Oort (2012) stated that, “one assessment model cannot be applied to all patient outcomes”.

**Questionnaires: A diagnostic tool.**

Various self-report instruments/scales to capture clinical characteristics are utilised to assist the clinician with diagnosis, prognosis and development of a treatment plan (Jette, Halbert, Iverson, Miceli, & Shah, 2009). They are often used in primary care settings. For example, among leading researchers in the field, Schellingerhout (2011) recommends “the assessment model of a pain Numerical Rating Scale of 0 to 11 (NRS-11) and the identification of three main predictors: accompanying back pain, age and an NRS-11 score greater than five”. Childs et al. (2014) and Fritz and Brennan (2007) recorded variables such as patient-history, frequency of headaches, physical examination and patient-preferred pain management to
Inform the treatment guidelines. Heintz and Hegedus (2008) and Childs et al. (2014) recommend the use of questionnaires such as the Short Form Health Survey (SF-12). In this case, the SF-12 is utilised to identify psychosocial variables followed by a physical examination. Lederman (2015) suggests that the postural, structural, biomechanical model unnecessarily complicates assessment, and that observation and physical assessments have “no value in the diagnosis of chronic non-specific neck pain”. He suggests that chronicity; disability and the episodic nature of chronic neck pain can be better predicted by evaluating biomechanical, psychological and social factors. Schellingerhout (2008) used a combination of clinical characteristics, social and demographic variables that would be simple for a General Practitioner to use in the first consultation. Diagnostic information gained in the initial assessment should be used to select the treatment protocol that will ensure the best prognosis. Recently researchers have agreed that a multimodal approach to diagnosis is required, although what that might entail is not clear (Cohen, 2015; Hudson & Ryan, 2010; Nicholas, Linton, Watson, & Main, 2011). Certainly the research points towards assessment of the patient’s level and frequency of pain and disability, with psychological and psychosocial assessment of factors such as stress and patient support networks.

**Treatment Guidelines for Chronic Non-specific Neck Pain**

Treatments of chronic neck pain have been widely studied (Bryans et al., 2014; Childs et al., 2008; Walton et al., 2013) but the results do not indicate a definitive protocol. There are many options for the treatment of chronic neck pain, including prescribed active exercise, manual therapy, drug treatments and patient education (Anderson-Peacock et al., 2005). Prescribed
active exercise is a common treatment choice with an increasing number of clinical trials emerging that provide evidence of the benefits of its use (Bryans et al., 2014; Childs et al., 2008; Walton et al., 2013). These trials predominantly investigate the effectiveness of a variety of exercise treatments in different situations, such as private treatment, group classes and home-based exercise programmes (Hudson & Ryan, 2010). Studies often examine the use of exercise therapy in conjunction with manual therapies, education, and psychosocial factors, any of which may confound results (Childs et al., 2008; Raney et al., 2009; Southerst et al., 2014).

Numerous well-designed studies evaluating treatments for chronic neck pain have been conducted over the last 10 years (Cohen, 2015; Schellingerhout, 2011; Walton et al., 2013). Schellingerhout (2011) reported that prognosis was directly affected by patient age and accompanying lower back. Cohen (2015) found “strong evidence” for intermediate relief of symptoms from exercise intervention, but there was no clear evidence for any one particular exercise intervention. Walton et al. (2013) conducted a systematic review across five reviews that reported generally poor outcomes for chronic neck pain and that the cognitive aspects of pain are more important to recovery than physical aspects. The validity of many of these studies is considered questionable (Cohen, 2015). This was due to the mixed study populations (Walton et al., 2013), limited patient clinical information (D. Falla, 2004), a wide variety of inclusion and exclusion criteria (Schellingerhout et al., 2008) and the differing duration of time between follow-up periods (Anderson-Peacock et al., 2005). Recent studies suggest that the best treatment approach for chronic neck pain is multimodal (Childs et al., 2008; Hudson & Ryan, 2010). Multimodal
treatment protocols may involve a combination of spinal manipulation, mobilisation, manual therapy, exercise, education and medication (Bryans et al., 2014).

Because of the multifactorial aetiology of non-specific neck pain and the diversity of participants in neck pain studies, complications arise when clinicians are seeking to single out one treatment protocol (Raney, 2009). Bryan et al. (2014) agree that the inter-study variation of treatment protocols complicate isolating a single intervention that is superior to any other. Treatment protocols should take into consideration patient treatment preference, adverse events caused by treatment, as well as costs to the patient and public health sector (Heintz & Hegedus, 2008). Bergstrom et al., (2009) found that variations in psychosocial characteristics result in different prognoses. Participants with fewer psychosocial difficulties appear to respond more favorably to multimodal treatment than those with greater psychosocial characteristics. In the Bergstrom et al., (2009) study, neck and lower back pain patients were allocated to three groups: dysfunctional – those who sleep poorly, catastrophise and are more depressed; interpersonally distressed – those who have inadequate social support; and adaptive copers – who have low reported pain compared to the other two groups as well as low emotional distress and less catastrophising thoughts. Bergsrtom et al., (2009) placed all groups into subgroups that received multimodal treatment, exercise treatment or cognitive behavioural therapy. Regardless of the treatment, the dysfunctional group reported a greater number of days off work due to pain over seven years than the other two groups.
Childs et al. (2008) state, “a guideline is not intended to be construed or to serve as a standard of medical care”. They further state that “adherence to them will not ensure a successful outcome in every patient”. Moreover, “the ultimate judgment should be made in the light of clinical data, diagnostic and treatment options available and the patient’s values, expectations and preferences”. This emphasises the multifaceted quality of non-specific neck pain and encourages clinicians to consider the patient’s expectation and wellbeing within a multimodal treatment approach (Hebert & Fritz, 2012). It is clear from this brief review of non-specific neck pain literature that there is room for further research with regard to diagnosis, treatment protocols and outcome measures.

When considering the validity of treatment guidelines, outcome measures should be assessed with multifaceted, patient-specific methodology. Oostendorp et al. (2013) suggest, “…scoring for function, disability and pain using questionnaires such as NDI, NRS-11 and VAS”. Oort et al. (2012) and Childs et al. (2008) suggest that the duration of treatment, time and number of treatments and time elapsed after the treatment all affects the reliability of outcome measures. Systematic reviews have compared outcome measures (Bollen, Dean, Siegert, Howe, & Goodwin, 2014; Jette et al., 2009), but due to the diverse nature of chronic non-specific neck pain all of the variables need to be considered. Differing diagnoses of neck pain and the complexities of the use of outcome measures may confound the results of studies, leaving the clinician few treatment guidelines.

**Outcome Measures**

Outcome measures are used to guide treatment plans, measuring
changes over treatment duration and providing data for research.

Scores from
outcome measures enable quantitative assessment of pain, disability, function and psychometric measures. These results can be used to identify patients at risk of on-going chronicity (yellow flags) and who may experience unfavorable outcomes from treatment (Smeets et al., 2008). Outcome measures taken during and post treatment may also be used to guide continuity of patient care, and assess clinician and organisational performance. This information can be used to determine the most effective treatment modalities for chronic neck pain. Each patient needs to be considered on an individual basis. Questionnaires should be simple to administer and relevant. Patient considerations that may affect treatment outcome are pain, disability, quality of life, patient credibility and expectancy of the treatment.

**Short-Form Health Survey – 36.**

The SF-36 is a generic, multi-purpose instrument that has been widely used for assessment of mental and physical health constructs (McHorney, Ware, & Raczek, 1993). The SF-36 consists of 36 questions that form eight multi-items scales. The eight multi-item scales comprise functional health and wellbeing scores, psychometrically based physical and mental health summary measures and a preference-based health utility index (McHorney et al., 1993). In all scales, a score of 100 corresponds to a high level of functioning and/or fewer symptoms. The SF-36 has been shown to be valid for comparison of the impact of diseases, and differentiating between the effects produced by a wide variety of treatments in surveys of general and specific populations (Fredheim, Borchgrevink, Saltines, & Kaasa, 2007).

The eight scales are thought to form two distinct groups, one relating to mental health, the other to physical health. Scales that load towards the
physical component respond to treatments for the musculoskeletal system, 
the mental health component responds to treatments such as drug therapy. 
Internal-validity and test-retest methods of the eight scales and the grouping 
of these scales into mental health and physical health has been shown to be 
statistically reliable (Sullivan, Karlsson, & Ware, 1995). A limitation of the 
SF-36 is the exclusion of questions that are pertinent in chronic pain 
conditions (Sullivan et al., 1995). Content frequently found in questionnaires 
for chronic pain but excluded in the SF-36 are quality and quantity of sleep, 
memory, sexual wellbeing, perception of health, family dynamics, self-
esteeem, diet, sport/recreation and the ability to communicate. The generic 
nature of SF-36 may mean that symptoms and complications that are disease 
specific are not reported.

**Visual Analogue Scale.** The visual analogue scale (VAS) is a simple 
and frequently used method for assessment of variations in intensity of pain 
(Hawker, Mian, Kendzerska, & French, 2011). The pain VAS is a continuous, 
single-item scale that is composed of a horizontal or vertical line, usually 100 
mm in length. The scale has verbal descriptors, one for each symptom 
 extreme. Instructions, time period for reporting and verbal descriptors are 
diverse in the literature and these are modified to suit the purpose of the scale 
(Hawker et al., 2011). The base of the scale is “no pain” (score of 0) and “pain 
as bad as it could be” or “worst imaginable pain” (score of 100). Pain recall 
varyes; participants are frequently asked to rate their “current” pain intensity or 
pain intensity “in the last 24 hours” (Carlsson, 1983). In clinical practice the 
percentage of pain relief assessed by VAS is often thought to be a measure of 
the treatment effectiveness (Hawker et al., 2011). Carlson (1983) suggests 
the validity of VAS estimates for chronic pain patients may be inadequate due
to the episodic nature of chronic pain. Hawker et al. (2011) state that VAS is not a complete measure of pain due to the intricate nature of chronic pain and suggests the use of additional questionnaires such as SF-36. Two types of VAS, a horizontal and vertical line, were compared with respect to factors influencing the reliability and validity of pain estimates (Ogon, Krismer, Söllner, Kantner-Rumplmair, & Lampe, 1996). The horizontal line was found to be more sensitive than the vertical line when evaluating usual pain for Western society, and may be more applicable for general clinical use. The capacity of patients to use VAS reliably seems to vary, potentially effecting the sensitivity of VAS (Carlsson, 1983). When assessing the efficiency of treatment, the clinician should utilise several additional measurements to record pain relief as well as the VAS. Price, Bush, Long, & Harkins (1994) demonstrated the valid use of VAS for measurement of pain by comparison between the participants’ chronic pain and the addition of experimental heat pain. The study confirmed that analogue scales are valid and reliable assessments for both chronic pain and acute experimental pain.

**Northwick Park Pain Questionnaire.** The Northwick Park Neck Pain Questionnaire (NPQ) was developed from the Oswestry Low Back Pain questionnaire in order to measure self-perceived disability from neck pain (Fairbank, Couper, Davies, & O’Brien, 1980). A neck pain questionnaire can expand upon the understanding of the impact of neck pain on patients’ quality of life (Hoving, O’Leary & Niere, 2002).

The NPQ was developed to measure the impact of non-specific neck pain on daily activities. There are nine items measured: extent of symptoms, tingling or numbness at night, sleep affected by pain, impact on social life,
lifting/carrying, reading/watching television, driving and the effect of pain on employment and household tasks. Each item has five potential responses; these describe the degree of difficulty (0 = no difficulty to 4 = severe difficulty). The overall NPQ score is a percentage. This is calculated by adding together the scores for each item (0–36) and calculating a percentage (total score/36*100). For items that do not apply, the total potential score can be reduced (e.g. one item not applicable, total score out of 32). The NPQ has been validated in patients complaining of neck pain attending a rheumatology clinic in the United Kingdom (Hoving, O’Leary & Niere, 2002). Kovacs et al. (2008) suggest that the NPQ is internally consistent when compared with other neck pain questionnaires such as the Neck Disability Index (NDI). However, they stated that NDI might offer researchers a more reliable and valid tool with sensitivity to changes, thus giving results that better match patients’ perceptions than alternatives do.

**Factors which Affect Outcome**

**Credibility Expectancy Questionnaire.** The Credibility Expectancy Questionnaire (CEQ) aims to measure participants’ outcome expectations and credibility beliefs. Smeets et al. (2008) suggest “Patients’ initial beliefs about the success of a pain treatment are shown to affect final treatment outcome”. The credibility factor is based on patients’ summed responses to three items. These items measure how logical the intervention and control seems, how successful the patient thinks it will be in reducing symptoms and how confident the patient would be in recommending it to a friend with similar symptoms (Devilly & Borkovec, 2000). Confirmatory factor analysis supports the two-factor structure (credibility/expectancy) of the CEQ (Devilly &
Credibility has been defined as how believable, convincing and logical the treatment is, whereas expectancy refers to improvements that patients believe will be achieved (Webb, Kertz, Bigda-Peyton, & Björgvinsson, 2013). Both definitions use the term ‘believe’. A belief contains both cognitive and selective components (Webb, Kertz, Bigda-Peyton, & Björgvinsson, 2013). What a person logically thinks is the case may differ from what is felt to be the case. Clinicians may experience patients who point out that they see the sense of alternative, logical thoughts but their concern or depression-provoking thoughts simply feel truer (Webb et al., 2013).

Research to evaluate the psychometric properties of CEQ were assessed from three previous studies (Devilly & Borkovec, 2000). This study reviewed factor structure, internal consistency, test-retest reliability and outcome prediction. Devilly and Borkovec (2000) found that lower credibility and expectancy were associated with higher levels of pain-related fear. Lower credibility was also linked to a decreased internal control of pain, and lower expectancy was associated with no radiating pain. Multiple linear regression analyses revealed that expectancy outcomes post-intervention were related to disability and satisfaction. Therefore expectancy was related to outcomes irrespective of treatment offered and after controlling for age, sex, pain-intensity at baseline and disability duration. For global perceived effect, as a measure of treatment success (Forouzanfar, Weber, Kemler, & van Kleef, 2003), treatment expectancy foretold outcome in active treatment only; treatment credibility in combination therapy only. Both expectancy and credibility had a significant association with treatment satisfaction (Devilly & Borkovec, 2000). A limitation of the CEQ is that it is often perceived by
participants as two sections, one related to thinking and one related to feeling (Devilly & Borkovec, 2000). However, the two factors derived are not grouped into those subheadings.

**Yellow Flags.** Yellow flags describe psychosocial prognostic factors for on-going chronicity of musculoskeletal pain or for perpetuating long-term disability and work loss. Psychosocial yellow flags may be a barrier which inhibits recovery in patients with neck pain (Grimmer-Somers, Prior, & Robertson, 2008). Assessment of the presence of yellow flags produces two outcomes: a decision as to whether more detailed assessment is needed, and identification of important factors for specific intervention (Nicholas et al., 2011). It is suggested that identification of yellow flags may save clinician time and assist in concentrating the use of resources (Nicholas et al., 2011). The yellow flags questionnaire asks the participant to list the areas of pain, how many days of work have been missed in the past 18 months and duration of the current pain. A further 24 questions are asked on pain, disability and psychosocial factors. Accident Compensation New Zealand state that the questionnaire scores provide correct identification of 75% of patients who do not need modification to ongoing management (Rule, 2009). In addition, it identifies 86% of those who will have between 1 and 30 days off work and 83% of those who will have more than 30 days off work. Considerations of psychosocial risk factors for disability have been shown to improve the treatment outcomes for pain ($p=0.001$), disability ($p=0.001$) and self-efficacy ($p=0.006$) when compared to interventions that have ignored these yellow flags (Gustavsson, Bergström, Denison, & von Koch, 2013).
Active Exercise Treatment for Chronic Neck Pain

In 2008, a set of clinical guidelines published by the American Physical Therapy Association for the treatment of neck pain advocated participation in active exercise (Childs et al., 2008). These guidelines are based upon lower neck muscle strength, neck flexor fatigue and decreased cervical range of motion in patients with chronic neck pain. Although muscle deficit in chronic non-specific neck pain is not reported as being restricted to certain muscle groups, it is suggested there may be a link between muscle weakness and neck pain (Salo, Häkkinen, Kautiainen, & Ylinen, 2010). Research has been unable to clarify whether neck pain is due to muscle weakness or whether muscle weakness is due to a long-standing painful condition controlled by the central nervous system (Hoy, Protani, De, & Buchbinder, 2010). Regardless of this lack of clear causation, exercise therapy is thought to be beneficial for decreasing pain and disability and increasing quality of life in patients with chronic neck pain.

Systematic reviews have consistently found exercise therapy, either alone or in conjunction with manual therapy, has a positive effect on neck pain (Evans et al., 2012; Haldeman, Carroll, Cassidy, Schubert, & Nygren, 2008; Walton et al., 2013). Exercise therapy embraces many modalities such as strength and endurance training, proprioceptive exercises, isometric training and patient education, to name a few. Often these modalities are considered to have an individual effect on the specific muscle group targeted, and a global effect on the patient’s wellbeing. Studies often combine these modalities, leaving the clinician uncertain as to which exact exercise is beneficial. Another confounding variable in many studies is the participants’
continuation with pain medication and manual treatment during the intervention, thus making it difficult to isolate the cause of any outcome observed.

General exercise rehabilitation is considered to improve fitness and functional ability for people with various long-term conditions such as chronic neck pain and lower back pain (Andersen et al., 2008). While some studies have found little effect from exercise programmes (Taimela, Takala, Asklöf, Seppälä, & Parviainen, 2000), others have demonstrated that pain can be lessened by strength training, endurance training, and proprioceptive training for muscle coordination (Chiu, Lam, & Hedley, 2005; O’Riordan et al., 2014). But according to a recent review (O’Riordan et al., 2014), there is poor evidence regarding the usefulness of physical exercise as treatment of chronic symptoms in the neck and/or shoulder regions due to a limited number of gold standard studies. There is a lack of evidence discerning any clear differentiation in the responses to varying forms of exercise. This seems to be due to an overlap between the applied exercise modalities (O’Riordan et al., 2014). Exercise rehabilitation may cause adverse events, and results may be confounded by physiological responses related to training. Exercising already tender muscles has been shown to cause an sharp increase in the levels of nociceptive products in the muscle tissue (Clauw, 2015). Moreover, unfamiliar strength training of muscles may lead to an increase in muscular tenderness. Thus, certain exercise modalities may increase the patient’s pain and disability levels, albeit only for the short-term. Patient education may alleviate the patient’s concerns; but often a perception of pain equates to a perception of further injury (Phillips & Clauw, 2011). A tailored, whole body
fitness programme, which incorporates cardiovascular training, may be an acceptable form of exercise for subjects with chronic pain.

General fitness training has been shown to increase the pain threshold in non-exercised parts of the body in healthy subjects. Increasing pain thresholds of patients with chronic pain has been shown to reduce their use of pain medication (Southerst et al., 2014). (Leeuw et al., 2008) indicated that individuals with low back pain should place emphasis on general physical activity, not local muscle training. Due to the similar nature of chronic lower back pain and chronic neck pain, general physical activity may also have a positive effect on pain and disability in chronic neck pain patients.

In the same way prescribed medication is adapted to the patient, a similar process in the prescription of exercises is advised; hence the development of the frequency, intensity, time, and type (FITT) format suggested by O’Riordan et al. (2014). By applying the FITT principles, the clinician can tailor the exercise programme to an individual’s needs. The adverse effects of unfamiliar exercise can be reduced by modifying the level of exertion, length of time and the type of exercise. O’Riordan et al. (2014) suggest “Despite the high incidence of chronic neck pain and the evidence of the benefits of active exercise for the treatment of associated symptoms, there is a paucity of evidence to recommend a definitive FITT principle in this population”.

Neck strength training is often prescribed to relieve chronic neck pain (Andersen et al., 2008). Salo, Häkkinen, Kautiainen and Ylinen, (2010) stated “…neck pain is associated with a decrease in neck muscle strength”. In addition to gaining neck muscle strength, neck strength training has been
shown to be effective in reducing neck pain and disability over twelve months in females with chronic neck pain (P=0.0019) (Häkkinen, Kautiainen, Hannonen, & Ylinen, 2008). Strength training seems to be regarded as an efficient exercise therapy for patients with neck pain, although its effect on psychosocial factors has not been shown. The authors (Salo et al., 2010) found only two studies where the influence of strength exercises on neck pain was assessed with psychosocial measurements and health-related quality of life (G Bronfort et al., 2001; Jari Ylinen, Nikander, Nykänen, Kautiainen, & Häkkinen, 2010). Short-term studies of exercise for neck pain have reported only temporary improvements across various outcome measures. Training for over twelve months is recommended to achieve long-term results (Salo et al., 2010).

Southerst, Nordinm Cote et al. (2014) conducted a systematic and best evidence synthesis to review and update the research on the management of neck pain and the effectiveness of exercise compared with other or no interventions. After screening 3,726 articles, only 21 articles were critically appraised. Eleven of these articles were scientifically admissible. The exercise programmes varied across the studies; seven different types of exercise were identified including range of motion exercises, cervical isometric strengthening exercises, cervical dynamic resistance strengthening exercises, shoulder range of motion or strengthening exercises, stretching, and general exercise programmes. Seven studies included supervised exercise programmes (Evans et al., 2012; Griffiths, Dziedzic, Waterfield, & Sim, 2009; Häkkinen et al., 2008; Michalsen et al., 2012; Salo et al., 2010; von Trott et al., 2009; Zebis et al., 2011) and most supplemented this with
home exercises. Unsupervised programmes usually had one instructional session accompanied by written materials. Five studies had exercise interventions delivered to participants in groups (Cramer et al., 2012; Häkkinen et al., 2008; Salo et al., 2010; von Trott et al., 2009; Zebis et al., 2011). The frequency of supervised sessions was one per week in three studies (Häkkinen et al., 2008; Michalsen et al., 2012; Salo et al., 2010) and twice per week in four studies (Evans et al., 2012; Michaleff et al., 2009; von Trott et al., 2009). The frequency of unsupervised exercise was three times per week in two studies (Evans et al., 2012; Häkkinen et al., 2008), and daily in four studies (Gert Bronfort et al., 2012; Evans et al., 2012; Griffiths et al., 2009; Kuiper, Tans, Beelen, Nollet, & de Visser, 2009). Three studies provided exercise programmes that progressively increased in intensity (Evans et al., 2012; Kuiper et al., 2009; Zebis et al., 2011). The duration of exercise programmes ranged from six weeks to twelve months. Overall, summarised results from the 21 studies showed that people with acute, low- level neck pain have similar outcomes regardless of the intervention. Chronic neck pain benefitted equally from supervised exercise, combined range of motion and strength training with or without multimodal therapy and home exercise. Home stretching exercises alone were as effective as supervised strengthening with home stretching for the management of chronic neck pain.

The evidence does not suggest there is a superior exercise intervention. Southerst et al. (2014) suggest that clinicians should consider patient preferences, cost-effectiveness data and the risk for transient non-serious events when determining what exercise intervention should be used for the management of chronic neck pain.
Exercise Compliance

Regardless of the exercise treatment offered for chronic neck pain, prognosis will be poor if patient compliance is low. Research has shown that exercise intervention for chronic neck pain must be long-term, therefore managing patient compliance is important (Walton et al., 2013). Compliance levels can be influenced by many factors, some of which are pain caused by exercising, low treatment credibility, low patient expectation, practitioner-patient relationship, cost and the quality of advice (Escolar-Reina et al., 2010). Methods of delivery vary; the most popular options are group classes, private treatment or home-based exercise. Compliance is difficult to measure as there are a lack of reliable, validated measures to assess adherence (Bollen et al., 2014). Moreover, such research investigating compliance with low back pain exercise interventions as does exist has shown inconsistent findings (Kolt & McEvoy, 2003).

Hudson and Ryan (2010) comment that 76% of participants declined the recruitment offer for the study of group multimodal treatment versus one-to-one physiotherapy. The authors felt this may be due to patients’ low credibility perception of group treatment. Home-based exercise programmes with limited supervision are considered inefficient (Escolar-Reina et al., 2010). Hudson and Ryan (2010) suggest that this is due to the long time taken for execution, difficulty performing the exercises and the adverse effects caused by exercising. Further investigation is needed to determine which aspects of rehabilitation programmes may increase adherence to prescribed exercise both at home and in the group setting (Escolar-Reina et al., 2010). Interestingly, supervised strengthening with home stretching provided no
additional benefit over home stretching exercises alone for the management of chronic neck pain.

Group rehabilitation encourages patients to interact and provide motivational support and encouragement for one another and has been shown to be as effective as individual treatment (Hudson & Ryan, 2010). Prescribed exercise programmes such as Pilates are time efficient, may reduce patient costs, relieve pressure from third party payers such as health insurance companies and act as a motivational influence for positive health behaviours (Howard & Gosling, 2008). Taimela et al. (2000) found that group exercise when compared to a home-based programme resulted in significantly higher self-experience benefits. No significant differences were recorded in pain and disability or compliance of the group versus the home-based exercise. The authors reported no withdrawals from the group exercise while 14% withdrew at three months from the combined home-based exercise and control groups. A limitation of this study may be the small number of participants (total n=15), which affects its ability to distinguish between real effect and random variation (Hackshaw, 2008). Exercises must be based on patients’ needs and current functional capacities, incorporating appropriate frequency, duration, intensity and exercise type (Howard & Gosling, 2008). Adverse effects from exercise such as muscle pain and fatigue decrease compliance due to the negative association with muscle pain and patients’ chronic pain (Beinart, Goodchild, Weinman, Ayis, & Godfrey, 2013). Supervision improves the effectiveness of programmes; an experienced clinician will be able to modify the exercises and educate the patient (Beinart,
Goodchild, Weinman, Ayis, & Godfrey, 2013), therefore reducing adverse effects and improving treatment outcome.

Home-based exercises may be used as stand-alone treatment or an adjunct within a multimodal treatment programme for chronic neck pain (Frih, Fendri, Jellad, Boudoukhane, & Rejeb, 2009). There are a variety of delivery methods for exercise content. The clinician may teach the patient the exercises, provide video and/or written instructions and hold regular group re-education programmes. A multifaceted approach incorporating stretches, strengthening, postural correction, relaxation and education is thought to be most beneficial (Ylinen, 2007). Escolar et al. (2010) state that compliance with home exercise programmes is as low as 50%. Among factors that influence compliance are exercise prescription, caregivers and intrinsic patient factors. Clinicians considering intrinsic factors should utilise the yellow flags questionnaire for psychosocial factors. The outcome of this may guide the FITT prescription of exercise, whether group, home or private rehabilitation is recommended and guide the level of clinician supervision required for positive outcomes. Kolt and McEvoy (2003) reported that the limitation of home-based exercises is the high level of patient motivation required, regular supervision and patient evaluation by the clinician.

A qualitative focus group design was utilised to obtain exercise compliance data from participants of home-based exercise programmes for chronic lower back and neck pain by Escolar-Reina et al. (2010). The aim of this study was to explore how the intrinsic characteristics of a home-based exercise programme and care provider style, in a clinical setting, affect chronic pain patients' compliance (Bollen et al., 2014; Hudson & Ryan, 2010).
Compliance was explored from the patients’ perspectives. This perspective may be of importance, as patients exercising to rehabilitate chronic pain states may make active decisions about their own exercises rather than being simply passive recipients of health care (Escolar-Reina et al., 2010).

The method of delivery and content of home-based exercises varies: several studies have reported that compliance with exercise programmes is often a serious issue for patients (Bollen et al., 2014; Hudson & Ryan, 2010). Participants reported that care providers’ styles affected exercise compliance (Kolt & McEvoy, 2003). Positive influences were reported when the clinician provided knowledge, promoted feedback during exercise instruction, gave reminders and monitored results (Kolt & McEvoy, 2003). Compliance decreased when participants felt the therapist lacked in clinical knowledge about the disease or the specific goal of the exercise (Escolar-Reina et al., 2010). When explanation was offered about the clinical condition, and treatment justification was accurate, understandable and convincing, an increase in motivation was reported (Daykin & Richardson, 2004). Inadequate instruction was reported to decrease compliance due to feelings of insecurity and reduced confidence in the ability to perform the exercises correctly at home. Exercise instruction, written or printed increased compliance and motivation (Schoo, Morris, 2003). Motivation and compliance levels were also high when the therapist monitored compliance and health status progress. Monitoring was achieved by direct questions regarding health status, exercise progression, pain and function (Slade, Molloy, & Keating, 2009). This study did not follow up the participants who did not complete the intervention.
(Escolar-Reina et al., 2010). This information may have enhanced the understanding of low compliance within a chronic pain population.

Specific characteristics of prescribed exercises have been reported to affect compliance (Frih, Fendri, Jellad, Boudoukhane, & Rejeb, 2009). The predominant characteristic was time taken to complete the exercise programme. If the home-based programme required a lot of their time, participants tended to prefer the regular use of painkillers. Other factors reported to impede compliance were high levels of complexity in the prescribed exercises and the potential of discomfort during or after exercising. Studies have shown that, due to the episodic nature of chronic neck pain, long-term exercise adherence is required for positive treatment outcome as a decrease in exercise may lead to an increase in pain and disability (Hoy, Protani, De, & Buchbinder, 2011). Low compliance to exercise is reported as pain decreases and patients experience health benefits. Escolar-Reina et al. (2010) identified the use of cross-sectional sampling and interviews as a limitation of the study. This may limit the ability to capture changes over time. Participants who abandoned their treatment were excluded from the results. The experiences of those participants who abandoned the prescribed regimen may offer a different perspective on the issue of compliance and motivation. Recall bias must be considered in this study as participant interviews were spread over the three months from the start of the prescribed exercise programme.

**Outcome measures and compliance**

Standardised outcome measures for the various aspects of compliance are few (Howard & Gosling, 2008). Differences in the definition of compliance
and the measurement protocol vary between studies (Bollen et al., 2014). In a systematic review of 58 studies (Bollen, Dean, Siegert, Howe, & Goodwin, 2014), 61 total measures of compliance were reported. A low level of internal consistency, psychometric and reliability validation measures was noted in these studies. The limited availability of validated measures makes it difficult to establish whether the prescribed exercise programme is effective or requires modification. Studies have identified factors that may be associated with compliance: these include higher health locus of control (Beinart et al., 2013), degree of supervision (Hudson & Ryan, 2010) and participation in a group exercise programme (Sjøgaard et al., 2014; Bollen et al., 2014). Beinart et al. (2013) suggest it is important to acknowledge that predictors of compliance may differ among patients with chronic pain. These predictors may be important when considering exercise prescription and the method of delivery. Increased support may be required for patients with low levels of compliance.

**Pilates**

Pilates is a mind-body exercise that targets core stability, strength, flexibility, posture, muscle control, breathing and relaxation (Wells, Kolt, & Bialocerkowski, 2012). Created during the First World War, the exercise system that Joseph Pilates developed mixed the movement styles of gymnastics, martial arts, yoga and dance with philosophical notions (Latey, 2001). Pilates believed ‘It is the mind itself which shapes the body’, basing his exercise on six principles (Latey, 2001). It is these principles that define Pilates with regard to other exercise methods.
Chronic pain states such as fear, anxiety, moodiness and anger may increase the perception of pain. A person’s mental or emotional state may be positively influenced by mind-body interventions. Mental focus and relaxation can be obtained by utilising physical movement (Hassed, 2013). Chronic pain sufferers report feeling lost and helpless, and many may adopt personal coping strategies such as anger or withdrawing from others. These strategies are utilised to sidetrack the perception of pain. Mind-body exercise achieves the same end by focusing the mind, body and breathing on the physical task being undertaken.

Exercise regimes based upon the Pilates principles have been extensively studied with regard to patients with chronic low back pain (da Luz et al., 2013; Miyamoto, Costa, & Cabral, 2011). These exercises can be performed with specific equipment (Equipment-based Pilates) or without (Mat Pilates). Pilates involves motor relearning of movement, including the cognitive, associative and the automatic stages (Mallin & Murphy, 2013). Modern Pilates combines Joseph Pilates’ principles with the FITT principles for general exercise (von Sperling de Souza & Brum Vieira, 2006). The six to eight basic principles are considered the essence of Pilates and include diaphragmatic breathing, control, concentration, centring, precision and flowing movements (Latey, 2001). Relaxation, adherence to the exercise and range of motion are principles that are often applied to modern Pilates (Herman, 2006; J. Smith, Kelly, & Monks, 2009). The principles are the backbone of the Pilates method (Herman, 2006); diaphragmatic breathing is the focus on equal inhalation and exhalation to release tension, maximise body control, increase lung capacity and promote relaxation (Herman, 2006).
Control refers to the exercise pace and overall attention to detail, thus creating a muscle synergy enhancing the balance and co-ordination of the body (Herman, 2006). Centring is the activation of the transverse abdominus and pelvic floor muscles, performed in-time with the exhalation to assist with stabilisation of the axial skeleton. Precision is similar to control with the addition of spatial awareness. All Pilates exercises require precise movements with regard to the placement of limbs and torso. Flowing movement is related to the ‘free-movement’ that must be maintained throughout the exercises. This flow is thought to integrate the nervous system, muscles and joints, training the body to move smoothly and evenly (Herman, 2006). Joseph Pilates describes the mind-body connection as follows: "Contrology – develops the body uniformly, corrects wrong postures, restores physical vitality, invigorates the mind and elevates the spirit" (Latey, 2001). The mind-body connection encouraged by Pilates exercises may assist in rehabilitation of chronic neck pain (Rosenzweig et al., 2010).

To date, research on the effectiveness of an Equipment Pilates intervention for neck pain is limited to a single pilot study (Mallin & Murphy, 2013). Most clinical research has focused upon on the effects of Pilates on non-specific lower back pain and disability (Queiroz et al., 2015; Stieglitz, Vinson, & Hampton, 2016; Wajswelner, Metcalf, & Bennell, 2012). Systematic reviews on the effectiveness of the Pilates exercises of patients with low back pain reveal conflicting results (Miyamoto et al., 2011; von Sperling de Souza & Brum Vieira, 2006; Wells et al., 2012). Mallin & Murphy (2013) reported no significant difference in pain between Pilates and usual exercise; this finding is similar to that of studies by Garcia et al. (2013) and Wells et al. (2013).
However, two recent studies reported a decrease in pain, an increase in function and improvement in quality of life following a Pilates intervention (Natour, Cazotti, Ribeiro, Baptista, & Jones, 2015; Oliveira et al., 2014). These conflicting results may be due to the multifactorial nature of chronic non-specific lower back pain (Wells, Kolt, Marshall, & Bialocerkowski, 2014). Similarly to lower back pain and exercise literature, current neck pain literature supports the use of a variety of exercises that Pilates can offer (Schellingerhout et al., 2008). Mallin and Murphy (2013) conducted a pre- and post-intervention study looking at the effectiveness of a six week Pilates intervention for patients with chronic neck pain. Subjects (n=13) were asked to attend a one hour Pilates class, once weekly for six weeks. The class consisted of 10 to 15 mat Pilates exercises based on a mat-work level one programme from the Australian Pilates and Physiotherapy Institute. Following course completion, subjects were given 20 minutes of home exercise to complete three times per week.

Mallin and Murphy (2013) recruited participants by advertising in physiotherapy practices, local general practitioners’ practices, libraries, sports clubs and a local newspaper. Inclusion criteria comprised age of between 18 and 60 years, a neck pain history with or without arm pain for a duration of greater than six weeks or recurring neck pain defined as pain for at least one week per month over the previous four months. Subjects were excluded if their Numerical Pain Rating Scale score was eight or higher, if they had previously been diagnosed with inflammatory joint disease, systemic metabolic disorder, chronic pain syndrome or poor cardiovascular status, if
they had recently had major surgery, or if they could not move up and down from the floor.

The primary outcome measures were the Numerical Pain Rating Scale, Neck Disability Index and Patient Specific Functional Scale. All outcomes were measured at baseline and after six and twelve weeks of the intervention. A significant decrease (p=<0.01) was recorded in the Neck Disability Index from baseline to week six, and from baseline to week twelve. Patient Scores for Specific Functional scale significantly increased (p=<0.01) from baseline to week six and baseline to week twelve. Numerical Pain Rating Scale decreased at 12 weeks, (p<0.01), however at six weeks the change was not significant (p>0.05). The participants in this study were mostly female. This is consistent with previous neck pain studies, since neck pain is more commonly experienced by women (Childs et al., 2008).

The limitations of the Mallin and Murphy (2013) study include the low number of participants, lack of blinding, lack of a control group and the short follow-up period. As participants volunteered for the Pilates intervention there may have been selection bias (Patel, 2003). Therefore, credibility and outcome expectancy may have been predictors of patient outcome. Short-term outcome measures and lack of a control group may compromise the ability to determine whether the improvements in neck pain and disability were the result of the Pilates intervention, an effect of time or simply due to the recurrent nature of neck pain. Of interest is the exclusion of chronic pain syndrome patients. According to current chronic pain research it is very difficult to diagnose chronic pain diseases versus syndromes (Phillips & Clauw, 2011).
da Luz, Costa, Fuhro et al., (2014) conducted a trial assessing the effectiveness of mat or equipment based Pilates exercises in patients with chronic non-specific lower back pain. Participants aged from 18 to 60 years with lower back pain of greater than three months’ duration were selected from patients referred for physiotherapy following a medical appointment. Individuals were excluded for the following participant contraindication for physical exercise according to the Physical Activity Readiness Questionnaire, regular Pilates practice, pregnancy, previous spinal and lower limb surgeries, a history of spinal fracture, inflammatory, rheumatic or neurological disorders, systemic metabolic disease, nerve root compromise, tumour, infection, osteoporosis or structural deformity. Participants who had received treatment for the lumbar spine in the previous six months were also excluded. The interventions received were mat Pilates (n=43) and equipment Pilates (n=43). The interventions lasted one hour, twice a week for six weeks. Participants in both groups received individual, supervised exercise modifications within the group. These exercises were adapted according to the limitations of each participant.

Assessment was at baseline, six weeks and six months. The primary outcomes were pain intensity measured with Pain Numerical Rating Scale (11-point), and disability using the Roland-Morris Disability Questionnaire. Secondary outcomes measured at six weeks and six months were global perceived effect, measured using the Global Perceived Effect Scale, specific disability via the Patient-Specific Functional Scale and kinesiophobia assessed using the Tampa Scale for Kinesiophobia.
The results from the study by da Luz, Fuhrro, et al., (2014) indicated significant differences within each group. Except for mat Pilates, the change in kinesiophobia was insignificant at six months. In the six week follow-up, no significant differences between the groups were recorded. At the six month follow-up, a significant difference in Roland-Morris disability score (mean difference = 3.0 points, 95% CI = 0.6), with greater improvement in the Equipment Pilates group in the disability, specific disability (mean difference = -1.1 points, 95% CI -2.0 to -0.1), and kinesiophobia (mean difference = 4.9 points, 95% CI = 1.6 to 8.2). No differences were found for pain intensity at six weeks or six months. Disability may have recorded an improvement due to the placebo effect of using exercise machines, as a study showed that confidence in the treatment technique increased with the use of high technology (Kaptchuk, Goldman, Stone, & Stason, 2000). The outcome for kinesiophobia may be due to the supportive environment that Equipment Pilates can provide, as the machines provide stabilisation and ease of use. A recent study that compared back stabilisation exercises with conventional exercises in participants with chronic non-specific lower back pain also found no significant differences for pain between these treatments (B. E. Smith, Littlewood, & May, 2014).

One of the limitations of this study was the selection bias based on the fact that the patients were already seeking treatment. This may predispose participants to a positive outcome based on their perception of the credibility and expectancy of the treatment (Patel 2003; Smeets et al., 2008). Therapists and patients were not blinded to group allocation. The researcher suggests
future studies such as economic evaluation analysis and patient exercise preferences.

Wells, Kolt, Marshall, Hill, & Bialocerkowski (2013) combined studies from five systematic reviews to investigate the effectiveness of Pilates exercise in participants with chronic lower back pain. Their review included a comparison of research questions and examined the level and quality of evidence of the systematic reviews. Evidence was assessed by two independent researchers, with any disagreements being resolved by a third researcher (Wells et al., 2013). The researchers found conflicting results for the effectiveness of Pilates in reducing pain and disability. Of a total of 44 papers in the five systematic reviews only five were included in the Wells et al. (2013) review. This low number was due to many studies differing in inclusion criteria, the lack of an adequate definition of Pilates in some studies, poor methodological quality and not being published in peer-reviewed journals. Methodological quality was assessed using R-AMSTAR, which has been shown to be a valid and reliable test for this (Kung et al., 2010).

The Pilates exercise protocols across the studies were diverse. Four out of five studies prescribed mat Pilates, three of the studies also prescribed home exercise and one study involved Pilates, yoga and physiotherapy. Comparison treatments ranged from no exercise, usual care, and physiotherapy to alternative exercises. The description of these comparison treatments was inconsistent. Similar outcome measures were utilised, although primary outcome measures were evaluated at different points in time. The timing of these measures was linked to the duration of the Pilates treatment and length of follow-up. The shortest follow-up period was six
weeks and the longest 12 months following the completion of Pilates treatment. The target group also varied amongst the five papers reviewed: three incorporated acute lower back pain; the remaining two included sub-acute, chronic and recurrent lower back pain. These diverse heterogeneous lower back pain populations have been reported to respond differently to exercise interventions, thus confounding the results (Hayden, 2005). The authors found no conclusive evidence that Pilates exercise is effective in reducing pain and disability in participants with lower back pain (Wells et al., 2013). This conclusion is based on the insufficient participant numbers and poor methodological quality of the original studies rather than that of the systematic reviews.

Wells et al. (2012) conducted another systematic review of 2182 studies to identify the definition of Pilates exercise. Only 119 studies fulfilled the selection criteria. Of the studies included, 38% were floor-based and/or equipment Pilates (such as the Trapeze Table, Reformer, Wunda Chair and Ladder Barrel) and 53% did not specify equipment or type of exercise. The traditional Pilates principles included in the studies were breathing (49%), centring (19%), control (19%), precision (18%), flow (18%) and concentration (18%). Apart from breathing, the researchers found that none of the papers investigating Pilates and lower back pain used all six traditional principles. Breathing was mentioned in all of the lower back pain studies. Only 21% mentioned the traditional principles when describing the Pilates programme. Pilates without the application of the six main principles is little more than an exercise programme.
A variety of research questions and methodological designs were noted across the studies. Forty-nine studies focused on a healthy population, 17 on the effect of Pilates on lower back pain and the remaining 53 focused on other pathologies, or did not consider the application of Pilates exercise to any particular group of people. None of the included articles defined Pilates. Differing definitions of Pilates exercise may result in varying exercise techniques. The authors suggest that the traditional principles, apart from breathing, are less important than previously reported, particularly in people with lower back pain. Due to the psychosomatic and psychosocial nature of chronic pain, the mind-body connection encouraged by the principles would seem a valid inclusion into chronic pain studies. The review was unable to provide details of the Pilates exercises in the different studies because it was not reported.

**Pilates Exercise Treatment for Chronic Neck Pain**

Though the use of Pilates exercise in the treatment of chronic low back pain has steadily increased, the current evidence of its effectiveness is not supported by many good quality studies (Wells et al., 2014). Current studies favour the hypothesis that Pilates exercises are more effective than minimal or no intervention for the reduction of pain and disability within a population of people suffering from chronic lower back pain. However, further research is needed on the effects of Pilates in people with chronic pain. Due to the heterogeneous nature of chronic neck pain and the complexity of research involving an exercise intervention for this, evidence is scarce. In previous Pilates studies, little consideration was given to the psychosocial aspects of chronic pain on quality of life. Research has shown that the mind-body
connection is becoming more accepted as part of the multifaceted approach to rehabilitation of chronic pain (Rosenzweig et al., 2010). Joseph Pilates himself said "Contrology is the complete coordination of mind, body and spirit ..... with mind, body and spirit functioning perfectly as a coordinated whole, what else could reasonably be expected other than an active, alert disciplined person" ("TOP 25 QUOTES BY JOSEPH PILATES (of 72) | A-Z Quotes," n.d.)

Conclusion

Further research on chronic neck pain causes, effects and patient preferences is required. Neck pain causes substantial disability and a decrease in quality of life (D. Hoy et al., 2014; Walton et al., 2013). In New Zealand, 50 to 85% of acute neck pain sufferers may go on to become chronic (greater than 12 weeks duration). Acute neck pain is often self-limiting, requiring little or no intervention. Patients who progress to chronic neck pain form a diverse population, diagnosis is complicated and long-term prognosis is often poor. Chronic pain may be neurological, musculoskeletal or psychosomatic in origin. Researchers must consider the physical, emotional and psychosocial facets of chronic neck pain in order to determine appropriate treatment and improve prognostic accuracy. Relevant, validated questionnaires can provide important information to guide treatment of this condition. The primary carer has limited resources for treatment guidelines. Research has been unable to identify a single treatment protocol; instead a multifaceted approach utilising general exercise, manual therapy and medication is advised. General exercise is thought to be more effective than specific exercise due to adverse events caused by the increase of nociceptive substances from specific training. Exercise therapy for chronic pain requires
long-term patient compliance. The practitioner needs to be aware of factors that may limit this. These include: motivation, education, outcome expectation, cost and psychosocial influences. Group exercise classes such as Pilates, where the instructor is able to offer supervised and individual exercise modifications in a cost-effective environment may increase patient compliance and prognosis. There is limited research on the effects of exercise on chronic neck pain with regard to wellbeing and quality of life. Pilates is a mind-body exercise reported to increase physical and mental wellbeing. Thus, it may be a suitable treatment for chronic neck pain sufferers. Further research on chronic neck pain causes, effects and patient treatment preferences is required.
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Section 2: Manuscript

Note to examiner: This manuscript has been prepared in accordance with the instructions for authors for the Journal of Bodywork and Movement Therapies (see Appendix A). Detailed information regarding the Pilates and exercise interventions was considered to be important information for the thesis, but was too long for the requirements of this particular journal. Therefore YouTube videos have been created and referenced. An abstract to fulfill the Journal of Bodywork and Movement guidelines is included.
A randomised controlled trial of Pilates plus home-based exercises and home-based exercise alone on pain, disability and quality of life in people with chronic non-specific neck pain.

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The institutional Ethics Research Committee approved the study (UREC Approval 2014-1043) (See Appendix B) which was registered with the Australia New Zealand Clinical Trials Registry (ANZCTR) ACTRN12614000841673.
Executive Summary

Background and aim

Despite the growing popularity of Pilates, a mind-body exercise that has been widely studied for chronic lower back pain, there is limited research on the effectiveness of an Equipment Pilates and home-based exercise intervention for chronic non-specific neck pain. The aim of this randomised controlled trial was to examine the effect of Equipment Pilates on pain, disability and quality of life in patients with chronic non-specific neck pain when applied in addition to home-based exercise, and to determine the effect of credibility, expectancy and Yellow Flags on changes in outcomes.

Method

Twenty four participants (n=19 females, n= 5 males) were recruited from the local community and randomly assigned to either an Equipment Pilates and home-based exercise group (Pilates+exercise) or a home-based exercise only group (exercise-only). The Pilates+exercise group attended 16 Pilates classes over 8-weeks, and both groups were asked to complete the home-based exercises daily for 8-weeks. Data were recorded at baseline, week-4, week-9 and week-12. Pain was assessed using the Visual Analogue Scale (VAS), disability using the Northwick Park Neck Pain Questionnaire, perception of health status (quality of life) using the Short-Form 36 questionnaire (SF-36), credibility and expectancy of the intervention (CEQ) and the ACC Yellow Flags questionnaire to assess psychosocial risk factors for on-going chronicity.

Results

Improvements were recorded in both groups, at all intervals for
disability (p < 0.05) and for pain at week-9 and week-12. The Pilates+exercise group recorded a higher minimal clinically important difference (MCID% change) with respect to pain and disability in comparison to the exercise-only group. At week-9 (Pilates+exercise VAS = 53%, NPQ = 60%; exercise-only VAS = 55.6%, NPQ = 60%) and at week-12 (Pilates+exercise VAS = 73%, NPQ = 70%; exercise-only VAS = 55.6%, NPQ = 60%). Quality of life showed an improvement in both interventions.

Conclusion

The result of this study shows that Equipment Pilates plus home-based exercise is at least as effective as home-based exercise alone for chronic neck pain with regard to pain, disability and quality of life. This study is limited by a small sample size, short-term follow-up only and confounding factors.

Keywords: Equipment Pilates, exercise, neck pain, randomised control trial

ABSTRACT

This randomised controlled trial examined the effect of Equipment Pilates on pain, disability and quality of life resulting from chronic non-specific neck pain when applied in addition to home-based exercise, and determined the effect of credibility, expectancy and Yellow Flags on changes in outcomes. Twenty four participants (n=19 females, n= 5 males) recruited from the local community were randomly assigned to either 8 weeks of twice weekly Equipment Pilates and home-based exercise (Pilates+exercise) or a home-based exercise only (exercise-only) control. Pain and disability outcomes were recorded at weeks 4, 9 and 12. More of the Pilates+ exercise group (n=15) than the exercise only group (n=11) reached minimal clinically
important difference for pain and disability. Quality of life improved in participants receiving both interventions. The result of this study suggests that Equipment Pilates plus home-based exercise is at least as effective as home-based exercise alone for chronic neck pain with regard to pain, disability and quality of life.

**INTRODUCTION**

Neck pain is the fourth leading cause of disability worldwide with an annual prevalence rate exceeding 30% (D. Hoy et al., 2014). In New Zealand, chronic neck pain is estimated to occur in up to 30% of the adult population (Rule, 2009). Chronic pain is described as pain which is present for more than 12-weeks and, therefore, is unlikely to resolve itself (Phillips & Clauw, 2011). Interestingly, women in high-income countries have shown increased prevalence when compared with low- and middle-income countries and the prevalence is higher in urban areas than rural areas (Schellingerhout, 2011). There is an increased risk of developing chronic neck pain in the 35 to 49 year age group, after which the risk begins to decline (Schellingerhout, 2011).

Chronic non-specific neck pain has significant financial, physical and psychosocial implications for individuals and countries in terms of lost productivity and health care costs (D. G. Hoy et al., 2011; Walton et al., 2013). While the causes and treatments have been widely studied; the causation, correct diagnosis and treatment protocols for chronic neck pain are not clearly defined (Childs et al., 2008).

**The course of chronic neck pain, and co-morbidities**

Most cases of acute neck pain will resolve spontaneously with or without treatment over a period of weeks to months (Cohen, 2015). Often this
neck pain can be attributed to a specific incident, with a defined injury site and local inflammation.

The onset and course of chronic neck pain is varied and not clearly understood: environmental and personal factors may play a role, making diagnosis complicated (Phillips & Clauw, 2011). Co-morbidities associated with neck pain include headaches, back pain, anxiety, a decrease in movement due to fear-avoidance and depression (Cohen, 2015).

**The nature of chronic pain**

Historically, chronic pain was considered to be limited to individuals with idiopathic/functional pain syndromes such as fibromyalgia. These pain syndromes have been shown to be familial/genetic (Clauw, 2015). Clauw (2015) stated, “when individuals are identified as having a new onset of chronic pain, questioning often reveals intense pain elsewhere and various somatic symptoms”. Clauw (2015) suggests that chronic regional pain is a chronic illness that began much earlier in life.

Many researchers believe that chronic pain is a disease, a mixed state involving the peripheral and central nervous system (Clauw 2015; Falla 2004; Phillips & Clauw 2011). Phillips and Clauw (2011) stated, “There is no chronic pain state where any radiographic, surgical or pathological description of peripheral nociceptive damage has been shown to be related to the presence or severity of pain”. The peripheral and central nervous systems play a critical role in determining which of the detected sensory nociceptive inputs will lead to the perception of pain (Phillips & Clauw, 2011). The core symptoms of chronic pain are multifocal pain, fatigue, insomnia, cognitive/memory difficulties and psychological distress. Patients may present with neck pain but
this may be a result of genetically determined sensitivity and/or neoplastic changes in the central nervous system (Phillips & Clauw 2011).

**TREATMENT**

**Current research**

Treatment of chronic neck pain has been widely studied (Bryans et al., 2014; Childs et al., 2008; Walton et al., 2013) but the results do not indicate a definitive treatment protocol. There are many options for the treatment of chronic neck pain, including prescribed active exercise, manual therapy, drug treatments and patient education (Anderson-Peacock, et al., 2005). Prescribed active exercise is a common treatment choice with an increasing number of clinical trials emerging that provide some evidence supporting its use (Bryans et al., 2014; Childs et al., 2008; Walton et al., 2013). These trials predominantly investigate the effectiveness of a variety of exercise treatments in different situations, such as private treatment, group classes and home-based exercise programmes (Hudson & Ryan, 2010). However, they often examine the use of exercise therapy in conjunction with manual therapies, patient education, and psychosocial factors, which may result in unclear conclusions regarding optimal prescription (Childs et al., 2008; Raney et al., 2009; Southerst et al., 2014).

Over the last 10-years numerous studies evaluating treatments for chronic neck pain have been conducted (Anderson-Peacock et al., 2005; Falla, Lindstrøm, Rechter, Boudreau, & Petzke, 2013; J. Schellingerhout, 2011; Walton et al., 2013). Systematic reviews have questioned the validity of many of these studies (Cohen, 2015) due to mixed study populations (Walton et al., 2013), limited patient clinical information (Falla, 2004), a wide variety of
inclusion and exclusion criteria (Schellingerhout et al., 2008) and the differing duration of time between follow-up periods (Anderson-Peacock et al., 2005).

In spite of the uncertainty, recent studies suggest that the best treatment approach for chronic neck pain is multimodal (Childs et al., 2008; Hudson & Ryan, 2010). Multimodal treatment protocols may involve a combination of manual therapy, exercise, education, medication and psychological intervention (Bryans et al., 2014).

**Exercise therapy**

Systematic reviews have consistently found exercise therapy to have an effect on neck pain, either alone or in conjunction with manual therapy (Evans et al., 2012; Haldeman et al., 2008; Walton et al., 2013). Exercise therapy embraces many modalities such as strength and endurance training, proprioceptive exercises, isometric training and patient education to name a few. A general exercise programme is considered to improve fitness and functional ability for people with various long-term conditions such as chronic neck pain and chronic lower back pain (Andersen et al., 2008). While some studies have demonstrated that pain can be reduced by strength training, endurance training and muscle coordination training (Andersen et al., 2008; McCaskey, Schuster-Amft, Wirth, Suica, & de Bruin, 2014), others have found little effect from physical training (Chiu et al., 2005; Salo et al., 2010). Furthermore, exercise rehabilitation, targeting specific muscle groups, may cause adverse events related to training caused by an increase in nociceptive substances (Clauw, 2015). Although a recent review O’Riordan, Clifford, Van De Ven and Nelson (2014) reported limited evidence for the effectiveness of
physical exercise with regard to the treatment of chronic symptoms of the neck and/or shoulder regions due to a lack of targeted high-quality research.

**Exercise compliance**

Regardless of the exercise treatment offered for chronic neck pain, prognosis will be poor if patient compliance is low. Research has shown that exercise intervention for chronic neck pain must be long-term, therefore managing patient compliance is important (Walton et al., 2013). Compliance levels can be influenced by many factors, some of which are: pain caused by exercising, low treatment credibility, low patient expectation, practitioner-patient relationship, cost and the quality of advice (Escolar-Reina et al., 2010).

**Pilates: mind-body exercise**

Pilates is a mind-body exercise that targets core stability, strength, flexibility, posture, muscle control, breathing and relaxation (Wells et al., 2012). Pain may be amplified by fear, stress and anxiety. To change a patient’s emotional or mental state, a mind-body intervention using movement and breath may produce mental focus and relaxation (Hassed, 2013). These approaches may reduce pain and disability by improving psychological states associated with increased pain perception such as stress, fear, depression and anxiety (Phillips & Clauw, 2011). They may distract from pain by focusing the mind, body and breathing on the physical task being undertaken (Hassed, 2013).

**Pilates Principles**

Joseph Pilates describes the mind-body connection as follows: "Contrology – develops the body uniformly, corrects wrong postures, restores physical vitality, invigorates the mind and elevates the spirit" (Latey, 2001).
Exercise regimes based upon the Pilates principles have been extensively used as an intervention for patients with chronic low back pain (da Luz et al., 2013; Miyamoto, Costa, & Cabral, 2011). These exercises can be performed with (Equipment-based Pilates) or without (Mat Pilates) specific equipment. Pilates involves motor relearning of movement, including the cognitive, associative and the automatic stages (Mallin & Murphy, 2013). Modern Pilates combines Joseph Pilates’ original principles with the fitness, intensity, time and type (FITT) principles for general exercise (O’Riordan et al., 2014; von Sperling de Souza & Brum Vieira, 2006). There are six to eight basic principles considered to be the essence of Pilates. The original six principles are; diaphragmatic breathing, control, concentration, centring, precision and flowing movements (Latey, 2001). Relaxation, adherence to the exercise and range of motion are principles often applied to modern Pilates (Herman, 2006; J. Smith et al., 2009).

These principles are the backbone of the Pilates method (Herman, 2006); diaphragmatic breathing is the focus on equal inhalation and exhalation to release tension, maximise body control, increase lung capacity and promote relaxation (Herman, 2006). Control refers to the exercise pace and overall attention to detail, thus creating a muscle synergy enhancing the balance and co-ordination of the body (Herman, 2006). Centring is the activation of the transverse abdominus and pelvic floor muscles; this is performed in time with exhalation to assist with stabilisation of the axial skeleton. Precision is similar to control with the addition of spatial awareness. All Pilates exercises require precise movements with regard to the placement of limbs and torso. Flowing movement is related to the ‘free-movement’ that
must be maintained throughout the exercises. This flow is thought to integrate the nervous system, muscles and joints, training the body to move smoothly and evenly (Herman, 2006). The mind-body connection encouraged by Pilates exercise may assist in rehabilitation of chronic neck pain (Rosenzweig et al., 2010).

**Pilates and Chronic Pain**

To date, research on the effectiveness of a Pilates intervention for neck pain is limited to a single pilot study (Mallin & Murphy, 2013). Most clinical research has concentrated on the effects of Pilates on chronic non-specific lower back pain and disability (Oliveira et al., 2014; Wells et al., 2014). Previous systematic reviews on the effectiveness of the Pilates exercises of patients with low back pain reveal conflicting results (Miyamoto et al., 2011; von Sperling de Souza & Brum Vieira, 2006; Wells et al., 2012). Mallin & Murphy (2013) reported no significant difference in the levels of chronic pain between Pilates and usual exercise; this finding is similar to that of studies by Garcia et al. (2013) and Wells et al., (2013), although, all three of the studies noted an improvement in disability.

**Rationale for Research**

Further research on chronic neck pain causes, effects and patient treatment preferences is required. Although a general exercise programme is thought to be more effective than the prescription of specific exercise for chronic neck pain, there is limited research on the effects of exercise on chronic neck pain with regard to wellbeing and quality of life. In addition, exercise therapy for chronic pain requires long-term patient compliance, and the practitioner needs
to be aware of factors that may limit this. These include motivation, education, outcome expectation, cost and psychosocial influences.

Group exercise classes such as Pilates, where the instructor is able to offer supervised and individual exercise modifications in a cost-effective environment may increase patient compliance and prognosis. Pilates is a mind-body exercise reported to increase physical and mental wellbeing. Thus, it may be a suitable treatment for chronic neck pain sufferers. This study examined the effect of Equipment Pilates plus home based exercise on pain, disability and quality of life in people with non-specific neck pain.

**METHODS**

This research project is part of a larger, two-armed randomised controlled trial conducted to examine the effect of Equipment Pilates or Yoga with the addition of standard, prescribed home-based exercise for chronic non-specific neck pain. Participants were randomised to one of three groups: Equipment Pilates and home-based exercise (Pilates+exercise), yoga and home-based exercise and home-based exercise only (exercise-only) as a control. The exercise-only group was divided between the two researchers and the results from this group were shared. Each researcher managed their participants separately.

Approval for the study was obtained from The Institutional Ethics Research Committee (UREC Approval 2014 – 1043) (see Appendix B) which was registered with the Australia New Zealand Clinical Trials Registry (ANZCTR) ACTRN12614000841673.
Study sample

The target sample size of 19 participants per group was calculated using G*Power 3. Change effect sizes of 0.7, assuming a level of significance of 0.05 and statistical power of 80% (Faul, Erdfelder, Lang, & Buchner, 2007) would be detected by this sample size. An initial sample size of 20 participants per group was planned to allow for study withdrawals and non-compliance.

Individuals were invited to participate by newspaper editorial (see Appendix F), posters (see Appendix E) and through social media (Scollay & Andrews, 2014a). Initial screening was by phone or email, followed-up with study information, an eligibility questionnaire (see Appendix D) and the inclusion and exclusion criteria as in Table 1.

Table 1.
Participant inclusion/exclusion criteria

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 18–60 years of age</td>
<td>• Chronic neck pain diagnosed via imaging e.g. disc protrusion, congenital deformity of the spine, spinal canal stenosis</td>
</tr>
<tr>
<td>• Non-specific neck pain of duration of at least 12 weeks</td>
<td>• Chronic neck pain due to systemic inflammatory disease e.g. neoplasm, inflammatory rheumatic disease, and active oncologic disease</td>
</tr>
<tr>
<td>• Pain described as 4/10 (10 being worst imaginable), lasting most days of the week</td>
<td>• Pregnancy</td>
</tr>
<tr>
<td>• Able to attended two classes per week if required, proposed timetable was emailed</td>
<td>• Invasive treatment of the spine in the previous 12 months</td>
</tr>
<tr>
<td>• Literate in the English language</td>
<td>• Chronic neck pain due to whiplash</td>
</tr>
<tr>
<td></td>
<td>• Regular practice of Pilates and/or Yoga in the last 6 months</td>
</tr>
<tr>
<td></td>
<td>• Currently involved in an Accident Compensation Claim (ACC) for neck pain of 90 days or less</td>
</tr>
</tbody>
</table>
**Randomisation**

Block randomisation for the three arms (Pilates+exercise; yoga+exercise; and exercise-only) was generated in advance of recruitment for the target sample size by an independent assessor, not involved in recruitment, using the website www.randomization.org. Upon enrolment the participant allocation was requested, and the principal researcher contacted the participant to advise of the group they were assigned to. The participant was then invited to meet with a researcher to give written consent (see Appendix C), complete baseline questionnaires (see Appendices J, K, L, M, N) and be guided through the home-based exercise programme.

**INTERVENTIONS**

**Equipment Pilates intervention**

The Equipment Pilates group participated in 16, 60-minute Equipment Pilates classes over a period of 8 to 10 weeks. The participants joined in general classes with the public. These classes were conducted in a private Equipment Pilates studio taught exclusively by the researcher (an Equipment Pilates and rehabilitation certified instructor). The Equipment Pilates classes were ‘studio style’; each participant was guided through a workout individually designed to suit their needs in a small group environment. Participant numbers in each class varied from 2 to 5. The study participants received a standard introductory Pilates programme (Scollay, 2016) (see Appendix I). The Pilates equipment utilised during the intervention was the Reformer, Wunda Chair, Trapeze Table, Spring Board, mat, foam-roller and Pilates.
circle (see Appendix H). The Pilates exercise programme was modified within frequency, intensity, time and type (FITT) guidelines for chronic neck pain to suit each participant for the duration of the intervention (O’Riordan et al., 2014).

**Home-based prescribed exercise**

Participants were guided through the home-based exercise in a small group or individual setting, and questions and feedback were invited. Exercises were modified if required. All participants received a YouTube link (Scollay & Andrews, 2014b) to the home-based exercise programme. Exercise selection was based on intervention guidelines for manual therapists treating patients with chronic non-specific neck pain (Bryans, Decina, Descarreaux et al., 2014; Childs, Cleland, Eliott, Teyhen., 2008). These exercises included diaphragmatic breathing training, strengthening and gentle stretching to decrease tension, increase range of movement and increase strength in the neck, shoulder and thoracic regions. Participants were requested to complete all 5 exercises daily for 8 weeks and record whether completed or not on a compliance sheet (see Appendix O). It was estimated the time it would take to complete these was 5 to 10 minutes. The researcher was available throughout the duration of the intervention to modify exercises and answer participant questions. The motivation and guidance offered was left to the discretion of the researcher.

**OUTCOME MEASURES**

Scoring instructions were followed for each of the four reported questionnaires (Visual Analogue Scale (VAS); Northwick Park Neck Pain Questionnaire (NPQ); Medical Outcomes Shortform 36 (SF-36); Credibility and Expectancy Questionnaire (CEQ)) for each of the four data collection
points (baseline, week-4, week-9, week-12).

**Neck pain intensity via Visual Analogue Scale (VAS)**

Participants were verbally asked to rate their current pain at the present moment using the VAS on a 100mm horizontal line marked ‘No pain’ at one end, and ‘Pain as bad as it could possibly be’ at either end (see Appendix J). The VAS is a reliable and well used clinical tool to measure pain intensity (Hawker et al., 2011). Participants were not shown their previous VAS scores at subsequent data collection time points. Minimal clinically significant difference (MCID) was defined as a reduction of $\geq 30$ mm (Oostendorp, Rutten, Dommerholt, Nijhuis-van der Sanden, & Harting, 2013).

**Disability**

Disability was assessed via Northwick Park Neck Pain Questionnaire (NPQ). The NPQ is a nine question, 5-part scale (0-4) used to measure patient neck pain intensity and the effects of this upon daily activities (Kose, Hepguler, Atamaz, & Oder, 2007; Lucas et al., 2003) (see Appendix L). The Northwick Park Neck Pain questionnaire was selected over the Neck Disability Index, another widely used specific neck pain questionnaire, due to its inclusion of a driving question. Many of the participants in the study resided in rural areas with no public transport and thus dependent upon driving. MCID was defined as a reduction of $\geq 25\%$ (Sim et al., 2006).

**Quality of Life**

Medical Outcomes Study Short Form 36 (SF-36) questionnaire is
utilised to identify the physical and mental components of health status (McHorney et al., 1993) (see Appendix M). The SF-36 represents multidimensional health concepts and measures a broad spectrum of these components on an multi-item questionnaire composed of eight sub-scales (Fredheim et al., 2007; Kean et al., 2016; Sullivan et al., 1995). The eight scales measure physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy/fatigue levels, emotional wellbeing, social functioning, pain and general health. Items within the subscales are scored from 0 – 100; higher scores represent greater functionality and wellbeing. The SF-36 has shown high test–retest reliability (Brazier et al., 1992). MCID was defined as an increase of ≥ 20.5 (Lauche et al., 2013).

**Credibility and expectancy**

Participants’ perceived credibility of the intervention and the expected outcomes were assessed via Credibility and Expectancy Questionnaire (CEQ) (Devilly & Borkovec, 2000; Amentrano, 2011) (see Appendix N). It is well established that patients’ beliefs and expectations impact their health outcomes, thus the CEQ was developed to measure both credibility and expectancy in clinical outcome studies (Linton, Vlaeyen, & Ostelo, 2002; Ruud et al., 2006; Pincus, Vogel, Burton, Santos, & Field, 2006; Demmelmaier, Asenlof, & Lindberg, 2010).

**Yellow flag questionnaire**

Participants psychosocial factors such negative pain beliefs, job dissatisfaction, anxiety and depression (yellow flags) have been associated with the development and continuation of chronic pain (Grimmer-Somers et
al., 2008). Participants completed the New Zealand Accident Compensation Corporation (ACC) low back pain Yellow Flag questionnaire at baseline to assess this risk (see Appendix K). This bio-psychosocial model was developed from the Orebro Musculoskeletal Pain questionnaire which was found to be valid and reliable for use in a variety of musculoskeletal pain populations (Gabel, P., Melloh, M., Yelland, M., Burkett, B., Roiko, 2010). A total score of between 90 - 105 indicated the patient is at risk of on-going chronicity (Grimmer-Somers et al., 2008).

**STATISTICAL DATA ANALYSIS**

All statistical analyses and descriptive statistics were performed using IBM SPSS Statistics version 22.0 (IBM Corporation, New York). Variables were checked for assumptions of normality by examining z-scores for skewness and kurtosis and the results of Shapiro-Wilks and Kolmogorov-Smirnoff tests of changes in pre- to post-intervention outcome variables.

Target compliance to the Pilates classes was set at 75%, 12 of 16 Pilates classes over the 8 to 10 weeks. The differences in changes to pain and disability between groups were determined by repeated measures
analysis of variance (ANOVA) for VAS and NPQ, and non-parametric equivalents for SF-36 scores. Credibility and expectancy scores and Yellow Flag scores were analysed for correlations with any changes in primary outcomes. The level of statistical significance was set at $p < 0.05$. Magnitudes of effects were described according to Hopkins’ complete scales (Hopkins, 2002).

Initially the data were tabulated, and each variable described using mean, maximum/minimum values, median and mode. Two-way ANOVA models were applied to determine whether a change in VAS (see Appendix J), NPQ (see Appendix L), or SF-36 (see Appendix M) was significant for those who completed the Pilates+exercise compared to those completing the exercise-only. The effect of intervention credibility and expectancy (see Appendix N) was assessed via correlation analysis. The ACC Yellow Flag questionnaire (see Appendix K) was scored as per ACC guidelines.

RESULTS

Participants

A flow diagram of participant enrollment and analysis, satisfying part of the Consolidated Standard of Reporting Trials (CONSORT), checklist is provided (see Appendix G). A CONSORT flow diagram is shown in Figure 1. (Schulz, Altman, Moher, & Group, 2010).

Ninety-seven participants were assessed for eligibility by email, phone and social media messaging. Of these, 56 were excluded mainly due to neck pain from specific pathologies, minor neck pain and scheduling problems.
Forty-one participants (median age 44 years; 35 females, 6 males) (range 18 - 58 years) were randomised to Pilates+exercise (n=17), yoga+exercise (n=13) or exercise-only (n=11), the Pilates and exercise characteristics shown in Table 2.

Three participants withdrew before the intervention began: Pilates+exercise n=1, exercise-only n=2. Eight withdrew during the intervention due to time constraints or for personal reasons (4 yoga, 1 exercise) and three due to worsening symptoms (1 from each group). Two
participants withdrew from the exercise component but continued to complete questionnaires and are included in the analyses. One of these participants was in the Pilates+exercise group the other in yoga+exercise.

Figure 1.
CONSORT participant flow chart

Enrolment

Assessed for eligibility (n=97)

Excluded (n=56)
Not meeting inclusion criteria (n=27)
Other reasons (n=29)

Randomized (n=41)

Allocation

Allocated to Pilates (n=17)
Received allocated intervention (n=17)
Did not receive allocated intervention
- Unrelated Illness (n=1)
- Adverse Reaction (n=1)

Allocated to yoga (n=13)
Received allocated intervention (n=9)
Did not receive allocated intervention (n=4)
- Scheduling problems (n=3)
- Adverse reaction (n=1)

Allocated to exercise only (n=11)
Received allocated intervention (n=9)
Did not receive allocated intervention (n=2)
- Scheduling problems (n=1)
- Symptoms worsening (n=1)

Analysis

Pilates analysed (n=15)
Male = 4
Female = 11

Yoga analysed (n=9)

Exercise only analysed (n=9)
Male = 2
Female = 7
<table>
<thead>
<tr>
<th></th>
<th>Pilates n=15</th>
<th>Exercise n=11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>nil</td>
</tr>
<tr>
<td>30-39</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>40-45</td>
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<tr>
<td>46+</td>
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<td>9</td>
</tr>
<tr>
<td>Average</td>
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</tr>
<tr>
<td>Standard Deviation</td>
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</tr>
<tr>
<td><strong>Duration of Symptoms (years)</strong></td>
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<td></td>
</tr>
<tr>
<td>1 to 5</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>6 to 10</td>
<td>3</td>
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<tr>
<td>11 to 15</td>
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</tr>
<tr>
<td>16+</td>
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<td>2</td>
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<td><strong>Site of Current Pain</strong></td>
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<td><strong>Average Height (cm)</strong></td>
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</tr>
<tr>
<td>Male</td>
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<td><strong>Average Weight (kg)</strong></td>
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<td>65.3</td>
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<td>Male</td>
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<td>97.5</td>
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<td>Other (Tramadol)</td>
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<td><strong>Previous Treatment</strong></td>
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<td>Physiotherapy</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Osteopathy</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Chiropractic</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Involved in Regular Weekly Exercise</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Average VAS most days</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>5 to 7</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>8 to 10</td>
<td>Nil</td>
<td>nil</td>
</tr>
<tr>
<td><strong>Days Painful per Week</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 2</td>
<td>Nil</td>
<td>nil</td>
</tr>
<tr>
<td>3 to 5</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>6 to 7</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: all data is frequencies unless otherwise stated.
Abbreviations: cm – centimeter, kg – kilogram, NSAID – Non-steroidal anti-inflammatories
The percentage of participants involving in regular exercise before and during the intervention was 67% for Pilates+exercise and exercise-only groups. Both groups had received a variety of treatment interventions (massage, acupuncture, reflexology), had used or were currently using medications for their pain. For the Pilates+exercise group, patient-reported average pain on most days was 1 – 4 cm for 5 individuals and 5 – 7 cm for the remaining 10 individuals. For the exercise-only group, VAS was VAS 1 – 4 cm for 1 individual and 5 – 7 cm for the remaining 7 individuals who answered this question. The pain frequency for number of days per week at baseline was equal in both groups (67%).

**Compliance**

All Pilates participants completed 100% of their scheduled sessions, except for the participant who withdrew due to an increase in symptoms. Mean compliance for home-based exercises was 63% for Pilates+exercise and 72% for the exercise-only group.

**Normality Assumptions**

Changes in VAS and NPQ met assumptions of normality and were analysed using parametric statistical approaches, whilst these assumptions were violated for changes in some SF-36 scales and non-parametric statistical analyses were therefore used for these.
Neck Pain Intensity via VAS

Significant reductions in pain were recorded for both groups at all intervals. The largest change in the Pilates+exercise was from baseline to week-12 (mean = 49.2% decrease; 95% confidence interval (CI) for the change -1.38 to -3.38 cm; p < 0.001; Figure 1A). The largest change in the exercise-only group was baseline to week-9 (39.6%; -0.15 to -3.88; p = 0.04). MCID for VAS (30% change) was reached by 9 (53%) of the Pilates+exercise group at week-9, and 12 (71%) at week-12. MCID for VAS in the exercise-only group was reached by 5 (55.6%) at week-9 and 5 (55.6%) at week-12.

NPQ

As for VAS, improvements in disability (NPQ) were noted for both groups at all intervals. The largest change in the Pilates+exercise was from baseline to week-12 (mean = 50.0% decrease; 95% confidence interval (CI) for the change 7.7 to 19.3; p < 0.001; Figure 1B). The largest change in the exercise-only group was baseline to week-12 (41.7%; 0.94 to 22.46; p = 0.04). MCID for NPQ (25% change) was reached by 10 (60%) of the Pilates+exercise group at week-9, and 12 (71%) at week-12. MCID for NPQ in the exercise-only group was reached by 5 (58%) at week-9 and 5 (58%) at week-12.

Quality of Life

Both Pilates+exercise and the exercise-only group recorded a general improvement in all SF-36 items (refer to Table 3.), although not all were statistically significant. The largest improvements noted in both groups were in
the energy/fatigue and pain scales, and the physical health scale. The Pilates+exercise group improved in physical health from baseline to week-9 (95% CI 0.078 to 52.55 p = 0.04), and to week-12 (2.71 to 57.21 p = 0.03). Energy/fatigue from baseline to week-4 (95% CI -23.68 to -3.66 p = 0.01), week-9 (8.67 to -26.66 p = 0.001) and week-12 (15.75 to -0.35.59 p = 0.001). Pain from baseline to week-12 (-0.26 to -30.41 p = 0.047). The exercise-only group reported a statistically significant change in emotional problems from baseline to week-9 (0.51 to -25.41 p = 0.043), energy/fatigue from baseline to week-9 (2.02 to -30.20 p = 0.03), and week-12 (-0.36 to -32.97 p = 0.05). Pain from baseline to week-4 (-1.35 to -13.65 p = 0.02), week-9 (-4.07 to -28.16 p = 0.015) and week-12 (-8.24 to -36.16 p = 0.01). The frequencies of participants reaching MCID for changes in SF-36 scales (20.5% increase) are in Table 4.

**CEQ and yellow flag correlations**

The Pilates+exercise group showed no significant correlations between baseline CEQ or Yellow Flag scores and changes in any of the outcomes at weeks-9 or week-12. The exercise-only group showed only two significant Pearson’s correlations: between baseline credibility and VAS at week-9 (r = -0.58; p = 0.042) and baseline expectancy and NPQ at week-12 (r = 0.77; p = 0.02). Statistically significant Spearman’s correlations were shown for the Pilates+exercise group between both credibility and expectancy and SF-36 General Health at week-9 (credibility: rho = 0.545, p = 0.04; expectancy: rho = 0.523, p = 0.045) and week-12 (credibility: rho = 0.63, p = 0.01; expectancy: rho = 0.60, p = 0.02). Yellow Flags score at baseline showed a significant
correlation with SF-36 physical function at week-9 (rho = 0.61; p = 0.02) only for the Pilates+exercise group.

Table 3.

**SF-36 Change from Baseline**

<table>
<thead>
<tr>
<th>Pilates</th>
<th>Baseline</th>
<th>Week-4</th>
<th>Change%</th>
<th>Week-9</th>
<th>Change%</th>
<th>Week-12</th>
<th>Change%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Function</td>
<td>87.7</td>
<td>90.3</td>
<td>3.0</td>
<td>87.3</td>
<td>-0.4</td>
<td>85.1</td>
<td>-2.9</td>
</tr>
<tr>
<td>Physical Health</td>
<td>48.3</td>
<td>65.0</td>
<td>34.5</td>
<td>75.0</td>
<td>55.2</td>
<td>78.3</td>
<td>62.1</td>
</tr>
<tr>
<td>Emotional Problems</td>
<td>62.2</td>
<td>75.6</td>
<td>21.4</td>
<td>64.4</td>
<td>3.6</td>
<td>68.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Energy/Fatigue</td>
<td>36.0</td>
<td>49.7</td>
<td>38.0</td>
<td>53.7</td>
<td>49.1</td>
<td>61.7</td>
<td>71.3</td>
</tr>
<tr>
<td>Emotional Wellbeing</td>
<td>65.3</td>
<td>70.4</td>
<td>7.8</td>
<td>69.9</td>
<td>6.9</td>
<td>71.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Social Function</td>
<td>75.8</td>
<td>75.0</td>
<td>-1.1</td>
<td>78.3</td>
<td>3.3</td>
<td>77.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Pain</td>
<td>60.7</td>
<td>69.3</td>
<td>14.3</td>
<td>74.0</td>
<td>22.0</td>
<td>76.0</td>
<td>25.3</td>
</tr>
<tr>
<td>General Health</td>
<td>58.0</td>
<td>62.0</td>
<td>6.9</td>
<td>61.7</td>
<td>6.3</td>
<td>64.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Total Average</td>
<td><strong>61.8</strong></td>
<td><strong>69.7</strong></td>
<td><strong>15.6</strong></td>
<td><strong>70.5</strong></td>
<td><strong>18.2</strong></td>
<td><strong>72.9</strong></td>
<td><strong>23.6</strong></td>
</tr>
</tbody>
</table>

**Credibility and Expectancy**

| Credibility             | 28.0     | 29.7   | 6.0     | 31.3   | 11.9    |
| Expectancy              | 12.4     | 12.5   | 1.1     | 14.5   | 16.7    |

**Exercise**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Baseline</th>
<th>Week-4</th>
<th>Change%</th>
<th>Week-9</th>
<th>Change%</th>
<th>Week-12</th>
<th>Change%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Function</td>
<td>76.0</td>
<td>86.0</td>
<td>13.2</td>
<td>88.9</td>
<td>17.0</td>
<td>88.9</td>
<td>17.0</td>
</tr>
<tr>
<td>Physical Health</td>
<td>57.5</td>
<td>57.5</td>
<td>0.0</td>
<td>77.8</td>
<td>35.3</td>
<td>75.0</td>
<td>30.4</td>
</tr>
<tr>
<td>Emotional Problems</td>
<td>70.0</td>
<td>70.0</td>
<td>0.0</td>
<td>79.6</td>
<td>13.8</td>
<td>77.8</td>
<td>11.1</td>
</tr>
<tr>
<td>Energy/Fatigue</td>
<td>43.0</td>
<td>49.0</td>
<td>14.0</td>
<td>61.1</td>
<td>42.1</td>
<td>61.7</td>
<td>43.4</td>
</tr>
<tr>
<td>Emotional Wellbeing</td>
<td>67.2</td>
<td>72.3</td>
<td>7.6</td>
<td>73.3</td>
<td>9.1</td>
<td>75.6</td>
<td>12.4</td>
</tr>
<tr>
<td>Social Function</td>
<td>70.0</td>
<td>80.0</td>
<td>14.3</td>
<td>81.9</td>
<td>17.1</td>
<td>79.2</td>
<td>13.1</td>
</tr>
<tr>
<td>Pain</td>
<td>48.5</td>
<td>58.8</td>
<td>21.1</td>
<td>67.5</td>
<td>39.2</td>
<td>73.6</td>
<td>51.8</td>
</tr>
<tr>
<td>General Health</td>
<td>61.0</td>
<td>60.0</td>
<td>-1.6</td>
<td>60.6</td>
<td>-0.7</td>
<td>60.0</td>
<td>-1.6</td>
</tr>
<tr>
<td>Total Average</td>
<td><strong>61.7</strong></td>
<td><strong>66.7</strong></td>
<td><strong>8.6</strong></td>
<td><strong>73.8</strong></td>
<td><strong>21.6</strong></td>
<td><strong>74.0</strong></td>
<td><strong>22.2</strong></td>
</tr>
</tbody>
</table>

**Credibility and Expectancy**

| Credibility             | 21.5     | 21.6   | 0.5     | 21.3   | -0.8    |
| Expectancy              | 18.5     | 18.1   | -2.2    | 20.0   | 8.1     |

Note: SF-36 scores >90 are considered a risk factor for on-going chronicity of pain.
Table 4.

*Frequency Attaining Minimal Clinically Important Differences (MCID for SF-36 scales SF-36)*

<table>
<thead>
<tr>
<th>MCID (25%) Frequency in SF-36</th>
<th>Week 9</th>
<th>Week 12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pilates</td>
<td>Exercise</td>
</tr>
<tr>
<td>Physical Function</td>
<td>6.7</td>
<td>11.1</td>
</tr>
<tr>
<td>Physical Health</td>
<td>46.9</td>
<td>33.3</td>
</tr>
<tr>
<td>Emotion Problems</td>
<td>13.3</td>
<td>33.3</td>
</tr>
<tr>
<td>Energy/Fatigue</td>
<td>60.7</td>
<td>33.3</td>
</tr>
<tr>
<td>Emotional Wellbeing</td>
<td>40.2</td>
<td>22.2</td>
</tr>
<tr>
<td>Social Function</td>
<td>20.1</td>
<td>33.3</td>
</tr>
<tr>
<td>Pain</td>
<td>53.6</td>
<td>33.3</td>
</tr>
<tr>
<td>General Health</td>
<td>20.1</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Overall, this study has highlighted the positive effects of studio-style Equipment Pilates classes on pain, disability and wellbeing related to chronic neck pain. The results from this study show no clear statistical significance between Equipment Pilates and home-based exercise versus home-based exercise alone with regard to pain. However, they did show a greater statistical and clinically significant effect on disability and many facets of wellbeing compared to home-based exercise alone. Chronic pain is a disease that is not well understood, the physical and bio-psychosocial components vary between patients. The results of this study demonstrate that Equipment Pilates is an intervention that will improve pain, disability and wellbeing in a population that is seeking treatment.

The level of compliance was similar in both groups for the home-based exercise (Pilates+exercise 72%, exercise-only 63.3%). Within this study the
researcher managed all of the Pilates+exercise group and 55% of exercise-only group participants. This was achieved by messaging the participants at least weekly. Exercises were often modified and advice given to educate and re-assure the participants. This has been shown to increase compliance and improve self-efficacy (Phillips & Clauw, 2011). Both are important components of the management of chronic pain (Hassed, 2013). The Pilates compliance was very high. Participants were able to attend classes on a variety of days and times, and extra classes could be arranged to suit. This is a common practice in studio-style Equipment Pilates. The researcher is an experienced teacher and has been working with chronic pain populations for 15 years. The ability to relate to patients, gain their confidence and trust is an important part of treating chronic pain syndromes (Beinart, Goodchild, Weinman, Ayis, & Godfrey, 2013).

Studio-style Equipment Pilates classes enable the instructor to modify each participant’s Pilates programme. This can be done on a session-per-session basis, enabling the practitioner to reduce adverse exercise effects (Walton et al., 2013), educate and re-assure (Anderson-Peacock et al., 2005), increase participant self-efficacy by incorporating their feedback into the exercise (McCaffrey, Ruth, Frock, Terri, L & Garguilo, McCaffrey, Frock, & Garguilo, 2003), and utilise the small group dynamics to motivate (Hudson & Ryan, 2010).

The similarity between the two interventions may have had an effect on the results. The home-based exercise programme incorporated diaphragmatic breathing, strengthening and stretching. These principles are also inherent in the Equipment Pilates intervention. In primary care, the practitioner will often
give an exercise programme encompassing these elements (Bergstrom, Jensen, Hagberg, Busch, & Bergstrom, 2012; Perri & Halford, 2004). As both exercise programmes, Pilates and home-based exercise are utilised in primary care settings, these results can applied be to members of the general population who are seeking exercise-based treatment.

It could be argued that the mind-body connection that Joseph Pilates bases his exercise modality upon (Latey, 2001), may also be achieved by the home-based exercise programme. Mindfulness while breathing, during relaxation and thoughtful movement were principles highlighted in the YouTube home-based exercise video (Scollay & Andrews, 2014b). Chronic pain sufferers are shown to benefit from mind-body interventions (Hassed, 2013) and practitioners are becoming more aware of the need to incorporate mindfulness into chronic neck pain treatment (Rosenzweig et al., 2010)

The changes in pain (VAS) and disability (NPQ) were similar in both groups. At week-12 Pilates+exercise recorded a higher frequency of MCID change in pain and disability from baseline than the exercise-only group (pain: Pilates+exercise 71%, exercise-only 55.6%; disability: Pilates+exercise 71%, exercise-only 58%). These outcomes may be attributable to the extra two hours of rehabilitative exercise the Pilates+exercise participants committed to per week (O'Riordan et al., 2014). Time spent exercising is a variable that is worth further consideration. Pilates offers a variety of exercises with a vast ‘range of motion’ potential (Herman, 2006). This may explain the decrease in pain and disability. Chronic pain causes sufferers to limit their range of motion; this is often fear-related (Shariff, Carter, Dow, Polley, & Ridge, 2009). The extra exercise training and education offered during the Pilates class may
increase proprioception and muscle endurance, improve range of motion by reducing fear of movement, increase self-efficacy and decrease pain and disability (Arami, Rezasoltani, Eghlidi, Ebrahimabadi, & Ylinen, 2014).

Quality of life (SF-36) was enhanced by Pilates+exercise, more so than exercise-only, although this was only clinically significant (MCID) in physical health, energy/fatigue and general health scales. Physical function improvement at week-12 corresponds with the VAS and NPQ results. Joseph Pilates himself said that Pilates healed the mind and the body, the results noticeable after ten sessions (Latey, 2001). This is similar to the study of 158 female dancers and the effects of Pilates on wellbeing (Caldwell, Adams, Quin, Harrison, & Greeson, 2013). Caldwell et al. (2013) reported the participants experienced an increase in wellbeing, energy and mood, a decrease in stress, and improved sleep when compared to an exercise only group.

**Strengths and limitations**

The strengths and limitations of this study are consistent with other studies of chronic pain and exercise such as Wells et al., (2013). The benefits of a smaller study are that they are often time and cost efficient to carry out, although the short duration (12-weeks) of this intervention may only have improved strength and decreased pain and disability for a limited time (Taimela et al., 2000). O’Riordan et al. (2014) postulated that if exercise is not continued after the intervention the benefits are lost.

The Pilates participants attended public small group classes. The researcher was the only provider of instruction for the Pilates group, providing continuity of teaching style. Each participant was guided through an individual
programme. This programme variation may reduce any perceived competition or feelings of inadequacy amongst participants. Observing experienced Pilates participants may have had a positive or negative influence on compliance and influenced motivation. The data were not collated until all participants had completed the intervention to avoid teaching bias.

Equipment Pilates has been promoted for sufferers of chronic lower back pain in many studies (Miyamoto, Costa, Galvanin, & Cabral, 2013; Oliveira et al., 2014). Miyamoto et al. (2013) stated that the research is subject to many flaws such as ignoring psychosocial factors and short-term data collection points, leaving the reader with inconclusive evidence. These flaws also apply to chronic neck pain studies. The major limitation of this study is the small participant numbers which may not be a reflection of the general population (generalisability). To establish a CI = 95%, fewer than 20 participants per group may be too small. The study may be subject to a large standard error and wide confidence intervals (CI95%) leading to an imprecise estimate of the effect (Hackshaw, 2008). Hackshaw (2008) states that if the p value is close to 0.05 there may be a ‘suggestion of an effect’, but the practitioner must consider if 5% chance of a positive treatment outcome is viable. Chronic pain studies are often limited by confounding factors, such as age and accompanying pain (Wahl et al., 2009). Attempting to adjust for these with multivariate linear or logic regression across several factors may produce unreliable results especially in studies with small numbers (Hackshaw, 2008). Minimal clinically important difference is influenced by baseline severity and reported to be dependent upon factors such as age, socioeconomic status and education (Cook, 2008). The participant baseline characteristics are
similar in both groups therefore MCID’s were considered in this study, a valid measure of clinical difference. The researcher read the baseline questionnaires before beginning the intervention; this may have caused an informed teaching bias allowing exercises to be pre-modified, decreasing the potential for exercise-induced pain. As the intervention was advertised, selection bias may be implicated and the trial outcome not applicable to the general chronic pain population due to the effects of credibility and expectation of the intervention. A limitation is that the study participants were seeking exercise treatment and their yellow flags scores were < 90, which is below the risk of chronicity. This may be a form of self-selection bias. Exclusion criteria applied to those in a current ACC claim, therefore the data from this trial does not relate to a population currently seeking ACC assistance.

**CONCLUSION**

Equipment Pilates in conjunction with home-based exercise is a viable option as management for chronic non-specific neck pain. This study has shown that Equipment Pilates can decrease pain and disability, and improve wellbeing. Future studies are needed to review the long-term effects, cost effectiveness and patient preference of an Equipment Pilates intervention for chronic non-specific neck pain.

**RECOMMENDATIONS**

Further studies with regards to chronic neck pain and Equipment Pilates should undertake a long-term intervention with consideration given to participant compliance, the cost of Pilates classes both financially and time-wise. Exercise compliance is influenced by many factors (psychosocial,
perceived outcomes, pain-fear relationships, self-efficacy) these need to be studied further.
Acknowledgements

Firstly, I wish to thank my supervisor, Dr. Catherine Bacon, for her incredible support and patience during this research project. Special thanks also to Dr. John Waugh, for the hours of reading, guiding and correcting; to my research partner, Naomi Andrews, and to all our participants for their time and humour throughout the project.

To my friends and family, thank-you most of all for your patience and for your endless support, sharing tears and laughter. Lastly, a special mention for the clients of 'Symmetryinmotion Pilates & Ponies' - thank-you for your support and encouragement through this five-year process - you guys are wonderful.
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Section 3: Appendices
Appendix A

Author information pack for the Journal of Bodywork and Movement Therapies

The Journal of Bodywork and Movement Therapies brings you the latest therapeutic techniques and current professional debate. Publishing highly illustrated articles on a wide range of subjects this journal is immediately relevant to everyday clinical practice in private, community and primary health care settings.

Presentation of typescripts

Your article should be typed on one side of the paper, double spaced with a margin of at least 3cm. Rejected articles, and disks, will not be returned to the author unless an SAE is enclosed.

Papers should be set out as follows, with each section beginning on a separate sheet: title page, abstract, text, acknowledgements, references, tables, and captions to illustrations.

You should give a maximum of four degrees/qualifications for each author and the current relevant appointment.

The abstract should be 100-150 words in length.

Text

Headings should be appropriate to the nature of the paper. The use of headings enhances readability. Three categories of headings should be used:
• major ones should be typed in capital letters in the centre of the page and underlined
• secondary ones should be typed in lower case (with an initial capital letter) in the left hand margin and underlined
• minor ones typed in lower case and italicised

Do not use 'he', 'his', etc. where the sex of the person is unknown; say 'the patient', etc. Avoid inelegant alternatives such as 'he/she'. Avoid sexist language.

Avoid the use of first person ('I' statements) and second person ('you' statements). Third person, objective reporting is appropriate. In the case of reporting an opinion statement or one that cannot be referenced, the rare use of 'In the author's opinion?' or 'In the author's experience?' might be appropriate. If in doubt, ask the editor or associate editor for assistance.

Acronyms used within the text are spelled out at the first location of usage and used as the acronym thereafter. For example, 'The location of a central trigger point (CTrP) is central to a taut fiber. The CTrP is palpated by......'

Single quotation are used to express a quote marks (Matthews (1989) suggests, 'The best type of?') while double quotation marks are used for a quote within a quote or to emphasise a word within a quote.

Promotion of self, seminars or products is inappropriate. Reference to a particular product as it applies to the discussion, particularly where valid research of the product or comparison of products is concerned, can be
included as long as a non-promotional manner is used.

Illustrations

The journal is fully illustrated throughout. Please give consideration at an early stage of writing your paper to the illustrations which will enhance and develop the text. It is the author's responsibility to provide all the illustrations for the paper. However, following discussion with the Editor, Journal of Bodywork & Movement Therapies may undertake (at no expense to the author) redrawing from supplied references figures. Additionally Journal of Bodywork & Movement Therapies has access, at no cost to the author, to illustrations appearing elsewhere in Elsevier imprint books and journals. Full source files should be supplied at submission. Label each figure with a figure number corresponding to the order it appears within the article (i.e., Figure 1, Figure 2). Ensure that each illustration is cited within the text ('see Figure 1') and that a caption is provided.

Reference style

The accuracy of references is the responsibility of the author. This includes not only the correct contextual use of the material, but also the citation itself. In the text your reference should state the author's surname and the year of publication (Smith 1989); if there are two authors you should give both surnames (Smith & Black 1989). When a source has more than two authors, give the name of the first author followed by 'et al'. (Smith et al 1989). No commas are used between the name and date. It is important to verify the correct and full title, the full authorship, and all other reference details with the original source (book, journal, etc.,) or through a service, such as Medline or Science Direct.

A list of all references in your manuscript should be typed in alphabetical order, double spaced on a separate sheet of paper. Each reference to a paper needs to include the author's surname and initials, year of publication, full title of the paper, full name of the journal, volume number and first and last page numbers. The names of multiple authors are separated by a comma with each appearing as surname followed by initials. The date is placed after the author's name(s), not at the end of the citation.

Here are examples:

References to books should be in a slightly different form:
Hicks CM 1995 Research for Physiotherapists. Churchill Livingstone, Edinburgh
When citing a paper that has a digital object identifier (doi) please use the following style:

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When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.
Appendix B
Ethics Approval Letter

Naomi Andewar and Freya Scollay
C/o 288c Metutara Rd
Muriwai
Auckland 0881

24.7.14

Dear Naomi and Freya,

Your ID number for this application: 2014-3043
Title: The effects of aquatic Pilates and yoga as adjuncts to home-based exercises for chronic non-specific neck pain.

Your application for ethics approval has been reviewed by the Unitec Research Ethics Committee (UREC) and has been approved for the following period:

Start date: 4.7.14
Finish date: 4.7.15

Please note that:

1. The above dates must be referred to on the information AND consent forms given to all participants.

2. You must inform UREC in advance, of any ethically-relevant deviation in the project. This may require additional approval.

3. Organisational consent/s must be cited and approved by your primary reader prior to any organisations or corporations participating in your research. You may only conduct research with organisations for which you have consent.

You may now commence your research according to the protocols approved by UREC. We wish you every success with your project.

Yours sincerely,

Gillian Whalley
Deputy Chair, UREC

cc: Catherine Bacon
Cynthia Almeida
Appendix C
Participant Consent Form

The effect of equipment Pilates/yoga as an adjunct to prescribed home-based exercises for chronic non-specific

This form is to ensure that you understand the requirements of your participation and that you aware of your rights. Please read carefully through the points below. If you understand and agree with the points then please sign at the bottom of the page. If you have any questions at all please ask the researcher before signing this form.

- I have had the research project explained to me and I have read and understood the information sheet given to me.
- I understand that my inclusion in this study is entirely voluntary and I may withdraw at any time during the course of the study.
- I understand that if at any time during the course of the study I feel uncomfortable with any yoga or Pilates postures or exercises I may inform the researchers so they can provide me with assistance to change the posture or exercise to better suit my physical needs.
- I understand that everything I say and the information I provide will be collected in accordance with the Health Information Privacy Code 1994 and kept confidential and in accordance with the Privacy Act 1993. I understand that the only persons who will have access to my information will be the researchers and relevant clinical staff.
- I understand that all the information I give will be stored securely on a computer at Unitec for a period of 5 years.
- I understand that I can see the finished research document.
- I have had time to consider the information provided, to ask questions, and to seek any guidance.
- I give my consent to be a part of this project

Participant Name:……………………………………Date:………………………………

Participant Signature: ………………………….. Date: ……………………………

Principal Researcher: …………………………….. Date: ……………………………
UREC REGISTRATION NUMBER: 2014-1043) This study has been approved by the UNITEC Research Ethics Committee from (March 2014) to (June 2015). If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix D
Participant Information Sheet

The effect of yoga and Pilates as an adjunct to prescribed home-based exercises for chronic non-specific neck pain

You are invited to participate in our research investigation. Please read carefully through this information sheet before you make a decision about volunteering.

Principal Researchers

Naomi Andrews and Freya Scollay, both Bachelor of Applied Science (Human Biology) graduates. Naomi and Freya are currently fourth year students of the Master of Osteopathy Programme at Unitec New Zealand. Additionally Freya is a qualified Pilates instructor, and Naomi is a qualified yoga instructor.

Our Purpose

This study aims to determine if yoga and Pilates are effective for chronic non-specific neck pain, when completed as an extra activity along with exercises that are often prescribed by a manual therapist, compared to prescribed exercises only. We also hope to find out whether your prior expectations about the effectiveness of yoga or Pilates or other psychosocial factors may determine the outcome.

Chronic neck pain is defined as pain which has been present for at least 12 weeks since onset (Merskey & Bogduk, 1994). It is often associated with varying degrees of disability which can affect a person’s quality of life, and may come about from specific conditions such as fracture, disc compression, or neurological compromise. However, for the majority of cases of neck pain a specific cause cannot be identified, and as such pain is classed as non-specific.

There are a wide range of treatments for chronic neck disorders ranging from pain management and manual therapy, to neck-specific strengthening exercises, and educational advice. Exercise is a common choice for the management of chronic neck pain, and participation in yoga and Pilates for musculoskeletal complaints including neck pain has grown substantially in the last 10 to 20 years. By participating in this study you will help us to determine
whether yoga and Pilates coupled with prescribed exercise is effective at reducing pain and disability, and increasing well-being, for people suffering from chronic non-specific neck pain.

**Who may participate?**

We are looking for adults aged 18 to 60 years who suffer from chronic neck pain that has lasted for at least 12 weeks. You must experience pain of mild-moderate severity (at least 3 out of 10 on a numeric pain scale) most days. You must be able to read, write, speak, and comprehend the English language.

Unfortunately, you will be ineligible to take part in the study if:

- Your symptoms are related to a motor vehicle accident or significant trauma that has occurred in the last 6 months.
- You have undergone neck or invasive spinal surgery in the previous 12 months.
- You have any diagnosis or signs of serious pathology such as fracture, inflammatory disorders, or infection.
- There are any signs of neurological symptoms determined by the presence of sensory abnormalities, weakness, or altered reflexes.
- You suffer from chronic and/or acute neck pain due to specific causes – disc protrusion, whiplash, congenital deformity of the spine, spinal canal stenosis, and neoplasm, inflammatory rheumatic disease, active oncologic disease.
- You are pregnant, or attempting to fall pregnant.
- You have been practicing equipment Pilates or yoga in the six months prior to the study.
- You have a current ACC claim for your neck pain of 90 days or less.

Please feel free to contact the principal researchers if you have any questions regarding your eligibility.

**What will happen in the study?**

If you meet the inclusion criteria of the study and are willing to participate you will be asked via an online survey to complete a medical questionnaire that provides information about your neck pain. These examinations will determine your eligibility to take part in the study. Once eligibility is confirmed, you will be randomly allocated to one of three groups – yoga, Pilates, or home-based prescribed exercise. The 60 minute yoga and Pilates classes will take place twice a week for 8 weeks (a total of 16 classes). All of the participants will be
asked to complete just 5-10 minutes per day of prescribed exercises at home, for 8 weeks. Details of timetabling of the yoga and Pilates classes will be advised to those in these groups, and we will allow a two-week window for confirmation of availability for the class dates and times proposed. Once timetabling has been confirmed you will be invited, along with your allocated group, to meet the researchers at our designated Pilates and yoga studio, based in Kumeu, North-West Auckland. At this meeting the researchers will go through with you in detail the requirements of whichever group you have been assigned to. Every participant will be shown in detail how to do the home-based prescribed exercises correctly and safely. At this meeting you will be required to fill out five brief questionnaires so the researchers can establish your pain, well-being, disability, and psychosocial factors that may affect study outcomes. This initial session will take approximately 60 - 80 minutes. At the end of the Week 4 and Week 9 you will be required to complete the same questionnaires that were carried out during your first meeting with the researchers. There will also be a follow up at Week 12 and Week 24, following the completion of the 8 week study, where you will be required to complete the same measures as Week 4. This data will provide us with some longer-term information.

**What we do with the data and results, and how we protect your privacy.**
Personal information is collected and stored under the guidelines provided by the Privacy Act 1993 and the Health Information Privacy Code 1994. Your name will be recorded on the written consent form, your health questionnaire, and on the online VAS, NPQ, SF-36, CEQ, and ACC Yellow Flag questionnaires. In all other instances of information collection your identity will remain confidential and you will be allocated an identification number. If the information you provide is reported or published, this will be done in a way that does not identify you as its source. All the data recorded and collected will be stored in a secure manner and access to it will be limited to the principal researcher, the research supervisors, and yourself. If you wish to access your confidential data you may do so at any time, with your allocated identification number.

**Discomforts/risks and benefits**
Any aggravation you may experience from the yoga, Pilates, or prescribed exercises should be immediately discussed with the researchers.

**Your voluntary participation**
The decision to participate in this study is totally voluntary. If at any time you feel uncomfortable with any Yoga or Pilates postures or exercises during the course of the study, you may inform the researchers so they can provide you with assistance to change the posture or exercise to better suit your physical needs. You may leave the study at any time, and any data collected from your involvement in the study may be withdrawn up until 1 week following your final assessment.
Your participation in this study will help to provide further research into the management of neck pain through exercise, yoga, and Pilates. It will provide a valuable addition to the ongoing research surrounding the effectiveness of yoga and Pilates for musculoskeletal complaints. Please contact us if you require further information about this study.

Naomi Andrews and Freya Scollay.
Phone: Naomi: 0220894139/ Freya: 0278662500
Email: symmetryinmotion@hotmail.com

Principal supervisor: Catherine Bacon
Phone: 0800 267 836 (Clinic41 Student Osteopathy clinic)
Email: cbacon@unitec.ac.nz

Ethics approval number: 2014 – 1043

Study start date: 7 July 2014
Study finish date: 7 July 2015
Appendix E
Advertising Poster for Chronic Neck Pain Study

Pain in the neck?

Join the Master of Osteopathy Pilates & Yoga Neck Pain Study

Freya Scollay and Naomi Andrews – both Master of Osteopathy students at Unitec and qualified Pilates and yoga instructors – are researching the effects of Pilates and yoga on chronic neck pain.

The study will be conducted from Kumeu for a duration of 8 weeks. If you are randomised into the Pilates or Yoga group you will be asked to attend 2 classes per week from a flexible timetable. All participants will be asked to undertake home-based exercises.

To confirm your eligibility to take part in the study email unitecneckpainstudy@gmail.com
Find out more at www.facebook.com/neckpainstudy
Appendix F
Advertisements for Chronic Neck Pain Study
Norwest News and Facebook Link

Norwest News

Publication: Nor-west News
Headline: Study looks at neck pain
Print Run Date: 8/01/2015
Page: 4Digital
Run Date:
Reporter: Caryn Wigmore
Caption: 
Source:
Keywords:
Column:
Special Instructions:
Restrict:
Text: Suffering from neck pain? Two osteopathy students are inviting volunteers to take part in their study run from Kumeu.

Freya Scollay of Kumeu and Naomi Andrews of Muriwai are master of osteopathy students at Unitec. They are researching if pilates and yoga are beneficial for neck pain when combined with the exercises manual therapists advise. They will study three groups - pilates and home based exercises, yoga with home based exercises or home based exercises only. Email Freya or Naomi at unitecneckpainsstudy@gmail. com if you are interested in volunteering.

Notes: Genera 8/01/2015Section: NEWSSub Section: GENERAL

Facebook Link

https://www.facebook.com/neckpainsudy/?fref=ts
### Appendix G

**CONSORT 2010 checklist of information to include when reporting a randomised trial**

<table>
<thead>
<tr>
<th>Section/Topic</th>
<th>Item No</th>
<th>Checklist Item</th>
<th>Reported on page No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title and abstract</strong></td>
<td>1a</td>
<td>Identification as a randomised trial in the title</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td>Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>2a</td>
<td>Scientific background and explanation of rationale</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>2b</td>
<td>Specific objectives or hypotheses</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>3a</td>
<td>Description of trial design (such as parallel, factorial) including allocation ratio</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>3b</td>
<td>Important changes to methods after trial commencement (such as eligibility criteria), with reasons</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>4a</td>
<td>Eligibility criteria for participants</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>4b</td>
<td>Settings and locations where the data were collected</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>5a</td>
<td>The interventions for each group with sufficient details to allow replication, including how and when they were actually administered</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>6a</td>
<td>A complete list of all interventions, including dosage in trials where this is relevant</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>6b</td>
<td>Any changes to trial outcomes after the trial commenced, with reasons</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>7a</td>
<td>How sample size was determined</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>7b</td>
<td>When applicable, analysis of any interim analyses and stopping guidelines</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Randomisation:</strong></td>
<td>8a</td>
<td>Method used to generate the random allocation sequence</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>9a</td>
<td>Type of randomisation, details of any restriction (such as blocking, and block size)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>9b</td>
<td>Mechanism used to implement the random allocation sequence (such as sequentially numbered envelopes), concealment mechanisms</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>10a</td>
<td>How generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Blinding:</strong></td>
<td>11a</td>
<td>If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>11b</td>
<td>If relevant, description of the similarity of interventions</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Statistical methods</strong></td>
<td>12a</td>
<td>Statistical methods used to compare groups for primary and secondary outcomes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>12b</td>
<td>Methods for additional analyses, such as subgroup analyses and adjusted analyses</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>13a</td>
<td>For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>13b</td>
<td>For each group, losses and exclusions after randomisation, together with reasons</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>14a</td>
<td>Dates defining the periods of recruitment and follow-up</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>14b</td>
<td>Why the trial ended or was stopped</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Baseline data</strong></td>
<td>15</td>
<td>A table showing baseline demographic and clinical characteristics for each group</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Numbers analysed</strong></td>
<td>16</td>
<td>For each group, number of participants (denominator) included in each analysis, and whether the analysis was by original assigned groups</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Outcomes and estimation</strong></td>
<td>17a</td>
<td>For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>17b</td>
<td>For binary outcomes, presentation of both absolute and relative effect sizes is recommended</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Anxiety analyses</strong></td>
<td>18</td>
<td>Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Harms</strong></td>
<td>19</td>
<td>All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td>20</td>
<td>Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Generalisability</strong></td>
<td>21</td>
<td>Generalisability (external validity, applicability) of the trial findings</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Interpretation</strong></td>
<td>22</td>
<td>Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Other information</strong></td>
<td>23</td>
<td>Registration number and name of trial registry</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Protocol</strong></td>
<td>24</td>
<td>Where the full trial protocol can be accessed, if available</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
<td>25</td>
<td>Sources of funding and other support (such as supply of drugs), role of funders</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming for those and for up-to-date references relevant to this checklist, see www.consort-statement.org*
Appendix H
Pilates Equipment

High Barrel

Spine Corrector

Pilates Trapeze Table/Cadillac
Appendix I
Pilates Exercise Description

**Examination**
Participants were assessed during each session for:

- cervical hyperlordosis
- thoracic kyphosis
- lumbar hyperlordosis
- hypertonic - hip flexors
  - upper trapezius
  - pectorals
- hypotonic - gluteal group
  - latissimus dorsi

This assessment occurred at each Pilates session during the warm-up exercises by visual and physical examination.

**Pilates Session Programming**
Each participant was individually guided, while in a group, through the Pilates exercise programme. The programme was considered suitable by the researcher for the participant’s current pain, disability and level of wellbeing. In each session the researcher ascertained via questions and visual observation if exercise modification and/or progression was required. Participants were invited to give feedback and to self-direct their workout.

The six Pilates principles (Latey, 2001) were adhered to at all times. Repetitions, sets and intensity were closely monitored and modified according to the FITT principles (O’Riordan et al., 2014).

The beginner Pilates programme exercise protocol was one set, up to 8-repetitions per exercise. Participants were reminded frequently to time the exercises with breathing, and to work focusing on the muscle groups highlighted by the instructor. Stretches were incorporated as the instructor felt appropriate. The Pilates programme is taught in a relaxed environment where participants can rest when needed and communicate freely between exercises. This studio is run this way as the instructor believes in encouraging
a group bond amongst participants and the freedom to communicate to express oneself and to develop self-efficacy. These may be important factors in the management of chronic pain (Phillips & Clauw, 2011). All of the exercises in this study are on a YouTube video (Scollay, 2016) (https://www.youtube.com/watch?v=SfScFEC_7hw).

**Exercises for Session One to Three**

- Pilates Breathing (Diaphragmatic)
- Core Activation – transverse abdominals and pelvic floor on exhalation
- Cervical Spine Flexion – with shoulder depress
- Pelvic Curl
- Chest Lift – feet on the floor
- Prone Back Extension
- Side-lying Rotation
- Reformer Leg Series
- Spring Board – Front Straight Arm Press
- Spine Corrector Side Lifts
- Spine Corrector Side-Lying Rotation
- Stretches: hip flexors, hips/buttocks, standing side stretch, chest

**Exercises for Session Four to Six**

- Pilates breathing/core activation/cervical spine flexion with shoulder depress (BCCFSD)
- Pelvic Curls
- Single leg lifts
- Chest lifts – feet on the floor
- Oblique Curls – feet on the floor
- Prone Back Extension
- Side-lying rotation
- Leg Series – Reformer or Trapeze Table
- Spring Board Front Straight Arm Press
- Spring Board Row
- Hands-in-straps: Front Press
  - Side Press
Triceps

Feet-in- straps:
Forwards press
Hamstring stretch
High ‘V’s’

Spine Corrector Side Lifts
Spine Corrector Side-Lying Rotation
Stretches: hip flexors, hips/buttocks, standing side stretch, chest

**Exercises for Session Seven to Ten**

BCCFSH
Pelvis Curls
Single/ Double Leg Lifts
Chest Lifts – Legs on floor/Legs at 90 degrees
Oblique Curls - Legs on floor/Legs at 90 degrees
Prone Back Extension
Side-Lying Rotation
Leg Series – Reformer or Trapeze Table
Spring Board Front Straight Arm Press
Spring Board Row

Hands-in- straps: Front Press
Side Press
Triceps
Circles
Chest Lifts

Feet-in- straps: Forwards press
Hamstring stretch
High ‘V’s’
Circles

Spine Corrector Side Lifts
Spine Corrector Side-Lying Rotation
Stretches: hip flexors, hips/buttocks, standing side stretch, chest
Exercises for Session Eleven to Fourteen

BCCFSH
Pelvis Curls
Single/Double Leg Lifts
Chest Lifts – Legs on floor/Legs at 90 degrees
Oblique Curls - Legs on floor/Legs at 90 degrees
Prone Back Extension
Side-Lying Rotation
Leg Series – Reformer /Trapeze Table/Wunda Chair
Spring Board Front Straight Arm Press
Spring Board Row
Hands-in- straps:
Front Press
Side Press
Triceps
Circles
Chest Lifts
Obliques
Feet-in-stra p s:
Forwards press
Hamstring stretch
High ‘V’s’
Circles
Hip Flexor Stretch
Reformer – Standing Skating
Spine Corrector Side Lifts
Spine Corrector Side-Lying Rotation
Stretches: hip flexors, hips/buttocks, standing side stretch, chest

Exercises for Session Eleven to Sixteen

BCCFSH
Pelvis Curls
Single/Double Leg Lifts
Chest Lifts – Legs on floor/Legs at 90 degrees
Oblique Curls - Legs on floor/Legs at 90 degrees
Prone Back Extension
Side-Lying Rotation
Leg Series – Reformer /Trapeze Table/Wunda Chair
Spring Board Front Straight Arm Press
Spring Board Row

Hands-in-straps: Front Press
Side Press
Triceps
Circles
Chest Lifts
100’s
Obliques

Feet-in-straps: Forwards press
‘V’ Press
Hamstring stretch
High ‘V’s’
Circles
Hip Flexor Stretch

Reformer – Standing Skating
Wunda Chair Pike – Front/Oblique
Spine Corrector Side Lifts
Spine Corrector Side-Lying Rotation
Spine Corrector Back Extension

Stretches: hip flexors, hips/buttocks, standing side stretch, chest
Appendix J

Visual Analogue Scale

Patient Name: ___________________________ Date: ______________

Visual Analog Scale (VAS)*

| No pain | Pain as bad as it could possibly be |

* A 10-cm baseline is recommended for VAS scales.


Visual Analog Scale

NO ___________________________ WORST
PAIN ___________________________ PAIN

Directions: Ask the patient to indicate on the line where the pain is in relation to the two extremes. Measure from the left hand side to the mark.

Appendix K
Accident Compensation Corporation Yellow Flags Questionnaire

Acute Low Back Pain Screening Questionnaire

Linton & Hallen, 1996

Today's date / / ACC Claim Number

Name

Address

Telephone / Home / Work

Job Title / Occupation / Date stopped work this episode / /

These questions and statements apply if you have ache or pain, such as back, shoulder or neck pain. Please read and answer each question carefully. Do not take too long to answer the questions. However, it is important that you answer every question. There is always a response for your particular situation.

1. What year were you born?

2. Are you male / female?

3. Were you born in New Zealand? yes no

4. Where do you have pain? Place a ✓ for all the appropriate sites.

   - Neck
   - Shoulders
   - Upper back
   - Lower back
   - Leg

5. How many days of work have you missed because of pain during the past 18 months? Tick ✓ one.

   - 0 days [1]
   - 1-2 days [2]
   - 3-7 days [3]
   - 8-14 days [4]
   - 15-30 days [5]
   - 3-6 months [6]
   - 6-12 months [7]
   - Over 1 year [10]

6. How long have you had your current pain problem? Tick ✓ one.

   - 0 days [1]
   - 1-2 days [2]
   - 3-7 days [3]
   - 8-14 days [4]
   - 15-30 days [5]
   - 3-6 months [6]
   - 6-12 months [7]
   - Over 1 year [10]

7. Is your work heavy or monotonous? Circle the best alternative.

   - Not at all
   - Very
   - Extremely

8. How would you rate the pain that you have had during the past week? Circle one.

   - No pain
   - Pain as bad as it could be

9. In the past 3 months, on average, how bad was your pain? Circle one.

   - No pain
   - Pain as bad as it could be

10. How often would you say that you have experienced pain episodes, on average, during the past 3 months? Circle one.

    - Never
    - Always

11. Based on all the things you do to cope, or deal with your pain, on an average day, how much are you able to decrease it? Circle one.

    - Can't decrease
    - Can decrease it completely
12. How tense or anxious have you felt in the past week? Circle one.

1. Absolutely calm and relaxed  
2. Not too bad  
3. Middling  
4. Quite tense  
5. Very tense  
6. Extremely tense  

13. How much have you been bothered by feeling depressed in the past week? Circle one.

1. No at all  
2. Not too bad  
3. Middling  
4. Quite depressed  
5. Very depressed  
6. Extremely depressed  

14. In your view, how large is the risk that your current pain may become persistent? Circle one.

1. No risk  
2. Very small risk  
3. Small risk  
4. Medium risk  
5. Large risk  
6. Very large risk  

15. Your estimation, what are the chances that you will be working in 6 months? Circle one.

1. No chance  
2. Very small chance  
3. Small chance  
4. Medium chance  
5. Large chance  
6. Very large chance  

16. If you take into consideration your work routines, management, salary, promotion possibilities and work mates, how satisfied are you with your job? Circle one.

1. Not at all satisfied  
2. Not very satisfied  
3. Middling satisfaction  
4. Slightly satisfied  
5. Very satisfied  
6. Completely satisfied  

Here are some of the things which other people have told us about their back pain. For each statement please circle one number from 0 to 10 to say how much physical activities, such as bending, lifting, walking or driving would affect your back.

17. Physical activities make my pain worse. Circle one.

1. Completely disagree  
2. More disagree than agree  
3. Middling  
4. More agree than disagree  
5. Completely agree  

18. An increase in pain is an indication that I should stop what I am doing until the pain decreases. Circle one.

1. Completely disagree  
2. More disagree than agree  
3. Middling  
4. More agree than disagree  
5. Completely agree  

19. I should not do my normal work with my present pain. Circle one.

1. Completely disagree  
2. More disagree than agree  
3. Middling  
4. More agree than disagree  
5. Completely agree  

Here is a list of five activities. Please circle the one number that best describes your current ability to participate in each of these activities.

20. I can do light work for an hour. Circle one.

1. Can’t do it because of pain problem  
2. Can do it with pain being a problem  
3. Can do it  

21. I can walk for an hour. Circle one.

1. Can’t do it because of pain problem  
2. Can do it with pain being a problem  
3. Can do it  

22. I can do ordinary household chores. Circle one.

1. Can’t do it because of pain problem  
2. Can do it with pain being a problem  
3. Can do it  

23. I can go shopping. Circle one.

1. Can’t do it because of pain problem  
2. Can do it with pain being a problem  
3. Can do it  

24. I can sleep at night. Circle one.

1. Can’t do it because of pain problem  
2. Can do it with pain being a problem  
3. Can do it
Appendix L
Northwick Park Pain Questionnaire

northwick park neck pain questionnaire

| Name ................................................................. | Date ................................. |
|------------------------------------------------------------------------|

Please read: this questionnaire has been designed to give information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section, & mark in each section only the one box which applies to you. We realise you may consider that two of the statements in any one section relate to you, but please just mark the box which most closely describes your problem.

1 - neck pain intensity
- I have no pain at the moment
- the pain is mild at the moment
- the pain is moderate at the moment
- the pain is severe at the moment
- the pain is the worst imaginable at the moment

6 - reading & watching tv
- I can do this as long as I wish with no problems
- I can do this as long as I wish, if I'm in a suitable position
- I can do this as long as I wish, but it causes extra pain
- pain causes me to stop this sooner than I would like
- pain prevents me from doing this at all

2 - neck pain & sleeping
- my sleep is never disturbed by pain
- my sleep is occasionally disturbed by pain
- my sleep is regularly disturbed by pain
- because of pain I have less than 5 hours sleep in total
- because of pain I have less than 2 hours sleep in total

7 - working/housework etc.
- I can do my usual work without extra pain
- I can do my usual work, but it gives me extra pain
- pain prevents me from doing my usual work for more than half the usual time
- pain prevents me from doing my usual work for more than a quarter the usual time
- pain prevents me from working at all

3 - pins & needles or numbness in the arms at night
- I have no pins & needles or numbness at night
- I have occasional pins & needles or numbness at night
- my sleep is regularly disturbed by pins & needles or numbness
- because of pins & needles I have less than 5 hours sleep in total
- because of pins and needles or numbness I have less than 2 hours sleep in total

8 - social activities
- my social life is normal and causes me no extra pain
- my social life is normal, but increases the degree of pain
- pain has restricted my social life, but I am still able to go out
- pain has restricted my social life to the home
- I have no social life because of pain

4 - duration of symptoms
- my neck and arms feel normal all day
- I have symptoms in my neck or arms on waking, which lasts less than 1 hour
- symptoms are present on and off for a total period of 1-4 hours
- symptoms are present on and off for a total of more than

9 - driving (omit this section if you never drive a car when in good health)
- I can drive whenever necessary without discomfort
- I can drive whenever necessary, but with discomfort
- neck pain or stiffness limits my driving occasionally
- neck pain or stiffness limits my driving frequently
- I cannot drive at all due to neck symptoms
4 hours

- symptoms are present continuously all day

5 - carrying

- I can carry heavy objects without extra pain
- I can carry heavy objects, but they give me extra pain
- pain prevents me from carrying heavy objects, but I can manage medium weight objects
- I can only lift light weight objects
- I cannot lift anything at all

10 - compared with the last time you answered this questionnaire, is your neck pain:

- much better
- slightly better
- the same
- slightly worse
- much worse

any other comments:

from: Leak AM, Cooper J, Dyer S, Williams KA, Turner-Stokes L & Frank AO
The Northwick Park neck pain questionnaire, devised to measure neck pain and disability
Br J Rheumatol 1994; 33: 469-74
Appendix M
Short Form 36 (SF-36)

Medical Outcomes Study: 36-Item Short Form Survey Instrument

RAND 36-Item Health Survey 1.0 Questionnaire Items

Unrounded version

1. In general, would you say your health is:
   - Excellent: 1
   - Very good: 2
   - Good: 3
   - Fair: 4
   - Poor: 5

2. Compared to one year ago, how would you rate your health in general?
   - Much better than one year ago: 1
   - Somewhat better than one year ago: 2
   - About the same: 3
   - Somewhat worse than one year ago: 4
   - Much worse than one year ago: 5

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(Circle one number on each line)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes, Limited a Lot</th>
<th>Yes, Limited a Little</th>
<th>No, Not Limited at All</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>4. Moderate activities, such as mowing a lawn, pushing a vacuum cleaner, bowling, or playing golf</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>5. Lifting or carrying groceries</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>7. Climbing one flight of stairs</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>8. Bathing, brushing, or showering</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>9. Walking more than a mile</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
<tr>
<td>10. Walking several blocks</td>
<td>[1]</td>
<td>[2]</td>
<td>[5]</td>
</tr>
</tbody>
</table>

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(Circle one number on each line)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>23. Cut down the amount of time you spent on work or other activities</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24. Accomplished less than you would have</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25. Were limited in the kind of work or other activities</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>26. Had difficulty performing the work or other activities (for example, it took extra effort)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(Circle one number on each line)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. Cut down the amount of time you spent on work or other activities</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>28. Accomplished less than you would have</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Appendix N
Credibility and Expectancy Questionnaire (CEQ)

Therapy Evaluation Form
We would like you to indicate below how much you believe, right now, that the therapy you are receiving will improve your chronic neck pain symptoms. Belief usually has two aspects to it: (1) what one thinks will happen and (2) what one feels will happen. Sometimes these are similar; sometimes they are different. Please answer the questions below. In the first set, answer in terms of what you think. In the second set answer in terms of what you really and truly feel.

Set I
1. At this point, how logical does the therapy offered to you seem?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all logical</td>
<td>somewhat logical</td>
<td>very logical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. At this point, how successful do you think this treatment will be in reducing your symptoms?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all useful</td>
<td>somewhat useful</td>
<td>very useful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How confident would you be in recommending this treatment to a friend who experiences similar problems?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all confident</td>
<td>somewhat confident</td>
<td>very confident</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. By the end of the therapy period, how much improvement in your symptoms do you think will occur?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Set II
For this set, close your eyes for a few moments, and try to identify what you really feel about the therapy and its likely success. Then answer the following questions.

1. At this point, how much do you really feel that therapy will help you to reduce your symptoms?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all</td>
<td>somewhat</td>
<td>very much</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. By the end of the therapy period, how much improvement in your symptoms do you really feel will occur?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Appendix O
Home-based exercise compliance sheet

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Breathing</th>
<th>Neck Extension</th>
<th>Extension w Rotation</th>
<th>Extension with Shoulder Drop</th>
<th>Upper Back Towel Stretch</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
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<td>Tuesday</td>
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</tr>
</tbody>
</table>

Please tick the box if you have completed the exercise, an ‘x’ if you didn’t complete it.
If you have any comments please type into the notes column.
Comments may be: exercise was more painful, less painful, you feel like you can move more, exercise is getting boring, your find the exercise effective.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Breathing</th>
<th>Neck Extension</th>
<th>Extension w Rotation</th>
<th>Extension with Shoulder Drop</th>
<th>Upper Back Towel Stretch</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
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<tr>
<td>Tuesday</td>
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<tr>
<td>Wednesday</td>
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<tr>
<td>Thursday</td>
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Department of: Occupational Therapy

Degree: Most... Year of presentation: 2016

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