POSITIVE CHARACTER TRAITS OF PATIENTS WITH CHRONIC PAIN WHO DISPLAY CATASTROPHIZING AND FEAR AVOIDANCE BEHAVIOUR

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A research report submitted to the Faculty of Health Sciences, University of Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Physiotherapy.

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DECLARATION

I, Kim Cocciuti, declare that this research report is my own unaided work. It is being submitted for the degree of Master of Science in Physiotherapy at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature

Date: 26 April 2021

DEDICATION

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This research report is dedicated to my mother, who knew about this project before she passed. I am grateful to my family and close friends who supported me endlessly and patiently.

ABSTRACT

Background: Fear avoidance behaviour and pain catastrophizing are poor outcomes predictors in pain management. Positive character traits contribute towards a resilient mind-set for patients facing the adversity of chronic disability or illness.

Objectives: To establish the presence of positive character traits amongst participants experiencing chronic pain, and whether a relationship between positive character traits and fear avoidance behaviour and/or pain catastrophizing exist.

Methods: 31 participants experiencing chronic pain completed self-reporting questionnaires. The Tampa Scale for Kinesiophobia-17 (TSK), Pain Catastrophising Scale (PCS) and Adapted Inventory of Virtues and Strengths (AIVS) was used to determine the presence of fear avoidance behaviour, pain catastrophizing and positive character traits (*emotional transcendence, practical wisdom, integrity, courage and commitment to action*), respectively. Pearson's product-moment correlations were used to explore the relationship between AIVS subscales and the PCS subscales and total score, and the AIVS subscales and the TKS score.

Results: A sample of 31 participants with a mean age of 53 years from a private physiotherapy practice in the Johannesburg area and the Helen Joseph Pain Clinic (HJPC) participated in the study. Pain catastrophizing and fear avoidance had a prevalence of 42 % and 71%, respectively. All participants possessed strong positive character scores across all subgroups. *Commitment to Action* (85%), *Integrity* (85%) and *Emotional Transcendence* (84%) were the strongest traits followed by *Practical Wisdom* (79%) and *Courage* (71%). There were no associations detected between the TKS or PCS and any of the AIVS subscales.

Conclusion: Albeit no established associations, positive character traits can be measured and do exist amongst individuals with chronic pain and should considered as a tool in self-management rehabilitation programmes to enhance resilience, function, and participation.

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CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

We are all destined to experience pain during our lives as it is a protection mechanism against physical harm. However, pain that continues beyond normal tissue healing for longer than 12 weeks and limits an individual's holistic function, is considered to be chronic pain (Bogduk and Merskey, 2011). Chronic pain is a worldwide, financially draining public health problem (Van Hecke, Torrance and Smith, 2013; Treede and Rief, 2015). The prevalence of chronic pain is approximately 20% throughout the world, with people of a lower socioeconomic status fronting a greater burden (Jackson et al., 2016; Sá et al., 2019). Under-management of pain is common in developing and developed countries, as it is largely based upon the biomedical model of care (Goldberg and McGee, 2011). However, in the 20 years there has been a positive shift towards a biopsychosocial approach in pain management that encompasses the influential psychosocial components of chronic pain (Williams and Craig, 2016).

The International Association for the Study of Pain (IASP) defines pain as, "an unpleasant sensory and emotional experience associated with or resembling that associated with actual or potential tissue damage" (IASP, 2019). The development of chronic pain involves pathophysiological mechanisms including peripheral and central sensitization and does not necessarily require overt pathology as it can also exist as a primary disease state (Treede et al., 2019). The stressful experience of persistent pain for the mind and body causes dysregulation of homeostatic reward processes that lead to cognitive impairments, emotional distress, social dysfunction and endocrine disruption (Elman and Borsook, 2016; Meints and Edwards, 2018). Cognitive evaluation assigns meaning to the noxious stimulus in a context shaped by a person's unique set of beliefs, memories, social support, coping strategies and mood that has developed over their lifetime (Edwards et al., 2016). Psychosocial factors including an unsupportive social network, catastrophic cognitions and unhelpful pain related beliefs can result in further maladaptive behaviours (such as fear avoidance), that perpetuate the chronic pain continuum (Vlaeyen, Crombez and Linton, 2016). Conversely, patients that exhibit high pain self-efficacy are more likely to evade the continuance of chronic pain as they tend not to catastrophize or fearfully avoid activities (Waddell et al., 1993; Sullivan, Bishop and Pivik, 1995; Martz and Livneh, 2016). It is necessary to identify and target appropriate treatment strategies that address physical and

psychosocial components through an interdisciplinary approach (Turk et al., 2009; Day, Ehde and Jensen, 2015).

Pain catastrophizing is the negative cognition an individual has towards their pain experience (Sullivan et al., 2001). Patients who exhibit pain catastrophizing tend to obsess, magnify and feel helpless in the context of their pain experience (Sullivan, 2012). Pain catastrophizing according to the Fear Avoidance Model of Chronic Pain acts as a catalyst for avoidant behaviour due to fear of movement or re-injury (Vlaeyen and Linton, 2000). The avoidance of previously enjoyable or routine tasks due to the fear of provoking pain, paradoxically increases their pain (Wong et al., 2015; Vlaeyen, Crombez and Linton, 2016). Kinesiophobia, is a construct of fear avoidance beliefs as it is defined as a fear of movement, due to the fear of re-injury or pain (Miller, Kori and Todd, 1991; Lundberg *et al.*, 2011). Therefore, in this study kinesiophobia and fear avoidance behaviour are used synonymously.

Cognitive behavioural therapy (CBT) has become the first line treatment for psychosocial factors in chronic pain (Ehde, Dillworth and Turner, 2014). It is a goal orientated intervention aiming to improve mental health by changing unhelpful cognitions and behaviours in the context of a person's unique psychological factors and social environment (Cherkin et al., 2016). CBT is an underutilized psychological resource as its effective delivery requires training and its integration into interdisciplinary framework is challenging, thus its accessibility to most chronic pain patients is reduced (Davey, 2016). Furthermore, the results of CBT in a clinical context are disappointing (Day, Ehde and Jensen, 2015; Wilson et al., 2017). There are other psychologies that have shown promise in addressing the psychosocial factors of chronic illness, including positive psychology (Seligman and Csikszentmihalyi, 2000; Kim et al., 2016).

Positive psychology focuses on harnessing and building upon existing positive character traits through various interventions such as savouring and mindfulness or positive self-reflection (Seligman and Csikszentmihalyi, 2000; Wood and Tarrier, 2010; Flink et al., 2015). Positive psychology has been established to be of benefit in other areas of chronic diseases, for example heart disease (Nikrahan et al., 2016). It may serve as an adjunct to existing management approaches to reduce pain awareness amongst individuals with chronic pain (Flink et al., 2015; Müller et al., 2016a; Nikrahan et al., 2016). For example, Hausmann et al., (2014) found an online positive psychology intervention resulted in a long-term reduction in pain amongst participants

from the general public. Following this encouraging result, Hausmann et al,. (2018) has described a randomized controlled trial using a positive psychology intervention "Staying Positive with Arthritis" targeted at participants with chronic pain from knee osteoarthritis. In 2016, Kim et al. identified that emotional transcendence, practical wisdom, integrity, courage and commitment to action are useful positive character traits in patients with chronic illness or disability that are associated with favourable rehabilitation outcomes.

Currently, the role of physiotherapy has been shown to be beneficial in prescribing specific physical activity and pain neuroscience education (PNE) for patients with chronic pain (Louw et al., 2011; Moseley, 2002; Moseley, 2005; Lee et al., 2016; Moseley, 2003; Day et al., 2015; Geneen et al., 2017). The role of positive psychology in improving physiotherapy treatment outcomes needs to be further explored. For example, a patient who is an unemployed manual labourer, experiencing chronic low back pain and displaying fear avoidance behaviour towards bending over and heavy lifting, will benefit from graded exposure to movements previously considered painful and damaging. Graded exposure requires commitment to action, a positive character trait that demonstrates strength of persistent, self-disciplined goal directed action all of which are necessary to gradually reconceptualise healthy, functional movements. Goal setting requires the positive character trait of courage, which is another positive psychology tool that can be developed and utilized to assist this patient. Perhaps it is necessary to consider the positive and not only the negative traits of patients to gain an all-inclusive perspective of their pain perception and potential inherent resources to assist them in realising resilience and achieving a sense of well-being (Friborg et al., 2006; Karoly and Ruehlman, 2006; Martz and Livneh, 2016).

1.2 PROBLEM STATEMENT

Chronic pain is complex and varied with intricate psychosocial and physical factors to consider. Cognitive behavioural therapy is widely accepted in addressing maladaptive behaviours experienced by patients with chronic pain, despite underwhelming evidence of its efficacy (Eccleston, Hearn and Williams, 2015). Pain catastrophizing and fear avoidance behaviour, have been identified to be predictors of poor outcomes in pain management (Wertli, Rasmussen-Barr, Held et al., 2014; Schütze et al., 2017). Positive psychology has been shown to be beneficial as an adjunct to interdisciplinary management in other areas of chronic disability and illness, such as heart disease (Nikrahan et al., 2016). There is limited but promising research on identifying positive

characteristics traits in patients experiencing chronic pain. Its benefit needs to be explored in chronic pain management.

It is well recognised that the traditional biomedical model does not encompass the complexities of chronic pain. In the last 20 years great strides have been made in incorporating the biopsychosocial model into clinical physiotherapy practice. Physiotherapists need to be aware that there is compelling evidence that both psychosocial and physical factors need to be addressed to achieve a more positive outcome in the management of patients with chronic pain.

1.3 RESEARCH QUESTIONS

1.3.1 What positive character traits (emotional transcendence, integrity, courage, commitment to action and practical wisdom) do patients with chronic pain exhibit?

1.3.2 What is the association between the positive character traits and the negative maladaptive behaviours (fear avoidance and pain catastrophizing) that patients with chronic pain exhibit?

1.4 AIM OF STUDY

The aim of the study was to determine which positive character traits patients with chronic pain exhibit and to determine the relationship between these positive character traits and pain catastrophizing, and fear avoidance behaviour.

1.5 OBJECTIVES OF STUDY

1.5.1 Establish the demographics of the study participants

1.5.2 Establish what positive character traits the study participant's exhibit

1.5.3 Establish the presence of pain catastrophizing and/or fear-avoidance amongst the study participants

1.5.4 Establish the association between pain catastrophizing and positive character traits

1.5.5 Establish the association between fear-avoidance and positive character traits

1.6 SIGNIFICANCE OF STUDY

There is a research gap on the role that positive psychology plays on chronic pain management. This study aims to determine an association between positive character traits and the poor treatment outcome predictors of fear avoidance and pain catastrophizing. Chronic pain is associated with negative maladaptive behaviours of fear avoidance and pain catastrophising. We tend to focus on how to resolve the negative by focussing on the negative. If a positive association between

positive character traits and fear avoidance behaviour or pain catastrophizing is found, rehabilitation can harness these positive character traits to promote function, participation and move away from attempting to resolve negative maladaptive behaviours.

It has been well established that in addition to fear avoidance and pain catastrophizing, patients with chronic pain battle with depression and anxiety which perpetuates the chronic pain condition. It is hoped that if the focus of treatment is redirected from the patient's preoccupation of pain catastrophizing or fear avoidance behaviour towards the utilization of their inherent positive character traits (which the patient may have forgotten or been unaware of) a better outcome will be achieved. It is hoped that in this study, participants that display fear avoidance and pain catastrophizing behaviour, will report low scores of positive character traits. Conversely, if no associations are found, it could be presumed that all people, regardless of their pain experience, possess the resources of positive character traits.

Identifying positive character traits will help build on the body of evidence to manage patients holistically within the biopsychosocial context and the International Classification of Functioning, Disability and Health (ICF) framework. Every person strives to participate fully within all areas of their life and chronic pain can interfere with meaningful life satisfaction. Disability can be seen as the dysfunction within the body structure or function that limits activity execution and restricts the participation in life. Physiotherapists are part of the inter-professional pain management team; each member of the team needs to be aware of the patients' psychosocial factors and the role these factors play in influencing a patient's function and participation. Our aim is not only to help decrease the patients' pain experience but to encourage a meaningful existence by reintegrating them into society as functioning and contributing members.

Psychosocial factors cannot be ignored for our management strategies to be effective within the biopsychosocial model. Hence, it is necessary that psychology or aspects of psychology in the physiotherapy context of pain management is researched.

CHAPTER 2

2. LITERATURE REVIEW

In this chapter, the epidemiology of chronic pain, risk factors, burden, pathology and management will be discussed. This review will demonstrate how positive psychology may contribute to the psychosocial management of individuals experiencing chronic pain.

The literature review was conducted from February 2017 to February 2021. The keywords *chronic pain, biopsychosocial, pain catastrophizing, fear avoidance behaviour and positive psychology* were searched in the databases PubMed, Scopus, Ovid, Clinical Key and Cochrane Library.

2.1 EPIDEMIOLOGY OF CHRONIC PAIN

Chronic pain is the leading cause of global human suffering and disability (Goldberg and McGee, 2011). It is a comorbidity to injury and many diseases, as well as a recently acknowledged primary condition (Rice, Smith and Blyth, 2016). The estimated global prevalence of chronic pain is between 20 and 49 % (Goldberg and McGee, 2011; Van Hecke, Torrance and Smith, 2013). The accuracy of epidemiological studies is challenged as collected data is largely heterogeneous (Mills, Nicolson and Smith, 2019). This is due to the lack of a universally accepted and accurate pain classification system. The current 10th edition of the International Classification of Disease (ICD-10) is widely used in many countries for clinical research yet, it does not reflect the multifaceted nature of chronic pain adequately as it is not systematically categorized within its framework of medical diagnoses (Treede et al., 2019). However, the IASP has recently classified chronic pain into primary and secondary chronic pain and its subgroups (Treede et al., 2019). Primary chronic pain is a primary disease state with pain as the chief complaint, for example, fibromyalgia or complex regional pain syndrome. The underlying aetiology may be unclear but there is identifiable psychosocial distress (Treede et al., 2019b). Secondary chronic pain has six subgroups syndromes where pain is secondary to a distinct pathology namely, chronic cancer-related pain, chronic neuropathic pain, chronic secondary visceral pain, chronic secondary posttraumatic and postsurgical pain, chronic secondary headache and orofacial pain, and chronic secondary musculoskeletal pain (Treede et al., 2019). Although there may be a distinct aetiology with differing mechanisms, there are a multitude of demographic, physical, social and psychological risk factors that

manipulate the development, intensity, duration and experience of chronic pain (Van Hecke, Torrance and Smith, 2013; Goren, Mould-Quevedo and daCosta Dibonaventura, 2014; Colloca et al., 2017).

2.1.1 Demographic Risk Factors

There are certain demographic characteristics of populations that increase the likelihood of chronic pain developing. These include socioeconomic status, gender and age.

Socioeconomic Status

The socioeconomic status of a country does not seem to be predictive of chronic pain development. There seems to be no difference in chronic pain prevalence between developed and developing countries, however developed countries account for the most research conducted in the field of pain (Wang and Zhao, 2018). As a result, there is limited access to a small number of epidemiological pain studies with heterogeneous results in developing countries. It is therefore likely that chronic pain prevalence in developing countries is underrepresented in the literature considering these countries possess higher known risk factors (for example, trauma, violence) for the development of chronic pain (Jackson et al., 2016). A recent review by Sá et al. (2019) found that the prevalence of chronic pain in developing countries ranges between 13 and 51 %. Comparatively, in the Netherlands, approximately 18% of their population experience chronic pain (Bekkering et al., 2011). Similarly, a recent study by Kamerman et al. in 2020 reported one in every five South Africans within the general population experience chronic pain. The United Kingdom has a high chronic pain prevalence of 43% and the prevalence of chronic pain in the rural South African setting is just as high at 42.9% (Igumbor et al., 2011; Fayaz et al., 2016). Developing countries dedicate the majority of the limited health care resources towards the necessary treatment of communicable diseases and childhood vaccinations (James et al., 2018; Morris et al., 2018). This has inadvertently permitted a higher incidence of comorbid pain from trauma, diabetes, cancer and cardiac disease to develop and exceed that of developed countries (Vos et al., 2017).

Nevertheless, one of the more distinct risk factors for a high chronic pain burden, is the socioeconomic status of an individual (Van Hecke, Torrance and Smith, 2013). The complex interplay between disadvantages in income, education and employment can predict the burden of chronic pain (Poleshuck and Green, 2008; Grol-Prokopczyk, 2017). These factors and the influence they exert upon health are not fully understood.

However, it has been suggested that a higher positioned job due to a high educational attainment leads to a higher income that affords greater resources to address health needs and therefore the burden of chronic pain is likely to be less (Fliesser, De Witt Huberts and Wippert, 2017).

Demographic factors influence socioeconomic status and this relationship and its impact upon pain is poorly understood (James et al., 2018). The influence of other important factors in facilitating the development of chronic pain, such as gender are necessary to consider (Varì et al., 2016; Fleming et al., 2017). Females experiencing socioeconomic disadvantage are more likely to report moderately severe chronic low back pain compared to their advantaged female counterparts and men (Lourenço et al., 2017). In fact, females are generally more likely to experience chronic pain than men (Greenspan et al., 2007).

Gender

Being female is a well-established risk factor for developing chronic pain (Bartley and Fillingim, 2013). However, the global prevalence of pain amongst females is thought to be overrepresented as women are more likely to report and seek social support and treatment for pain than men (Bartley and Fillingim, 2013). A study by Johannes et al. (2010) showed a 34.3% prevalence of chronic pain amongst woman compared to 26.7% amongst their male counterparts. Mechanisms that increase a female's risk of developing chronic pain are partially known. Hormonal factors are thought to increase a woman's sensitivity towards pain and reduce their response to analgesics (Greenspan et al., 2007; Bartley and Fillingim, 2013). A cross sectional study of women by Gibson et al. in 2019, revealed that women experiencing menopause were twice as likely to experience chronic pain concurrently ($p< 0.001$). Additionally, females have a longer lifespan expectancy and so their risk for developing chronic pain is compounded (Zarulli et al., 2018).

Age

Longevity is a universal risk factor for the development of chronic pain (Vos et al., 2017). The United Kingdom's chronic pain prevalence steadily climbs from 43 to 62% amongst people over the age of 75 years (Fayaz et al., 2016). Advances in medical technology are resulting in an increase in the average human lifespan therefore, the development of chronic pain and its prevalence are expected to increase across the world (Larsson et al., 2017; James et al., 2018). The older a population the greater the risk of chronic pain developing as they also experience an increased pain perception

related to a cognitive decline, decrease in physical activity, depression and poor sleep (Hoy et al., 2012).

The experience of chronic pain can begin earlier in life. Twenty five percent (25%) of children and adolescents in Denmark experience chronic pain (Perquin et al., 2000). Five to eight percent of children globally report severely disabling chronic pain. The most common chronic complaints are headaches, abdominal pain and musculoskeletal pain (Friedrichsdorf et al., 2016). Paediatric pain management is largely inadequate and injury to a developing nervous system without adequate pain management can sensitize a child's nervous systems predisposing them to chronic pain later in life (Campos et al., 2011; Stevens et al., 2011; Knaepen et al., 2013).

Misconceptions together with the fact that, children do not remember painful experiences or feel less pain than adults, create an obstacle in providing adequate and routine paediatric pain management (Mathews, 2011; Becker et al., 2018). Pain expression across different age groups can also be influenced by various lifestyle factors that similarly modulate the nociceptive pathway (Varì et al., 2016).

2.1.2 Lifestyle and Behaviour Risk Factors

There are certain daily behaviours and habits that increase the likelihood of chronic pain developing. These include smoking and alcohol abuse, poor nutrition, inactivity, and poor sleeping habits.

Smoking & Alcohol Abuse

There is consistent evidence that smoking and alcohol abuse are strongly associated with the development of chronic diseases (Varì et al., 2016). People who smoke are more likely to develop chronic pain as smoking causes a dramatic release of inflammatory mediators that promote hyperalgesia within the somatosensory system (O'Loughlin et al., 2008). This effect is compounded as nicotine causes vasoconstriction mediated tissue injury (Daniel and Pirotta, 2011). Furthermore, smoking has been shown to enhance activities within the brain areas (nucleus accumbens and prefrontal cortex) that promote pain persistence in people experiencing back pain (Petre et al., 2015). Comparatively, people with chronic pain tend to smoke more (Orhurhu, Pittelkow and Hooten, 2015). Orhurhu, Pittelkow and Hooten (2015), found the prevalence of smoking with people with chronic pain attending an outpatient pain clinic to be 23.5%. Of these smokers the majority of them were unemployed and there was a significant association with increased opioid use

($p<0.001$) (Orhurhu, Pittelkow and Hooten, 2015). The addictive substance nicotine, found in cigarettes, has shown to have analgaesic properties similar to that of opioids, while on the other hand perpetuating the pain cycle due to vasoconstriction mediated tissue injury and cascade the released inflammatory mediators (Yoon, Lane and Weaver, 2015). Alcohol abuse has similarly been noted for its self-medicating effect amongst people with chronic pain (Alford et al., 2016; Maleki et al., 2019).

Alcohol abuse can precipitate the development of peripheral and central sensitization mechanisms involved in chronic pain as they share common neural networks (Apkarian et al., 2013). Excessive alcohol use has been noted in a review by Mellion, Gilchrist and De La Monte in 2011 to induce small fibre neuropathies, contributing towards the development of chronic neuropathic pain.

Smoking and alcohol abuse are considered modifiable risk factors for chronic pain development (van Hecke, Torrance and Smith, 2013). However, a review of 73 articles by Reyes-Gibby et al. in 2015 concluded there exists a genetic predisposition for addiction to nicotine, alcohol and opioids in patients with chronic pain. This is a fundamental problem as smoking and alcohol use are known risk factors for cancer and opioids are the pharmacological treatment of choice for cancer pain (Swarm et al., 2010). The genetic predisposition towards alcohol, nicotine and opioids in chronic pain may be less amenable to modification strategies. However, the consumption of a healthy balanced diet may be easier to modify in mitigating the development of chronic pain.

Nutrition and Obesity

Emerging research suggests a diet deficient in certain micronutrients including omega-3 fatty acids, vitamin B6, magnesium, zinc and antioxidants may be associated with the exacerbation of pain in chronic pain states, such as fibromyalgia (Holton, 2016). In addition, a critical review by Akbar et al., in 2017 determined fish oil supplementation in rheumatoid arthritis, is linked to a short term reduction in pain intensity amongst patients with rheumatoid arthritis. Similarly, a diet high in sources of glutamate and aspartate (meat, soy sauce, fish sauces and aged cheeses, monosodium glutamate and yeast extract) have been shown to increase neuronal excitability and pain perception in patients experiencing fibromyalgia (Smith et al., 2001). However, developing countries are not only burdened by an inadequate nutritional intake resulting in one third of infants experiencing stunted growth but by the additional problem of lacking the required dietary intake of minerals and vitamins for optimal

health compared to developed countries (WHO, 2017). For example 29% of women in their child bearing years have anaemia that could be avoided through adequate diet or supplementation (WHO, 2017). Nutritional factors between countries or individuals with economic inequalities influences healthy behaviours and thus impacts chronic pain development (Fliesser, De Witt Huberts and Wippert, 2017). Furthermore, poor nutrition is associated with a disruption of gut microbe balance causing chronic pain.

A diet high in processed food and sugar can cause a disruption in gut microbe balance which has been found to be present in patients experiencing irritable bowel syndrome (IBS) (Distrutti et al., 2016). IBS is the most common complaint seen by gastroenterologists and often presents with other non-gastrointestinal symptoms, including anxiety and depression (Lackner et al., 2013). Gut microbial imbalances results in the painful perception of digestive processes due to the influence it has upon the nociceptive pathway via the “gut-brain axis” (the bidirectional communication between the gut and the brain) (Distrutti et al., 2016). Disruption in gut microbes has been found to be common in people with obesity (Turnbaugh et al., 2006).

Obesity is a growing global public health problem, and an important risk factor for many chronic diseases (Varì et al., 2016). People who are unable to afford nutritious food (such as fruit, vegetables and protein) buy cheaper processed food items (high in fat, sugar and salt) that promote obesity (WHO, 2017). The prevalence of chronic pain rises to 33% amongst people with obesity (Green et al., 2016). The increased mechanical load upon the musculoskeletal system and elevated systemic inflammation are mechanisms thought to link obesity to chronic pain development (Green et al., 2016). Conversely, pain limits physical activity and influences eating behaviour thus promoting weight gain (Chin et al., 2020). Obesity is additionally linked to Vitamin D deficiencies (Pereira-Santos et al., 2015).

Vitamin D is produced endogenously through sunlight exposure and it can be obtained from certain foods and supplementation (Khammissa et al., 2018). Studies have shown that a lack of sunshine, cooler weather and pain are related however, further research is required to clarify the relationship (Macfarlane et al., 2010; Daniel and Pirotta, 2011). Vitamin D is essential for optimal overall physiological function and a deficiency has been linked to chronic pain states, particularly inflammatory arthritis and fibromyalgia patients (Jesus, Feder and Peres, 2013; Wepner et al., 2014; Jeffery, Raza and Hewison, 2016; Sassi, Tamone and D’Amelio, 2018). Furthermore, its deficiency can have a wide effect upon the body particularly within the musculoskeletal system,

negatively impacting physical performance (Baldwin, 2004). The supplementation of Vitamin D can assist in the prevention of osteoporosis (Kanis et al., 2019). Chronic pain as a result of osteoporosis, is associated with a sedentary lifestyle which further promotes chronic pain development (Paolucci, Saraceni and Piccinini, 2016; Geneen et al., 2017).

Physical Activity

Physical activity has been widely acknowledged as an important mitigating factor in reducing the development of many chronic diseases including cardiovascular disease, diabetes, colon and breast cancer (Samuelson, 2004; Warburton et al., 2010). It is estimated that only one in four adults lead active lifestyles, in addition, people experiencing chronic pain have a reduced capacity for physical activity (Parker et al., 2017; Guthold et al., 2018). This is unfortunate as systematic reviews conclude that despite limitations in available studies, exercise can improve quality of life and reduce pain severity (Geneen et al., 2017; Marley et al., 2017). For example, a randomized control study by Alghadir et al. in 2019 demonstrated that a six week walking program for osteoarthritis treatment, decreased pain intensity and improved functional ability. Exercise has a bidirectional relationship with sleep, which in deficit can increase the risk of developing chronic pain (Kline, 2014).

Sleep Disorders

Insomnia is an important risk factor for the development of chronic pain (Finan, Goodin and Smith, 2013). Sleep and pain are reciprocally intertwined survival strategies that maintain bodily homeostasis and overall health (Finan, Goodin and Smith, 2013). The global prevalence of insomnia is estimated to be between 6% and 10% and approximately 50% of people with chronic pain report having poor sleep habits (Sivertsen et al., 2009; Jank et al., 2017). The role of sleep deprivation in facilitating pain is stronger than chronic pain predicting sleep disorders (Finan, Goodin and Smith, 2013). A cross-over randomised control trial of 79 adults by Smith et al. (2019) concluded that sleep disturbances created changes within the central nervous system (secondary hyperalgesia and temporal summation) that are associated with pathophysiological changes necessary for the development of chronic pain. Furthermore, the awareness of pain can conversely disrupt sleep and acute pain is a risk factor for chronic pain development.

2.1.3 **Physical Risk Factors**

Acute Pain

Unresolved acute pain is a noteworthy risk factor for the development of chronic pain (Gold and Gebhart, 2010). Acute pain is more likely to persist if there are multiple sites of pain and if the reported pain is of a high intensity (Van Hecke, Torrance and Smith, 2013). The development of chronic pain in the acute pain setting is commonly a result of inadequate pain control (Hoofwijk et al., 2015).

Inadequate pain control in the acute post-operative setting is a common cause for the development of post-surgical pain, in particular breast surgery, amputations and cardiothoracic surgery (Brummett, 2011; Bottiger, Esper and Stafford-Smith, 2014; Flor and Fuchs, 2016). The prevalence of post-surgical chronic pain ranges between 10 and 22.3% (Fletcher et al., 2015; Hoofwijk et al., 2015).

A reduced post-surgical outcome prediction is further compounded if individuals are experiencing a higher burden of comorbidities, such as diabetes and chronic obstructive pulmonary disease (COPD) (Nishikawa et al., 2019; Wang et al., 2019).

Comorbidities

Approximately 88% of people experiencing primary chronic pain have coexisting morbidities such as cardiac disease, osteoarthritis and diabetes mellitus (Barnett et al., 2012). An observational study by Abbott et al. (2011) found one third of 15 692 diabetic patients in North West England reported having neuropathic pain and diabetes mellitus, which is also associated with lumbar spine stenosis (Asadian et al., 2016). Accordingly, the prevalence and intensity of low back pain is higher amongst diabetic people experiencing chronic pain compared to their non-diabetic counterparts (Anekstein et al., 2010; Jimenez-Garcia et al., 2018). There is an association between cardiac disease and chronic pain, however the exact relationship is not yet established. A review by Ansari-Ramandi and Naderi (2017) suggested heart failure causes a high burden of chronic pain. A review by Fayaz et al. (2016) indicated the perpetual stress of chronic pain increases cardiovascular disease incidence, particularly if the pain intensity is severe. The co-occurrence of chronic pain and comorbidities is not limited to physical diseases as certain pre-existing psychosocial factors increase the likelihood of chronic pain developing (Edwards et al., 2016).

2.1.4 **Psychosocial Risk Factors**

Certain pre-existing psychosocial factors, including anxiety and depression, catastrophic cognitions, a history of trauma and unsupportive social structures at work or home, can influence the development of chronic pain by creating an increased distress response within the body (Simons, Elman and Borsook, 2014; Crofford, 2015). Personal beliefs and cultural influences further impact the development of chronic pain (Sharma, Abbott and Jensen, 2018). Pain perception in individuals with higher pain-related fear and higher self-reported pain catastrophizing seems to be strongly influenced by psychosocial factors and less by nociceptive signalling.

Anxiety and Depression

Approximately 50% of people with chronic pain experience anxiety and depression (Feingold et al., 2017). Pre-existing anxiety and depression are reliable predictors for the development of chronic pain (Edwards et al., 2016). In 2017, Alattas et al. performed a review of 10 studies that investigated pre-operative psychological factors in patients undergoing a total knee replacement. They found preoperative anxiety and depression reliable indicators of persistent postoperative pain and reduced quality of life (Alattas et al., 2017). The bidirectional relationship that depression has with pain has been demonstrated in numerous investigations (Dominick, Blyth and Nicholas, 2012; Ghoneim and O'Hara, 2016; Sheng et al., 2017). Additionally, the severity of depression is directly proportional to the number of sites of pain (Melkevik et al., 2018). A randomized controlled study in 2009 by Kroenke et al. (2009) showed a clinically significant reduction in overall pain ($p=0.007$) in patients experiencing chronic musculoskeletal pain and depression, when effective antidepressant therapy was established compared to the control group. In 2016, Rayner et al. found that 60.8% of people attending a tertiary pain clinic in England reported having concurrent depression. The shared pathophysiological mechanisms of chronic pain and depression deepen the complexities and aggravate the severity of each perception when in coexistence with each other (Sheng et al., 2017).

Personal Attitudes, Beliefs and Behaviours

Pain related beliefs are acquired throughout one's life in response to painful experiences, knowledge acquisition and personal values that are all shaped within a social context (Barbosa, Vieira and Garcia, 2018). The resource of pain knowledge is reflected in positive pain related beliefs that assist in the establishment of self-efficacy and helpful coping strategies that enhance an individual's self-management (Pons, Shipton and Mulder, 2012; Vanhaudenhuyse et al., 2018). For example, a study of 122

people with chronic rheumatological pain, found that those with positive pain beliefs (pain is a protective system and it does not always equate to damage) reported a greater quality of life compared to people who had negative beliefs (pain signifies physical damage) (Pons, Shipton and Mulder, 2012).

Catastrophic pain related cognitions (negative thoughts towards a pain experience) are an independent risk factor for the development of chronic pain, as well as a poor outcome predictor for chronic pain management strategies (Martinez-Calderon et al., 2019). A systematic review including six longitudinal studies by Burns et al. (2015) concluded pain catastrophizing is a strong preoperative predictor for chronic pain to develop amongst patients undergoing a total knee replacement. Another study of 648 chronic pain patients by Craner, Sperry and Evans in 2016, confirmed that pain catastrophizing is associated with a depressed mood, a reduced quality of life and a higher pain severity.

The thoughts of perceived injustice towards the experience of chronic pain are associated with an increase in pain intensity and a greater disability. This cognition of unfairness and loss correlates with the emotion of anger (Scott et al., 2013). A study by González-Roldán et al. (2013) found patients with fibromyalgia have an increased processing and attention towards negative angry facial expressions. This cognitive bias towards anger contributes towards the development of a perceived injustice and heightened pain experience. The predictability of a person's behaviour response based on their pain related knowledge and beliefs is however, not straightforward as it is also influenced by pain intensity, familiarity of pain, threat value of the stimulus, mood and culture (Malfliet et al., 2017).

Culture and Ethnicity

Pain expression across different cultures is globally variable (Sharma, Abbott and Jensen, 2018). Attitudes, goals, beliefs, coping and communication strategies towards pain are socially conditioned within an individual's racial, religious and social group (Sharma et al., 2020). However, the existence of individual differences in pain perception and resilience between people of the same culture or ethnicity should not be discounted to avoid the risk of unhelpful stereotyping.

In South Africa, within the Sesotho culture it is unacceptable for a man to express feelings of pain as it is perceived as a sign of weakness. However, women of the same culture are encouraged to express pain until their needs are met (Nortjé and Albertyn,

2015). Aboriginal people, a marginalized population in Australia, similarly display a reduced pain expression despite experiencing profound disability from chronic low back pain (Lin et al., 2012; Arthur and Rolan, 2019). However, this discrepancy is largely a result of discriminatory attitudes within their society and of healthcare workers causing poor communication that impede their accurate pain reporting (Strong et al., 2015).

Cultures, ethnicities or groups of people that are systemically disrespected and not valued within society experience stigma, bias and discrimination (Craig et al., 2020). These marginalised people are at higher risk for developing chronic pain states and not receiving appropriate medical care compared to their more “socially accepted” counterparts (Green et al., 2003). Marginalised people within society are further at risk for experiencing suboptimal working conditions which has the potential to influence chronic pain development (Fleming et al., 2017).

Occupational Factors

Physically demanding jobs, reduced acknowledgment and poor monetary compensation at the workplace contribute towards the chronicity of pain (Esquirol et al., 2017). A Japanese study of 1764 workers found job dissatisfaction and reduced quality of life amongst workers experiencing chronic pain was related to inadequate social support at work and job dissatisfaction. Comparatively a study, by Etuknwa, Daniels and Eib in 2019, noted that the ability to return to work following an illness is facilitated by support within the occupational environment, a positive attitude, high self-efficacy, younger age and higher education levels. This creates a conundrum where a person with poor health is less likely to be employed however, having this person re-employed is likely to facilitate health improvements (Nwaru, Nygård and Virtanen, 2016). Occupational factors are necessary to address to lessen the economic burden of unproductivity and promote a work environment infused with resilience and job satisfaction.

Social Support

Social support refers to the assistance or help received from others. It has the capacity to buffer an individual against the stress induced from a pain experience and therefore influences the persistence and development of chronic pain (Edwards et al., 2016; Che et al., 2018). These relationships vary from immediate social environments involving spouses or parents to interactions between patients and healthcare providers. Social support that promotes autonomy and independence is helpful in reducing pain related

disability. Conversely, a study in Germany of 92 patients with chronic low back pain, showed that all participants exhibited some degree of invalidation and social rejection from close relationships and this was significantly associated with a higher pain related disability ($\beta = .28$, $p = .03$) (Wernicke, de Witt Huberts and Wippert, 2017). Spouses, partners or parents who take over tasks or encouraging avoidant behaviour contribute towards a higher pain related disability (Jensen et al., 2011). This type of social support although well intended, is disempowering, promoting disuse and loss of independence and integration into daily life and function in society. Additional negative social experiences, such as trauma, can similarly predict chronic pain developing (Edwards et al., 2016).

Trauma

Physical trauma, psychological trauma, sexual abuse, torture, childhood abuse and combat exposure are examples of social experiences that are strongly associated with the development of chronic pain (Edwards et al., 2016). An observational study by Akhtar et al. in 2019 noted prevalence of post-traumatic stress disorder (PTSD) amongst people attending a chronic pain clinic was 28%, compared to 7% amongst the general population. Moreover, a meta-analysis of 71 studies by Afari et al. in 2014, investigating the relationship between chronic pain and trauma showed that people are 2.7 times more likely to develop chronic primary pain if they have experienced trauma. Trauma elicits a physiological fight or flight stress response that facilitates pain transmission (Turk, 2002). This effect persists if the traumatic event and its psychological consequences remain unresolved (Turk, 2002).

2.1.5 **Genetic Predisposition**

There is also evidence linking the genetic predisposition towards the development of certain primary chronic pain states, such as fibromyalgia as well as the co-occurrence of multiple primary chronic pain states (Fitzcharles, Perrot and Häuser, 2018; Sexton et al., 2018). A systematic review by Nielsen et al. in 2012 on twin studies, noted that there is an estimated heritability of 50% to develop migraines, tension-type headaches, fibromyalgia and chronic widespread pain, 35 % for back and neck pain and 25% for irritable bowel syndrome (Nielsen, Knudsen and Steingrímsdóttir, 2012). A genetically enhanced nociceptive transmission and increase pain perception can result from variation in expression of sodium, calcium and potassium channels within the somatosensory nervous system (Cox et al., 2006; Chidambaran et al., 2020). In addition, alterations in the synthesis, transmission and metabolism of certain pain signalling neurotransmitters, such as serotonin, dopamine, epinephrine and

norepinephrine have been identified as a pain promoting phenotype (Zorina-Lichtenwalter et al., 2016). However, the use of clinical risk factors (including anxiety and depression – refer to 2.2.4 page 16) are more reliable than identifying pain promoting genotypes in predicting the development of chronic pain (Dimova et al., 2015; Montes et al., 2015).

Chronic pain is a prevalent worldwide health epidemic that is likely to grow over time (Mills, Nicolson and Smith, 2019). The interaction between demographic, physical, lifestyle, psychosocial and genetic risk factors that increase the likelihood of chronic pain developing is complex and not straightforward for the individual, healthcare provider and society to address. The burden of chronic pain impacts the individual and society with psychosocial, physical and economic implications.

2.2 THE BURDEN OF CHRONIC PAIN

Chronic pain creates suffering experienced in varying degrees by individuals and society (Phillips, 2009). Individuals suffer if they are unable to participate in activities of daily life, recreation, work and society (Von Korff et al., 2016). In 2016, Morales-Espinoza et al. found the average person experiencing chronic pain had a significantly worse quality of life associated with a greater burden of mental and physical health risks compared to people not suffering from chronic pain ($p<0.001$). It is well documented that chronic musculoskeletal pain, including back, neck and peripheral joint pain, are leading causes of disability (Vos et al., 2015; Vargas et al., 2018; Traeger et al., 2019).

Challenges faced by the globally ill-equipped healthcare system in addressing chronic pain include inadequate drug availability, deficient healthcare worker education, lack of pain management implementation policies, restrictive pharmacological regulations and a high cost of pain treatments (Vargas et al., 2018). These factors compound the burden of pain experienced by individuals as a reduced quality of life is associated with an increased utilization of healthcare and a higher reported pain intensity (Lohman, Schleifer and Amon, 2010; Von Korff et al., 2016).

The economic burden of chronic pain results from high levels of work absenteeism, reduced productivity and early retirement (Phillips, 2009). In the United States of America, it is estimated that direct medical bills and loss of work productivity due to chronic pain cost the country $560 billion dollars annually with $78.8 billion per year accounting for the misuse of opioids (healthcare costs, loss of productivity, addiction

treatment and criminal justice) (Florence et al., 2016; Dahlhamer et al., 2018). Contrasting with a rural South African environment where economic disadvantage is already experienced by the majority of the population, chronic pain has less influence in determining quality of life compared to food availability (Jelsma, Mkoka and Amosun, 2008). The majority of people with little or no access to adequate pain relief are from developing countries and tend to experience higher pain severity and a greater disability than their developed world counterparts (Vos et al., 2015; Janevic et al., 2017).

The burden of chronic pain is global. The alleviation of this burden through adequate pain management, is one of the oldest challenges of the healthcare industry (Rice, Smith and Blyth, 2016). Developing and developed countries face global and unique challenges to their healthcare systems in delivering effective pain management strategies. There is a unified need to uphold the human right of alleviating the suffering caused by chronic pain.

2.3 THE NOCICEPTIVE PATHWAY

Nociception is the biological mechanism of encoding sensory information and transmitting it to the central nervous system for interpretation (Binshtok, 2011). A noxious stimulus is only perceived as pain after higher order cognitive processing has occurred (Simons, Elman and Borsook, 2014). The dynamic interplay between cognitive appraisal and resulting endogenous pain relief is reliant upon the parallel nociceptive processing occurring within numerous networks within the brain including, the prefrontal cortex, amygdala and anterior cingulate cortex (ACC) (Isenberg-Grzeda and Ellis, 2015; Morton, Sandhu and Jones, 2016).

However, our current understanding of the mechanism of pain perception is not complete as the scientific investigation of nociception has focused upon the neurophysiology of pain. The psychology of pain is equally important to appreciate but it tends to be inadequate in explaining the neurophysiological processes. For example, neurophysiologists determine nociception through distinct factual occurrences within the body. Whereas psychologists rely upon various hypothetical constructs to determine theories upon which to explain various phenomena. Melzack's Neuromatrix theory (2001) provided a framework of brain areas and psychological function that are activated by nociceptive stimuli, resulting in a unique pain experience termed, the neurosignature of pain (Melzack, 2001). Furthermore, a review by Morton, Sandhu and Jones (2016) identified six areas in the brain that are primarily involved in acute pain

processing and perception: the thalamus, insular cortex, primary and secondary somatosensory cortices, anterior cingulate cortex and the prefrontal cortex.

The thalamus receives the noxious input and projects it to the primary and secondary somatosensory cortices and prefrontal cortex for the sensation to be discriminated (intensity, quality, location) (Oshiro et al., 2009). Thalamic projections also extend to the ACC and insula for the emotional and motivational component of pain to be assigned (Porreca and Navratilova, 2017). Its meaning, perception and resulting behaviour response is influenced by cognitive (attention, knowledge, expectation, past experiences, coping beliefs) and emotional factors (anxiety, depression, fear) (Crofford, 2015; Sawicki, Humeidan and Sheridan, 2020,Turk et al., 2016).

According to Melzack's Neuromatrix theory, the experience of pain relies less upon tangible nociceptive input and more upon the brain actively creating a subjective experience based upon sensory input (Melzack, 2001). Further to this concept, the salience detection theory hypothesizes that pain perception results if a threat to bodily tissues is perceived by the brain (Moseley and Arntz, 2007; Legrain et al., 2012). It is necessary to attach a threatening meaning to the stimuli in order for the awareness of pain to occur.

Alternatively, according to the Bayesian brain model, perception of one's sensory world is a cognitive prediction (De Ridder, Vanneste and Freeman, 2014). The brain is continuously predicting the state of the body and its perception of the world by integrating incoming sensory input with past experiences and context. For example, in an acute pain state, there is a high correlation between pathology or injury and pain perception as the disruption of homeostasis is unexpected and unwanted. However, in a chronic pain state, the presence of peripheral and central sensitization (see subsection 2.5) causes the brain to predict pain despite an absence of bodily injury. The different theories that explain pain perception agree that the complex and dynamic network of peripheral and central somatosensory neurons, are influenced by cognitive, emotional and behavioural factors (Clark, 2013; Moayedi and Davis, 2013).

Cognitive appraisal of sensory input provides emotional motivation for necessary survival behaviours and this process involves the release of dopamine from the nucleus accumbens (NAc) and frontal lobes within the mesolimbic circuitry of the brain (Porreca and Navratilova, 2017,Bushnell, Čeko and Low, 2013). For example, an acute noxious stimulus that has not been experienced before, has a high salience and

therefore signalling of dopamine neurons in the ventral tegmental area (VTA) and their projections into the NAc, along with the striato-nigro-striatal circuit linking the NAc shell to the dorsal striatum, will motivate an appropriate escape and avoidance response. However, in a chronic pain state, the threshold of the mesolimbic circuitry is reduced and the behaviour to avoid and escape is maladaptive, automatic and based upon memory.

The awareness of pain requires nociception to initiate a protective behaviour response. However, nociception does not always result in pain perception, if no threat is perceived by the brain (Moseley and Arntz, 2007). It is necessary to attach a threatening meaning to the stimuli in order for the awareness of pain to occur. Certain clinical states such as, nociceptive pain, inflammatory pain, neuropathic pain and primary central pain, have been identified according to distinct mechanisms of injury (Meacham et al., 2017).

2.3.1 Different Clinical States of Chronic Pain

The various causes of disruption along the nociceptive pathway results in certain characteristic clinical pain states including nociceptive pain, inflammatory pain, neuropathic pain and primary central pain (Vardeh, Mannion and Woolf, 2016). In chronic states, nociceptive, inflammatory and neuropathic pain tend to have a previous acute initiating event whereas, primary central pain is always chronic and more dependent upon centrally mediated mechanisms and psychosocial distress (Vardeh, Mannion and Woolf, 2016). Awareness of the different states that present clinically provides an indication of the underlying pain mechanisms.

Persistent mechanical factors can give rise to chronic nociceptive pain for example, stenosis of the oesophagus due to scarring leads to chronic secondary visceral pain (Aziz et al., 2019). Persistent inflammation of bones, muscles, ligaments and tendons is a noteworthy contribution towards ongoing nociceptive transmission (Rifbjerg-Madsen et al., 2017). Chronic inflammation secondary to infection from viruses, bacteria, fungi or parasites, crystal deposition or autoimmune processes is thus responsible for the establishment of chronic secondary musculoskeletal pain (Perrot et al., 2019). Systemic inflammation can similarly cause ongoing nociceptive input (Rifbjerg-Madsen et al., 2017).

Systemic inflammatory pain states such as systemic lupus erythematosus (SLE) or rheumatoid arthritis are largely attributed towards autoimmune driven inflammation

(Oliveira Júnior, Portella Junior and Cohen, 2016). More recently, stress has been implicated in the dysregulation of immune response mediating hypersensitivity within the nociceptive system in these individuals (Sawicki, Humeidan and Sheridan, 2021). Various studies have also identified an increase in systemic inflammatory markers as the causative factor in primary chronic pain states such as irritable bowel syndrome or ulcerative colitis (Kuroki et al., 2011; Hore and Denk, 2019; Labanski et al., 2020).

Neuropathic pain mechanisms, although they involve the initiation of secondary inflammatory processes, are distinct from primary chronic inflammatory pain where inflammation is the primary cause of altered chemical events (see nociceptive pathway for more information) (Colloca et al., 2017). Neuropathic pain is the result of damage or disease affecting the neurons of the peripheral or central nervous system (Meacham et al., 2017). For example, central post stroke pain, peripheral nerve injury, spinal cord injury, trigeminal neuralgia and diabetic neuropathy affects approximately 7-10% of the general population (Colloca et al., 2017). Patients with neuropathic pain present with anatomical distribution of pain relating to affected the neural structure, as well as some degree of sensory dysfunction (Perrot et al., 2019). It is uncommon for chronic nociceptive pain to occur in isolation and often presents in combination with neuropathic pain. For example, Liu et al identified 50% of people attending a primary pain clinic experiencing chronic neck pain presented with a combination of nociceptive and neuropathic mechanisms (Liu et al., 2017).

It is a challenge to diagnose a primary chronic pain state as its clinical presentation is variable and there is no defined diagnostic criteria (Nijs, Van Houdenhove and Oostendorp, 2010). The identification of primary central pain states is also challenging due to the wide clinical presentation of symptoms (Cooper and Gilbert, 2017). In conditions where there is no peripherally originating pathology, the role of genetics and psychosocial factors are a dominating precipitating feature that causes hypersensitivity of the entire somatosensory system (Lõpez-Solà et al., 2014; Vardeh, Mannion and Woolf, 2016).

Chronic pain in its various overlapping states, is determined by pathophysiological changes within the somatosensory system, namely peripheral sensitization and central sensitization. The establishment of an imbalance between excitatory and inhibitory signalling within the somatosensory system creates a state of hypersensitivity towards incoming sensory stimuli (Marchand, Perretti and McMahon, 2005; Pak et al., 2018).

2.4 THE PATHOPHYSIOLOGY OF CHRONIC PAIN MECHANISMS

Chronic pain is a maladaptive disease state characterised by pathological changes within the somatosensory nervous system. There exists a multitude of chronic pain syndromes with a variable state of hypersensitivity due to distinct mechanisms that can occur at various levels within the nociceptive pathway (Harte, Harris and Clauw, 2018; Meints and Edwards, 2018). Small molecular changes to alterations within network connections arise depending upon the aetiology (tissue trauma, nerve damage infection, systemic diseases or inflammation or a genetic predisposition). Scientific research in the fields of neuroimmunology, endocrinology, genetics, psychology and physiology have contributed towards the complex mechanisms involved in pain perception.

This section of the literature review aims to discuss the structural plasticity occurring within the nociceptor (peripheral sensitization) and the synapse between the nociceptor and spinal neurons within the spinal cord and changes in processing within the brain (central sensitization). The contribution of peripheral or central sensitization mechanisms towards the development of chronic pain are specific to the causative pathology. The development of peripheral sensitization requires ongoing peripheral pathology and central adaptation for it to be maintained (Latremoliere and Woolf, 2010).

2.4.1 Peripheral Sensitization in Chronic Pain

Peripheral sensitization reflects remodelling of the nociceptors membrane within the periphery of the body following tissue injury, nerve injury or persistent inflammation (Xu and Yaksh, 2011). The property of dynamic plasticity of the nociceptor accounts for the development of primary hyperalgesia (a heightened pain perception within the area of injury/noxious stimulation) particularly towards thermal stimuli (Woolf and Salter, 2000; Nickel et al., 2012). This dynamic neuroplasticity has been extensively investigated in the development of chronic inflammatory or neuropathic pain states (Xu and Yaksh, 2011; Colloca et al., 2017; Meacham et al., 2017; Pak et al., 2018). The two processes identified in peripheral sensitization that directly enhance the responsiveness of nociceptors are alterations in ion channel kinetics and increased expression of ion channels along the nociceptors membrane (Nickel et al., 2012; Meacham et al., 2017). The persistent presence of inflammatory mediators prolongs the heightened excitability of a nociceptor's membrane (Meacham et al., 2017). In addition, the more ion channels and receptors the nociceptor has, the more easily it can be activated by subthreshold stimuli) (Nickel et al., 2012; Meacham et al., 2017).

2.4.2 **Central Sensitization**

Central sensitization is the increased responsiveness and enhanced synaptic efficacy of sensory neurons within the central nervous system to normal or sub threshold afferent inputs (IASP, 2017). The disruption of the bidirectional neuroimmune signalling between the periphery and spinal cord and brain, is a pivotal driving force in the development of central sensitization (Vardeh, Mannion and Woolf, 2016; Sawicki, Humeidan and Sheridan, 2021).

Spinal Cord

Persistent or excessively high noxious input from primary nociceptors cause neuroimmune processes to mediate an increase in glutamate function. Glutamate is a fast-acting excitatory neurotransmitter and its enhanced signalling function within the spinal cord is a fundamental feature of central sensitization. (Latremoliere and Woolf, 2010). Immune cells within the spinal cord (microglial cells) increase the function of the synapse by increasing the production of glutamate and its receptors (α-amino-3-hydroxy-5-methyl-4-isoxazole-propionic acid (AMPA) and N-methyl-D-aspartic acid (NMDA) receptors (Gwak et al., 2012). This causes an amplification of noxious and non-noxious signalling mediated by dysregulated neuroimmune signalling of resident microglia (Akinci et al., 2016). Further inflammatory mediators (TNF, interleukins) and neurotrophic peptides (Substance P, Calcitonin gene-related peptide, BDNF) augment noxious transmission and promote the development of temporal summation (increased awareness of pain to repetitive painful stimuli, particularly thermal or mechanical stimulation) (Vardeh, Mannion and Woolf, 2016; Iyengar, Ossipov and Johnson, 2017; Meacham et al., 2017). The hypersensitivity at the spinal cord is further enhanced by a loss of local inhibition (Herrero, Laird and Lopez-Garcia, 2000; Vardeh, Mannion and Woolf, 2016).

Disinhibition of inhibitory spinal interneurons provide the opportunity for secondary hyperalgesia and widespread pain to develop (Bourke, Langford and White, 2015). Prostaglandins, TNF, Interleukin -1β (IL-1β) and Interleukin-6 (IL-6) have been identified in being responsible for the disinhibition of GABAergic and glycinergic spinal interneurons (Vardeh, Mannion and Woolf, 2016). A heightened noxious signalling is augmented by the enrolment of other sensory fibres into the nociceptive pathway (Vardeh, Mannion and Woolf, 2016).

In certain chronic pain states there are alterations in the complex functioning of the sensory neurons within the dorsal horn that contribute towards the development of allodynia and other abnormal sensations, such as spontaneous pain (Vardeh, Mannion and Woolf, 2016; Peirs, Dallel and Todd, 2020). Additionally, novel nociceptive input from Aδ fibres from the surrounding area are recruited into the pain pathway, extending the area of pain beyond the site of injury, namely secondary hyperalgesia (the increased sensitivity to mechanical nociceptive stimuli that develops after cutaneous tissue injury in the surrounding uninjured skin) or widespread pain (Vardeh, Mannion and Woolf, 2016; Arendt-Nielsen et al., 2018).

The past 20 years has produced many brain imaging studies including functional magnetic resonance imaging (MRI)scans, positron emission topography scans (PET and electroencephalogram (EEG) that have revealed the complex network interactions between psychological processes and nociceptive processing involved in modulating a unique pain experience (Morton, Sandhu and Jones, 2016; Kuner and Flor, 2017).

Brain

Pain awareness is the ultimate output of the brain and in a state of chronic pain the brain undergoes extensive maladaptive reorganisation (Melzack, 2001; Kuner and Flor, 2017). The relentless bombardment of noxious input creates functional network changes and specific alterations within the pain processing circuitries of the brain (Flor, 2002; Kuner and Flor, 2017). Alterations in neurochemistry activity in the numerous networks within cortical and subcortical areas of the brain that process pain account for enhanced pain perception and reduced descending pain inhibition (Nijs et al., 2011; Moseley, Gallace and Spence, 2012).

Dysfunctional communication between cortical neurons accounts for alterations in the resting brain activity, maladaptive connections between various pain networks and disruptions in cortical sensorimotor representations (Kuner and Flor, 2017). Thus, the meaning of pain in modulating behaviour is given priority over less important higher order tasks (Elman and Borsook, 2016).

Altered Activity within Pain Processing Areas

Brain imaging and electrophysical studies have identified increased activity within the areas of the brain involved in assigning emotion to a noxious stimuli in chronic pain states compared to healthy controls (Isenberg-Grzeda and Ellis, 2015; Kuner and Flor, 2017). A longitudinal study by Hashmi et al. (2013) similarly identified an increase in

activity in the amygdala and prefrontal cortex that accounted for their chronic pain experience rather than in somatosensory brain regions.

A loss of grey matter amongst people with chronic pain can account for reduced tactile perception, poor motor control and a distorted body image that compounds the impairments of patients with chronic pain (Moseley, 2008). However, in their systematic review Cauda et al. (2014) found inconsistent evidence of changes in grey matter density in chronic pain states to characterize morphological changes within the brain in chronic pain. For example, a study by Younger et al., (2010) noted that increased grey matter density within the rostral anterior cingulate cortex and posterior cingulate was associated with an increased self-reported pain severity. Whereas, decreased grey matter density within the thalamus was identified by Henderson et al., (2013) as a contributing factor towards the persistence of chronic neuropathic pain. The alteration in the complex functioning in a chronic pain state is associated with a decrease as well as an increase in grey matter density in different areas of the brain resulting in variable outcomes. Grey matter atrophy has also been noted to occur within areas of the brain that provide endogenous analgesia (den Boer et al., 2019).

Reduced Descending Pain Inhibition

The development of central sensitization includes the deficient functioning of the periaqueductal grey matter, prefrontal cortex and posteroventral medulla in providing descending pain inhibition (Akinci et al., 2016). The reduced action of inhibitory neurotransmitters including encephalin, serotonin and noradrenaline upon the spinal cord significantly facilitates pain transmission and perception (Isenberg-Grzeda and Ellis, 2015). A randomized controlled study by Niesters et al. in 2014 identified a reduction in function of this endogenous pain modulation system amongst people experiencing chronic neuropathic pain. Furthermore, this study noted the administration of a drug that mimicked the action of neurotransmitters involved in the activation of descending pain inhibition, resulted in a 24% reduction in pain intensity after a four week period (Niesters et al., 2014). It is unclear whether the reduction in function of this necessary endogenous system in a chronic pain state is causative or resulting from a persistent nociceptive signalling due to centrally mediated peripheral sensitization (Petersel, Dror and Cheung, 2011; Isenberg-Grzeda and Ellis, 2015). However, Botelho et al. (2016) suggested in their cross-sectional study on women experiencing primary chronic pain (myofascial pain syndrome) that disinhibition of descending pain inhibitory networks is compensatory to increased pain signalling

within the brain. Their findings were supported by other studies (Harris et al., 2009; Gussew et al., 2011; Bushnell, Čeko and Low, 2013).

The clinical identification of central sensitization is tricky. However, in experimental human studies, the presence of allodynia, widespread pain, temporal summation, secondary hyperalgesia and structural and functional changes within in the brain have been found to be reliable indicators (Vardeh, Mannion and Woolf, 2016; Kuner and Flor, 2017; Arendt-Nielsen et al., 2018; den Boer et al., 2019). It is necessary to appreciate the complex and dynamic physiological mechanisms of pain within the somatosensory nervous system in order to appreciate the role psychosocial factors play. Peripheral and central sensitization represent neuroplastic learning mediated by persistent nociceptive input. However, in a state of chronic pain, the relationship between tissue damage and nociception becomes less reliable as healing occurs and psychological processes dominate the pain experience (Moseley, 2007).

2.5 THE PSYCHOLOGICAL PROCESSES OF PAIN CATASTROPHIZING AND FEAR AVOIDANCE BEHAVIOUR IN CHRONIC PAIN

Survival and the maintenance of good health requires the dynamic interaction between nociception, appropriate cognitive appraisal, emotional regulation and helpful motivation that promotes safety seeking behaviours (Hagger et al., 2017). Chronic pain often represents maladaptive cognitive appraisal of sensory stimuli and dysfunctional emotional regulation and behaviours that perpetuates a cycle of pain. Therefore, psychological factors, including attention, expectation, beliefs, mood, motivation and coping behaviours are necessary to identify and address in the clinical setting of chronic pain (Bushnell, Čeko and Low, 2013). Catastrophic cognitive appraisal of pain and resulting fear avoidance behaviour are well established to be poor outcome predictors for individuals with chronic pain (Wertli, Eugster, et al., 2014; Wertli, Rasmussen-Barr, Weiser, et al., 2014).

2.5.1 Catastrophizing

Catastrophizing was formally described by psychologist, Albert Ellis, as an emotional dysfunction in perceiving oneself as vulnerable and lacking the necessary coping skills to escape danger (Ellis, 1962). In the context of pain, the tendency to think a situation worse than what it actually is, became a popular research topic following the publication of the Pain Catastrophizing Scale (PCS) in 1995 by Sullivan, Bishop and

Pivik. These authors identified rumination, magnification and helplessness as cognitive constructs of pain catastrophizing.

Pain Catastrophizing

Pain catastrophizing is a tendency to experience pain in an exaggerated manner, feel helpless in its management and ruminate on its unpleasantness (Sullivan, 1995). It can establish as an inherited trait or arise from environmental factors such as social learning (Fillingim, 2015; Trost et al., 2015). Stone et al., (2018) observed that adolescents with chronic pain displayed social learning of pain catastrophizing through observing their catastrophizing primary caregivers who were also experiencing chronic pain (Stone et al., 2018). Attention towards sensory input, is magnified in individuals who exhibit pain catastrophizing and results in an enhanced pain sensitivity (Ellingson et al., 2018).

Heightened attention (resulting from catastrophic thinking) towards salient stimuli increases activity within the brain areas responsible for sensory awareness of noxious stimuli (somatosensory cortex, insula and ACC) and reduces descending pain inhibition (Legrain et al., 2012; Ellingson et al., 2018). For example, Carriere et al. (2019) and Ellingson et al. (2018) both determined that a direct relationship exists between catastrophic thinking and an increased pain perception, amongst participants experiencing chronic pain. Equally, distraction reduces ones attention and expectedly, activity in these areas (somatosensory cortex, insula and ACC) decreases along with pain perception (DeCharms et al., 2005; Abramov et al., 2009; Wiech, 2016). Therefore, patients exhibiting pain catastrophizing are susceptible to the pain reduction effects mediated by distraction (Schreiber et al., 2014). The expectation has the capacity to increase pain perception (Rossettini, Carlino and Testa, 2018).

Expectation relies upon the body of knowledge and beliefs a person has towards pain which develops over time through experience and learning (Fabbro and Crescentini, 2014). The anticipation of pain increases activity within the ACC, insula and reduces the function of descending inhibitory pathways (Moseley and Arntz, 2007; Bushnell, Čeko and Low, 2013; Testa and Rossettini, 2016; Bartels et al., 2017; Blasini et al., 2017). In an experimental brain imaging study by Vase et al. (2012) non-painful stimuli were found to enhance activity within brain areas responsible for attention and negative expectation amongst patients with phantom limb pain that display pain catastrophizing. The meaning of chronic pain varies between individuals and if a person feels they have limited control over their pain experience, the expectation of pain will cause them to

experience a higher level of suffering through disability rather than increase in pain intensity (Touche et al., 2019). Comparatively, people who have high levels of self-efficacy, are cognitively better equipped to confront difficult challenges and achieve a desired outcome (Söderlund, Sandborgh and Johansson, 2017). Pain intensity can also be mediated by mood.

Negative emotion catalyses the process of nociception into a pain experience through its influence upon behaviour (Puglisi-Allegra and Ventura, 2012). Furthermore, the pain catastrophizing constructs of rumination and magnification increase activity within the prefrontal cortex that is involved in assigning the threat value to a noxious stimulus which evokes emotional distress including anxiety, depression, worry and fear (Sarter, Gehring and Kozak, 2006). Catastrophizing is a predictor for the development of depression and anxiety (Noëssl et al., 2012; Chan, Chan and Kwok, 2014). Increased activity within the nociceptive areas of the insula, anterior cingulate cortex (ACC), prefrontal cortex and amygdala have been noted during a state of negative emotion, particularly anxiety and pain catastrophizing (Jones et al., 2012). Furthermore, the pre-existence of a negative emotional state, such as depression amongst individuals with chronic pain, can compound the decreased function of descending inhibitory pain modulation (Ghoneim and O'Hara, 2016; Feingold et al., 2017). In addition, a negative mood mediated by catastrophizing alone can impair an individual's ability to engage socially (Wood et al., 2016; Fernandes, Davidson and Guthrie, 2018).

Catastrophizing can serve as a coping behaviour to elicit social support (Sullivan et al., 2001). According to the communal coping model of catastrophizing theory, the display of exaggerated pain behaviours reflects a helplessness to cope and an attempt to gain social support to reducing suffering (Sullivan, 2012). However, when catastrophic thoughts are out of proportion to the context of the threat, this strategy is less effective as unrealistic demands placed upon family members, spouses or partners can exhaust their capability to assist, validate and be empathetic (Lackner and Gurtman, 2004; Manczak, DeLongis and Chen, 2016). Social support, as long as it promotes functional independence, is necessary to ameliorate the impact chronic pain has upon an individual's quality of life (Jensen et al., 2011).

The impact of pain catastrophizing upon diverse population groups in predicting pain and reduced satisfaction with life, has been extensively researched (Marshall, Schabrun and Knox, 2017; Furrer et al., 2019; Martinez-Calderon et al., 2019). Pain catastrophizing influences pain and negative outcomes through its impact upon coping

behaviour (fear avoidance behaviour) as identified in the fear avoidance model of pain by Vlaeyen, Crombez and Linton (2016).

2.5.2 Fear Avoidance Behaviour

Coping with chronic pain is the combination of thinking a certain way and adopting various behaviours to function in all spheres of life. Coping responses towards chronic pain are dynamic and context specific and may include guarding/fear avoidance, resting, activity persistence, seeking support, coping self-statements, distraction techniques or reinterpreting pain sensations (Sharma et al., 2020). Fear avoidance behaviour hinders recovery and perpetuates the cycle of chronic pain (Benyon et al., 2010; Vlaeyen, Crombez and Linton, 2016). Not all chronic pain sufferers display maladaptive fear avoidance behaviour. Cresswell, Galantino and Myezwa (2020) noted a 25.5% prevalence of fear avoidance behaviour amongst patients with chronic neck pain attending outpatient physiotherapy treatment in South Africa. There is a lack of available evidence to compare this study to.

Lethem et al. (1982) first described fear avoidance behaviour in patients with chronic low back pain. He theorized that a fear of pain resulted in avoidance behaviour towards physical activities and caused an increase in pain perception (Lethem et al., 1983). Kori et al. (1991) later defined a similar construct of kinesiophobia where individuals with chronic pain experienced an "excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury". The cognitive-behavioural fear-avoidance model, more recently termed the fear avoidance model of pain, suggests when a person has catastrophic interpretations of a painful experience and deems it threatening, pain related fear and avoidance behaviour ensues as a maladaptive way of coping with pain (Vlaeyen et al., 1995; Zale et al., 2013; Vlaeyen, Crombez and Linton, 2016). This theory is helpful in understanding why acute pain can transition into chronic pain: In certain individuals, the fear of pain is more potent than the pain itself thus, the persistent maladaptive avoidant behaviour towards innocuous activities or situations perpetuates the pain cycle beyond healing (Crombez et al., 1999). The neurobiological basis for fear avoidance behaviour involves emotional dysregulation towards incoming sensory input (Navarini and De Monte, 2019).

The alterations in emotional regulation of pain amongst chronic pain sufferers increases pain perception and interferes with cognitive functions (Moriarty et al., 2017). Altered amygdala function, is associated with in fear avoidance beliefs and the storage

of pain memories (Wilcox et al., 2016). The amygdala assigns a fearful emotion to pain and through its connections with the anterior cingulate cortex (ACC) and prefrontal regions, it is able to increase pain perception and reduce descending inhibitory pain control at the spinal cord level (Meier et al., 2015). The importance of identifying patients with avoidance behaviour has been shown to be of importance in predicting disability in primary chronic pain states (Vlaeyen and Linton, 2000; Nijs et al., 2013).

Avoidant behaviour negatively impacts the pursuit of a meaningful existence as it leads to inactivity, physical deconditioning, depression, social isolation and disability (Wertli, Rasmussen-Barr, Weiser, et al., 2014a; Marshall, Schabrun and Knox, 2017). Although there is a need for more longitudinal studies to confirm this long term association, Kamper et al., (2012) found the fear avoidance model to be a reliable explanation for pain and disability amongst people with whiplash associated disorders after six months (Zale et al., 2013; Marshall, Schabrun and Knox, 2017; Luthi et al., 2018). Interestingly, fear avoidance behaviour does not always foster a negative outcome as demonstrated in a retrospective study by Riley, Bialosky and Coronado (2020). These researchers identified that an improvement in function was related to an enhanced self-efficacy rather than a reduction in fear avoidance behaviour. However, numerous studies have confirmed that individuals displaying high levels of pain catastrophizing have stronger fear avoidance beliefs that directly worsen function and mood (Wertli, Eugster, et al., 2014; Wertli, Rasmussen-Barr, Held, et al., 2014).

Chronic pain influences behaviour through its effect upon emotions and thoughts. Coping is a predictor of emotional distress, pain perception, and disability. Catastrophizing and fear avoidance behaviour are important factors to identify amongst individuals with chronic pain in order to provide the appropriate management strategy, because of their influence upon pain intensity and pain related disability (Edwards et al., 2016). Optimising cognitive reappraisal of sensory input and emotional regulation towards a pain experience are necessary components in addressing the suffering of individuals with chronic pain (Eccleston, Hearn and Williams, 2015; Hagger et al., 2017).

2.6 THE MANAGEMENT OF CHRONIC PAIN

The effective management of chronic pain requires a thorough biopsychosocial evaluation within an interdisciplinary patient centred approach to assist patients in adjusting to all areas of function in their lives (Turk et al., 2009; Simons, Elman and

Borsook, 2014). An interdisciplinary team comprising of the patient, family and doctor and rehabilitation team should provide complementary skills and services to foster a patient centred approach (Jelsma, Mkoka and Amosun, 2008; Turk et al., 2009; Parker and Madden, 2020).

Pharmacological interventions partially lessen pain intensity by addressing peripheral and central sensitization changes involved in chronic pain (Woolf, 2020). Furthermore, invasive surgeries, such as rhizotomies, have shown some limited use in reducing nociceptive inputs (Smith et al., 2016). However, the provision of effective psychological interventions is a pivotal aspect in chronic pain management particularly amongst individuals that display catastrophizing and fear avoidance behaviour (Williams et al., 2020). Due to the neuroplasticity of the brain, the functional changes involved in chronic pain are partly reversible and suggests opportunities to modulate and manipulate the body through interventions of the mind (Nijs et al., 2018). Psychological therapies to reduce pain, distress and disability are complex and not fully understood. Therefore, there exist many types of theoretical frameworks to address maladaptive cognitions and behaviours. CBT is the most widely prescribed psychological intervention for chronic pain, albeit a paucity of convincing research (Bernardy et al., 2013; Williams et al., 2020).

2.6.1 Cognitive Behavioural Therapy

Cognitive behavioural therapy addresses cognitively mediated dysfunctional behaviour and has been extensively researched over the past 40 years across a wide variety of psychological disorders including depression, panic disorder, social phobia and obsessive compulsive disorder (Hollon and Beck, 1994; Dobson and Dozois, 2010). It is thought to be helpful in empowering individuals to learn long term skills in modifying thinking patterns to enable healthier behaviours (Williams et al., 2020).

Cognitive behavioural therapy is a first line psychological treatment for chronic pain as its approach addresses emotional distress, cognitive appraisal, behaviour and social functioning which appears wholly appropriate for individuals suffering with chronic pain (Ehde, Dillworth and Turner, 2014). There is a considerable amount of low quality literature supporting the efficacy of CBT over a wide variety of pain syndromes including fibromyalgia, chronic low back pain, rheumatoid arthritis, or mixed chronic pain in reducing pain, emotional distress and disability and across a variety of differing populations (children and adolescents and older adults) (Palermo et al., 2009; Bernardy et al., 2013; Monticone et al., 2015; Prothero et al., 2018; Williams et al.,

2020). In 2012, Jensen et al. demonstrated that CBT increases activity within the prefrontal cortex areas of the brain resulting in an enhanced cognitive function, reduced pain perception, anxiety, and depression amongst participants experiencing fibromyalgia. Despite CBT being a safe treatment for various chronic pain conditions, repeated systematic reviews have shown its effect size upon emotional distress, cognitive reappraisal and disability to be low (Butler et al., 2006; Williams, Eccleston and Morley, 2012; Eccleston, Hearn and Williams, 2014, 2015). Baez, Hoch and Hoch (2018) reviewed five high quality studies that addressed fear avoidance beliefs amongst participants with acute, subacute or chronic low back pain using CBT and found its effect small and only if treatment was personalized. The necessity of a psychological intervention for patients experiencing chronic pain cannot be argued, however the superiority of CBT over other psychological therapies is less apparent and contentious.

A current review of psychological treatments for chronic pain comparing studies that investigated the benefit of CBT over Acceptance and Commitment therapy showed there was no difference in the treatment outcomes of pain reduction and disability for either therapy after a six month follow up (Williams et al., 2020). The preoperative delivery of CBT to patients undergoing a total hip replacement that displayed catastrophizing, showed no effect upon pain compared to the randomized control group that received usual care (Birch et al., 2020). Moreover, the modifiable nature of pain catastrophizing that arises situationally has been shown to not necessarily require a formalized psychological intervention for it to reduce. For instance, Clarke et al. (2013), found a reduction in preoperative pain catastrophizing amongst patients awaiting surgery following the administration of gabapentin (anxiolytic drug). Anxiety and catastrophizing are related constructs and this effect is therefore likely to be indirect (Sullivan, Bishop and Pivik, 1995). Furthermore, the accessibility of CBT to all patient populations is limited and therefore, the rigid reliance upon formalized psychological interventions needs to be reconsidered (Ehde, Dillworth and Turner, 2014). The standard delivery of CBT by psychologists requires doctorate level training thus, its integration into an interdisciplinary framework is not always available (Davey, 2016).

Cognitive behavioural therapy aims to positively influence a negative pathology model by addressing the maladaptive cognitions (catastrophizing) and behaviours (fear avoidance behaviour). However, the available evidence does not imply it is superior to other therapies. An alternative psychology that focuses rather on identifying and

encouraging positive aspects of human life rather than negative pathological origins is positive psychology.

2.6.2 Positive Psychology

In 1998, Martin Seligman introduced positive psychology as the “scientific study of optimal human functioning that aims to discover and promote the factors that allow individuals and communities to thrive” (Seligman and Csikszentmihalyi, 2000). The focus of positive psychology is on emotional and social wellbeing and life satisfaction rather than addressing maladaptive cognitions as in CBT.

Wellbeing is subjective and according to positive psychology, it embodies having positive emotions and good relationships with people, while finding meaning in one’s existence and a sense of accomplishment in the pursuit of ones goals (Park, Peterson and Seligman, 2004). Positive psychology interventions provide an opportunity to cultivate well-being through sensory experiences (for example, a savouring activity where one mindfully focusing ones attention on a specific positive sensory experience to prolong its pleasurable effects), social interactions (for example, acts or activities of kindness or expressing gratitude towards others activities) or cognitive experiences (for example, optimism activities where one thinks about the future in a positive light and writes down positive expectations) (Parks and Titova, 2016). These interventions are evidence based which differentiates them from “positive thinking” (Biswas-diener and Parks, 2014). Additionally, the application of positive psychology interventions are often straightforward, requiring minimal provider training and have been shown to be of benefit amongst various populations of people (Seligman and Csikszentmihalyi, 2000; Wood and Tarrier, 2010; Flink et al., 2015). For example, Wellenzohn, Proyer and Ruch (2016) found that humour based interventions improved measures of happiness amongst healthy participants in a six month long randomized control study. Similarly, participants using kindness and gratitude based interventions showed enhanced satisfaction levels with their relationships as noted by O’Connell, O’Shea and Gallagher (2016) in their randomized control trial. The cultivation of positive emotions such as happiness, hope or gratitude predict wellbeing just as negative emotions such as fear and anxiety predict suffering (Ferris et al., 2019; Olsman, 2020).

Ill health can often reduce well-being. Meta-analysis studies have established that positive psychology interventions are a helpful treatment strategy for individuals with depression, anxiety and emotional distress symptoms (Bolier et al., 2013; Carr et al., 2020). The subjective experience of well-being has a bidirectional relationship with

physical illness (Lamers et al., 2012; Bolier et al., 2013). For example, individuals with cardiac disease that display negative affective states (such as depression and anxiety) have a significant risk ($p<0.001$) of a reduced lifespan (Rasmussen, Scheier and Greenhouse, 2009). A randomized control study of 55 participants with heart disease that attended six weekly 90 minute sessions of individual positive psychology treatment showed improvements in happiness, depression and hope compared to the control participants that received usual care (no psychological intervention) (Nikrahan et al., 2016). In the context of chronic pain, there is growing research exploring the use of positive psychology.

Positive psychology fosters positive emotion which has been shown to ameliorate maladaptive cognitions and emotional responses towards pain thus promoting active participation in chronic pain self-management (Finan and Garland, 2015). Resilience to chronic pain is thought to be achieved through improving positive influential psychosocial factors (Hassett and Finan, 2016). Individuals who display high levels of resilience, report greater positive emotions and exhibit less day-to-day pain catastrophizing compared with individuals with low levels of resilience (Ong, Zautra and Reid, 2010). Flink et al. (2015) found that an individual hour-long session of positive psychology conducted weekly with a psychologist with home-based activities, had a modest positive effect on most of the participants in reducing disability and catastrophizing. Similar positive results of positive psychology for chronic pain patients were achieved via an online intervention by Müller et al. (2016), demonstrating the ease at which positive psychology interventions can be administered. The cultivation of positive emotions can encourage certain helpful behaviours. For example, Boselie et al. (2014) noted in an experimental study that optimism improved the executive task performance amongst participants with chronic pain. This suggests that positive emotion improves the cognitive ability for this population to self-regulate their behaviours. By developing positive psychological skills, it is hoped these patients will have a reduction in self-reported pain and an improvement in function. Positive psychology interventions however, have a low to moderate effect size and do not benefit everyone (Carr et al., 2020).

A study by Sergeant and Mongrain (2011) found positive psychology interventions for people with depression that displayed needy behaviour, were not beneficial and negatively impacted their self-reported measure of self-esteem. Individual differences amongst people can determine a response towards a particular intervention. For example, motivation to engage and follow through with a chosen intervention is not

always guaranteed as it varies amongst people. Therefore, identifying whether a certain intervention will be appropriate for each individual is necessary to establish. Similarly, different people possess different degrees of positive character strengths that can influence different behaviours (Carr et al., 2020).

Positive psychology interventions that identify, develop and promote the use of one's positive character traits to achieve well-being in the context of chronic illness and rehabilitation is an area of growing interest (Macaskill, 2016). Savouring and mindfulness (positive psychology interventions) has been shown, amongst healthy individuals, to enhance and directs one's ability to develop positive character traits as it provides a clarity towards current experiences, emotional states and ultimately awareness of oneself (Brown and Ryan, 2003; Wolever et al., 2012; Sharma and Dewangan, 2017). Moreover, mindfulness and the development of awareness of oneself is linked to Melzack Neuromatrix theory (Melzack, 2001). Neural networks generate patterns of nerve impulses that create the subjective perception of one's self and our actions. Therefore, developing one's ability of awareness, can reduce pain perception as pain is a conscious sensation (Moseley, 2007). A review of neuroimaging studies on pain by Martucci and MacKey (2018) concluded that a mindfulness practice not only reduces pain, as seen by a reduction in activity in the anterior cingulate cortex and anterior insula, but also reduces activity in the prefrontal cortex (an area considered to be responsible for pain catastrophizing). Verhiel et al., (2019) found that the presence of mindfulness was associated with a less reported physical impairments amongst individuals attending an upper limb orthopaedic clinic. Positive psychology interventions that develop positive character strengths can be helpful in modifying behaviour.

Positive character strengths can be defined as inherent capacities in individuals that allow them to behave, think or feel in ways that optimize function and performance in the pursuit of valued goals (Macaskill, 2016). Park, Peterson and Seligman (2004) identified 24-character strengths that when combined present six virtues of wisdom, courage, humanity, justice, temperance, and emotional transcendence. In 2016, Kim et al. further identified emotional transcendence, practical wisdom, integrity, courage and commitment to action as useful positive character resources that contribute towards a resilient mind-set for patients facing the adversity of chronic illness or disability.

Emotional Transcendence

Emotional transcendence is a measure of one's ability to be "religious, spiritual, thankful, grateful, optimistic, enthusiastic, energetic, forgiving, caring, affectionate, loving, believing life has meaning and admiring beauty" (Kim et al., 2016). The reinterpretation of pain within a spiritual context provides patients with the ability to detach emotional significance from their pain experience, thus reducing the pain intensity (D'Souza and Astrow, 2020). In addition, individuals who are religious or spiritual are more likely to experience psychological wellbeing due to the positive strategies that they employ in their daily life (such as praying and seeking spiritual support) (Dedeli and Kaptan, 2013). However, certain individuals pain may worsen due to their religious or spiritual beliefs as they may experience feelings of anger or disappointment towards their deity in response to a painful experience (Exline, Krause and Broer, 2016). Overall, spirituality plays an important role in the adopting positive coping behaviours in the face of chronic illness (D'Souza and Astrow, 2020). There are barriers in implementing spirituality into healthcare as it is delicate and complex in nature, and varies across cultures and races. However a systematic review by Lee et al. (2020) found interventions that enhance social, emotional and spiritual components of wisdom beneficial amongst people with physical illness. The specific construct of implementing the spiritual and development of emotional transcendence requires further research in the chronic pain context.

Courage

Courage in rehabilitation requires being commanding, bold, leading and brave (Kim et al., 2016). The uncertainty and vulnerability that is associated with chronic pain, requires individual courage to pursue valued goals in spite of fear and anxiety (Sachs et al., 2013). Goal setting in chronic pain management is an integral part of pain management (see subsection: 2.6.3 The Role of Physiotherapy in Chronic Pain Management, p40). The character strength of courage is related to rational thought and consistent behaviour necessary to counteract maladaptive fear (Navarini and De Monte, 2019). In the context of chronic pain, it requires individuals displaying pain catastrophizing and fear avoidance behaviour to confront unhelpful emotions, behaviours, relationships and thoughts in order to overcome adversity and improve self-regulatory strategies (Vlaeyen and Linton, 2000). There are no studies demonstrating the fostering of courage upon fear avoidance behaviour in chronic pain. Although Chockalingam and Norton (2019) found courageous participants, that were fearful of spiders, were able to reduce their fear avoidance behaviours if they had an important task to complete. These results reiterate the malleable nature of behaviour when it is in synchrony with one's values.

Integrity

Integrity embodies being “careful, cautious, prudent, sensible, self-controlled, loyal, honest, trustworthy, modest, humble and fair” (Kim et al., 2016). These skills are helpful in developing healthy interpersonal relationships which is a necessary part of the biopsychosocial model (Che et al., 2018). Healthy social support is a useful coping skill for patients with chronic pain, particularly individuals that possess catastrophic thoughts (Gauthier et al., 2012). Integrity further fosters consistency and commitment towards the pursuit of valued goals required in rehabilitation (Kim et al., 2016). An employer that creates a positive work environment with integrity and mentorship, a sense of belonging, trust and encouragement promotes employees to cultivate positive emotions and traits (Kannan-Narasimhan and Lawrence, 2012).

Commitment to Action

Commitment to action represents the ability to accumulate helpful patterns of behaviour that move an individual toward valued life directions. It encompasses strengths of scholarship, persevering, persistent, hardworking, appreciating excellence and self-discipline to foster independence in managing adversities (Kim et al., 2016). Self-discipline mediates self-efficacy and is a key aspect of the self-regulation theory (Hagger et al., 2017). The ability to persevere with consistent goal directed action is helpful in achieving rehabilitation goals. According to the self-regulation theory, persistent behaviour is associated with higher functioning, however, misdirected persistent pain behaviours can worsen disability and wellbeing (a boom and bust cycle) (Bandura, 2004; Flink, Boersma and Linton, 2013). Ruehlman, Karoly and Enders (2012) found the majority of participants in their internet based self-management skills development study, had a reduction in pain severity, pain related interference, perceived burden and disability, catastrophizing and pain related fear. However, some of the participants did not benefit in these areas as they were unable to develop these self-management skills. Psychological flexibility allows individuals to disregard unhelpful pain behaviours, and practical wisdom is necessary to retain helpful pain behaviours (Lin et al., 2018; Kashdan et al., 2020).

Practical Wisdom

According to Kim et al. (2016) practical wisdom reflects being “open minded, receptive to new ideas, curious, inventive, creative, valuing equality, unbiased, light hearted, playful, humorous and funny”. It is correlated with courage (r=.03) and allows for good decision making and requires a comprehensive body of knowledge with self-reflection

as an essential component to facilitate positive life outcomes including, improved quality of life and resilience (Kim et al., 2016; Jeste et al., 2019). These psychological processes activate areas within the brain responsible for cognitive and emotional regulation including the prefrontal cortex, insula, amygdala, nucleus accumbens (Jeste et al., 2019). Age related changes within the brain that cause cognitive and sensory deficits have been shown to be accommodated for by an enhanced activity within the frontal areas of the brain, including the prefrontal cortex (Davis et al., 2008; Zhang, Lee and Qiu, 2017). This remarkable neuroplasticity of the brain has been associated with an enhanced capacity for wisdom as one gets older (Zhang, Lee and Qiu, 2017). Certain individuals experiencing chronic pain, that are able to cultivate wisdom in the face of adversity, experience a greater life satisfaction (Walsh, 2011). They display self-reflection and knowledge on the relationship between stress and pain, and adopt positive lifestyle behaviours such as physical activity, recreational activities and social engagements that reflect participation in all aspects of life (Walsh, 2011; Owens et al., 2016). An individual's identity is closely linked to life participation and the role it plays adds meaning and value to one's life. Lee et al., (2019) found the more wisdom a person possesses the less social isolation they will experience. This emphasizes the need for social integration to be developed amongst individuals with chronic pain. There is a need for more studies to investigate the applicability of wisdom fostering interventions in the general population as well as within the chronic pain populations (Kim et al., 2016; Sharma and Dewangan, 2017).

In chronic pain, it is necessary to be aware of patients psychosocial assets as well as their physical impairments (Nierenberg et al., 2016). Positive psychology provides a potential tool to assist individuals with chronic pain to adapt to their disability by enhancing wellbeing. Research of positive psychology interventions in chronic pain, although limited shows promising effects as an adjunctive tool in improving clinical outcomes. It can also be helpful as part of a psychologically informed physiotherapy approach.

2.6.3 **The Role of Physiotherapy in Chronic Pain Management**

The role of physiotherapy in the management of chronic pain is rooted in the unhelpful biomedical model (França et al., 2019). Traditional physiotherapy assessment of patients experiencing chronic pain are not always reliable, as pain perception is not an accurate measure of tissue damage. The broader management focus should be on

optimizing quality of life rather than focusing on the tissue and eliminating pain. Therefore, a methodical, flexible and reflective assessment of all psychosocial factors is necessary to ensure all factors that contribute towards their pain experience are identified and explored. The deep-rooted physiotherapy interventions such as manual therapies that aim to primarily address physical impairments are not helpful for individuals experiencing chronic pain, as shown by Thomas et al., (2020) and Oliveira (2018). Manual therapy composes of passive skilled movements directed towards anatomical structures or systems to provide short term pain reduction and address physical impairments (joint hypomobility, muscle spasm) (Balthazard et al., 2012; Louw et al., 2017). It is only in the last 20 years with the increased appreciation of the biopsychosocial model that a shift has occurred in restructuring undergraduate programs with a psychosocial emphasis (Parker and Madden, 2020).

CBT and patient education mediate changes in unhelpful thoughts, emotions and behaviours. However, it is equally important for patients to cultivate acceptance of their situation, set realistic expectations of recovery and engage in helpful active coping behaviours (Forman et al., 2012; Plow et al., 2016; Cameron et al., 2018). Therefore, the implementation of self-management, a dynamic learning process that relies upon the development of knowledge and skills (problem solving, decision making, positive relationships and active coping behaviours) should be emphasized and supported by all members of the interprofessional team (Plow et al., 2016). Successful self-management of other chronic diseases (including diabetes, cancer and HIV) has been shown to reduce the burden of symptoms and utilization of healthcare through the development of psychological flexibility and, a set of beliefs and behaviours that engage and empower patients to be independent in the management of their health (Boger et al., 2015; Boucher et al., 2019; Almutairi, Hosseinzadeh and Gopaldasani, 2020).

Chronic pain cultivates suffering when an individual is unable to recruit helpful behaviours that reduce the stressful adversity of pain (Treede et al., 2019). Moreover, the self-regulation theory suggests that a person's behaviour is less motivated by pain relief and more by values and life goals (Hagger et al., 2017). Therefore, chronic pain can be perceived as a barrier towards attaining work-related goals, performing leisure activities or attending social engagements. Additionally, avoidant behaviour is a coping response to resolve the psychological discomfort of not being able to attain these valued goals (Hagger et al., 2017). The recognition of achieving a meaningful existence is encompassed within the biopsychosocial model and ICF model. Thus,

promoting self-efficacious behaviour that increases well-being, participation and function within society is the underlying theme of chronic pain management (Nugraha et al., 2019). Patients that believe their health is related to their own behaviours (internal locus of control) feel more responsible for their health and adopt helpful behaviours to cope with their illness (Strudler Wallston and Wallston, 1978). For example, Zuercher-Huerlimann et al. (2019) found chronic pain participants that displayed a high internal locus of control experienced a lower pain severity, reduced chronic opioid use and an increased physical function. An internal locus of control can predict a patient's engagement in self-management strategies as this type of belief set seeks information and learning (Jensen, Nielson and Kerns, 2003). Effective implementation of self-management requires an appreciation of a patients positive psychological resources (including resilience, self-efficacy and internal locus of control) (Jensen, Nielson and Kerns, 2003; Anderson et al., 2016; Du et al., 2017).

However, it has been acknowledged that not all people with chronic pain are candidates for the development of self-management strategies as certain individuals find it burdensome (Mair and May, 2014). These individuals often display an external health locus of control that recruits passive coping (fear avoidance behaviour) and often experience negative emotions such as depression, anger, anxiety, and heightened physical symptoms (Basinska and Andruszkiewicz, 2012). The aim is that this cohort should be the minority.

Psychologically informed physiotherapy (PIPT) was introduced by Main and George (2011) initially as a cognitive behavioural based strategy to incorporate helpful behavioural modification to prevent and manage chronic pain within the rehabilitation setting. It requires compassion and enables a patient centred approach that empowers the patients to determine their course of their rehabilitation guided by the physiotherapist (Coronado et al., 2020). To date, various methods of PIPT have been explored and include graded exposure or activity, cognitive behavioural based physiotherapy, acceptance and commitment based physiotherapy, and internet based psychological programs with physiotherapy (Coronado et al., 2020). Guerrero et al. (2018) and Wilson and Cramp (2018) concluded, in their systematic reviews that psychological interventions delivered by physiotherapists have a small, but significant, effect on improving both physical and psychological health for patients with chronic pain compared to standard physiotherapy care.

There have been no studies to our knowledge of physiotherapists exploring positive character traits in patients with chronic pain. However Hill et al. (2017) demonstrated that mindfulness, a positive psychology tool, shows promise in reducing emotional distress and heightening self-compassion amongst participants with chronic pain. Mindfulness provides an opportunity for cognitive reappraisal towards a perceived threat from ones environment and has been shown to reduce fear avoidant behaviour amongst individuals experiencing chronic pain (Vago and Nakamura, 2011). Techniques including mindful walking, mindful eating, sitting meditation, body scan and yoga are easy to implement as it requires minimal training on the physiotherapist's part and it allows patients that are resistant to formalised psychological therapies to benefit from informal psychological interventions. Furrer et al., (2019) found the application of positive psychology interventions in a physiotherapy setting resulted in an enhanced subjective wellbeing and a reduction in perceived disability amongst chronic pain participants diagnosed with spinal cord injury, multiple sclerosis, neuromuscular disease, or post-polio syndrome. Exploring a patients unique positive character traits may further augment the potential for successful self-management (Plow et al., 2016). All helpful psychologically informed approaches requires a therapeutic alliance and requires effective communication between the healthcare provider and patient (Pinto et al., 2012; Hutting et al., 2019).

Therapeutic alliance between the patient and physiotherapist is a powerful placebo and modulator of a pain experience. The potential to utilise a patients inherent resources to optimize treatment outcomes through placebo, has been identified by Testa and Rossettini (2016) and Rossettini, Carlino and Testa (2018). These researchers noted that by establishing positive psychosocial context for patient-physiotherapist interaction, treatment outcome is optimized. Neural networks within the endogenous analgesic areas of the brain have been shown to increase activity following the implementation of a positive healthcare interaction context (Wager et al., 2004; Fuentes et al., 2014; Testa and Rossettini, 2016). A randomized control study by Ferreira et al., 2013 of 182 patients experiencing chronic low back pain, demonstrated that establishing therapeutic alliance (sense of collaboration, warmth, and support between the patients and therapist) was a positive predictor for improved outcomes (patient satisfaction, reduced pain and disability and improved function). South Africa, is a multi-linguistic population therefore, communication and the establishment of therapeutic alliance is challenged as the majority of healthcare interactions are not conducted in the patients first language (Nortjé and Albertyn,

2015). Communication skills are further necessary for effective implementation of educational strategies such as Pain Neuroscience Education (PNE).

The body of knowledge on the efficacy of educational interventions, such as PNE, in decreasing pain, catastrophic thinking, fear avoidance behaviour, and quality of life, is expanding rapidly (Louw et al., 2016; Adriaan Louw et al., 2016; Louw et al., 2019; Watson et al., 2019). PNE is a psychologically informed approach as it reconceptualize unhelpful pain beliefs to empower active participation in an individual's self-management (Parker and Madden, 2020). For example, a randomized controlled study on preoperative pain neuroscience education (PNE) for lumbar radiculopathy with a 3 year follow up by Louw et al., (2016) showed the intervention group had a 37% reduction in seeking healthcare. Pain neuroscience education aims to empower patients with a greater understanding of the neurobiology and neurophysiology of pain mechanisms and the effect psychosocial factors have upon their pain experience (Louw et al., 2011). Pain neuroscience education is further enhanced by providing movement strategies for patients (Blickenstaff and Pearson, 2016). Physiotherapists are skilled in prescribing useful movement strategies that aim to alter maladaptive pain response behaviours (Stenner et al., 2016). These include, for example, graded exposure to movements or activities that evoke fear of pain (George et al., 2010). Activity pacing is another useful behaviour modifying movement strategy equipping and empowering patients with the necessary skills needed to complete activities in the face of pain (Scott-Dempster et al., 2014). In order for physiotherapists to be effective in implementing these treatment strategies, communication and listening skills as well as understanding the psychosocial factors impacting each individual patient need to be addressed (Wilson et al., 2017).

Exercise is medicine for pain (Nijs et al., 2015). Physiotherapists are trained in exercise prescription which can improve various physical and mental health domains including stress, mood, sleep, sexual health, muscle strength, aerobic capacity and reduce pain severity amongst many different kinds of chronic pain conditions (Polaski et al., 2019; Vaegter and Jones, 2020). Exercise induced analgesia (EIH) causes changes within the brain, spinal cord, immune system to prevent and reduce pain (Lesnak and Sluka, 2020). Owen et al. (2020) identified Pilates, stabilisation/motor control and aerobic exercise the most helpful in reducing pain amongst adults experiencing chronic low back pain. In addition, Lesnak and Sluka, (2020) noted the analgaesic benefits of running, swimming and resistance training within animal studies. It is a challenge to accurately determine the appropriate dose (type of exercise, time, frequency, duration)

of exercise therapy for each individual patient as there is a lack of explicit evidence to apply (Geneen et al., 2017; Polaski et al., 2019). The wide variation amongst individuals requires a sensible graded approach to exercise prescription and adjust the dosage parameters according to the individual needs of the patient. For example, individuals with that display fear avoidance require additional counselling and education to engage in exercise therapy (Booth et al., 2017; Geneen et al., 2017). Graded activity or exposure directly addresses fearful cognitions towards movement gradually in a goal directed and collaborative manner (Coronado et al., 2020). Furthermore, Izquierdo-Alventosa et al. (2020) that found low intensity exercise reduced catastrophizing amongst participants with fibromyalgia. This was likely due to the distraction from pain and reduction in rumination that exercise provides for individuals experiencing chronic pain (Puterman et al., 2011). Comparatively, Lazaridou et al. (2020) showed individuals with fibromyalgia that display catastrophizing, displayed an increased pain intensity after partaking in physical activity. This study reiterates the need not only to determine appropriate dosage guideline but to appreciate psychosocial factors such as mood and cognition when prescribing physical treatment modalities such as exercise. Therefore, exercise therapy in combination with other psychological therapies has additional benefits.

Physiotherapy has the potential to play a larger role in the management of chronic pain if strides towards a patient centred approach is taken. The biopsychosocial model has allowed physiotherapists to incorporate traditional exercise prescription with PNE and psychological approaches. The psychological component is in its early stages of establishing itself as a necessary tool in the physiotherapist's role on chronic pain management.

CHAPTER 3

3. METHODOLOGY

This chapter shows how demographic information, positive character traits, fear avoidance and pain catastrophizing behaviour were measured amongst participants experiencing chronic pain.

3.1 TYPE OF STUDY

This study involved collection of information during one point in time to determine whether patients with chronic pain display positive character traits (emotional transcendence, integrity, courage, commitment to action and practical wisdom). In addition, the association of fear avoidance and/or pain catastrophizing behaviour needs to be established. Therefore, a quantitative, cross sectional, correlational study design was implemented using self-reporting questionnaires. Participants were sampled sequentially.

3.2 PARTICIPANTS

3.2.1 Source of Participants

Participants were recruited from a private outpatient physiotherapy practice in Randburg and the Helen Joseph Pain Clinic (HJPC) in Johannesburg. It was decided to source participants for this study from medical or physiotherapy practices that largely see chronic pain patients for chronic pain management.

It was initially planned for HJPC to be the only data collection site. However, following the pilot study, it was found there was a lack of English-speaking patients at the HJPC. It was therefore decided to include an additional data collection site.

We approached a medical practice located within Donald Gordon Medical Institute (DGMI). Despite obtaining approval from DGMI management, it was difficult to recruit patients due to personal issues. Therefore, a second medical practice located within Olivedale Netcare hospital was approached as an alternative data collection site. The medical practice provided verbal and written approval for us recruit patients from their practice into our study, however I struggled to get approval from the Netcare management group. Thus, after six months of continuous follow-up to no avail, I approached a private outpatient physiotherapy practice in Randburg that granted me approval to recruit patients from their practice into my study.

3.2.2 Sample Size and Selection

The sample size was calculated using a population-based size calculator, based on a sample of convenience of English-speaking people. There were approximately 20 English speaking patients attending the HJPC monthly and approximately 20 English speaking patients attending a private physiotherapy practice in Randburg, Johannesburg. Therefore, the total population per month comprised of 40 patients. Using a population-based sample size calculator, the following sample size was obtained: Sample size= 37 (Confidence Interval 95%, standard deviation at 5 %) (Appendix 1)

3.2.3 **Inclusion Criteria**

Males and female patients experiencing continuous pain for a minimum of 3 months were included in the study. In addition, they needed to be between the ages of 18 and 80 years with and speak English[1] as their home language.

3.2.4 **Exclusion Criteria**

Patients with documented primary psychiatric disorders (Schizophrenia, Bipolar disorder, Autism, Dementia, Attention deficit/Hyperactivity disorder) were excluded from the study, as well as patients who were unable to independently complete questionnaires.

3.3 **INSTRUMENTATION AND OUTCOME MEASURES**

The following instruments were used to gather data:

3.3.1 **A Self-developed Demographics Questionnaire** (Appendix 3)

Basic demographic data was required; therefore, a simple self-developed demographics questionnaire was designed. This determined age, gender, first language, highest level of education, dependents and type of chronic pain. Types of chronic pain was based upon the IASP's classification of chronic pain (Bond *et al.*, 2019).

3.3.2 **The Adapted Inventory of Virtues and Strengths Tool** (Kim *et al.*, 2016) (Appendix 4)

[1] The AIVS tool (the tool uses to gather data in this study) is a new tool and has not yet been translated into any other South African home languages yet.

The Adapted Inventory of Virtues and Strengths tool (AIVS) is a new tool in identifying positive character traits in patients within the rehabilitation setting of chronic illness and disease (Kim et al., 2016). It has not been used in the context of chronic pain before. This psychometrically sound tool was developed to measure positive character traits in patients with chronic disability. It is a semantic differential scale consisting of five factors: Emotional Transcendence, Courage, Practical Wisdom, Integrity and Commitment to Action. Each of the five factors have been identified as positive character strengths that can be useful for patients with chronic illness and disability. They can each be harnessed in a rehabilitation setting to help achieve psychosocial adaptation. There are in total 46 item pairs of opposing adjectives each describing the meaning of a factor (positive character trait). Patients place a mark on the numeric scale ranging from 1-7, closest to the word that best describes them. Subgroup scores are then calculated and interpreted. A higher the score on each item indicates a more positive self-perception on the associated character strength. Descriptive analysis, exploratory factor analysis, item total correlation, bivariate correlational analysis and simultaneous multiple regression analysis were used to establish the validity and reliability. Reliability and internal consistency were found to be within acceptable coefficient alpha ranges of 0.77 to 0.84 for each subscale: Emotional Transcendence (α=.84), Integrity (α=.78), Commitment to Action (α=.78), Practical Wisdom (α=.78) and Courage (α=.77). Expert panellists were recruited to develop, review and categorize the items. Multiple and cross over review systems provided sufficient content and face validity measures. The AIVS tool was correlated with outcome measures (the Sense of Well-Being-Revised (SWBI-R), Connor-Davidson Resilience Scale (CD-RISC) and the Satisfaction with Life Scale (SWLS) to establish its construct validity. Emotional Transcendence and Commitment to Action were found to be moderately and statistically significant in predicting life satisfaction and wellbeing ($p< 0.01$) when correlated with the SWLS and SWBI-R. Furthermore, through simultaneous multiple regression analysis, the AIVS subscales of Emotional Transcendence, Courage and Commitment to Action significantly predict one's resilience therefore establishing criterion validity ($F=80.15$, $p<0.00$ with an adjusted $R^2= 0.608$) (Kim et al., 2016).

In this study, the AIVS tool was used in its original English format.

3.3.3 **The Pain Catastrophizing Scale** (Sullivan, Bishop and Pivik, 1995) (Appendix 5)

The Pain Catastrophizing Scale is a valid and reliable tool to assess catastrophic thinking related to pain. It has 13 items with a 5-point scale ranging from 0 (not at all)

to 4 (all the time). It yields a total score and three subscale scores to assess rumination, magnification and helplessness. The PCS total score is calculated by adding the scores from each item together, which ranges from 0 – 52. The total and subscale scores are interpreted using a table (Appendix 6) provided in the PCS manual. The minimum total a person can score to represent a significant level of catastrophizing would be 30 points. The minimum significant subscale scores for rumination, magnification and helplessness are 5, 11 and 13 respectively. Test-retest reliability (ICC=0.81) and interrater reliability (ICC=0.77) has been shown to be excellent. It has shown adequate to excellent internal consistency (coefficient alphas: total PCS=0.87, rumination= 0.87, magnification= 0.66 and helplessness= 0.78). It demonstrates excellent validity when correlated with the Inventory of Negative Thoughts in Response to Pain tool ($p<0.01$).

3.3.4 **The Tampa Kinesiophobia Scale-17** (Miller, Kori and Todd, 1991) (Appendix 7)

The Tampa Kinesiophobia Scale (TSK) is a reliable tool with a strong construct validity in assessing fear avoidance behaviour. It has an acceptable to high internal consistency (Cronbach alpha, 0.74-0.87) and a moderate test-retest reliability (ICCr=0.747). It is a 17-item scale with four options: “strongly agree” scores four points, “strongly disagree” scores one point. The total score ranges between 17 and 68 points. The higher the score, the higher the fear avoidant behaviour. According to Vlaeyen et al., (1995), a score of 37 or above indicated clinically significant levels of fear avoidance behaviour.

3.4 PROCEDURE

3.4.1 Pilot Study

The pilot study was conducted once ethical clearance was obtained. The aim of the pilot study was to test the feasibility and procedure of the main study. The researcher recruited five participants in one morning from the HJPC [2] that was held weekly. The researcher was available to answer any questions from the participants before during and after data collection. Only two questionnaires were completed. The other three participants experienced difficulty in completing the questionnaires as the AIVS required a high level of English language literacy to comprehend. Moreover, there was a lack of English-speaking patients at the HJPC. We were concerned that the use of a translator would compromise the validity of the AIVs tool so it was decided that an

[2] An additional study site was sought due to the poor recruitment at Helen Joseph Hospital as a result of the AIVS tool being difficult to understand amongst English speaking participants.

additional data collection site be included into the study. Following ethical clearance (Appendix 8), two physiotherapists at a private physiotherapy practice in Johannesburg were trained as research assistants by the researcher. Training included how to clarify the various pain aetiologies and the various items or words in the demographic's questionnaire as well in the AIVS, TSK and PCS tools. Refusal to partake in the study did not impact the physiotherapy treatment received. The research assistants recruited two participants. All participants were given an information letter (Appendix 2) which clearly outlines the purpose of the study. Completed questionnaires were considered consent to participate in the study. Completed questionnaires were deposited in a box by the research assistants. At the end of each week the researcher would collect the completed questionnaires and file in a locked cabinet after the data was captured.

3.4.2 **Main Study**

The physiotherapists at the private practice in the Johannesburg area continued from the pilot study as research assistants for the main study. The physiotherapist from HJPC was invited to be trained as a research assistant by the researcher. Training of the research assistant followed the same procedure as outlined in the pilot study above. As the research assistant at each site was also the participant's treating physiotherapist, they could accurately guide the participant on the correct pain aetiology option in the demographics questionnaire if needed. All research assistants from the private physiotherapy practice and HJPC identified and invited willing participants based on the inclusion and exclusion criteria to participate in this study. The participants were enrolled sequentially. Participants who agreed to participate in the study, were given an information letter which clearly outlined the purpose of the study. The research assistants were available to answer any questions or provide clarification on any of the questionnaires while they were completing the self-administered questionnaires. Data was collected over a period of seven months. Completed questionnaires were deposited in a box by the research assistants that was provided by the researcher, at the respective data collection sites. At the end of each week the researcher would collect the completed questionnaires and file in a locked cabinet once the data was captured.

3.5 **DATA MANAGEMENT**

No identifying/personal information was captured on the questionnaires. Completed questionnaires were filed in a locked cabinet, accessible only to the researcher and supervisors. The completed questionnaires were coded with a study number by the

researcher. All information was captured on an MS Excel spread sheet by the researcher.

3.6 ETHICAL CONSIDERATIONS

Ethical clearance was obtained for the pilot and the main study (Appendix 8). Permission was obtained from the owner of the private physiotherapy practice and the Helen Joseph Hospital management to conduct this study (Appendix 9 and 10). Completed questionnaires were considered as consent to participate in the study. Participants were not incentivised to partake in the study.

Each participant was provided with an information letter that highlighted how various aspects of rights (Autonomy, Justice, Beneficence, and Nonmaleficence) were upheld (Appendix 2). Each participants freedom and choice to partake in the study was respected and no participant was made to feel any negative repercussions if they choice to withdraw or not partake in the study. The information letter also provided contact information of the Researcher and the Human Research Ethic Committee for participants to utilise if they had any ethical concerns.

Justice was upheld as all eligible participants were recruited without bias. They were provided with equal and fair opportunity to request any clarification or assistance from the research assistants while completing the questionnaires. It was necessary for patients to complete the questionnaires independently to ensure accurate data being obtained and to avoid a bias from a potential person completing the questionnaire on their behalf. This would unfortunately exclude certain people experiencing chronic pain from the study including those with visual impairments. Furthermore, their privacy of personal information was maintained as no identifying information was recorded. No harm intended or induced during the process of completing questionnaires. The intention of the study was benevolent, and all the choices made during conception of the research was made with good intention towards patients experiencing chronic pain.

The physiotherapists that were recruited as research assistants gave verbal permission to the researcher to collect data for the study. They did not receive incentives. They were trained to ensure that patients were confident that their physiotherapy treatment not be compromised whether they partook in the study or not. For example, the completion of questionnaires did not take place during their treatment session. In addition, each patient was ensured verbally that the quality of the treatment

by the physiotherapist would not be less if they refused to partake in the study. This was provided verbally by the research assistants to each patient.

3.7 STATISTICAL METHODS

The statistical analysis was completed with the assistance of an experienced researcher. All categorical data are presented as percentages, and all continuous data are presented as median (interquartile range). Pearson's product-moment correlations were used to explore the relationship between AIVS subscales and the PCS subscales and total score, and the AIVS subscales and the TKS score. Statistical significance was set at $p < 0.05$, and a Bonferroni correction was used to control the family-wise error rate. All statistical analyses were performed using R CoreTeam v3.6.3 (2020).

Table 3.1: Objectives and Statistical Methods

Objectives	Outcome Measure	Type of Data	Test
Establish the demographics of the study participants	Demographics Questionnaire	Continuous & Categorical	Parametric tests: Median and standard deviation Descriptive statistics: Frequencies and percentages
Determine which positive character traits study participants exhibit	Adapted Inventory of Virtues and Strengths tool	Ordinal	Descriptive statistics Frequencies and percentages
Establish the presence of fear avoidance and catastrophizing amongst study participants	Pain Catastrophizing Scale & Tampa Scale of Kinesiophobia	Ordinal	Descriptive statistics: Percentages
Establish the association between catastrophizing and positive character traits			Pearson's correlational
Establish the association between fear avoidance behaviour and positive character traits			Pearson's correlational

CHAPTER 4

Positive character traits (emotional transcendence, integrity, courage, commitment to action and practical wisdom) are exhibited by all patients with chronic pain. There is no association between positive character traits and the negative maladaptive behaviours of fear avoidance and pain catastrophizing.

4. RESULTS

During the collection of data, a total of 35 participants were recruited for the pilot and main study from both study sites. Due to COVID-19 lockdown regulations, collection of data was terminated before a desired sample size was achieved. A total of 31 questionnaires were analysed from the main study, and four for the pilot study.

4.1 PILOT STUDY RESULTS

During the pilot study, the Fear Avoidance Beliefs Questionnaire (FABQ) was used to measure fear avoidance behaviour. The FABQ measures fear avoidance beliefs, relating to physical activity and work. Due to its subscale of work-related fear avoidance beliefs, it is more applicable towards employed participants. South Africa has a high unemployment rate and the researchers decided to replace the FABQ with the Tampa Scale of Kinesiophobia (TSK-17) for the main study. Therefore, the data from the four participants recruited in the pilot study were not included in the main study.

Although we experienced difficulty in recruiting first language English speaking participants, HJHPC remained a data collection site. The full-time physiotherapist at Helen Joseph hospital that was treating patients referred from HJPC, was invited to be trained as a research assistant and recruit participants into the main study. A further result of the pilot study was the private practice was added as an additional data collection site, because as mentioned above the AIVS required a high level of English language literacy to comprehend. Moreover, there was a lack of English-speaking patients at HJPC and it was therefore decided to include an additional data collection site.

4.2 MAIN STUDY RESULTS

4.2.1 OBJECTIVE 1: DEMOGRAPHIC INFORMATION

The study sample comprised of 31 participants: 20 from HJPC and 11 from the private practice. Table 1 describes the demographic characteristics of the study participants. Most participants were women (61%), with a mean age of 53 years. Despite 58% having tertiary qualification, unemployment was high (42%). Approximately three-quarters of those participants that were unemployed stated that pain was the reason they were not able to work. Depression (48%) and anxiety (23%) were common amongst all participants. The majority (32%) of the participants were experiencing chronic musculoskeletal pain, followed by chronic neuropathic pain (26%) and primary chronic pain (23%).

Table 4.1: Demographic Characteristics of the Study Participants

DEMOGRAPHIC DATA n=31	
Variable	**Value**
Age in years [median (IQR)]	53 (45.5 to 66.6)
Female [n (%)]	19 (61)
Unemployed* [n (%)]	13 (42)
Unemployed because of pain [n (%)]	10 (77)
Level of Education [n (%)]	
Primary school	1 (3)
Secondary school	12 (39)
Tertiary qualification	18 (58)
Psychiatric illness [n (%)]	
Depression	15 (48)
Anxiety	7 (23)
Post-Traumatic Stress Disorder	1 (3)
Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder	0 (0)
Autism	0 (0)
Bipolar Disorder	0 (0)
Dementia	0 (0)
Schizophrenia	0 (0)

Medication [n(%)]	
Antidepressants	25 (81)
Opioids	20 (65)
Paracetamol	17 (55)
Anticonvulsants	15 (48)
Non-Steroidal Anti-inflammatories	7 (23)
Corticosteroids	1 (3)
Local anaesthetics	1 (3)
Pain Experience [n (%)]	
Musculoskeletal	10 (32)
Neuropathic	8 (26)
Primary	7 (23)
Post-surgical	5 (16)
Headache/orofacial	3 (10)
Cancer	0 (0)
Visceral	0 (0)

* Unemployment definition: unemployed individuals that are not retired.

4.2.2 OBJECTIVE 2 & 3: POSITIVE CHARACTER TRAITS, CATASTROPHIZING AND FEAR AVOIDANCE BEHAVIOUR

All participants possessed strong positive character scores across all subgroups. The average score for positive character traits across the study population was represented as a percentage. Commitment to Action (85%), Integrity (85%) and Emotional Transcendence (84%) were the strongest traits followed by Practical Wisdom (79%) and Courage (71%).

The median total PCS score for pain catastrophizing was 26 (10 to 34) which lies below the 30-point (75^{th} percentile) cut-off score for being clinically significant. However, 42 % of the participants displayed clinically relevant levels of catastrophizing above this threshold. Of the PCS subscales, only the median score for the subscale of magnification (5) was within the 75^{th} percentile, therefore the participants did tend to magnify their pain experience.

The median TKS score for fear avoidance behaviour was 42 (36 to 47). Therefore, the study population displayed clinically significant fear avoidance behaviour with 71% of the participants above the 37-point cut-off score.

Table 2 shows summary statistics for the three scales (AIVS, PCS, TKS), including subscales.

Table 4.2: Median Scores for AIVS, PCS and TSK Questionnaires

Scale	**Median (IQR)**
AIVS	
Action	43 (38 to 46)
Courage	24 (21 to 32)
Emotion	73 (64 to 81)
Integrity	70 (60 to 72)
Wisdom	62 (58 to 67)
PCS	
Total	26 (10 to 34)
Helplessness	10 (6 to 14)
Magnification	5 (2 to 6)
Rumination	9 (3 to 12)
TKS	
Total	42 (36 to 47)

The study population of chronic pain participants were largely female patients reporting musculoskeletal pain. They all displayed strong positive character traits with 42% and 71% of pain catastrophizing and fear avoidance behaviour respectively. Median (IQR) was used as it is a better measure of spread. Our sample size was small and the data obtained was varied therefore median (IQR) was determined over mean (SD) for a more accurate reflection of the spread of data.

4.2.3 OBJECTIVE 4: ASSOCIATION OF POSITIVE CHARACTER TRAITS WITH CATASTROPHIZING BEHAVIOUR

No associations were detected between the PCS score and any of the AIVS subscales (Figure4.1).

r>-0.5 (significant negative association); r>0.5 (significant positive association)

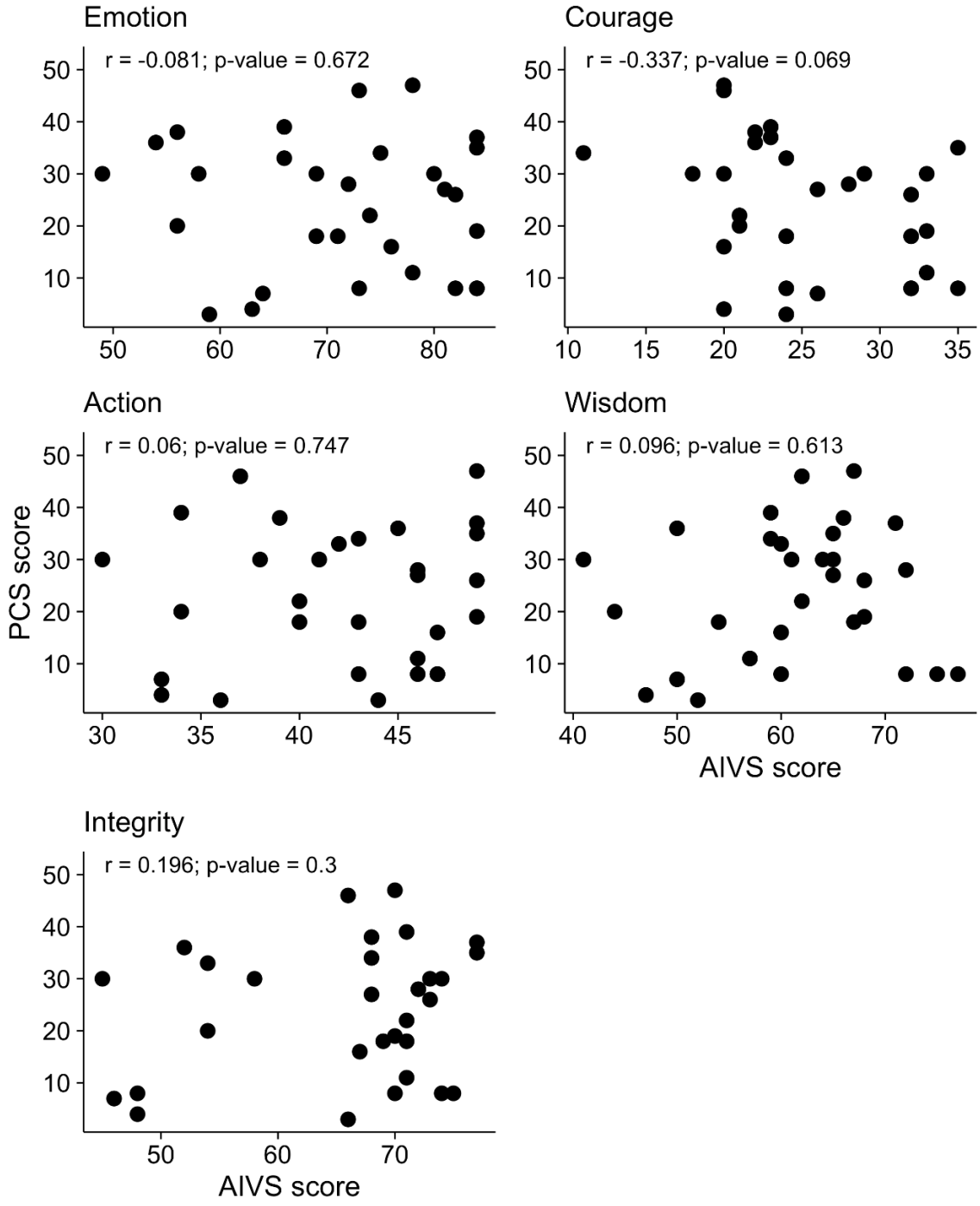

Figure 4.1: The Relationships between the Total PCS Score and AIVS Subscale Scores

Of the study participants that did display pain catastrophizing behaviour, there was a weak negative relationship between the positive character trait of courage and the pain catastrophizing subscale of magnification, ($r = -0.369$, $p = 0.045$, $R^2 = 0.136$) (Table 4.3). This association was no longer statistically significant after correcting for multiple comparisons. No other associations were found.

Table 4.3: Pearson's Correlation between PCS and AIVS Subscale Scores

	Correlation coefficient	**P-value***
PCS Helplessness		
AIVS Emotion	-0.092	0.627
AIVS Courage	-0.282	0.131
AIVS Action	0.025	0.896
AIVS Wisdom	0.166	0.540
AIVS Integrity	0.197	0.297
PCS Rumination		
AIVS Emotion	-0.032	0.865
AIVS Courage	-0.276	0.139
AIVS Action	0.123	0.510
AIVS Wisdom	0.166	0.380
AIVS Integrity	0.268	0.152
PCS Magnification		
AIVS Emotion	-0.093	0.626
AIVS Courage	-0.369	**0.045**
AIVS Action	0.010	0.959
AIVS Wisdom	-0.081	0.672
AIVS Integrity	0.004	0.983

* Uncorrected for multiple comparisons

4.2.4 OBJECTIVE 5: ASSOCIATION OF POSITIVE CHARACTER TRAITS WITH FEAR AVOIDANCE BEHAVIOUR

There were no associations detected between the TKS and any of the AIVS subscales, as seen in figure 4.2.

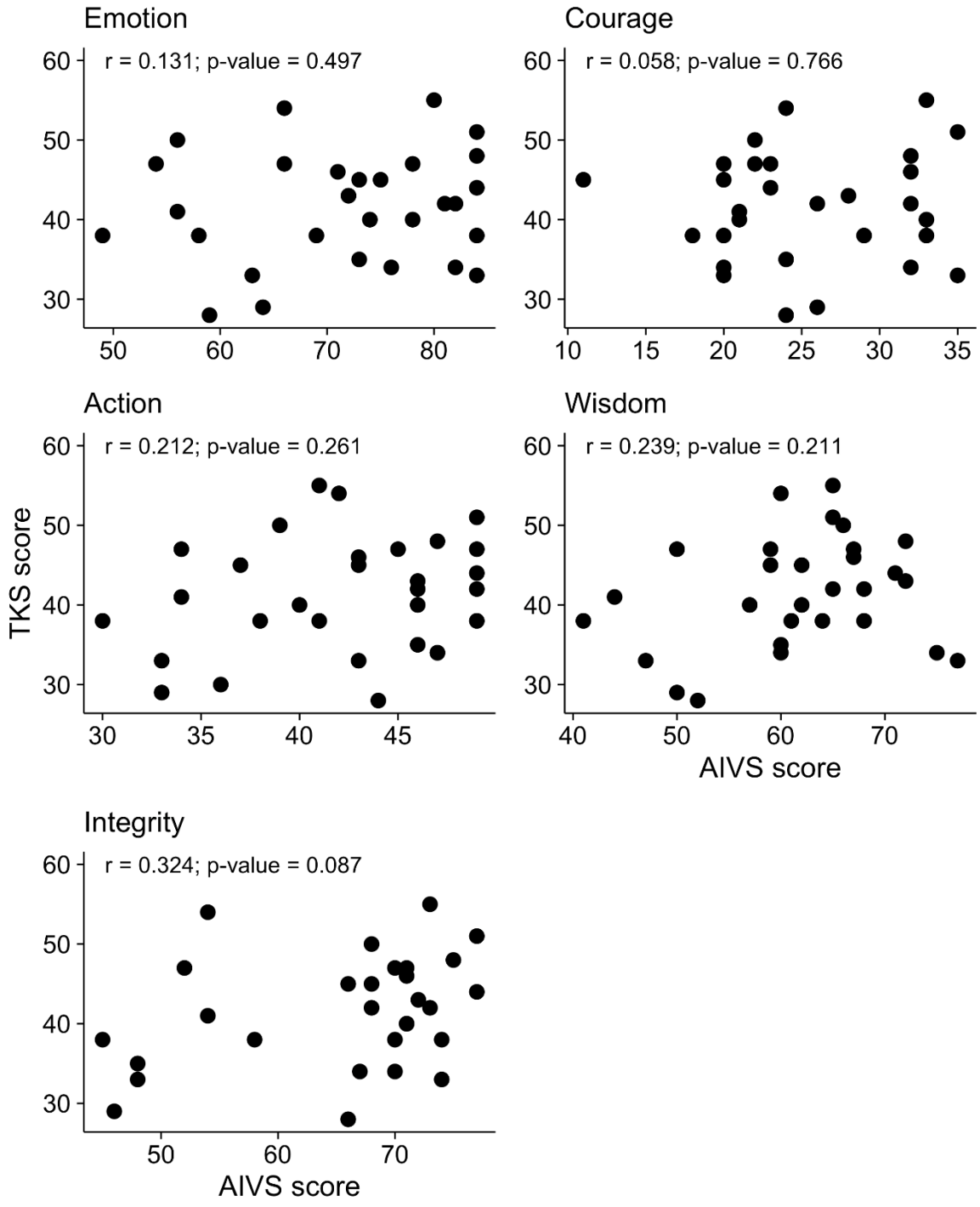

Figure 4.2: The Relationships between the TKS Score and AIVS Subscale Scores

In summary, high levels of Emotional Transcendence, Integrity, Courage, Commitment to Action, Emotional Transcendence and Practical Wisdom were found amongst all participants. Additionally, no association between fear avoidance behaviour or pain catastrophizing and positive character traits could be made.

CHAPTER 5

5. DISCUSSION

The aim of this study was to determine which positive character traits patients with chronic pain exhibit and to determine the relationship between these positive character traits and pain catastrophizing and fear avoidance behaviour. It has been established in other studies that the resource of positive character traits exists in healthy people in varying degrees (Broadhurst and Harrington, 2016; Gayton and Kehoe, 2016). This study population displayed high levels of positive character traits (Emotional Transcendence, Integrity, Courage, Commitment to Action, Emotional Transcendence and Practical Wisdom). Our study results established no association between positive character traits and fear avoidance behaviour or pain catastrophizing, suggesting that the inherent resources of positive character traits exist amongst people with chronic pain and that these positive traits are not depleted or negatively impacted by the co-existence of pain catastrophizing or fear avoidance behaviour.

The majority of the study population was female, which was to be expected as females tend to experience chronic pain more than men (James et al., 2018). Additionally, as the participants were recruited from a physiotherapy setting, it is understandable that the majority of patients complained of chronic musculoskeletal pain (32%), followed by neuropathic pain (26%). The most prescribed pain medications were antidepressants (81%) and opioids (65%) which is in line with prescribed pain medication guidelines in South Africa (Chetty et al., 2012).

The study population displayed high levels of positive character traits (Emotional Transcendence (84%), Integrity (85%), Courage (71%), Commitment to Action (85%), and Practical Wisdom (79%)). Participants recruited for my study, did not undergo any positive psychology intervention nor was it measured if they were they successful in self-managing their pain condition. It was however assumed that as they were attending physiotherapy, that they had not yet realised independence in their self-management. Different cultures influence character traits however, all people possess inherent positive character traits in varying degrees and display them at different times depending on the circumstance. (Seligman and Csikszentmihalyi, 2000; Macaskill, 2016).These inherent positive character traits have the potential to impact the outcome of rehabilitation as they support behaviours that assist the realisation of well-being and independence, particularly when aligned with one’s personal values and goals (Wood

et al., 2011). For example, a person with high levels of Integrity is more likely to succeed in self-management as it is associated with honesty. Honesty is pivotal in establishing positive relationships between close family members and healthcare providers through helpful communication (Vestjens, Cramm and Nieboer, 2020). In a study based on older adults, Perry et al., (2015) found that the application of Practical Wisdom improved self-management as participants were engaged to utilize creative problem solving and apply skills gained from earlier life experiences to new health-related problems. Furthermore, Emotional Transcendence lends itself to hope and gratitude which promotes positive emotion and well-being (Wood, Froh and Geraghty, 2010). Emotional transcendence promotes acceptance of pain in certain people (Exline, Krause and Broer, 2016). Hope is the opposite of fear and helplessness, two constructs that define fear avoidance and catastrophizing behaviour (Olsman, 2020). Commitment to Action is a central theme to self-management and its course of action is directed by one's values. Its use, along with Courage, is also paramount to goal setting (a tailored self-management strategy). For example, Kristjansdottir et al. (2018) identified courage as an important positive character trait necessary for self-management of chronic illness as it promotes determination and autonomy. Therefore, if a patient requires goal setting and displays low levels of Courage, positive psychology interventions (for example, performing deliberate acts of kindness towards others) may be used to augment the development of this necessary positive character trait in order for the patients goals to be achieved (Sullivan et al., 2005; Kristjansdottir et al., 2018). Kindness towards others requires determination and courage (Gilbert et al., 2019). Furthermore, courage has been linked to a higher internal locus of control, therefore engaging patients to utilize this strength will empower them to choose more helpful coping behaviours (Hannah, Sweeney and Lester, 2007). Chronic pain cannot be cured, therefore our aim is to teach patients how to harness their positive character traits in order to cope with the challenges of chronic pain and live a life of quality and function.

It is well known that individuals experiencing chronic pain are likely to display maladaptive behaviours such as pain catastrophizing and fear avoidance behaviour (Chan, Chan and Kwok, 2014; Fillingim, 2015). In my study sample, 71% of participants exhibited fear avoidance behaviour and 42% pain catastrophizing. Comparatively, Cresswell, Galantino and Myezwa, (2020) found a prevalence of 25.5% and 15.1% of fear avoidance behaviour and pain catastrophizing, respectively amongst South African patients with chronic pain in a private physiotherapy clinic. Their study sample was however, larger and only comprised of patients experiencing

chronic neck pain. People modify their behaviour in response to the pain they are experiencing as a protective mechanism to prevent experiencing more pain – which is their belief. This belief and behaviour change is counterproductive as it perpetuates their pain experience and limits their function in society, mood, and quality of life. The aim of rehabilitation is to change these maladaptive behaviours and improve patients function and quality of life. Physiotherapists need to be aware that the necessary and accurate identification of patients displaying pain catastrophizing and fear avoidance behaviour requires the use of outcomes measures in clinical practice (Calley *et al.*, 2010). In addition, reassessment of outcome measures are necessary to identify if treatment or interventions have been successful in reducing these unhelpful behaviours.

This study showed a lack of association between positive character traits and the maladaptive behaviours of pain catastrophizing and fear avoidance behaviour. This could be due to the limitation our study population to participants that were proficient only in English. This resulted in a small sample size and facing a selection bias as the questionnaires used were not accurately applicable to the South African context. The lack of association between positive character traits and the maladaptive behaviours of fear avoidance and pain catastrophizing can also be seen as a promising resource that this challenging population can be taught to utilize in their self-management. Not only is this population not exempt from possessing useful positive character traits but they possess an untapped resource necessary for their successful self-management. Providing patients with information on their inherent positive character traits can promote successful self-management, through the development of metacognition (knowledge about one's own cognitive processes and the understanding of how to regulate those processes to maximize learning) (Shea, 2020). Boselie, Vancleef and Peters (2018) implemented a positive psychology intervention (eight-week online home program) amongst participants experiencing chronic low back pain. They found an increase in happiness, optimism, positive expectations, positive affect, self-compassion and ability to live a desired life despite pain, and a reduction in pain catastrophizing, depression and anxiety compared to patients in the control group. Positive character strengths may assist some individuals displaying pain catastrophizing or fear avoidance behaviour to apply more informed healthy self-regulatory behaviours consistent with ones needs and values (Müller et al., 2016b).

Self-efficacy is the belief and confidence in one's self to behave in a helpful manner that results in the achievement of a desired goal, is thought to be a mediator of successful self-management (Bandura, 2001; Lorig and Holman, 2003; Farley, 2020). Self-efficacy promotes resilience as it reflects the perceived control an individual has over a situation and in turn, resilience allows patients to adapt and to reduce the suffering and burden in chronic pain (Karoly and Ruehlman, 2006; Kashdan et al., 2020). Patients with chronic pain tend to have a low self-efficacy in performing activities of daily living and managing their pain experience independently (Söderlund, Sandborgh and Johansson, 2017; Cameron et al., 2018). Somers et al. (2012) found participants experiencing chronic pain who reported low levels of self-efficacy and/or high levels of pain catastrophizing reported more physical symptoms and psychological distress than patients with lower levels of pain catastrophizing. The protective factor of self-efficacy is associated with positive functional outcomes across a wide variety of pain conditions. Hermsen et al., (2016) and Touche et al. (2019) showed that a higher perceived self-efficacy facilitated an improved functional outcome and a reduced pain intensity amongst chronic pain sufferers. In addition, Riley, Bialosky and Coronado (2020) identified that an improvement in function was related to an enhanced self-efficacy rather than a reduction in fear avoidance behaviour.

The need for self-management has been highlighted during the COVID-19 pandemic. Countries, particularly with an overburdened healthcare system, such as South Africa, require citizens to employ self-managements strategies in managing their chronic illness. Digital health, for example telemedicine (the ability for healthcare providers to meet with patients remotely via telephone or video), is being adopted exponentially across the world. This allows not only the direction of healthcare resources towards reducing the burden of COVID, but a cheaper and more accessible platform for patients requiring healthcare for chronic illnesses including chronic pain (Calton, Abedini and Fratkin, 2020). In South Africa most people have mobile/smart phones which can be effectively used in telemedicine. In light of the COVID-19 pandemic, The Paediatric Chronic Pain Clinic the Hospital for Sick Children (SickKids) in Toronto, Canada successfully transitioned nearly all appointments and individual treatment sessions (psychology, physical therapy, occupational therapy, psychiatry, and medication check-ins) from face to face consultations to a digital a platform (D'Alessandro et al., 2020). Telemedicine does not replace the benefit of face-to-face consultations; however, its strengths can improve the interprofessional care that patients with chronic pain require during and post the COVID-19 pandemic. For example, a review by Calton, Abedini and Fratkin (2020) concluded telemedicine is

beneficial in chronic pain management in monitoring vital signs, consolidating electronic medical records and providing a comprehensive evaluation of patient-reported outcomes.

Chronic pain management is a challenge and its success requires patients to achieve a sense of well-being in all aspects of their lives (Hassett and Finan, 2016). A necessary component in chronic pain management is facilitating the ability of patients to appreciate one's thoughts and emotions as mental events rather than representations of reality as patients do not have the reflective acute tissue damage that their experience of pain would suggest they do. Their perception of pain is rather a result of dysfunctional thoughts and emotions that create an altered state of perception (Galambos et al., 2019). Therefore optimising cognitive reappraisal of sensory input and emotional regulation towards a pain experience is of particular importance amongst patients with chronic pain. (Moseley and Butler, 2015). Successful self-management requires patients to draw upon and harness their positive character traits for them to engage in their healing journey in an independent and effective manner within a supportive social context (Boger et al., 2015). The Chronic Care Model highlights collaboration between healthcare provider and patient as a necessary component of successful self-management for patients with chronic illnesses (McCorkle et al., 2011). Furthermore, patient activation (knowledge, skills and confidence a person has in managing their own health and care) and patient engagement (the combination of a patient activation and interventions designed to increase activation to promote helpful behaviours) reflect a more successful self-management program (Newland, Lorenz and Oliver, 2021).

Individuals experiencing chronic pain should not be treated as objects of diagnosis and treatment but rather clients that are actively involved in adapting and facing the social, emotional and physical challenges that reduce the quality of their life. However, pain catastrophizing and fear avoidance behaviour are profoundly challenging problems to address within this population as these behaviours form part of the "self" that is part and parcel of the problem in chronic pain conditions. Positive character traits are positive psychological resources that show potential in assisting individuals achieving successful self-management.

CHAPTER 6

6. CONCLUSIONS, LIMITATIONS, SCOPE FOR FUTURE RESEARCH AND CLINICAL RECOMMENDATIONS

6.1 CONCLUSION

Our primary findings show that people experiencing chronic pain display positive character traits. We could not establish an association between the maladaptive behaviours of fear avoidance and pain catastrophizing with positive character traits which can be seen as an encouraging sign that this challenging population of people possess untapped psychological resources. The benefit of positive psychological resources have been associated with longevity, cardiac health and a reduced incidence of chronic diseases (Lamers et al., 2012; Hoofwijk et al., 2015; Lambiase, Kubzansky and Thurston, 2015). Positive psychology shows promise as a helpful adjunct in the management of this challenging patient population.

6.2 LIMITATIONS

Our study had various limitations. The questionnaires used were in English and the majority of patients attending Helen Joseph pain clinic did not speak English as their home language. As this is the first study in South Africa to use to AIVS tool to identify positive character traits amongst patients with chronic pain and due the nature of this research report, it was not feasible to translate it into any other official South African languages. Although this created a selection bias, the nature of a research report did not allow for the tool be translated into a language that would have improved its utility amongst the South African population. Finally, COVID-19 regulations and ensuing research restrictions prevented me from achieving the predicted sample size, and this could have additionally affected accuracy of our data. If this was not a research report and time was not a limiting factor, more physiotherapy practices could have been contacted and included in the study population. This would have helped to achieve adequate sample size.

6.3 SCOPE FOR FUTURE RESEARCH

More research on positive psychology is needed in its clinical application for patients with chronic pain. This study showed that positive character traits can be measured and do exist amongst individuals with chronic pain. It would therefore be valuable to translate the tool into the various languages spoken in South Africa. Hope and

resilience are necessary in order to experience subjective wellbeing in times of adversity and counteract negative psychosocial factors associated with chronic illness and disability (Munoz, Hanks and Hellman, 2020).

6.4 CLINICAL RECOMMENDATIONS

Self-management can be a successful strategy that requires patient activation, high self-efficacy and an internal locus of control in order to adopt helpful behaviours that promote a life of meaning. By fostering a positive therapeutic alliance, patient education can be supplemented by the development and utilization of inherent positive psychological resources. Positive psychology, shows the ability in empowering a self-management strategy which can in turn foster hope for a better quality of life. The journey of healing can be a lonely road and patients require their interdisciplinary healthcare team to inspire hope for a better quality of life, as the perception of pain should not equate to suffering.

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APPENDIX 1

- **SAMPLE SIZE CALCULATION**

20 English speaking chronic pain patients/month at Richard Feher, 20 English speaking chronic pain patients/month at Helen Joseph.

CI=95%, margin of error 5%, Population proportion 50 %, Population size= 40 people
Sample size= 37.

Actual number of participants=31

APPENDIX 2

- **INFORMATION SHEET FOR PARTICIPANTS**

Dear Participant

Good day, my name is Kim Cocciuti. I am a master's student from the University of the Witwatersrand. I am doing a research study on the positive character traits of patients with chronic pain, as part of my studies. I would like to invite you to participate in my study.

Importance of this Study

Chronic pain is a global health problem affecting 1 in every 5 people. The management of chronic pain is complex. Positive character traits are aspects of ourselves that can lead us to a sense of well-being. Increasing our knowledge of positive character traits in chronic pain is needed.

The aim of this study is to determine the presence of positive character traits in patients with chronic pain. There is no direct benefit to participate in the study however, the study findings will assist in improving the management of chronic pain.

What are you, the participant, expected to do?

Should you agree to participate in this study, you will be asked to fill in 4 questionnaires:
Personal details questionnaire
Positive character traits questionnaire (AIVS)
Pain Catastrophizing Scale Questionnaire (PCS)
Tampa Scale of Kinesiophobia (TSK)
These will be given to you by myself or my research assistant. It will take approximately 30 minutes of your time to complete the questionnaires. Participation is voluntary and refusal to participate will not have any negative consequences. *You may withdraw from the study at any time without fear of suffering any negative repercussions*

What are the risks of taking part in this study?

There are no risks that you will be exposed to. There is no monetary reward for participating in this study. The authors of the AIVS tool have requested that in return for using their tool, data from this study will be shared with them to assist in further validating the AIVS tool, however none of your personal details will be shared.

Confidentiality

To ensure the confidentiality of participants is maintained, study numbers will be used instead of participant names. Each participant will be assigned a study number. The key to these study numbers will be kept in the possession of the researcher only. Participants are to write their names only on the personal details form attached. Information obtained from participants will be used only for the purpose this study is intended for.

More Information Requests

I am readily available if you have any questions, concerns or require more information. Alternatively, you can contact me on 0832926868 or email me at kimcocciuti@gmail.com. Should you have any ethically related concerns, please contact Professor Cleaton Jones on 011 7172700 at the Human Research Ethics Committee of the University of the Witwatersrand.

If you are willing to participate in this, please complete the attached forms.

Kind regards

Kim Cocciuti

APPENDIX 3

- **SELF-DEVELOPED DEMOGRAPHICS QUESTIONNAIRE**

Personal Details Questionnaire Study No:_____

Age: _____

Have you had pain for longer than 3 months? Please tick appropriate box
□Yes □No

Are your employed? Please tick the appropriate box
□ Yes □ No

3.1 If YES, what work do you do? _____

3.2 Do you work full time or part time? Please tick the appropriate box
□ Full time □ Part time

3.3 If you work part time, is it because of your pain? Please tick appropriate box
□ Yes □ No

3.4 If NO, are you NOT working due to your pain? Please tick appropriate box
□ Yes □ No

3.5 If you are NOT working, what work DID you do? _____

Highest level of education: Please tick the appropriate box
□ Primary school □ High School □ College □ University

Have you been diagnosed with one or more of the following conditions? Please tick any of the following:
Depression
Anxiety
Schizophrenia
Bipolar disorder
Autism
Dementia
Attention deficit/Hyperactivity disorder
Other: Please state:_____

Please list the medications you are currently taking:

_____
_____
_____
_____

How would you best describe the source of chronic pain that you experience?
Please read the following 7 options and tick the most appropriate box:

 Chronic primary pain:
Pain in one or more body areas that has persisted longer than 3 months with an unknown cause.
Examples: unexplained back pain, fibromyalgia, irritable bowel syndrome.

 Chronic post-surgical or post traumatic pain
Pain that developed following an operation or tissue injury and persisted for longer than 3 months.
Examples: Burns, any operation.

 Chronic cancer pain
Pain caused by the cancer itself or by the cancer treatment (surgical, chemotherapy, radiotherapy etc.)

 Chronic neuropathic pain
Chronic pain for longer than 3 months following an injury to skin, muscles, bones, nerves, internal organs.
Examples: stroke, nerve trauma, diabetic neuropathy.

 Chronic headache and orofacial pain
Headache or pain in the face for at least half of the day that persist for longer than 3 months.
Examples: temporomandibular disorders, tension headaches, trigeminal neuralgia, burning mouth syndrome, migraines.

 Chronic visceral pain
Chronic pain originating from the internal organs of the chest (heart, lungs etc), abdominal (stomach, bowel, liver, pancreas etc) or pelvic cavities (uterus, ovaries, testes etc)

 Chronic musculoskeletal pain
Chronic pain arising directly from bones, joints, muscles or related soft tissues.
Examples: Rheumatoid arthritis, osteoarthritis

APPENDIX 4

- **ADAPTED VIRTUE INVENTORY OF STRENGTHS**

Jeong Han Kim, Ph.D., CRC

(jeonghankim.vcu@gmail.com)

	Direction: For the following items, read each word and place a checkmark (√) closest to the word that you think most accurately describes you. There are no right or wrong answers							
1	Hateful	1	2	3	4	5	6	7	Loving
2	Bold	1	2	3	4	5	6	7	Timid
3	Lazy	1	2	3	4	5	6	7	Hardworking
4	Honest	1	2	3	4	5	6	7	Dishonest
5	Curious	1	2	3	4	5	6	7	Apathetic
6	Unfair	1	2	3	4	5	6	7	Fair
7	Unfunny	1	2	3	4	5	6	7	Funny
8	I believe life has a meaning	1	2	3	4	5	6	7	I believe life is meaningless
9	Uninventive	1	2	3	4	5	6	7	Inventive
10	Modest	1	2	3	4	5	6	7	Arrogant
11	Unforgiving	1	2	3	4	5	6	7	Forgiving
12	Self-disciplined	1	2	3	4	5	6	7	Undisciplined
13	I am receptive to new ideas	1	2	3	4	5	6	7	I am not receptive to new ideas
14	Submissive	1	2	3	4	5	6	7	Commanding
15	Energetic	1	2	3	4	5	6	7	Lifeless
16	Biased	1	2	3	4	5	6	7	Unbiased
17	Sensible	1	2	3	4	5	6	7	Nonsensical
18	I give up easily	1	2	3	4	5	6	7	Persistent
19	Trustworthy	1	2	3	4	5	6	7	Untrustworthy
20	I disregard beauty	1	2	3	4	5	6	7	I admire beauty
21	Prejudiced	1	2	3	4	5	6	7	Valuing equality
22	Optimistic	1	2	3	4	5	6	7	Pessimistic
23	Open-minded	1	2	3	4	5	6	7	Close-minded
24	Unscholarly	1	2	3	4	5	6	7	Scholarly
25	Playful	1	2	3	4	5	6	7	Serious
26	Thankful	1	2	3	4	5	6	7	Unthankful
27	Boastful	1	2	3	4	5	6	7	Humble
28	Courageous	1	2	3	4	5	6	7	Cowardly
29	Uninterested	1	2	3	4	5	6	7	Interested
30	Affectionate	1	2	3	4	5	6	7	Unaffectionate
31	Light-hearted	1	2	3	4	5	6	7	Sombre
32	Imprudent	1	2	3	4	5	6	7	Prudent

33	I appreciate excellence	1	2	3	4	5	6	7	I disregard excellence
34	Perseverant	1	2	3	4	5	6	7	I quit easily
35	Grateful	1	2	3	4	5	6	7	Ungrateful
36	Incautious	1	2	3	4	5	6	7	Cautious
37	Loyal	1	2	3	4	5	6	7	Disloyal
38	Fearful	1	2	3	4	5	6	7	Brave
39	Unenthusiastic	1	2	3	4	5	6	7	Enthusiastic
40	Humorous	1	2	3	4	5	6	7	Humourless
41	Careless	1	2	3	4	5	6	7	Careful
42	Unspiritual	1	2	3	4	5	6	7	Spiritual
43	Caring	1	2	3	4	5	6	7	Uncaring
44	Impulsive	1	2	3	4	5	6	7	Self-controlled
45	Creative	1	2	3	4	5	6	7	Uncreative
46	Follower	1	2	3	4	5	6	7	Leader

APPENDIX 5

- **PAIN CATASTROPHIZING SCALE QUESTIONNAIRE**

PCS

Client No.: _____ Age: _____ Sex: M(__) F(__) Date: _____

Everyone experiences painful situations at some point in their lives. Such experiences may include headaches, tooth pain, joint or muscle pain. People are often exposed to situations that may cause pain such as illness, injury, dental procedures or surgery.

We are interested in the types of thoughts and feelings that you have when you are in pain. Listed below are thirteen statements describing different thoughts and feelings that may be associated with pain. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are experiencing pain.

0 – not at all **1** – to a slight degree **2** – to a moderate degree **3** – to a great degree **4** – all the time

When I'm in pain …

1 ☐	I worry all the time about whether the pain will end.
2 ☐	I feel I can't go on.
3 ☐	It's terrible and I think it's never going to get any better.
4 ☐	It's awful and I feel that it overwhelms me.
5 ☐	I feel I can't stand it anymore.
6 ☐	I become afraid that the pain will get worse.
7 ☐	I keep thinking of other painful events.
8 ☐	I anxiously want the pain to go away.
9 ☐	I can't seem to keep it out of my mind.
10 ☐	I keep thinking about how much it hurts.
11 ☐	I keep thinking about how badly I want the pain to stop.
12 ☐	There's nothing I can do to reduce the intensity of the pain.
13 ☐	I wonder whether something serious may happen.

… Total

APPENDIX 6

- **PCS MANUAL OF RAW SCORES AND PERCENTILES**

PCS Total	Rumination	Magnification	Helplessness	Percentile
				1
0				2
	0			3
				4
2				5
3	1		0	6
				7
				8
4				9
			1	10
5				11
				12
	2			13
		0		14
6				15
			2	16
7				17
				18
8	3			19
				20
9				21
			3	22
				23
10				24
				25
	4			26
		1		27
11				28
			4	29
				30
12	5			31
				32
				33
13				34
14				35
			5	36
				37
	6			38
15				39
				40
16				41
		2	6	42
				43
17	7			44

PCS Total	Rumination	Magnification	Helplessness	Percentile
				45
				46
18			7	47
19				48
				49
-20-	**-8-**	**-3-**	**-8-**	**-50-**
				51
				52
21				53
				54
22			9	55
				56
23				57
	9			58
				59
24			10	60
				61
25				62
		4		63
			11	64
26	10			65
				66
27				67
				68
28				69
			12	70
				71
				72
29				73
				74
30	**11**	**5**	**13**	**75**
				76
				77
31				78
		6	14	79
32	12			80
33				81
				82
			15	83
34				84
35				85
	13	7		86
36			16	87
37				88
			17	89
38		8		90
39	14			91

PCS Total	Rumination	Magnification	Helplessness	Percentile
40			18	92
41		9		93
42				94
43			19	95
44	15			96
45		10	20	97
46		11	21	98
47-48			22	99
49-52	16	12	23-24	100

APPENDIX 7

TAMPA SCALE FOR KINESIOPHOBIA

Tampa Scale for Kinesiophobia
(Miller , Kori and Todd 1991)

1 = strongly disagree
2 = disagree
3 = agree
4 = strongly agree

1. I'm afraid that I might injury myself if I exercise	1	2	3	4
2. If I were to try to overcome it, my pain would increase	1	2	3	4
3. My body is telling me I have something dangerously wrong	1	2	3	4
4. My pain would probably be relieved if I were to exercise	1	2	3	4
5. People aren't taking my medical condition seriously enough	1	2	3	4
6. My accident has put my body at risk for the rest of my life	1	2	3	4
7. Pain always means I have injured my body	1	2	3	4
8. Just because something aggravates my pain does not mean it is dangerous	1	2	3	4
9. I am afraid that I might injure myself accidentally	1	2	3	4
10. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening	1	2	3	4
11. I wouldn't have this much pain if there weren't something potentially dangerous going on in my body	1	2	3	4
12. Although my condition is painful, I would be better off if I were physically active	1	2	3	4
13. Pain lets me know when to stop exercising so that I don't injure myself	1	2	3	4
14. It's really not safe for a person with a condition like mine to be physically active	1	2	3	4
15. I can't do all the things normal people do because it's too easy for me to get injured	1	2	3	4
16. Even though something is causing me a lot of pain, I don't think it's actually dangerous	1	2	3	4
17. No one should have to exercise when he/she is in pain	1	2	3	4

APPENDIX 8

- **ETHICAL CLEARANCE CERTIFICATES**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mrs Kim Elizabeth Cocciuti

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M171190

NAME: (Principal Investigator)	Mrs Kim Elizabeth Cocciuti
DEPARTMENT:	Physiotherapy Helen Joseph Hospital Wits Donald Gordon Medical Centre
PROJECT TITLE:	Positive Character Traits in Patients with Chronic Pain
DATE CONSIDERED:	24/11/2017
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Vaneshveri Naidoo
APPROVED BY:	Prof C Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	12/04/2018

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193. University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in November and will therefore be due in the month of November each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

21 November 2018

Kim Cocciuti
Physiotherapy

Sent by email to: kimcocciuti@gmail.com

Dear Kim Cocciuti

Re: **Protocol Ref No: M171190**
Protocol Title: Positive Character traits in patients with chronic pain
Principal Investigator: Kim Cocciuti
Protocol Amendment: Study site addition

This letter serves to confirm that the Chairperson of the Human Research Ethics Committee (Medical) has approved the amendment for the above-mentioned protocol, as detailed in your letter, dated 8 November 2018.

The following documents were received:

- Summary Letter
- Letter of request

Thank you for keeping us informed and updated.

UNIVERSITY OF THE WITWATERSRAND
OFFICE OF THE DEPUTY VICE [illegible] RESEARCH
21 NOV 2018
RESEARCH OFFICE HREC (Medical)
JOHANNESBURG

Yours Sincerely.

Mr Joshua Ndlangamandla
Administrative Officer
Human Research Ethics Committee (Medical)

Research Office Secretariat: Faculty of Health Sciences, Phillip Tobias Building, 3rd Floor, Office 304, Corner York Road and 29 Princess of Wales Terrace, Parktown, 2193 Private Bag 3, Wits 2050 T +27 (0)11-717-1234/2600/2703/1252 E: Khotjani.Mkansi@wits.ac.za | Office E HREC-Medical.ResearchOffice@wits.ac.za | Website: www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/

APPENDIX 9

- **LETTER OF PERMISSION FROM HELEN JOSEPH HOSPITAL**

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

Gauteng Department of Health
Helen Joseph Hospital
Enquiries: Dr. M.R. Bilia
Chief Executive Officer
Tel: (011) 489-0306/1087
Fax :(011) 726 5425
Email: Raymond.Bilia@gauteng.gov.za
Date: 01 August 2018

Dr.M.R.Bilia
Chief Executive Officer
Helen Joseph Hospital

Dear Dr. M.R Bilia

STUDY: Positive Character Traits in Patients with Chronic pain

RESEARCHERS: Mrs. Kim Elizabeth Coccuiti

Ethics: M171190

Above the study was discussed at the Research Committee meeting. We recommend that permission be granted for Helen Joseph Hospital to be used as a site for the above research, However , since this is individual /Patients.
Upon completion of the study, copy thereof should be submitted to Helen Joseph Hospital.
It is duty of the researcher to collect the data to the relevant department after the Research Committee approved the study.
Thank you

Dr. Murimisi Mukanki
CHAIRPERSON
DATE: 07/08/2018

Approved

Dr. M.R. BILIA
CHIEF EXECUTIVE OFFICER
DATE: 08/08/2018

APPENDIX 10

- **LETTER OF PERMISSION FROM PRIVATE PHYSIOTHERAPY PRACTICE**

Richard Feher BSc (Physio) Wits
MPhil (Sports Physiotherapy) UCT
Tel. (011) 791 3454

Richard Feher
Physiotherapy & Associates

Fax no. (011) 791 6847
E-mail: physiofeher@telkomsa.net
Postnet suite 407, Private Bag X1, Northcliff, 2115

P R A C T I C E N.O.:

7238843

To whom it may concern
10/05/2019

I have granted Kim Cocciuti full permission to use my private practice physiotherapy rooms to obtain her data collection, in order to complete her Physiotherapy Master's degree. I hope this is in agreement with your ethics process and research methodology for the study titled: Positive character traits of patients with chronic pain who display catastrophizing and fear avoidance behavior.

For any questions please do not hesitate to contact me.

Kind regards

R Feher BSc MPhil WITS UCT CSP

APPENDIX 11

- **TURN-IT-IN REPORT**