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Levels of Physical Activity in People Living with Chronic Pain: Do they change after participating in a Chronic Pain Management Program?

Mini-Dissertation in partial fulfilment of MSc. Sports Physio and Exercise

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Chapter 1: INTRODUCTION

1.1. Chronic Pain in South Africa

Chronic Pain is a complex, multi-dimensional experience, which can cause suffering, decreased functioning and a decrease in quality of life (Breda, et al., 2013; Jones & Bari, 2014; Tse, et al., 2011). According to the International Association for the Study of Pain (IASP), chronic pain is classified as "pain that persists beyond normal tissue healing time, which is assumed to be three (3) months" (Elliott, et al., 1999). It has been recognised as a world-wide burden, with estimated treatment costs above any other chronic condition and a prevalence as high as 45% in developed nations like the United States of America (USA) and the United Kingdom (UK) (Elliott et al., 1999; Fayaz, et al., 2016; Kindler, et al., 2010). Chronic pain prevalence has been reported to be 12-30% in Europe (Breivik, et al., 2006; Breivik, et al., 2013), while in South Africa, a developing country, prevalence is comparable to developed countries, reported to be between 10-43% (Igumbor, et al., 2011; Parker & Jelsma, 2010; Smuts & Meyer, 2008). Of note, chronic pain prevalence in South Africans living with Human Immunodeficiency Virus (HIV) may be as high as 74-80% (Mphahlele, et al., 2012).

The multi-factorial nature of chronic pain affects various aspects of the sufferer's life and can include mood, psychological state, daily functioning and levels of physical activity. Stubbs et al. (2015) found that physical activity was affected by various aspects in those suffering from pain associated with the common chronic pain conditions of hip and knee osteoarthritis. These aspects include, but are not limited to demographic, social, physical, psychological and environmental factors which all play a role in the interactions between chronic pain and levels of physical activity (Institute Of Medicine [IOM], 2011; Stubbs, et al., 2015).

Apkarian and colleagues describe the typical process which a chronic pain sufferer will go through once diagnosed with chronic pain (Apkarian, et al., 2009). After treatment for a specific acute condition, chronic pain sufferer's generally do not recover, with pain lasting anywhere from a few months to a number of years. Patients are then sent to a chronic pain clinic or centre for chronic pain management, where pharmacological, non-pharmacological and anaesthesiological interventions are introduced. The majority of these patients do not recover fully, and this adds to the burden of chronic pain, putting increased strain on the health care system, family and friends, as

well as on the chronic pain sufferer (Apkarian, et al., 2009; Bogduk, 2004). This produces a proverbial cycle of chronic pain by affecting the psychological state of the patient that can cause an increase in catastrophizing as patients believe that there is no cure for their pain and a decrease in physical activity that leads to de-conditioning of body tissue at all levels.

Chronic pain can be described as the pain that a person experiences, which does not necessarily reflect the presence of a peripheral noxious stimulus. Commonly, chronic pain can lead to limited physical activity and participation in everyday Activities of Daily Living (ADL) [Breivik, et al., 2006; Elliott, et al., 1999; Karlsson, et al., 2018)

The purpose of this study was to determine whether levels of physical activity in people with chronic pain change after participating in a Chronic Pain Management Program (CPMP) at Groote Schuur Hospital (GSH).

1.2. Theoretical Framework

In a paper by Moseley (2007) describes the phenomenon of pain, first observed by Lt. Col. H. K. Beecher in 1946, as one which is misunderstood as a straightforward relationship between a noxious stimulus and intensity of pain, but this is not the case. It is understood that pain is not directly linked to the state of tissue damage, but is modulated by various factors which include somatic, psychological and social domains, as described by this study: "…the relationship between pain and the state of the tissues becomes less predictable as pain persists." In other words, the longer pain is present, the more likely it is that the brain will perceive any stimulus to the body segment as one which is threatening. Chronic pain can be understood to mean that the brain has the ability to augment or distort the sensation of pain experienced by an individual even in the absence of tissue damage or the presence of a noxious stimulus (Beecher, 1946; Moseley, 2007).

The International Classification of Functioning, Disability and Health (ICF) is an internationally standardised healthcare tool used to provide a common framework for classifying diseases and the impact these diseases have on the individual. The classification is used to describe the effects of the disease on function (function, activity and participation) and disability (impairments, activity limitation and participation restrictions), forming a bio-psychosocial approach to the classification of an individual's disease process within the dynamic environment in which the individual lives. It is used to provide a wide range of health information in a way that provides for standard

communication about health states of an individual in an international setting. According to the World Health Organisation, the aims of the ICF include the provision of a "scientific basis for understanding and studying health and health-related states, outcomes and determinants," establishing a common language in healthcare to improve communication among individuals within the healthcare space (including those with disabilities), to enable the comparison of health data across countries and disciplines and to provide a standardised coding scheme for health information systems (Peden, et al., 2008).

The ICF provides the basis for developing insight and understanding that health and health-related states are not only based on the absence of disease, but relate to the management of these health-states and subsequent environmental factors (including activity limitations and participation restrictions) to reduce disability and improve self-reliance in the disease-management process. Chronic Pain Management Programmes (CPMP's) are based on the ICF approach, which combines two conceptual models of disability, the social and medical model. These programmes attempt to address limitations of these individual models by acknowledging that disability is affected by factors both intrinsic and extrinsic within the disease process, that both models have limitations.

These CPMP's aim to enable patients to engage with personal and environmental factors and ultimately optimise function and participation within their communities, because the treatment approach moves focus from a curative approach to one of self-management over the long-term. The ongoing theme with this treatment approach (CPMP) is that chronic pain is a complex phenomenon which affects function and participation in the environment which a patient interacts with on a daily basis. It is therefore important to recognise that treatment approaches cannot be at the impairment level only and should address activity limitations and participation restrictions in the pursuit of a truly bio-psychosocial approach, where a change in one component of the ICF (Activity, for instance) results in a change within another component (Participation) and vice versa (Cameron, et al., 2018; Parker, et al., 2009).

1.3. Research Setting

1.3.1. Population Growth and Income Inequality in the City of Cape Town

The South African economy has shown signs of struggling growth due to various economic pressures and deteriorating household financial health since 2011, resulting in increased poverty levels with the inflation-adjusted poverty line more than doubling between 2006 and 2017. The GINI Co-efficient is a measure of income inequality and wealth distribution in an economy. The closer to 1.0, the more income inequality exists in an economy, with 0 equating to every citizen earning the same amount and 1 equating to 1 citizen earning everything and everyone else earning nothing at all (Gale, et al., 2015; Russouw, et al., 2010). One of the aims of the National Development Plan is to reduce income inequality from a GINI Co-efficient of 0.7 to 0.6 by 2030 (it currently stands at 0.61 for the City of Cape Town as at 2016) (Socio-Economic Profile [SEP], 2017).

In 2018, the City of Cape Town had a population of around 4 055 580 people. This number is expected to grow by nearly 200 000 by 2023 according to the latest Socio-Economic Profile of the Western Cape in South Africa, with the aged population increasing by 3.4% year-on-year, ahead of the child population. These numbers imply that the population as a whole will age over the forthcoming years. Most notable is that the working age population will grow at the slowest rate amongst the three population groups and can indicate a greater strain on the 'sandwich' generation (the working population who need to provide for their children, as well as their families, forming a proverbial 'sandwich' strain on resources within households). These factors imply an increased strain on state resources, especially the public healthcare sector (SEP, 2017).

1.3.2. Right to Education and Healthcare

Every child in South Africa has the right to basic education and further education which the state needs to make progressively available and accessible (South African Constitution, 2017). Education may improve employment opportunities, maintain and accelerate economic growth and provide other indirect effects, including improvements in health and life expectancy that naturally lead to a decreased dependence on public health resources. The Socio-Economic Profile of the Western Cape in 2017 notes that nearly 1 in 3 young people who enrolled in Grade 10 in 2014, did not complete

Grade 12 in 2016. A number of reasons have been hypothesised, ranging from increased learner-teacher ratios (less personalised attention and decreased educational outcomes) to economic factors such as unemployment, poverty and teenage pregnancy (SEP, 2017). These factors have an indirect future impact on public resources that include, but are not limited to an overburdened public healthcare sector.

The South African Constitution states that all citizens have a right to access to basic healthcare services (South African Constitution, 2017), but it is reasonable to argue that adequate access to healthcare is limited by state resources and geographical constraints of healthcare facilities. The public healthcare system is designed so that patients move from primary, to secondary and then tertiary-level through a referral system. At the time of this study, it was noted that the number of district and regional hospitals have remained unchanged since 2014 (SEP, 2017). It is safe to deduce that an increasing population, combined with stagnant public healthcare facilities will result in increased strain on the system.

Medical insurance is a luxury few South Africans can afford, with only 17% of South Africans having this cover, leaving 83%, or 45 million people dependent on public healthcare resources. Of interest is that 70% of all households choose to use public healthcare services, although it is unclear whether this includes those patients who have medical insurance but choose to seek treatment at a public healthcare facility (StatsSA, 2017).

1.3.3. Groote Schuur Hospital

The Western Cape in South Africa has two tertiary hospitals which service the Greater Western Cape area. At Groote Schuur Hospital (GSH) in Observatory, Cape Town, a CPMP is run by the Hospital and the University of Cape Town Physiotherapy units after a realisation as early as 2006 that the Chronic Pain Management Clinic at GSH was struggling to cope with the number of individuals presenting with chronic pain. The CPMP is based on principles of CBT, which aims to equip patients with, knowledge about and understanding of chronic pain, skills of relaxation, exercise, activity pacing, nutrition and stress management. The main objective of the programme is an increase in the patient's ability to self-manage their chronic pain and reduce the negative impact of chronic pain on their daily functioning. The program was designed to be run from the Outpatient physiotherapy department of GSH (Parker, et al., 2009). Since 2006, the program has been

implemented in this setting providing accessibility to a wide number of chronic pain patients.

While the present study was being conducted, the CPMP was run over five weeks with weekly two-hour sessions. Each week had a different focus topic, namely: Self-management and Chronic Pain Physiology; Exercise; Stress Management; Eating Well; Medications and Continuing as a Successful Self-Manager (Parker, Personal Communication, July 2014; Parker, et al, 2014). Participants were referred to the program from the Chronic Pain Management Clinic of the hospital where they would have had a full assessment from the multidisciplinary team. Active participation in all aspects of the program, including in the weekly exercise and goal-setting activities was highlighted to participants on referral and at the first session with the use of a patient contract. Full description of the CPMP and justification for its structure is presented in the literature review.

1.4. Study Outline

The following chapter outlines the current literature on chronic pain and includes the purpose of the study, a description of how literature was identified and used in the formation of the review. Also contained within chapter two is the current evidence on prevalence of disability and chronic pain, pharmacological treatments of chronic pain, exercise, education, surgery, interventions, mindfulness-based strategies and the psychology associated with the treatment of the chronic pain phenomenon. This is in order to obtain a better understanding of the development in the treatment approaches to an otherwise complex illness which affects physiological, psychological and environmental factors of the chronic pain patient.

Chronic Pain Management Programs (CPMP's), their development and implementation will then be discussed, as these programs form the current best evidence for the treatment of chronic pain. Measuring physical activity will be discussed so that we might fully appreciate the need for multiple subjective and objective criteria when assessing the effect of CPMPs on a patient's wellbeing after taking part in the program.

In Chapter three, the methodology of the study is presented and includes the aims and objectives of the study, a description of the participants, inclusion and exclusion criteria, sample size determination and a description of the measurement instruments. This chapter describes the rationale behind the way in which the study was conducted. As such, a description of the procedure

follows, including ethical considerations and statistical analyses of the data. Chapter three is included so that the reader may adequately and accurately reproduce the study in future.

Chapter four describes the results of the study and contains the characteristics of the participants, their changes in pain, as well as physical activity. The results conclude with the reporting of the self-report and objective outcomes of the aims and objectives of the study. The inclusion of chapter four contains the description of the results as they are from the outcomes of the measurement instruments described in chapters two and three.

Chapter five is the Discussion section and includes participation and pain characteristics, levels of physical activity prior to the CPMP and the changes in physical activity as it relates to the CPMP. The inclusion of chapter five is so that the investigators may discuss various aspects of the results, presenting possible explanations of the results, as well as identify anomalies that may exist in the findings, which include both positive and negative aspects. Chapter five concludes with limitations of the study and is included to make readers aware of the identifiable restrictions and limitations within the study, in order that further studies into this topic may be recognised and be accounted for, so as to improve the outcomes of future studies.

The final part of this study is chapter six, the Conclusion. This chapter outlines, once again the aims and objectives of the study, including the most important, relevant findings of the study and further suggestions for future research. It is my hope that this study may contribute to the existing literature and data available in the study of chronic pain, as well as an improved knowledge of treatment approaches to this highly complex field of disability.

Chapter 2: LITERATURE REVIEW

The purpose of this literature review is to provide a comprehensive overview of the current literature regarding the topic of "levels of physical activity in people living with chronic pain." The concept of chronic pain has been researched over many years with the theory of up-regulation of the Central Nervous System due to hypersensitivity from tissue injury and was studied in greater depth ever since (Woolf, 1983; Woolf, 2011). Since then, many aspects of chronic pain have been investigated, but one which has not been thoroughly researched is the change in levels of physical activity after participation in a CPMP in people living with chronic pain, with results being scarce and inconclusive, or with poor methodologies and short follow-up periods (Van Den Berg-Emons, et al., 2007). Many studies have looked at the changes in severity of pain in chronic pain sufferers, but there is a paucity of data in the objectively-assessed changes in physical activity after a CPMP intervention.

During a comprehensive search of various databases, no study could be found that investigated the long-term effects of participating in a CPMP and the effects on changes in levels of physical activity (Apkarian, et al., 2009). The majority of studies found in the database search investigated the efficacy of manual treatments in chronic pain with a focus on changes in pain severity of chronic pain sufferers, without assessing changes in physical activity. This review will start with definitions of chronic pain, its relevance, as well as the methodology for how the articles were selected for review. The review will outline and discuss the evidence for the prevalence of, and disability associated with chronic pain, current treatments for chronic pain and relevant measurement tools. The final part of the review will outline CPMP and current best evidence.

In order to assess the literature, a number of databases were searched. These databases included: Science-direct, PUBMED, The Cochrane Library and Google Scholar. Keywords used included: Chronic Pain, Physical Activity, Exercise, Cognitive Behavioural Therapy (CBT), Prevalence, Physiology, Chronic, International Association for the Study of Pain, Pedometer, 6-minute Walk Test, Physical Activity Questionnaire, Brief Pain Inventory, Visual Analogue Scale. As this is a narrative review, articles were chosen based on their relevance to the scope of the study.

2.1 Prevalence of Chronic Pain

In the United States of America (USA), healthcare costs can be up to three times higher in people with chronic pain as compared to healthy individuals with cost estimated to be as high as $635 billion in healthcare and productivity loss in 2011 (Fishman, et al., 1997; IOM, 2011). Prevalence of chronic pain has been documented in a number of studies to be as high as 45%-50% in the USA and the United Kingdom (Elliott, et al., 1999; Fayaz, et al., 2016; Kindler, et al., 2010) with rates of around 12-30% in Europe (Breivik, et al., 2006; Breivik, et al., 2013; Gran, 2003; O'Riordan et al., 2014). The prevalence of chronic pain in Brazil, a country similar to South Africa in respect of demographics, economic status and population, was as high as 25.4% (Meucci, et al., 2015). Prevalence of chronic pain increases linearly with age from the third decade of life and was higher in women, with some studies reporting incidence of non-specific chronic lower back pain (CLBP) as high as 60-80% in these sub-groups (Bourigua, et al., 2014; Karlsson, et al., 2018; Larsson, et al., 2016; Meucci, et al., 2015). The majority of these numbers are based on first-world, developed nations, whereas South Africa is a developing nation. Data on chronic pain statistics in South Africa are sparse, but there is an indication, even if at a basic level, of the burden of this multi-faceted phenomenon (Meyer & Kenny, 2010; Pillay et al., 2014; Rauf et al., 2013).

The prevalence of chronic pain in South Africa appears to be comparable with developed countries, with ranges of between 10%-43% (Igumbor, et al., 2011; Parker, et al., 2010; Smuts & Meyer, 2008). Further, prevalence of HIV-related pain in South Africans may be as high as 94% (Mphahlele, et al., 2008). This is worrisome in a country where there is a high prevalence of HIV/ AIDS, higher than any other single country (Parker, et al, 2014).

2.2. Prevalence of Disability associated with Chronic Pain

2.2.1. Prevalence of Disability

Chronic pain is a multi-factorial experience that can cause disability and affects almost all aspects of the sufferer's life, including mood, psychological state and daily functioning, resulting in disability (Alschuler, et al., 2011; Fayaz, et al., 2016; Meucci, et al., 1999). Chronic pain impacts all aspects of the chronic pain sufferer's life, as well as their family's lives (Igumbor, 2011). According to one qualitative study, chronic pain sufferers value physical activity and exercise, but are limited by various aspects of chronic pain that include pain severity, motivation and self-efficacy, among others (Karlsson, et al., 2018). The study concludes that chronic pain sufferers want to be physically active, but due to the nature of chronic pain, are limited in their participation in physical activity that can increase feelings of disability in the patient's life. In a country such as South Africa, a large group of the population make use of public transport as a means of getting to work. It can therefore be assumed that the self-imposed limits placed on chronic pain sufferers, whether consciously or not, would affect their ability to access public transport, and consequently participate in activities reliant on such transport including the ability to participate in work.

Patients suffering from chronic pain had less rest periods than their healthy age- and gender-matched counterparts but spent significantly more time being inactive (Van Den Berg-Emons, et al., 2007). These are the years when individuals are at the peak of their working life and are generally supposed to be most active in their work environment. The study highlights the increased disability within this age group that ultimately affects not only the chronic pain sufferer's life, but the lives of family members due to the strain placed on income-earning potential. In South Africa, the high unemployment rate often mean that there is only one breadwinner in a household, or one income-earner who supports more than one family.

Chronic pain sufferers were found to have significantly lower aerobic fitness, when compared to healthy individuals. This has been theorised to be due to disuse of large muscle groups, which resulted in lower levels of aerobic fitness (Smeets, van Geel, & Verbunt, 2009). In South Africa, the many individuals walk large distances to access public transport. It is possible that chronic pain sufferers in South Africa may not fit the above profile as one could argue that by merely walking to the bus stop, train station or taxi rank, increases physical activity on a daily basis could mitigate

some impact of de-conditioning in the chronic pain sufferer. The study also found that there were significantly lower levels of physical activity in chronic pain sufferers compared to healthy individuals and found that the fear-avoidance model of pain was not associated with this decrease. The measure of aerobic fitness is linked to a significant increase in the Maximal Volume of Oxygen Consumed in one minute (VO2-Max test) as compared to physical activity, which is a measure of the general movement of an individual during activities of daily living (Smeets, et al., 2009). This fundamental difference in definition is vital when looking at the way information is presented, as it is discussed later in this review that chronic pain sufferer's tend to do almost no vigorous activity, which would be the basis for assessing aerobic fitness. The importance of this statement lies in the fact that the study by Smeets and colleagues looks at the interaction between a relatively high (vigorous) level of physical activity and the chronic pain experience, which seems to be difficult to reason as the fear-avoidance model could not play a part when the chronic pain sufferer avoids one of the tested variables all-together (Smeets, et al., 2009). Nonetheless, in order to get a greater picture of the impact of chronic pain on a patient's life, one needs to understand the impact of external factors involved.

2.2.2. Disability and Pain

Disability is not solely dependent on pain intensity (Elliott, et al., 1999; Staton, et al., 2007). In the latest 2017 General Household Survey, it was found that as much as 4.2% of the South African population was classified as disabled according to the Washington Group, which included questions about walking for one kilometre and climbing a flight of stairs (General Household Survey, 2017).

Dansie and colleagues found that levels of physical activity were not associated with pain status, yet chronic pain sufferers did not participate in moderate-vigorous activity, even when advised to do so by health care providers. They suggest that this indicates that more than one mechanism is responsible for the low levels of physical activity and aerobic fitness in people with chronic pain (Dansie, et al., 2014). There is evidence that physical activity has both positive and negative effects on the parts of the brain which process pain, when physical activity is repeated, compared to initial physical activity, where, for example, a fibromyalgia patient may have negative feelings toward initiating physical activity (McLoughlin, et al., 2011). Current evidence suggests that in order to reduce disability associated with chronic pain, treatment needs to shift away from pain, and towards living well with pain (Moseley & Butler, 2015).

A 2011 systematic review of 13 articles on physical activity (including sporting activities) and CLBP found that there was very little evidence of an association between physical activity and lower back pain, possibly suggesting that those suffering from chronic pain should continue physical activity despite pain (Sitthipornvorakul, et al., 2011). The study commented that the majority of articles reviewed were found to be of mediocre quality and as such definitive conclusions cannot be drawn from them. The review does, however, show that the 13 articles (mostly randomised controlled trials) included had good insights into recommendations for continuing with sport despite low back pain, as well as strategies to prevent increasing the risk of CLBP. These are the type of high quality studies which are needed in the field of exercise-based treatments in the management of chronic pain. Ultimately, there is a positive theme throughout these studies, which is that the levels of physical activity in CLBP do not seem to be associated with severity of pain and that it could be beneficial and safe for those suffering from CLBP to continue physical activities.

External factors play a role in chronic pain, associated disability and includes among others, age, gender, smoking, level of education, level of physical activity, social interaction, income group, depression, anxiety, sleep disorders, manual work and marital status (Cimmino, et al., 2011; Egli, et al., 2013; Kindler, et al., 2010). A complicated scenario presents itself for the clinician to address and as such, a multidisciplinary team needs to be involved, consisting of various health care providers with a range of specialties in different aspects of chronic pain. One specialty which has garnered much attention in the scientific community is that relating to physical activity and exercise and how they affect this multi-faceted phenomenon known as chronic pain.

Bousema and colleagues describe disuse as decreased physical activity during daily life that can cause decreased physical fitness levels (Bousema, et al., 2007). They conducted a study with a large sample of 124 patients, good follow up and a validated set of testing tools. Patients had a pain duration of 4-7 weeks after the onset of pain, which is less than the IASP classification for chronic pain, but well on track towards dysfunction and de-conditioning. Interestingly, the study found that only around half of the participants had decreased activity levels, but a subset had a level of excessive physical activity, indicating a lack of reasonable pacing and moderation of physical activity. The basis of treatment for chronic pain sufferers therefore is modification of physical activity (rather than merely increasing physical activity) based on the understanding that pain is not

necessarily indicative of tissue damage (Moseley & Butler, 2015). The adaptability of the body can occur at any age, merely being slower in older adults. This is positive, as it is a sign that any patient can engage in some form of physical activity modification and have a positive impact on their perception of pain.

2.3. Current Treatments for Chronic pain

2.3.1. Pharmacological Treatment

Studies have shown that chronic pain sufferers can, at times take medication which exceeds the recommended dosage that can lead to possible side effects and increased tolerance to medication. It was suggested as early as 1984 that dosage frequency be changed to time-based ingestion, as opposed to taking medication when the patient feels an increase in the perception of pain (Fordyce, 1984; Gatzounis. et al., 2012). This is vital in the pharmacological management of chronic pain, as addiction to opioid medication has been shown to be as high as 50% in some studies, with other medication prescribed to adults including analgesics and anti-depressants (Gatzounis, et al., 2012; Gu, et al., 2010; IOM, 2011). A Cochrane review found that topical analgesics were effective in only a very small group of chronic pain sufferers (Derry, et al., 2017). Given the limited and short term effects of pharmacological treatments, it is no surprise then that patients often develop tolerance to these medications, inevitably leading to higher dosages and increased dependence, further reinforcing the ongoing cycle of chronic pain and its maladaptive behaviours. A natural response to this information would be to ask which other options a patient is left with, if medication has limited use in treating chronic pain.

Dansie found that patients suffering from chronic pain participated in less moderate- and vigorous activity than those without chronic pain (Dansie, et al., 2014). The evidence for physical activity and exercise in pain management is well-documented, with improvements in many aspects of a chronic pain sufferer's condition (Giubilei, et al., 2007; Ribaud, et al., 2013; Tse et al., 2011). This led to the interest of investigating the effects of exercise in chronic pain management and how this affects a chronic pain sufferer's daily physical activity.

2.3.2. Exercise

According to Caspersen, physical activity is defined as "any bodily movement produced by skeletal muscle that results in energy expenditure," whereas exercise is defined as "a subset of physical activity that is planned, structured and repetitive and has a final or intermediate objective [of] the improvement or maintenance of physical fitness" (Caspersen, et al., 1985). Another way to describe physical activity to lay-persons is any activity which a person does during their daily life which does not necessarily have a structured plan to it, such as would be the case with an exercise program. There is evidence to show that both physical activity and exercise improved functional mobility and decreased pain in older patients and improved functional capacity and muscle strength by increasing physical activity, without detrimental effects on disease progression (Kujala, 2009; Tse, et al., 2011). The endorphin release during exercise causes the activation of the endogenous opioid receptors centrally and peripherally to modulate the pain through analgesic effects (Nijs et al., 2012).

The use of exercise in pain management is well documented and has been associated with increased levels of physical activity, as well as improvements in many aspects of a chronic pain sufferer's experience of this multi-dimensional dynamic. In a double-blind, randomised study by Giubilei and colleagues, it was found that an aerobic exercise program was superior to a placebo/stretching program (Giubilei, et al., 2007). The study consisted of males only, as it investigated chronic pain due to prostatitis and Chronic Pelvic Pain Syndrome and follow-up was relatively short at six and 18-weeks with a reasonably small sample size, meaning that these results can't reliably be generalised for the population. However, the results are corroborated in a wide range of studies of exercise for various chronic pain conditions.

The evidence for exercise in pain management is further supported by studies such as Ribaud et al. (2013) where a literature review that included 121 studies found that moderate, but regular exercise was beneficial for a chronic pain sufferer. A complex multi-stage sampling study by Dansie and colleagues with a large representative sample found that patients suffering from chronic pain participated in less moderate-to-vigorous activity than those without chronic pain and noted that the difference between these groups of participants was smaller among females than among males (Dansie, et al., 2014). A running theme of studies on different aspects of chronic pain is that there

are significantly more females than males, which supports the fact that more females than males suffer from chronic pain with various reasons due to both internal and external factors, such as females reporting more pain responses, lower pain thresholds and increased negative responses to pain (Ramírez-Maestre & Esteve, 2014).

The decrease in moderate-to-vigorous physical activity can affect bio-psychosocial aspects in the chronic pain patient, as South Africa has a large number of low-skilled/unskilled workers. This directly impacts other social factors in the sense that if a worker cannot do the required physical tasks in their work environment, they may ultimately be retrenched and therefore cannot earn an income to support their families. This leads to loss of income, associated psycho-social factors such as depression and anxiety, as well as spousal stress, which negatively affects the chronic pain sufferer's experience of pain.

The study by Tse and Colleagues (2011) had a moderate number of participants (75), with predominantly females and chronic pain sites of the lower limb. There was a significant decrease in pain intensity scores of the participants after participating in an eight-week physical exercise programme, but one could argue that this is due to the simple notion that doing any type of physical activity, least of all a structured-, monitored exercise program, will likely result in an improvement in physical conditioning, improved mood and a general decrease in overall pain state. One must take into account that the evidence presented shows that with a 'recipe' approach to exercise programs, the investigators still found a significant positive impact in the chronic sufferer, and in a setting such as a nursing home, this approach may be adequate to address and manage pain conditions which cannot be cured, such as in the cases of knee and hip osteoarthritis.

South Africans living with chronic pain have been found to have lower levels of physical activity compared to healthy individuals (Parker, et al., 2014) and those in developed nations (Gradidge, et al., 2014). The introduction of moderate physical activities such as swimming, walking and cycling for this population of chronic pain sufferers may be of benefit to the general population, as well (Giubilei, et al., 2007; Parker, et al., 2017; Ribaud, et al., 2013; Tse, et al., 2011).

2.3.3. Education

A single one-on-one educational session on lumbar spine physiology or pain physiology has a positive effect on subjective and objective measures of chronic pain (Moseley, 2004). The cognitive changes affected various measures, possibly indicating that there was a process of rationalisation of pain and pain states in chronic pain sufferers. It may be rationalised that if one session of physiology education could change these outcomes, how much more could a structured CBT intervention, over multiple weeks affect various aspects of chronic pain?

The introduction of pain neuroscience in the management of chronic pain aims to increase a patient's knowledge of pain and encourages a return to activity, which can decrease the perception of disability of the chronic pain patient (Clarke, et al., 2011; Moseley, 2004). This method of teaching the various models of chronic pain, pathophysiology and underlying neurophysiology is conveyed using simple diagrams and metaphors, so that patients may grasp concepts more easily (Clarke, et al., 2011). A systematic review and meta-analysis by Clarke and colleagues noted that pain neurophysiology and a pain management program showed a significant improvement in back pain for up to 12 months. The critical component of any CBT is the education which aims to change the beliefs (cognitive restructuring) on which behaviours are based, ultimately focussing on the need to manage pain, as opposed to curing chronic pain (Moseley & Butler, 2015). This educational component can be seen as having a much further reach than most clinician's grasp, as there can be long-lasting effects (12 months) from helping a chronic pain patient gain the knowledge about their pain, which can potentially improve the clinical outcomes of treatment and help a patient understand the disease-management process better.

2.3.4. Surgery

Surgical intervention is often one option presented to a patient suffering from chronic pain when attempting to cure pain. Some data suggests the incidence of post-surgical chronic pain to be as high as 50% and has a significant effect on quality of life and significant economic cost (Jones & Bari, 2014). Factors such as age, psychological factors, genetic factors, preoperative pain, acute postoperative pain, surgical factors and pharmacological interventions have effects on chronic pain after surgery. The myriad of factors that can negatively affect chronic pain after surgery needs to be addressed to establish if the risk for non-lifesaving surgical intervention outweigh its benefits.

A randomised controlled trial in 2005 investigated the outcome of surgical intervention compared to a CBT intervention in patients suffering from CLBP. The study concluded that a CBT intervention has similar outcomes compared to a surgical intervention (spinal fusion), without the added healthcare cost and risk involved with invasive surgical intervention (Fairbank, et al., 2005). It must be noted that although patients reported a decreased perception of disability after surgery, which has a high cost and risk associated with this type of intervention, this difference was only marginally more than the CBT approach, which has low cost and minimal risk to the patient. The reductions in perceived disability, similarities in objective outcomes as much as 24 months after intervention gives credence to the use of CBT as a viable approach to the management of chronic pain, which may decrease the burden placed on the resource constrained public healthcare sector when surgical intervention is utilised as an attempt to treat pain.

2.3.5. Multimodal Interventions

When investigating the effect of exercise and physical activity on chronic pain, a 2012 review showed that exercise has a positive effect on chronic pain sufferers' perception of pain, but this effect is dysfunctional if the exercise program is a "recipe" program (a one-size-fits-all approach where each patient is given the same program as the next), resulting in possible symptom exacerbation. Yet when these individuals have a tailor-made, individualised exercise program, the positive effects were significant (Nijs, et al., 2012). Heneweer presents a compelling argument that the interaction of physical activity and chronic pain is a U-shaped one, where sedentary behaviour (doing very little physical activity), as well as excessive-activity (doing very high levels of physical activity) can cause a moderate increase in risk and pain perception in chronic pain sufferers (Heneweer, et al., 2009). This presents a challenge to the health-care practitioner, as each chronic pain sufferer will have a different response to treatment due to various factors, including psychological state, progression of disease, mood, family situation, level of stress, to name a few.

Kujala (2009) describes a strategy whereby chronic pain conditions need to be addressed by evidence-based exercise programs, involving aerobic and functional movements to increase functional capacity in these groups. The benefits of these types of exercise programs include a delay in mortality, an increase in functional capacity in muscle strength, increased independence, decreased disability and a decrease in pain (Kujala, 2009). There have been a number of studies

documenting the effect of exercise on chronic pain, as well as the effect of chronic pain on physical activity (Alschuler, et al., 2011; Andrews, et al., 2012; Dansie, et al., 2014; Giubilei, et al., 2007; McLoughlin, et al., 2011; O'Riordan, et al., 2014; Ryan, et al., 2009; Tse et al., 2011), yet no data on the effect of a CPMP on changes in physical activity levels in chronic pain sufferers after a Chronic Pain Management Program intervention could be found.

A multi-modal approach was found to be the most effective form of exercise in the management of chronic pain. This includes specific strength-training, stretching, relaxation techniques and aerobic exercises which increase strength, improve function, health-related Quality of Life and decrease pain scores (Bogduk, 2004; Parker, et al., 2014; O'Riordan, et al., 2014). This is important to note as the approach to exercise is not just uni-modal, it needs to focus on various aspects of physical activity and exercise in order to put the patient in control of their management, which includes them in the decision-making progress, as well as the responsibility of being accountable for their own management. In a South African health context where a large part of the population is dependent on limited state healthcare resources which are already stretched, this type of chronic pain intervention has the potential to decrease the load placed on the system as a whole, potentially increasing the effectiveness of services rendered, decreased dependence on state resources and an overall improved feeling of control within the chronic pain population with regards to their management.

O'Riordon notes that exercise programs should last at least 6-12 weeks and should preferably be advised to be life-long for individuals suffering from chronic pain (O'Riordan, et al., 2014). Due to the complex nature of chronic pain, one may deduce that the implementation of a consistent, structured exercise program be coupled with education in the form of dealing with the cognitive affects which are associated with chronic pain.

A robust Cochrane review by Busch and colleagues which included 34 studies and 2276 subjects supports the fact that supervised aerobic exercise, as well as supervised strength training has positive effects on physical activity and symptoms associated with Fibromyalgia, one of many chronic pain conditions (Busch, et al., 2008). In a South African context where chronic pain conditions are high among certain groups of chronic pain sufferers, especially those living with HIV/AIDS in low-income areas, the effect of aerobic and strength training exercises which are supervised can be supportive in decreasing the disabling effect of de-conditioning in the chronic pain sphere. Many patients hold the belief that any exercise will make their pain worse and thus

avoid any type of physical activity, further adding to the fear-avoidance model of chronic pain (Vlaeyen & Linton, 2000). The avoidance of physical activity increases the disability faced by these individuals, as the constant loop of fear, avoidance and de-conditioning is further exacerbated by a misguided belief that pain will be made worse. Up to this point, it should be quite evident that exercise, whether done in groups, given individually, or whether aerobic, strength-based or functional-based, needs to form part of treatment in the management of chronic pain. It is also prudent to have the entire multi-disciplinary team aware of this fact and to ensure that exercise plays a vital part in helping a chronic pain sufferer manage their individual conditions.

2.3.6. Mindfulness-based strategies

Thompson and colleagues describe the significant impact that cognitive factors have on the chronic pain process and recommend that these factors be addressed during treatment (Thompson, et al., 2010). Treatment aims should be focussed on decreasing levels of catastrophizing, pain awareness and vigilance, as well as increasing patient understanding of their chronic pain condition to decrease the levels of pain intensity experienced by these patients (Geisser & Roth, 1998; Main & Watson, 1996; Murphy, et al., 2012; Thompson, et al., 2010). Improved patient education about different aspects of their specific conditions, nutrition and exercise programs, specifically the FITT principles (Frequency, Intensity, Type and Time) of the program in order to guide the patient through the exercise program are recommended (O'Riordan, et al., 2014).

Pacing strategies are one of the treatment techniques used which can ultimately decrease pain intensity by modifying the amount of physical activity and the intensity at any given time. When pacing strategies are not employed, chronic pain sufferers risk hyper-activity, or hypo-activity that can lead to an exacerbation of symptoms and increase the perceived intensity of pain, resulting in poor patient outcomes (Andrews, et al., 2012; Thompson, et al., 2010). Time spent in sedentary positions and postures is a growing concern worldwide, with averages ranging from 5-8 hours of sitting per day (Bauman, et al., 2011). This is significant, as it is a large portion of individual's lives (20-34%, excluding time spent in bed). In the South African context, it has been found that the levels of physical activity are below those of the rest of the world, with the subset of those chronic pain sufferers referred to GSH specifically found to be lower than healthy-matched individuals (Parker, et al., 2017). This is of particular concern as these individuals' levels of physical activity are well below normal levels. This previous cross-sectional study done at GSH in Cape Town,

although small in sample size, is an important step on the way to understanding the levels of physical activity of chronic pain sufferers in the GSH community (Parker, et al., 2017). The information from this study opens the way for building an understanding of a baseline from which the current study may have a comparable set of data within the same demographic of patients.

2.3.7. Psychology

Cognitive factors play a significant role in the chronic pain experience, with various aspects of the models of chronic pain affecting the patient's overall presentation (Geisser & Roth, 1998; Vlaeyen & Linton, 2000). The fear-avoidance model is an example where the chronic pain sufferer fears that pain is exacerbated by physical tasks which are subsequently avoided, leading to a decrease in physical activity, increased dysfunction of the body tissue and an increase in disability from under-utilising body tissue (Leeuw, et al., 2007; Monticone, et al., 2013). Chronic pain sufferers had altered self-report measures of pain, catastrophizing, fear, pain vigilance and awareness, as well as altered beliefs of pain (Apkarian, et al., 2009, Carragee, 2001). The overall picture is one of disability, where cognitive and physical-avoidance factors play a role in a cycle of increasing disability of the chronic pain patient. This greater perception of disability can augment the central pain processes, increasing input from the periphery and in doing so, increase firing of the nociceptors when increased activity is attempted. Such processes lead to an increase in perceived levels of pain and further disability.

Chronic pain affects the sufferers' psychological state, which, combined with disuse of the musculoskeletal system can compound the effects on a patients' mood. A change in physical activity and exercise has multiple effects on conditioning and pain. The above definitions give a good description for what is otherwise often misunderstood and ill-described as 'exercise,' the general consensus being that this describes any type of bodily movement, when in fact this actually describes physical activity. It is this type of seemingly 'unimportant' correction that forms part of the basis of improving aerobic capacity in the greater community, because South Africans have a lower level of physical activity when compared to the rest of the world, so an improvement in the knowledge of what constitutes physical activity can be the basis for not only improving physical fitness within the chronic pain community, but in the general population as a whole (Giubilei, et al., 2007; Parker, et al., 2017).

Chronic pain has been shown to increase the difficulty with which chronic pain sufferers may perform activities of daily living and lead to a decrease in desire and motivation to participate in exercise and social events (Tse, et al., 2011). This was described in 1983 by W. M. Bortz II who comments that a decrease in physical activity has been linked with an increase in co-morbidities, musculoskeletal fragility and depression, otherwise known as Disuse Syndrome (Bortz, 1984).

Chronic pain has been shown to increase the difficulty with which chronic pain sufferers perform ADL, because it can cause a decrease in desire and motivation to participate in exercise and social events (Tse et al., 2011). Ryan et al. (2009) describes the fear avoidance model as a chronic pain sufferer's avoidance of activities which they perceive could lead to further injury and pain. This model becomes dysfunctional in the chronic pain sufferer as even though there is an absence of injury/threat to the body, the sufferer perceives movements to be potentially harmful. This pattern of repetitive fear and avoidance usually leads to a vicious cycle of kinesiophobia and disuse/de-conditioning in the individual. The chronic pain sufferer tends to do less and less moderate-vigorous activity and in so doing, affects their Quality of Life negatively (Ryan, Margaret Grant, Dall, et al., 2009). Ryan and colleagues (2009) describe the model in relation to its effect on study participants suffering from chronic pain. They note that fear avoidance usually leads to disuse and a decrease in physical activity of as much as 44% (Leeuw, et al., 2007; Lethem, et al., 1983; Philips, 1987; Ryan et al., 2009; Verbunt, et al., 2003).

In a study by Bourigua and colleagues, chronic pain sufferers were found to exhibit freezing-like patterns when instructed to move their trunk as fast as possible, whereas their healthy counterparts tended to alter pace and pattern in order to achieve a high velocity of trunk movement. The chronic pain sufferers tend to exhibit dysfunction in terms of motor control, both statically and dynamically. This was due to the loss in trunk stability, decreased trunk mobility and dysfunctional activation patterns. These changes in movement patterns are related to the cognitive factors of central processing of pain. There are various changes in pain cognitions, combined with changes in the central processing and sensitization of nociception which contributes to gross dysfunction of the trunk musculature and stabilizing mechanisms. This ultimately augments the disuse of the body tissues and therefore increases the fear-avoidance model, leading to lower physical activity and increased disability (Bourigua, et al., 2014).

Lower pain awareness and vigilance are associated with lower levels of pain intensity (Goubert,

Crombez, & Van Damme, 2004; Roelofs, et al., 2004). Pain vigilance and awareness is proposed to lower the threshold of pain, the level at which pain is perceived to be a threat to the system and it can conversely be deduced that the lower awareness and vigilance decreases the risk of disuse and fear-avoidance. As can be seen from these results, the change in cognitive factors as they relate to chronic pain can become a "vicious cycle" of ever-increasing disability and pain, which can augment secondary complications (allodynia and secondary hyper-algesia) and further complicate the overall presentation of the chronic pain sufferer through various factors, both internal and external.

There seems to be a fundamental shift needed from standardized, 'recipe' exercise programs to a more bio-psychosocial type program, which addresses physical, emotional, psychological and external factors in the chronic pain space (Moseley & Butler, 2015).

2.4. Chronic Pain Management Programs

The main aim of treatment in chronic pain should be to help chronic pain sufferer's change their chronic pain behaviours, to use the knowledge to self-manage their condition, to essentially "live well with pain" (Morley, 2011; Moseley, 2004; Moseley & Butler, 2015; Smeets, et al., 2006; Parker et al., 2014). GSH has a Chronic Pain Management Unit which runs a program based on CBT and the management of chronic pain behaviours based on the Fear-Avoidance model of pain. A large part of this patient-centered program relies on the use of exercises and the idea that not all exercise will exacerbate pain, but that graded, moderate exercise can actually help the chronic pain sufferer in various ways.

Activity advice and patient education have been found to be beneficial in treating patients with chronic pain and Long and colleagues describe these aspects of management in relation to "Directional Preference," where programs use CBT approaches to address and manage chronic pain based on the fear-avoidance model of pain (Long, Donelson and Fung, 2004; Parker et al., 2014). A large portion of cognitive behavioural approaches aims to change chronic pain behaviour and the idea that they can influence their perception of pain through education, exercise and pacing strategies, with the basis being that pain is not an accurate measure of the amount of tissue damage and that exercise is beneficial (Moseley, 2004; Moseley, 2007; Morley, 2011; Moseley & Butler, 2015). This is due to the fact that in the chronic pain picture, the beliefs about pain and its relation

to tissue damage is misunderstood, resulting in altered pain behaviours, based on fear-avoidance, de-conditioning and ever-increasing disability that results in a perpetual cycle of negative bio-psychosocial effects on the chronic pain sufferer.

Lorig & Holman describe the action of 'self-management' as consisting of three management tasks, namely: Medical management, Role management and Emotional management, as well as six self-management skills, namely: problem solving, decision making, resource utilization, patient-provider relationships, action planning and self-tailoring (Lorig & Holman, 2003). The self-management aspect of treatment is a life-long task in which the chronic pain sufferer is responsible for the efficacy of their management. A Cochrane Review of psychological treatments (including CBT) by Eccleston and colleagues determined that they do not necessarily alleviate pain, but they do have a positive effect on mood states, which is an important aspect of the chronic pain experience (Eccleston, et al., 2012). This change in mood state can be used to great effect in education about chronic pain, as well as potentially in the chronic pain patient's willingness to partake in various forms of exercise (Eccleston, et al., 2012).

Most CPMP's focus on modifying behaviours associated with the fear-avoidance model, as the movement of painful segments and input from a non-noxious stimulus is generally misinterpreted as a noxious/threatening stimulus which will have a detrimental effect on the body (Leeuw, et al., 2007). One of the aims of the CPMP is to change the chronic pain patients' beliefs about their pain through the use of education and structured exercise programs aimed at changing behaviour more than simply giving the patient a specified amount of sets and repetitions of various exercises. A number of reviews have shown that exercise has a positive effect on chronic pain, with the mechanism described by Nijs and colleagues, where they state that endogenous compounds are released from the pituitary gland and the hypothalamus, the proverbial 'feel-good hormones.' Exercise increases the pain threshold by activation of supra-spinal descending inhibitory pathways (Bogduk, 2004; Nijs, et al., 2012) but patients are only going to be able to change their behaviour and maintain exercise as a long-term treatment if the exercise is delivered in conjunction with education to allow cognitive restructuring about the danger of nociceptive input received. Therefore, CPMPs utilize the multi-modal approach of combining exercise, CBT principles of education and cognitive restructuring and Mindfulness-based strategies to reduce pain and increase function.

2.5. Measuring physical activity

Since we have described the change in physical activity in daily life, as well as the avoidance of physically-exertive tasks due to various factors, it should be of concern that in the chronic pain population the amount of time spent in sitting positions (sedentary behaviours) would presumably increase due to factors such as fear-avoidance, catastrophizing and disuse. The consequences of a sedentary lifestyle are well known and this can only negatively compound the effect on psychological and physical status of a chronic pain sufferer. There has been some research into the use of pedometers to measure behaviours in various subgroups of different populations, but none have looked at pedometer use to determine the effect of a specific, supervised CPMP on physical activity.

2.5.1. Subjective vs. Objective measures

A moderate association has been found between self-reporting of physical activity and a battery of physical tests in patients suffering from acute- and chronic low back pain (Lee, et al., 2001). However, physical activity in daily life was not evaluated, but rather a battery of tests under laboratory conditions, usually strictly controlled with various processes and procedures in place were used, which may explain the outcomes of the study. The investigators also noted more correlations between psychosocial factors and self-reporting than with pedometer-measured testing, which could indicate a discrepancy between perceived and actual physical activity among chronic pain sufferers (Cleland, et al., 2011). This should come as no surprise, as the general discrepancy between self-reported physical activity and objectively-tested physical activity are documented and discussed in various studies within the chronic pain space (Cleland, et al., 2011; Lee, et al., 2001; Oyeyemi, et al., 2014).

A systematic review by Sitthipornvorakul and colleagues found that the majority of the studies reviewed used self-report outcome measures as opposed to using objective-measures to assess physical activity (Sitthipornvorakul, et al., 2011). An investigation into the physical performance of female subjects with Fibromyalgia revealed that physical activity, measured by self-report questionnaires, were similar in Fibromyalgia and non-Fibromyalgia women, yet physical performance was significantly lower in the Fibromyalgia group (Breda, et al., 2013). This highlights the importance of using both self-report assessments, as well as objective measures when dealing

with chronic pin patients, as people suffering from chronic pain tend to have a dissociation between self-report questioning and objective findings (McLoughlin, et al., 2011; Sebastião, et al., 2012). This was substantiated by O'Riordon and colleagues who note that "self-assessment can lead to bias and may not be a true indication of the results of an intervention" (O'Riordan, et al., 2014). It was therefore prudent to include subjective, self-report questionnaires, as well as objective testing into the current study, as these methods of testing prove to be fundamental in getting an accurate idea of the change in physical activity after a Chronic Pain Management Program intervention.

2.5.2. Subjective measures of physical activity

The International Physical Activity Questionnaire (IPAQ) is used as a self-report tool to assess physical activity and is "suitable for assessing population levels of physical activity across countries (Craig, et al., 2003). Mynarski et al. (2012) found that the IPAQ was a potentially positive tool which is cost-effective and can be implemented without more sophisticated measuring tools in the ongoing process of managing and subsequently increasing physical activity (Mynarski, et al., 2012). Oyeyemi in Nigeria found that it is important to have both a subjective (modified IPAQ) and an objective (accelerometer) measure in order to increase the accuracy with which physical activity can be determined and ties in with the afore-mentioned studies above (2.5.1. Subjective and Objective measures) (Oyeyemi, et al., 2014). The investigators found that there was poor evidence linking subjective/self-report data and objective findings, further increasing the argument that a subjective questionnaire like the IPAQ would over-estimate components of physical activity done by an individual and would therefore need an objective measure to increase accuracy in the research process (Oyeyemi, et al., 2014). The Short-version of the IPAQ has been selected as it was shown to have adequate reliability and validity according in a South African context and can therefore be used in this study to get an easy-to-use, simple subjective assessment on self-reported physical activity levels (Craig, et al., 2003). The findings of Oyeyemi and colleagues back up our further reasoning that subjective and objective measures need to be used, further made relevant in the fact that it was done in another African country similar to South Africa in terms of resources and public healthcare.

2.5.3. Objective measures of physical activity

Pedometers are an inexpensive, easy-to-use tool with adequate convergent and construct validity, increasingly used to assess physical activity (Tudor-Locke, et al., 2004). In a similarly designed study to the current one, the use of a pedometer was found to increase physical activity and decrease sitting time by an average of 12 minutes per day, including weekend days. This can be a simple, positive strategy to increase the level of physical activity among chronic pain sufferers. It must be noted however, that the study was done using healthy individuals in both the control group and experimental group (De Cocker, et al., 2008). This fact is important as these individuals would not have the myriad of other bio-psychosocial factors experienced by those living with chronic pain, but does however give a positive indication on how simply having an increased awareness of physical activity and 'moving more' can increase physical activity.

In a chronic pain context, one needs to understand both positive and potentially negative effects a pedometer may have on research within the field, specifically that the use of a pedometer can alter an individual's level of physical activity. This can lead to altered results and a false reflection of physical activity in some subgroups. However, the use of a pedometer to measure physical activity and it's positive effects on this activity far outweigh the potentially negative, as a study by Ho et al. (2013) found, wearing a pedometer only increased physical activity marginally and even decreased physical activity in some groups, with a slight increase in physical activity in adolescent girls and no increase in adolescent boys. It was also found that physical activity decreased over the four-day trial, possibly indicating that the novelty of the pedometer wore off very quickly, most likely bringing levels of physical activity down to normal levels for the age group (Ho, et al., 2013). The last sentence is of utmost importance, in that the fact that the novelty of wearing a pedometer wears off relatively quickly mitigates a pedometer possibly skewing results when physical activity is measured for more than four days. This is the reasoning for measuring physical activity using pedometer over seven days, as opposed to three days. Therefore, when using pedometers as outcome measures, their impact on the levels of physical activity of participants must be considered, with use being made for longer periods of time in addition to other measures of physical fitness (e.g. a six-minute walk test or sit to stand test) being used concurrently to provide validity.

2.6. Chronic Pain Management Programs

Many approaches have been undertaken in the treatment of chronic pain, ranging from pharmacological treatments, to activity pacing strategies (Andrews, et al., 2012), yet one of the most effective treatment strategies have been the implementation of CPMP (Giubilei, et al., 2007; Kujala, 2009; O'Riordan, et al., 2014; Parker, et al., 2014; Tse, et al., 2011). These CPMP focus on physical activity and use the principles of CBT, where the focus is on altering a patient's belief about their pain and the behaviours used to live and cope with pain.

A number of studies have documented the effect of exercise on chronic pain, as well as the effect of chronic pain on physical activity (Alschuler, et al., 2011; Andrews, et al., 2012; Dansie, et al., 2014; Giubilei, et al., 2007; McLoughlin, et al., 2011; O'Riordan, et al., 2014; Ryan, et al., 2009; Tse, et al., 2011), yet there are a paucity of data on the effects of participating in a CPMP on levels of physical activity in people with chronic pain. CPMPs play a vital role in current best treatment for chronic pain sufferers, with the program providing support to the chronic pain sufferer through education, clarifying answers, exercise and change in physical activity behaviours, nutritional advice and life-skills in some cases (Parker, et al., 2014).

The hypothesis of this pre-experimental study is that chronic pain sufferers who participate in the CPMP at GSH will have increased levels of physical activity and function in ADL when compared to baseline testing.

2.6.1. CPMP at GSH

One of the most effective treatment strategies have been the implementation of CPMP (Giubilei, et al., 2007; Kujala, 2009; O'Riordan, et al., 2014; Parker, et al., 2014; Tse, et al., 2011). These Chronic Pain Management Programs focus on physical activity and use the principles of CBT, where the focus is on altering a patient's belief about their pain, increasing knowledge of pain and the behaviours used to live and cope with pain through education, problem solving, activity management and improving skills related to managing chronic pain (Parker, et al., 2009).

The CPMP is run at GSH by the GSH- and University of Cape Town (UCT) Physiotherapy units. The Program aims to equip patients with an increased knowledge about- and understanding of chronic pain, behavioural skills of relaxation, exercise, pacing, nutrition and stress management. The main objective is an increase in the self-management of patient's chronic pain and maintenance of normal daily functioning (Parker, et al., 2009). Chronic Pain sufferers are given a gradually increasing responsibility for their own management, with integration into the decision-making process, planning and execution of all aspects of treatment.

This intervention has been shown to be highly beneficial in various groups, including those living with HIV/AIDS. The increase in responsibility portrays trust in the patient's own perceived ability to manage their condition, allowing a greater sense of control, which in turn decreases one of the most important aspects of chronic pain, the fear-avoidance, disability and loss of control (Parker, et al., 2014; Lorig & Holman, 2003). O'Riordon and colleagues advise that the patient be encouraged to continue with self-management, as well as group-based exercise in order to increase compliance with exercise and stay motivated, retaining the positive health benefits related to exercise (O'Riordan, et al., 2014).

In conclusion, the adage of "live well with pain" as described by Moseley & Butler is an apt one to end this literature review, but to critically analyse this statement, one will realise that simply "living well" is subjective, a mere portion of the overall chronic pain experience. To enhance understanding in the field of chronic pain and its management, we as clinicians need to know the facts, in research and numbers. This is the reason why the current study that investigates the changes in physical activity in a group of Chronic Pain sufferer's after a CPMP Intervention is being undertaken, so we may start to get an idea of the effect of these types of programs, with objective, facts-based numbers

and ultimately fully understand how these programs could be implemented into the greater chronic pain population, allowing clinicians to have yet another tool in the ongoing pursuit of managing these myriad of conditions we know as Chronic Pain.

Chapter 3: METHODS

A pre-experimental pre-test, post-test study was conducted to explore whether there was a change in the levels of physical activity and physical performance in people with chronic pain who had completed the chronic pain management program at GSH.

3.1. Aims

This study aimed to evaluate the differences in levels of physical activity and physical performance of patients suffering from chronic pain before and after participating in a CPMP run by the Chronic Pain Management Clinic (CPMC) at Groote Schuur Hospital in Observatory, Cape Town.

3.2. Objectives

In a group of patients who were referred from the CPMC at GSH to participate in the CPMP to determine:

1. Levels of physical activity one week (seven days) before and one week (seven days) after participation in the CPMP.
2. Changes in physical activity levels (Pedometry) and physical performance (Battery of physical tests) after participation in the CPMP.
3. Changes in pain intensity and interference after participation in the CPMP.
4. Whether self-report levels of physical activity correlate with actual physical activity levels measured with a pedometer among these patients suffering from chronic pain.

3.3 Participants

Patients who were referred to the CPMP by the Chronic Pain Management team of GSH, diagnosed with chronic pain (including medical conditions associated with chronic pain, such as fibromyalgia) of more than 6 months duration (IASP, 1986) were recruited.

3.3.1. Inclusion Criteria

Patients were invited to participate in the study if they had pain that lasted longer than six (6) months and were referred to the Chronic Pain Management Program by the multidisciplinary team

of the Chronic Pain Management Clinic at Groote Schuur Hospital. Patients aged between 18 and 65, who were willing to have their physical activity measured using a pedometer for seven days before and after participation in the CPMP were recruited to the study. All patients participating in the CPMP are screened to ensure that they may participate in moderate-vigorous activity according to the ACSM's *Guidelines for Exercise Testing and Prescription* (ACSM, 2011).[1]

3.3.2 Exclusion Criteria

Participants were excluded if they were recorded as having intellectual or cognitive disorders in their medical records. Patients were also excluded if they had undergone surgery in the six (6) months prior to admission to the CPMP or had a lower limb amputation and were not mobile with a prosthesis. Participants were excluded if they were recorded as having intellectual or cognitive disorders in their medical records.

3.4. Sample Size Determination

As this was a pre-experimental, pre-test, post-test design, a sample size calculation was not performed. Sample size was determined based on the number of patients attending the CPMP. The CPMP includes a maximum of 12 patients in each five-week program. For the purposes of this study, two sets of patients participating in the CPMP were targeted for recruitment to the study, a maximum of 24 potential participants. If there were a large number of drop-outs due to meeting exclusion criteria or failure to complete the CPMP, which included a participant's desire to withdraw from the study, a third group of participants who participate in the CPMP were recruited. Therefore, the maximum number of potential participants was 36.

[1] The ACSM guidelines include the following contra-indications for exercise prescription: Recent acute myocardial infarction, unstable angina, ventricular tachycardia and other dangerous dysrhythmias, dissecting aortic aneurysm, acute congestive heart failure, severe aortic stenosis, active or suspected myocarditis or pericarditis, thrombophlebitis or intra-cardiac thrombi, recent systemic or pulmonary embolus, acute infection.

3.5. Measurement instruments

The measures of pain and physical activity used in the study included the Brief Pain Inventory (Cleeland & Ryan, 1994), International Physical Activity Questionnaire Short Version (Craig, et al., 2003), 6-Minute walk test (Du, et al., 2009) Timed repeated sit-to-stand test (Smeets, et al., 2006) and pedometer tracking over seven consecutive days (Dansie, et al., 2014; Ellingson, et al., 2012; Oyeyemi, et al., 2014; Ryan, et al., 2009; Tudor-Locke, et al., 2005).

All participants completed the baseline measurements, starting with the questionnaires and proceeding to the 6-Minute Walk Test (ATS Statement, 2002; Breda, et al., 2013; Du, et al., 2009) and the Timed repeated sit-to-stand Test with a 5 minute rest between physical tests (Lee, et al., 2001; Novy, et al., 1999; Simmonds, et al., 1998).

3.5.1. Brief Pain Inventory

The Brief Pain Inventory (BPI) uses a series of short questions to assesses pain severity and pain interference with function using a 10-point Numerical Rating Scale (Cleeland & Ryan, 1994). The questionnaire includes four (4) questions which generate a Pain Severity Score, and seven (7) questions which generate a Pain Interference with function score (Appendix 1). The BPI has been shown to have good reliability, validity and is transferrable to a South African context (Keller, et al., 2004; Mphahlele, et al., 2008; Tan, et al., 2004) (Appendix 1).

The BPI is used as a regular assessment tool by the CPMC and patients are routinely asked to complete the instrument at each visit. The BPI was a self-administered questionnaire for this study. For those participants who were unable to read, the BPI was administered verbally in the form of an interview. The investigator read the form as it appeared in the hard copy to maintain consistency and adequate understanding of the questions.

3.5.2. International Physical Activity Questionnaire Short Version

The International Physical Activity Questionnaire (IPAQ) was developed in 1998 by an International Consensus Group and is used to assess self-reported measures of physical activity (Craig et al., 2003). The Short Version consists of seven (7) core questions, which assess the respondent's perceived physical activity during the "last seven (7) days," the week before completing the questionnaire (appendix 2). This version was selected as it has been shown to have adequate reliability and validity in a South African context (Appendix 2) [Craig et al., 2003]. The IPAQ was self-administered in this study. If a participant could not read, the IPAQ was administered as a verbal interview and was read as it appeared on the hard copy to maintain consistency and adequate understanding of the questions (Craig et al., 2003).

3.5.3. 6-Minute Walk Test

The 6 Minute Walk test is a widely-used physical performance assessment tool that evaluates "an individual's global and integrated responses of all the systems involved during exercise," and is widely used to assess the sub-maximal level of Functional Capacity (Du, et al., 2009).

According to the American Thoracic Society guidelines for the 6-minute walk test, a 30m long, flat, indoor hallway should be used with incremental markings at 3m intervals. The start and end points should be clearly marked with a cone. The use of the hallway and not a treadmill is to allow participants to adequately pace themselves during the 6-minute walk test. For this study, the participant started by resting in a chair for 10 minutes prior to the test. Using a lap counter and stopwatch, 6-minutes was set on the stop-watch and the patient rated their level of effort according to the Borg Scale. A one-lap demonstration was given by the investigator with instructions on how intense the level of exercise should be during the test, as described by the American Thoracic Society Guidelines (2002). Participants completed as many laps of the course in the allotted time, namely 6-minutes and the distance covered was recorded on a data sheet for each individual. (Breda ,et al., 2013; Du, et al., 2009).

3.5.4. Timed repeated sit-to-stand test

The Timed repeated sit-to-stand test is a simple functional measure which evaluates a participants' ability to get up from a chair into standing and then return to sitting as quickly as possible (Smeets, et al., 2006). The sit-to-stand movement is repeated five times, while the investigator notes the time taken with a stopwatch. Five repetitions are sufficient to achieve acceptable reliability (Simmonds, et al., 1998).

If the participant stepped forward during the test or used their arms to push up off the chair/sitting surface, the test was restarted after a one-minute rest to allow the participant time to recover. This is a simple, yet effective test, supported by Simmonds, et al. (1998) stating that this test has good-to-excellent reliability, validity and clinical utility when assessing physical function of those suffering from Lower Back Pain.

3.5.5. Pedometry for seven (7) days

Participants were required to wear a pedometer for seven (7) days in order to assess physical activity in an open environment (patient's Activities of Daily Living) one (1) week prior to the commencement of the CPMP and one week immediately after completion of the CPMP.

Participants wore a pedometer throughout the day, except during water-based activities (bathing and swimming). Participants were encouraged to wear the pedometer for at least 12 hours per day and were sent a text message every morning to remind them to attach the pedometer to their clothing. Oregon Scientific® PE326PM pedometers were used for this study.

3.6 Procedure

3.6.1. Prior to testing

The procedure is outlined in Table 3.1. After Ethical Approval was granted, permission was granted by the GSH Physiotherapy Department to conduct the study.

All patients who were referred to the CPMP who met the Inclusion Criteria were invited to participate in the study by contacting them telephonically two weeks prior to their first scheduled session of the CPMP. Patients were informed that the aim of the study was to investigate how the CPMP affects their levels of physical activity. Participants were also informed that the decision not to take part in the study would, in no way affect their participation in the CPMP. Participants who were interested in taking part in the study were invited to attend the Physiotherapy Outpatient Department at GSH to provide full study information, obtain written informed consent and start the pre-CPMP testing (Appendices 3,4 and 5 respectively). Participants were asked to dress comfortably, with comfortable walking shoes for the physical tests (Dansie, et al., 2014; Ellingson, et al., 2012; Oyeyemi, et al., 2014; Ryan, et al., 2009; Tudor-Locke, et al., 2005).

3.6.2. Testing at GSH

On attendance at the Physiotherapy Outpatients Department of GSH, participants were taken to a private cubicle with the investigator where the study was explained in full, through provision of an Information sheet (Appendix 3) and were given the opportunity to have any questions answered. Participants interested in participating in the study provided written informed consent (Appendix 4). After obtaining written informed consent, participants were asked to complete the Brief Pain Inventory (Appendix 1) (Keller, et al., 2004; Mphahlele, et al., 2008; Tan, et al., 2004), as well as the International Physical Activity Questionnaire Short Version (Appendix 2) via self-administration in the language of their choice (Belohlavek, et al., 2011; Craig et al., 2003; Lee, et al., 2011).

The GSH Physiotherapy Department's Gymnasium floor was used as it has good ventilation, lighting and space requirements for the 6-Minute Walk test. A 30-m long, flat, indoor straight line was used, with incremental markings at 3m intervals. Turnaround points (Start- and end-points)

were clearly marked, with each participant confirming that they understood that the markers indicated the beginning and end of the distance to be tested. A Stopwatch (Count-down timer) was used to time each test accurately. Each lap was marked on a data sheet for analysis after the test. For ease of use and safety, chairs were placed at 10m intervals along the distance being tested, to allow the participant to take a break if needed. All emergency equipment was available at the time of testing. Participants were instructed to wear comfortable clothing to walk in, as well as appropriate footwear for walking and were allowed to use any assistive device for walking during the test (Cane, crutches, walking frame etc. if applicable). Participants were instructed that they were to walk at a pace comfortable to them and that they may take rests when needed. The participant started by resting in a chair for 10 minutes prior to the test. A 1-lap demonstration was done by the investigator and instructions on what to do during the test to ensure understanding from all participants during this rest period. Participants were reminded that they were allowed to rest as needed, but were to continue walking when they felt able between the turnaround points as time elapsed. Using a stopwatch (count-down timer), 6 minutes was set on the stop-watch and the test was initiated by the investigator instructing the participant to start when ready.

Participants began at the starting point of the test and completed as many laps of the course in the allotted time. The distance covered was recorded on a data sheet for each individual participant. After each lap successive completion of a lap, participants were encouraged using standard words of encouragement ("Keep up the good work" and "you are doing well"). After each minute, they were told how much longer was remaining. Participants were neither encouraged to walk faster or further, as set out in the ATS guidelines. (ATS statement, 2002; Breda, et al., 2013; Du, et al., 2009)

On completion of the six-minute walk test, participants were escorted to a separate room for the timed-repeated sit-to-stand test to maintain confidentiality. A standard chair was used in a well-lit, ventilated and spacious room, with no objects on the floor. Safety equipment was readily available during testing. Participants were instructed to sit and stand repeatedly, as quickly and safely as possible, five times. If the participant stepped forward or sideways during the test, or used their arms to push up off the chair/sitting surface, the test was stopped and participants were reminded not to use their hands to aid themselves. The participant was given one (1) minute to allow for recovery before restarting the test. Once the time taken was recorded on the data sheet, the participant was instructed of the end of the test (Simmonds, et al., 1998).

3.6.3. Pedometry testing

On completion of the sit-to-stand test, participants were provided with a pedometer and shown how to use it. Instructions regarding Total Step Count, Average Step Count and what to do when the Pedometer is reset accidentally were given to each patient. Patients were required to wear the pedometer for seven (7) consecutive days (Cleland, et al., 2011; De Cocker, et al., 2008; Oyeyemi, et al., 2014) in the week prior to the commencement of the CPMP. Patients wore pedometers for seven (7) days for a minimum of 12 hours of consecutive wearing. Each morning, participants were contacted telephonically to obtain daily readings and data were recorded in the data sheets. Participants were reminded to wear the pedometer according to the guidelines above. Pedometers were returned to the investigator when participants attended the first session of the CPMP.

Participants were contacted telephonically daily to record the number of steps for that day. If a participant was illiterate or could not relay information adequately for any reason, a family member or member living with the participant was asked to report the number of steps captured on the pedometer per day. Levels of physical activity were tracked by the pedometer every day and were checked by the investigator at the end of the seven (7) days.

3.6.4. CPMP intervention

As chronic pain management persists, treatment approach favours one which equips patients to manage their pain long-term and is based on principles of Cognitive Behavioural Therapy (Parker, Burgess et al., 2009). The goals of CPMP aim to increase patient knowledge of pain, increase skills related to self-management and to increase confidence in the decision-making process in their management. (Morley & Eccleston, 2008; Morley, 2011; Moseley, 2004; Moseley & Butler, 2015; Smeets, et al., 2006; Parker et al., 2014).

Although exercise interventions have been shown to have little to no effect on pain or function in those suffering from chronic pain when used in isolation, combining this with education regarding self-management can result in improved knowledge, with increased belief in the benefits of exercise and changes in exercise habits (Jessep, et al., 2009; Hurley, et al., 2010; Lorig, et al., 2005; Saw et al., 2016)

The CPMP is facilitated by qualified physiotherapists trained in the field of chronic pain management. Patients are provided with an educational workbook and participate in educational activities (including goal setting and problem solving), exercise and relaxation training.
Each session of the 5-week CPMP lasts two hours with an integration of patient education on relevant chronic pain topics (Table 2) with simple self-management strategies. Each patient receives a book (containing of the objectives of the course, the content of each session as well as a goal setting sheet to complete at each session.

Exercise includes aerobic, strengthening and range-of-movement components. Sessions are interactive and similar for all participants. Each patient is monitored according to ability, rate of progression and level of disability and necessary modifications are implemented whenever necessary. The complexity and intensity are increased weekly, progressing from 20 minutes, by two minutes each week.

At the end of each session, the physiotherapist facilitates a relaxation activity utilising deep breathing and mindfulness techniques. During these sessions patients lie down on comfortable mats with pillows for support.

Table 2: Chronic Pain Management Program Educational Topics

Week 1	Education component: **Theme: What is Self-Management** What is meant by self-management – steps forward Importance of goal orientated progression (SMART goals). Hand out of work book. **Theme: What is Pain** Pain neuroscience education Relaxation 10 min of relaxation technique.
Week 2	Education component: **Theme: Exercise** Effects of exercise on pain Exercise is medicine – getting the dosage right Goal setting on exercise Exercise component: component: 20 min of low grade aerobic exercise and low grade strengthening exercise and stretching. Relaxation 10 min of relaxation technique
Week 3	Education component: **Theme: Stress and stress management** Causes of stress. What happens in the body during stress. Sleep management Relaxation skills and coping mechanisms - Why it is a helpful tool. Continued goal setting and feedback to group. Exercise component: As week 1 – with progression Relaxation 10 min of relaxation technique
Week 4	Education component: **Theme: Nutrition** Nutrition – what we eat determines our output in terms of energy. The link between healthy food choices and pain. Goal setting and feedback. Exercise component: As week 1 – with progression Relaxation 10 min of relaxation technique
Week 5	Education component: **Theme: Medication** Groups of medication used in the management of pain. Which medications works for what – appropriate use of medication Making informed treatment decisions Goal setting and feedback Exercise component: As week 1 – with progression Relaxation 10 min of relaxation technique

A summarised outline of the procedure can be found below (Table 3.1).

Table 3.1 Outline of Procedure

Step	Week	Description
1	Prior to week 1 of the CPMP	Patients referred to CPMP from CPMC - On referral, patients were invited to take part in the study.
2	Prior to week 1 of the CPMP	Patients who agreed to participate in the study were contacted by the investigators telephonically. An appointment was set up one week prior to commencement of CPMP for baseline testing.
3	Week 1 of the CPMP	Pedometers were returned investigators and CPMP commenced
4	Weeks 2-5 of the CPMP	Participants attended 2-hour long CPMP contact sessions, once a week for 5 weeks
5	After week 5 of the CPMP (one week)	Participants were given pedometers at the final, fifth week CPMP contact session and reminded how to use them.Data collected by investigator at the end of the seven-day period.

3.7. Ethical considerations

The principles of the Declaration of Helsinki and the bioethical principles of beneficence, non-maleficence, autonomy, just and confidentiality were adhered to throughout this study (Williams, 2008; WMA, 2013; Rid & Schmidt, 2010). Ethical approval was obtained from the University of Cape Town, Faculty of Health Sciences Human Research Ethics Committee (HREC REF: 546/2016) and the Groote Schuur Hospital Human Research Ethics Committee (Appendices 6 & 7).

Beneficence was ensured by every participant being provided with information to improve their understanding of how a CPMP can affect their physical activity in their everyday lives. Non-maleficence was ensured by reducing risk at all interactions with participants. All relevant precautions were taken to minimise the potential for harm during the 6-minute walk test and Timed repeated sit-to-stand tests. Participants were informed that they may experience Delayed Onset Muscle Soreness (DOMS) after exercise sessions during the CPMP and testing, but this was projected to be mild. If Participants did experience DOMS, they were assessed by the physiotherapist in charge of the CPMP and, if needed were provided treatment. Participants were supervised during all exercise sessions by a qualified physiotherapist and site-specific measures were used to maintain privacy of each participant during data collection.

Justice was ensured, as all patients who met the Inclusion Criteria were invited to participate in the study without bias or prejudice, with the explanation explicitly relayed to each participant that their role in the study was to provide more information in the ongoing research into the study of chronic pain. Participants were informed that they were free to withdraw at any stage during the study without consequences in order to maintain autonomy. These participants were reassured that their choice not to take part in the study would, in no way affect their participation and treatment in the CPMP or future treatment at the CPMC of GSH. In addition, autonomy was preserved by all information sheets, consent forms and data collection forms beings available in the language of choice (English, Afrikaans or isiXhosa).

Procedural information was documented in the Informed Consent Form and participants were invited to ask any questions regarding any aspects of the study of which they did not understand. All queries were answered to participants' satisfaction as far as reasonably possible. No remuneration was given for participation in this study, although the investigator paid for transport

costs (taxi-fare and bus-fare) to hospital for extra visits where required, in order to collect baseline data and follow-up data, as these visitations to GSH were above normal treatment costs for the participant.

All information and data collected for the study were recorded on electronic spreadsheets. These were held on a password-protected computer, which is secured on password-protected and encrypted cloud-based software. This information was protected by up-to-date antivirus and anti-malware software and only accessible by the investigator and the supervisor of the study.

3.8. Statistical Analysis

As this was a small, pre-experimental study with data which was not normally distributed, non-parametric analysis was conducted. Results are summarised as Median (Interquartile Range 25%-75%), with significance accepted as $p<0.05$. To determine significant changes in pain, 6-minute walk test, Timed repeated sit to stand test and number of steps in a seven (7) day period from before to after participation in the CPMP, the Wilcoxon-Matched Pairs test was used.

Where data were lost to follow-up, last data were carried forward. To explore agreement between self-reported levels of physical activity on the IPAQ and objective measures of physical activity (six-minute walk test), a Kruskal-Wallis ANOVA by Ranks test was used to evaluate convergent validity of the instruments. Normality was assessed using the Kolmogorov-Smirnov test.

Chapter 4: RESULTS

Twenty-five patients agreed to be part of the study, spread over 3 CPMP groups. Two (2) patients did not attend the initial testing prior to the commencement of the CPMP. Two (2) patients did not attend the first CPMP meeting and subsequent meetings thereafter. Three (3) patients did not follow the guidelines for tracking data and had incomplete data. Four (4) participants withdrew from the study for various reasons, ranging from family commitments, to not attending the post-CPMP testing meeting. A total of 14 patients completed the CPMP and had pre-test/post-test data captured.

Participants who did not complete pre-post CPMP testing and those who withdrew from the study were encouraged to complete the CPMP regardless of participation in the current study.

4.1. Participant Characteristics

A total of 48 patients were contacted for inclusion into the study (Table 4.0). Twenty-five patients agreed participants in the study, of whom 12 females and two (2) males completed the full pre-test and post-test data collection. Their median age was 45 years (IQR 34.5-55.5). Participants had been referred for a range of chronic pain conditions including fibromyalgia (n=4); back pain (n=4) and osteoarthritis (n=2) (Table 4.1). Half of the participants were employed, as summarised below in Table 4.1.

Table 4.0: participant recruitment process

Step	Description
1	48 participants were contacted to be part of the study
2	25 participants agreed to be part of the study, spread over three intakes of CPMP patients
3	None of the 25 participants were excluded from participation in the study, as set out in the Exclusion Criteria (3.2.2. Exclusion Criteria)
4	25 participants were included in the study
5	Two participants did not attend initial baseline testing. Two participants attended less than 50% of the CPMP.
6	14 participants post-CPMP data collected. Three participants did not follow guidelines for tracking data and had incomplete data.

Table 4.1: Participant demographics

Case Number	Gender	Age	Referring Diagnosis	Employment Status	BPI - Pain Severity Score	BPI - Pain Interference Score	BPI - Number of pain areas
1	Female	26	Fibromyalgia	Employed	6.25	6.86	1
2	Female	37	Complex Regional Pain Syndrome	Unemployed	5.75	5.14	2
3	Female	28	Endometriosis	Unemployed	7	8.86	1
4	Female	47	Complex Regional Pain Syndrome	Unemployed	8.75	8.71	3
5	Male	48	Osteoarthritis	Employed	2	3.29	1
6	Female	63	Fibromyalgia	Employed	7	7.57	2
7	Female	43	Failed Back Syndrome	Unemployed	5.25	7	3
8	Female	65	Osteoarthritis	Unemployed	6.75	6.57	3
9	Male	42	Chronic Back Pain	Employed	4.75	6.71	1
10	Female	54	Failed Back Syndrome	Unemployed	7.75	6.43	3
11	Female	32	Fibromyalgia	Unemployed	7.25	7.43	2
12	Female	57	Chronic Back Pain	Employed	6	7.29	4
13	Female	55	Chronic Back Pain	Employed	6.25	6.14	2
14	Female	36	Fibromyalgia	Employed	5.75	5.43	4

4.2. Change in Pain

Prior to participating in the CPMP, participants had a median of 2 different sites of pain (IQR: 1-3) with Pain Severity Scores (PSS) of 6.17 (IQR: 5.8-7; Figure 4.2) and Pain Interference Scores (PIS) of 6.67 (IQR: 6.2-7.4). After completion of the CPMP, participants had a median of 3 Pain Sites (IQR: 3-4) and PSS of 5.48 (IQR: 5-6.2) and PIS of 4.94 (IQR: 3.7-6).

There was no significant change in the number of Pain sites from before the CPMP to after. There was a statistically significant improvement in both PSS (z=2.39, p=0.02; Figure 4.2) and PIS after participation in the CPMP (z=2.93, p<0.01; Figure 4.3).

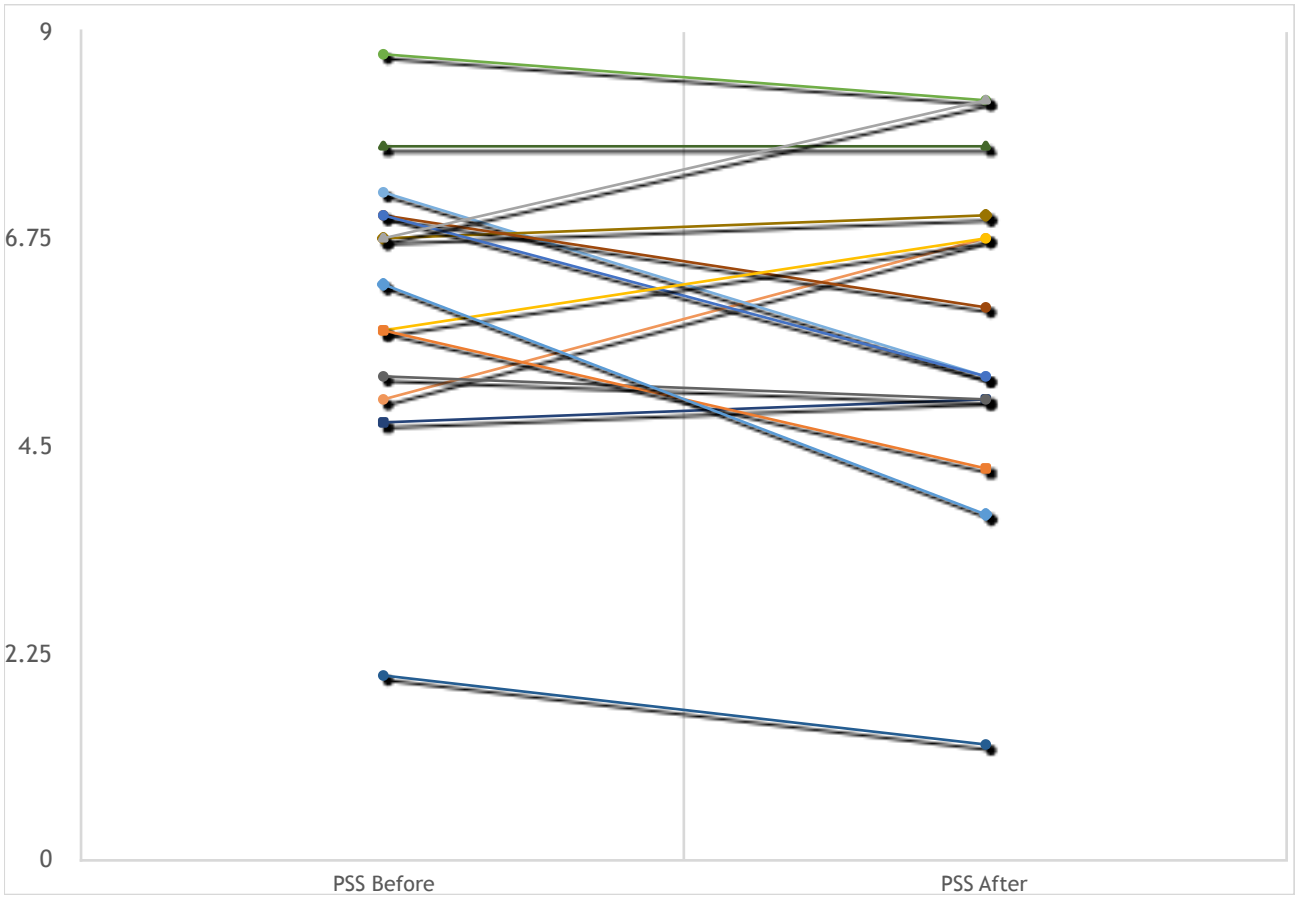

Figure 4.2: Change in Pain Severity Score from before participation in the CPMP to after the CPMP

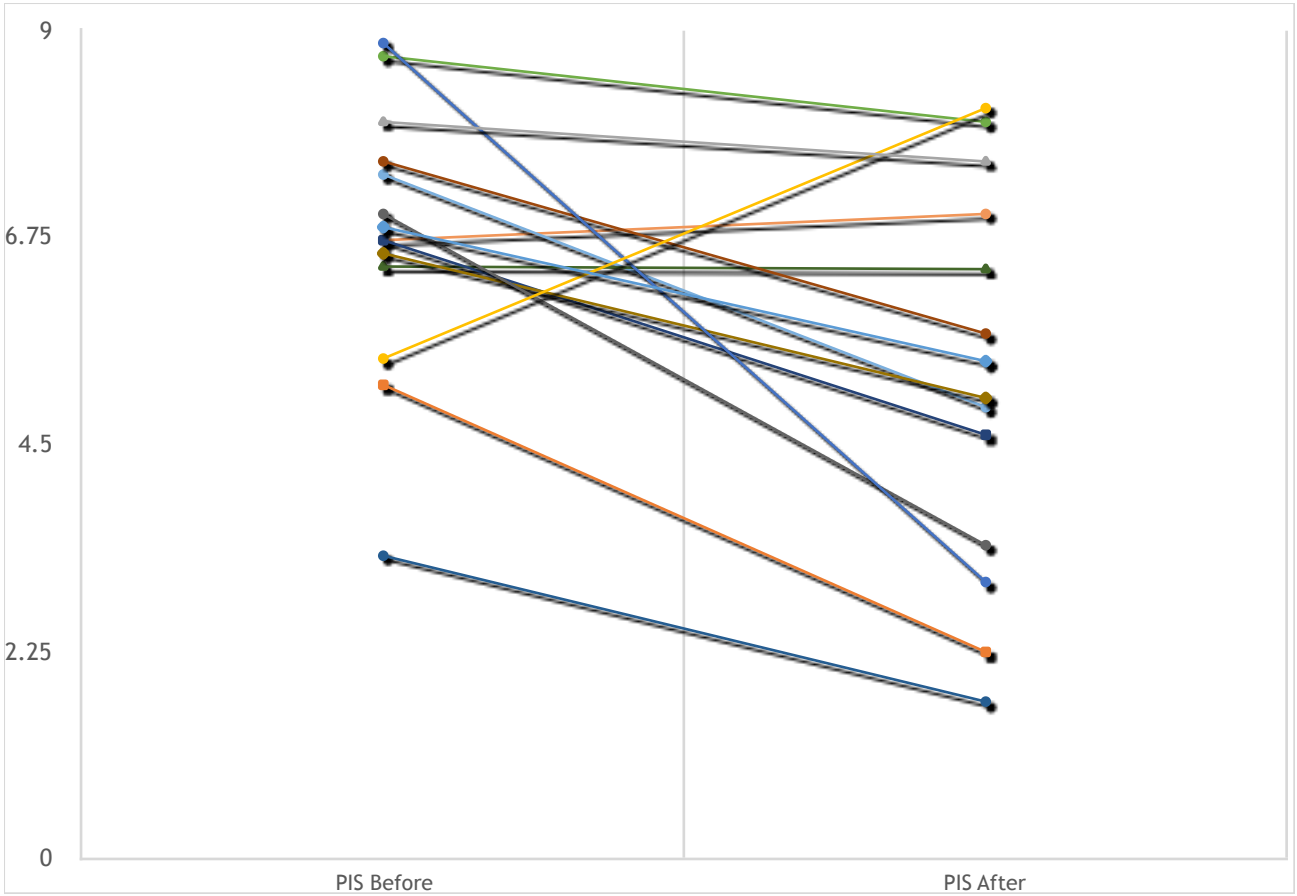

Figure 4.3: Change in Pain Interference Score from before participating in the CPMP to after participation

4.3. Levels of Physical Activity

4.3.1. Self-reported levels of Physical Activity - IPAQ

In order to analyse levels of physical activity in participants in the CPMP, each participant was categorised according to IPAQ scoring as either Inactive (Low), Moderately Active (Moderate) or Highly Active (High), as shown in Table 4.2. The combined Metabolic Equivalent of Task (METs) before CPMP improved from 9.78 (IQR 4.28-24.47) to 13.08 (IQR 8.41-30.55) after CPMP, which indicates an improvement in the overall physical activity in the group.[2]

[2] METs: MET-min/week. The Metabolic Equivalent of Task (MET), or metabolic equivalent, is a physiological measure expressing the energy cost of physical activities and is defined as the ratio of metabolic rate (and therefore the rate of energy consumption) during a specific physical activity to a reference metabolic rate, usually represented by resting metabolic rate. In this case, the variable MET-min/week expresses weekly metabolic engagement in walking, and in both moderate and vigorous physical activities practice.

Table 4.2: IPAQ Categories before CPMP compared to after CPMP

Case Number	Combined METs Before CPMP	IPAQ Category Before CPMP	Combined METs After CPMP	IPAQ Category After CPMP
1	64.13	High	155.1	High
2	25.8	Moderate	20.93	Moderate
3	0	Low	7.96	Moderate
4	24.93	Moderate	17.03	Moderate
5	134.3	High	171.55	High
6	8	Low	9.78	Moderate
7	3.3	Low	11.55	Moderate
8	23.1	Moderate	33.75	Moderate
9	6.3	Moderate	38.91	High
10	3.6	Low	14.6	Low
11	19.28	Moderate	1.98	Low
12	6.6	Low	6.6	Low
13	0.66	Low	0.66	Low
14	11.55	Moderate	11.55	Moderate

The levels of self-reported physical activity according to the IPAQ Categories (Table 4.3), improved from before to after participation in the CPMP ($\chi 2=0.65$; $p=0.01$).

Table 4.3: Self-report levels of Physical Activity

MET.min-1/week	Before CPMP Median	After CPMP Median	Statistic
Walking	4.7	6.77	z=0.27; p= 0.79
Moderate	3.3	5	z=1.22; p=0.22
Highly active	0	0	z=0.53; p=0.59
Combined	9.78 (IQR 4.28-24.47)	13.08 (IQR 8.41-30.55)	z=1.78; p=0.08


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4.3.2. Time spent in different types of Physical Activity

The percentage of time spent in different levels of physical activity (walking, moderate, vigorous) before participating in the CPMP to after participation were compared using the Wilcoxon-Matched pairs test. There was no significant difference in the percentage of time spent in different levels of physical activity from before to after participation in the CPMP (Table 4.4). Prior to the CPMP, the participants spent 44.6% (IQR: 11.7-100%) of their physical activity time doing walking physical activity and 11.1% (0-66.1%) of their physical activity time doing moderate physical activity. The percentage of time in walking physical activity increased to 47.5% (25.5-100%) and in moderate physical activity to 32.1% (0-55.9%), but these were not statistically significant improvements (Table 4.4).

Table 4.4: Percentage of time spent at different levels of Physical Activity

% of time spent:	Before CPMP Median (IQR)	After CPMP Median (IQR)	Statistical Test: Wilcoxon-Matched Pairs test
Walking	44.6 (11.7-100)	47.5 (25.5-100)	Z=0.6; p=0.6
Moderate Physical Activity	11.1 (0-66.1)	32.1 (0-56)	Z=0.2; p=0.9
Vigorous Physical Activity	0 (0-0)	0 (0-0)	Z=0; p=1.0

There was no statistically significant difference in the combined METs by group before and after the CPMP, but on individual spaghetti plotting, it appears that some individuals did improve, as can be seen in Figure 4.4 below:

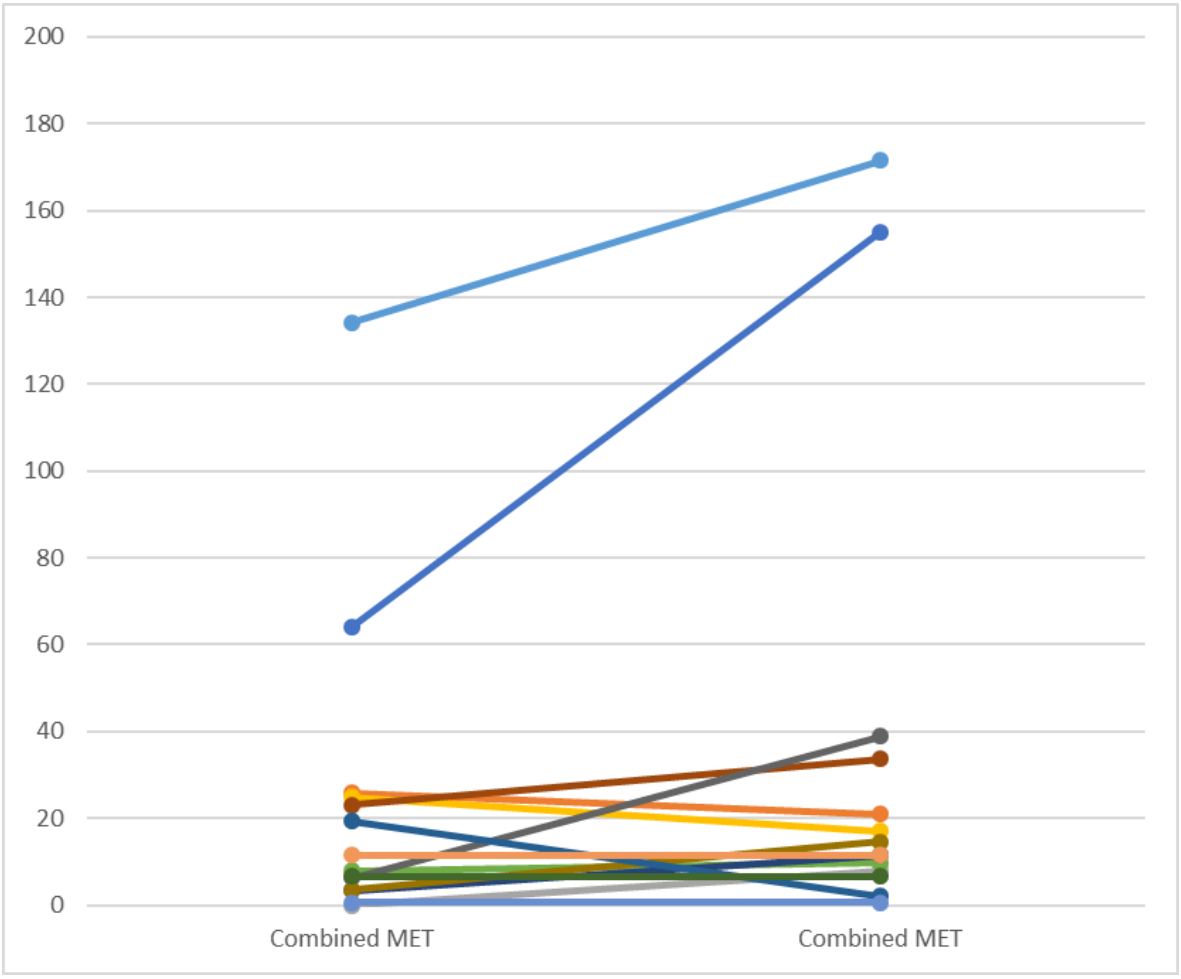

Figure 4.4: Change in the Combined METs before and after participation in the CPMP

4.4 Change in Physical Activity on Physical Tests

4.4.1. Objective measures of physical activity and Physical performance

The participants' performance on the 6-Minute walk test and the Timed repeated sit-to-stand test (Physical performance) improved significantly from before to after participation in the CPMP (Table 4.5).

Table 4.5: Objective measures of Physical Activity and Physical performance

Test	Before CPMP (IQR)	After CPMP (IQR)	Statistical test (Wilcoxon-Matched pairs test)
6-Minute Walk test (m)	300 (225-393.8)	375 (281.3-450)	Z=2.1; p=0.03*
Timed-Repeated Sit-to-Stand test (s)	25.8 (18.7-38)	17.9 (12.2-25.6)	Z=2.8; p=0.01*
Pedometer reading (steps in 7 days) N=14	18899.5 (14633.8-21902)	30692 (22503-41708.5)	Z=1.5; p=0.13

4.4.2. Pedometer readings

Levels of physical activity were measured over a period of seven (7) days using Pedometers (Table 4.5). One (1) participant's data was carried forward. Before the CPMP, participants had a median pedometer reading over seven (7) days of 18899.5 steps (14633.8-21902 steps) which increased to 30692 steps (22503-41708.5 steps) after participation. This was not a statistically significant improvement (Z=1.51; p=0.13). Spaghetti plots of individual pedometer readings over seven days (Before and After CPMP) demonstrate a general pattern of increased number of steps (Figure 5).

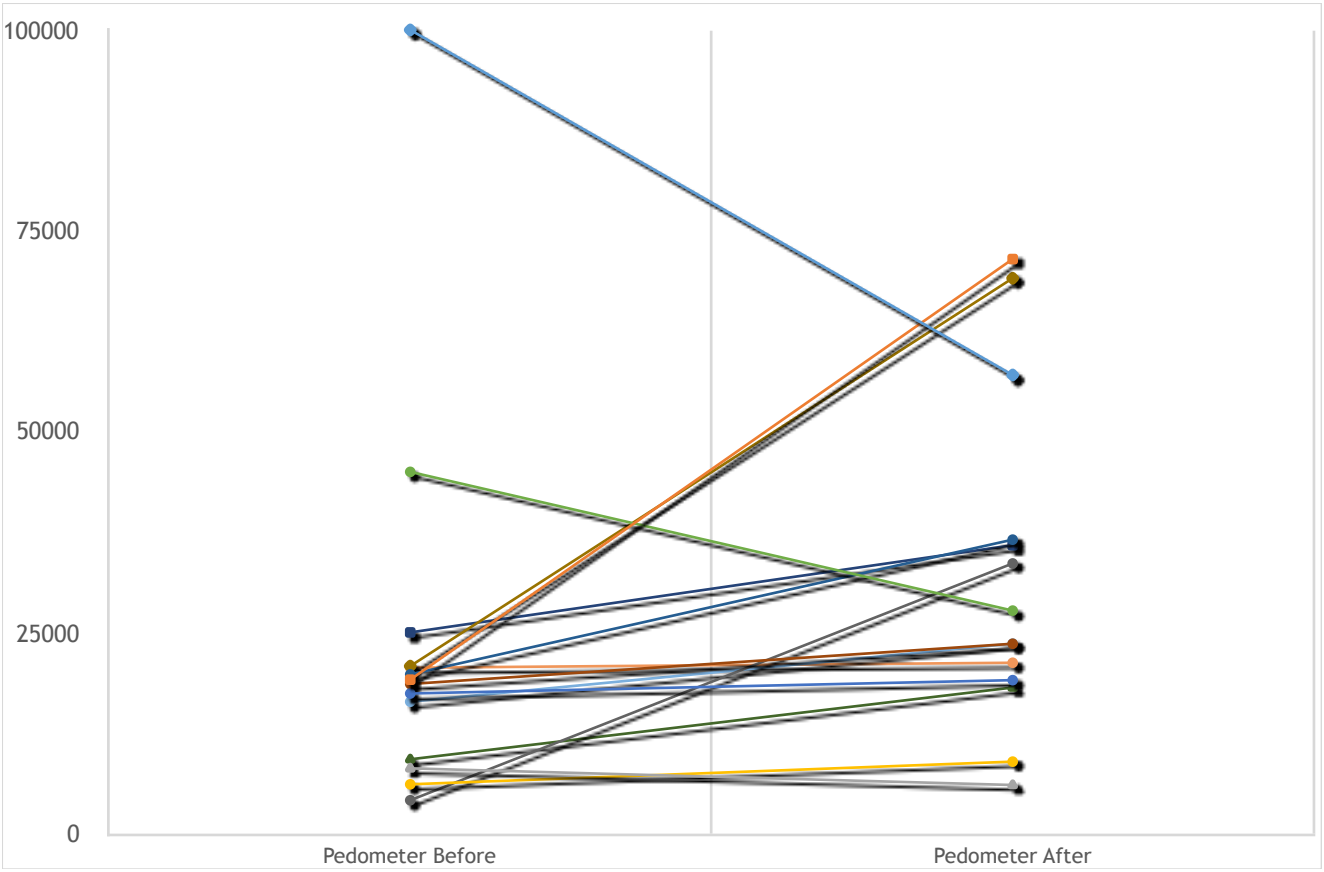

Figure 5: Change in Seven (7) day pedometer readings (n=14)

4.5. Agreement of Self-report and Objective measures of physical activity

A Kruskal-Wallis ANOVA by Ranks test was conducted to evaluate the convergent validity of agreement of the self-report levels of physical activity with the objective tests. Participants were grouped according to their IPAQ category scores (High, Moderate and Low). The median number of steps recorded for participants in each of the IPAQ category groups was significantly different in the expected direction, both before participating in the CPMP ($\chi 2=8.8$; df=2; p=0.01) and after participation ($\chi 2=6$; df=2; $p<0.05$) (Figures 6 and 7), which indicates convergent validity of self-reported levels of physical activity with the objective tests.

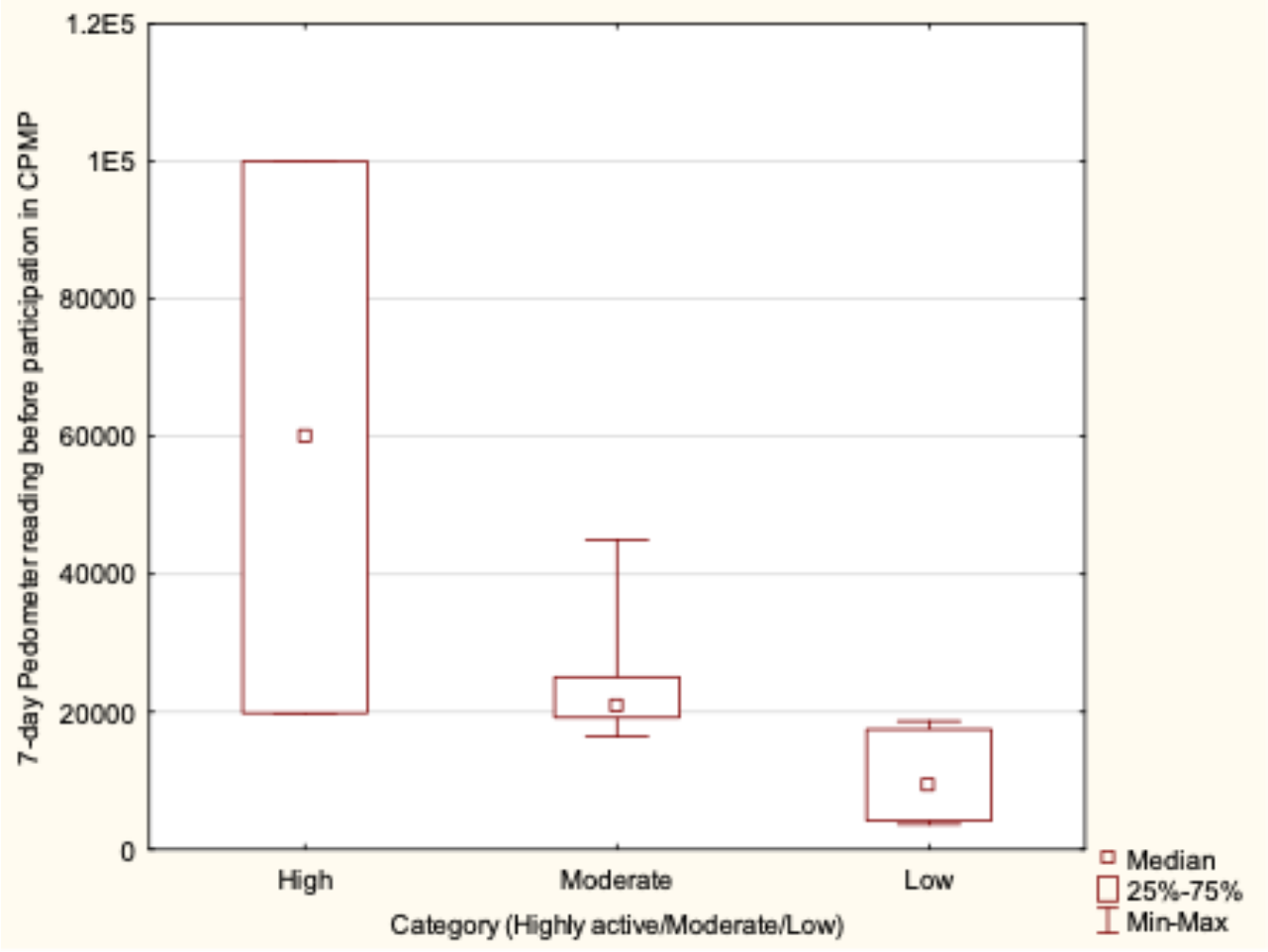

Figure 6: Kruskal-Wallis ANOVA by Ranks test before participation in CPMP

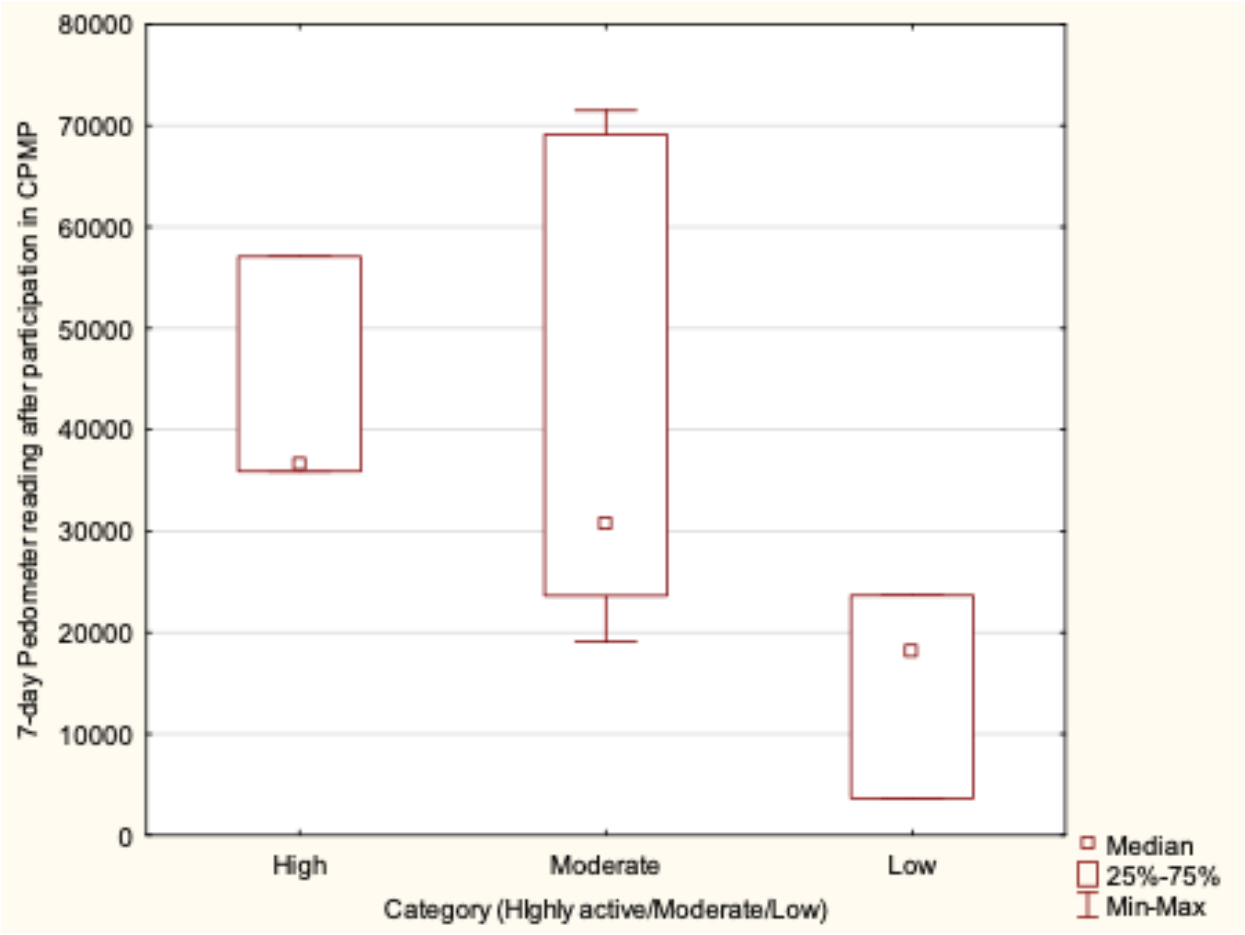

Figure 7: Kruskal-Wallis ANOVA by Ranks test after participation in CPMP

Chapter 5: DISCUSSION

This study aimed to evaluate the differences in levels of physical activity and physical performance in a battery of tests of patients suffering from chronic pain before and after participating in a CPMP run by the CPMC at Groote Schuur Hospital in Observatory, Cape Town.

The objectives of the study were to determine the levels of physical activity one week (Seven days) before and one week (Seven days) after participation in the CPMP, to determine if there were changes in physical performance (battery of physical tests) after participation in the CPMP, whether physical activity levels changed after participation in the CPMP, if there are any changes in pain intensity and interference after participation in the CPMP and whether self-report levels of physical activity correlate with actual physical activity levels measured with a pedometer among these patients suffering from chronic pain.

5.1. Participant Characteristics

The participants who took part in this study were predominantly female, comprising 12 of 14 participants in total. Data from other studies show that more females suffer from chronic pain than males, while males tend to have a different chronic pain response to female counter-parts and an older person is also at greater risk for chronic pain (Igumbor et al., 2011; Ramírez-Maestre & Esteve, 2014; Rauf, et al., 2013). This could explain why a greater number of females took part in this study and explain the median age of 45 years. However, the gender split may not merely be a reflection of chronic pain conditions being more prevalent in females, it may also be a reflection of females seeking treatment more readily than males. The lack of male representation limits the generalisability of the findings because females generally seek treatment more than males, males report higher levels of pain and disability, as well as lower levels of physical activity and quality of life (Marcus, 2003).

5.2. Pain Characteristics

The BPI scores, number of sites of pain and moderate PSS and PIS are similar to patients of other studies and was expected to be as such prior to participation in the CPMP (Parker, et al., 2017; Cameron, et al., 2018). What was unexpected to see was the improvement in both PSS and PIS after

participation in the CPMP, as patients' pain do not usually improve in the short-term after CPMP. The statistically significant improvements in these scores is clinically meaningful, as it indicates that CPMP's can be implemented in the management of chronic pain. The work of Fordyce in the 1970's through to Acceptance and Commitment Theory (ACT) in early 2000's in essence describe the approach to chronic pain where pain is no longer treated, but is more so 'managed' using the concept of the bio-psychosocial approach, the theoretical framework of the ICF in this study. This, in essence, describes the aim of CPMP, where the focus is not on decreasing or 'curing pain,' but improving the self-management, as well as decreasing the disability associated with chronic pain. Health professionals provide knowledge, understanding and skills to reduce pain and disability, with the ultimate goal of optimising Quality of Life, despite pain (Hayes, et al., 2006; Lotze & Moseley, 2015; Main, et al., 2015; Morley, 2011). This approach, with the ICF as a basis for classifying disability in the individual, provides a good foundation from which the clinician may gain an alternate perspective on treating pain in the chronic space, where the idea of 'curing pain' is not the focus, but more so living life well, even though pain is present (Monticone, et al., 2013; Morley, 2011).

Participants had a significant improvement in Pain Severity Scores and Pain Interference Scores, which may indicate that patient's perception of their disability regarding their chronic pain has had a positive effect in the sense that the focus of the CPMP is to encourage an increase in physical activity, and by extension an increase in function through Activities of Daily Living, with an emphasis on pacing strategies and managing over-and under-activity (Fordyce, 1976; Morley, et al., 1999; Osbourne, et al., 2006;). This being said, it should be noted that an important finding in the results of the current study was an increase in the number of painful areas. Various explanations could be hypothesised, especially because there were some extraneous variables which could not have been foreseen, such as participant injuries during the course of the study. The focus on increasing physical activity could be the most likely explanation for the increase in painful areas, as the increased movement from an increase in physical activity would likely affect the dysfunctional movement patterns of the chronic pain sufferer during various parts of their daily life, which could place new stresses on previously de-conditioned/disused bodily systems (Griffin, et al., 2012; Karlsson, et al., 2018; Smeets, et al., 2006; Vlaeyen & Linton, 2000)

5.3. Levels of Physical Activity Prior to CPMP

A study by Gradidge et al., (2014) notes that South Africa is classified as the third most physically-inactive country in Africa, with females being generally more inactive than males, as well as those living in urban areas less active than those in rural areas. Parker and colleagues found that in a South African context at Groote Schuur Hospital in Cape Town, within a similar community to the participants in the current study, similar results of decreased physical activity was found (Parker, et al., 2014). More than half of the participants were found to be inactive, which supports the findings of this study. One possible reason could be that most of the participants' occupation were of a sitting nature, as well as the fact that in most urban areas, the use of private transport, combined with sedentary behaviours such as television watching, adds to the growing problem of physical inactivity.

A recent study by Parker and colleagues conducted in 2017 found that participants in the chronic pain management program had significantly worse scores than healthy-matched controls in physical tests (Parker, et al., 2017). Participants with chronic pain, of the same demographic as the current study had similar median test scores, indicating the possibility that this sub-group of chronic pain sufferers are all affected by disability in similar ways (Gradidge et al., 2014; Parker et al., 2017).

5.3.1. Physical Inactivity

As clinicians, we need to be aware of the impact of such physical inactivity, as sedentary behaviour has been shown to increase the risk for all-cause mortality, independent of physical activity-time. This fact highlights the need for concerted efforts to improve physical activity in the chronic pain subset of patients, as these patients have been shown to have significantly lower levels of physical activity than normal, which is classified as accumulating a minimum of 150 minutes of moderate activity or 75 minutes of vigorous activity per week (Gradidge, et al., 2014; Griffin, et al., 2012; Parker, et al., 2017; Proper, et al., 2011; Ryan, et al. 2009; WHO, 2008).

Recent data of healthy individual physical activity trends for most low- and middle-income countries, such as South Africa, are scarce. The global trend of physical inactivity is around 31.1%, with Africa around 27.5% physical inactivity (Hallal, et al., 2012). Joubert and colleagues note that the physical activity levels of the South African population falls well-short of the recommended

norms for health-promotion and -maintenance levels of physical activity (Joubert, et al., 2007). To promote health and maintain good health, moderate-intensity aerobic physical activity for a minimum of 30 mins, five days per week is recommended or vigorous-intensity aerobic physical activity for a minimum of 20 mins, three days of the week (Haskell, et al., 2007). One aspect that is often overlooked is the recommended norm for people living with disabilities and chronic illnesses.

Tudor-Locke and colleagues recommended that older adults living with disabilities and chronic illness should take 3500-5500 steps per day, or 24500-38500 steps per week (Tudor-Locke et al., 2002). Although the participants of the present study did not present with any physical disabilities, prior to participating in the CPMP, they were only taking 60% of the number of steps recommended as the norm for the chronic illness population group. On completion of the CPMP, the participants had improved their step count to 97.5% of the recommended median norm for adults with chronic illnesses, an encouraging statistic, but still far short of the recommended daily number of steps for healthy adults. That being said, the improvement to the recommended median norm for adults with chronic illnesses is clinically significant, as these individuals may have a solid foundation from which to improve their physical activity after participation in a CPMP.

5.3.2. Overactivity/Avoidance Endurance

One of the participants in the study appeared to be highly or even over-active before participating in the CPMP (over 100000 steps) and reduced their activity levels after participating in the program (60 000 steps; Figure 5). Hasenbring and colleagues (2001) describes the Overactivity/Avoidance Endurance Model to explain the mechanisms by which some chronic pain sufferers who ignore their chronic pain and continue with high levels of physical activity, may lead to maladaptive behaviors. Based on this model, it is proposed that people with chronic pain learn to associate pain and physical activity as proportional, so that when physical activity is excessive, they predict or expect pain to be exacerbated. This may ultimately lead to negative feelings and beliefs about movement (Gatzounis, et al., 2012). Andrews, Strong & Meredith note that the ‘overactivity’ phenomenon reflects a chronic pain sufferer’s belief that earlier activities (assessed subjectively and retrospectively) are the cause of current increased levels of pain (Andrews et al., 2015). By extension, doing less-strenuous physical activity (usually in the form of complete avoidance of all physical effort) should lead to a decrease in pain, in the chronic pain sufferer’s mind.

Both overactivity and underactivity are some of the multiple contributors to chronic pain. The box plots showing levels of pedometer readings prior to the CPMP shows a classic example of this, as there is a large spread of physical activity among patients in the High category of the IPAQ scoring system (Figures 6 and 7). This widespread amount of physical activity measured by pedometry changed after participating in the CPMP (Figure 7) with a shift towards the Moderate category, in other words, participants at either extreme (high or low) appeared to have acquired the ability to modulate their levels of physical activity to a manageable 'moderate' level of physical activity. It may be that modulation of physical activity contributed to the improvements in the Pain Interference Scores and Pain Severity Scores, indicating the possibility that these individuals learned about the importance of pacing strategies in the management of their chronic pain conditions. However, it is equally possible that learning about pain and reducing the threat of the pain resulted in the improved Pain Severity Scores and Pain Interference Scores allowing patients to engage with physical activity and the concepts of pacing presented in the program. A larger experimental study would need to be conducted to explore the modulating mechanisms discussed here.

5.4. Change in Physical Activity

Participants' performance in the timed-repeated sit to stand and 6-minute walk tests significantly improved from before the CPMP to after the CPMP. These tests have been shown to be a good measure of baseline function, as was described previously in this study. The improvement in these tests is encouraging, as participants taking part in the CPMP engage in exercise as part of the program and also set goals on a weekly basis on ADL, focussing on the management of chronic pain as opposed to 'curing' chronic pain. In a 2011 review by Stephen Morley, the author makes a note that Cognitive Behavioural Therapy approaches work best when implemented in a structured, well-developed program such as the one used in the CPMP (Morley, 2011). This is supported by Monticone and colleagues where they found that a CBT program aimed at addressing fear-avoidance beliefs using cognitive behavioural strategies was superior to an exercise program alone for chronic pain sufferers (Monticone, et al., 2013).

The overall levels of physical activity of participants improved significantly after participation in the CPMP, however no statistically significant difference in the METs of participants was found when comparing pre- and post-participation in the CPMP. One possible explanation for the lack of

difference in the METs of participants pre- and post-participation in the CPMP is that subjective and objective findings have poor correlation, indicating that the assessment of subjective (IPAQ and BPI) and objective (Battery of tests including pedometer for seven days) should not be assessed in isolation (Oyeyemi, et al., 2014; Fillipas, et al., 2010; Medina, et al., 2013; Parker, et al., 2017).

It is possible that prior to participation in the CPMP, that participants were over-estimating their levels of physical activity on the IPAQ. The lack of change may also be a lack of sensitivity in the tool. While Metsek and colleagues note that the IPAQ is the most widely used questionnaire in physical activity assessment with adequate reliability and validity (Mestek, et al., 2008; Parker, et. al., 2017), a number of studies found that the IPAQ has been shown to overestimate moderate and vigorous physical activity in certain subgroups who have chronic pain, as well as the IPAQ Short version having variable validity for various populations (Lee et al., 2011; Fillipas, et al., 2010; Medina, et al., 2013; Oyeyemi, et al., 2014; Parker, et al., 2017). In the current study, this variance was accounted for, as it has been shown to have adequate reliability and validity in a South African context (Craig, et al., 2003). While the evaluation of convergent validity for the IPAQ was encouraging with categories changing significantly in the expected directions the small number of participants and limited analysis does not negate the above discussion.

The changes in pedometer readings from before and after the CPMP gives us a good insight into participant's daily lives. The levels of physical activity measured on the pedometers were varied, with some participants having very high levels of daily physical activity, while others had very low levels. Although there was an improvement in participants' pedometer readings of over 62% from a median of 18899.5 steps, to a median of 30692 steps, this was not statistically significant. The lack of significance may be a consequence of the small sample size. In addition – it may be more relevant to explore under-activity participants separately from overactivity as per the Hasenbring under-activity/over-activity model (Hasenbring, et al., 2001). In the present study, one participant was clearly following a different activity profile to the others. In a larger study, it would be helpful to classify patients according to activity level at initiation and then explore whether participation in the CPMP normalized levels of activity rather than the simplistic approach of determining if there was an increase in physical activity.

One cannot ignore a common phenomenon in the field of behavioural science as it relates to intervention studies, called the "Hawthorne effect," where individuals improve productivity/effort

regardless of intervention, due to having knowledge of an evaluation or being watched (Parsons, 1974; McCarney, et al., 2007; Wickström & Bender, 2000). This behavioural change in participants can possibly be the cause for the improvement in scores, because various interventions and treatments, including measuring instruments were used. This can skew some results and may affect the generalisability of the current study to the wider population, because participants may feel that they are getting "extra attention" due to the contents of the study and extra testing due to prior knowledge that other CPMP groups may not have been tested in the past (Prior to the commencement of the study). Because of this, participants may improve regardless of intervention used.

5.5. Study Limitations

The main limitation of this study is the design bias, as a pre-experimental design and a small sample size was used. Due to the nature of the investigation, future studies should have a greater sample size and be done in a blinded Randomized Clinical Trial (bRCT). The use of a bRCT will eliminate the bias of the investigator to possibly treat one group of participants differently to another, as the investigator would be blinded to which participants would form part of the experimental group and which form part of the control group, possibly consisting of chronic pain sufferer's who undergo a different treatment approach other than the CPMP. bRCT's also produce higher quality results, as participants are randomised and the investigators are blinded, negating any effect of investigator bias towards one participant or another. As this was a pre-experimental study, no blinding was needed in it's current form, as participants were compared to pre- and post-test data. The use of a pre-experimental design and small sample size limits the ability to generalise the results of the study to the greater population (Polit & Beck, 2010).

The complexity of chronic pain warrants that future studies may need to consist of quantitative, as well as qualitative data. In the current study, quantitative data was used, not taking into account the complex nature of the chronic pain experience and in so doing, there is minimal insight into the psychological effect of the chronic pain experience as it relates to the data. Future studies may need to include qualitative data, so the investigators may get get an in-depth analysis of the various factors which influence the chronic pain experience.

Selection bias was another limitation in the study, as patients were included in the study if they

were referred to the CPMP from the CPMC only. This does not account for the individuals who suffer from chronic pain, but are not referred to the CPMP for various reasons, which can include long waiting times, small focus groups within the CPMP, new referrals to the CPMC, or those individuals who may have chronic pain, but do not seek treatment for their pain at GSH, possibly going to another primary healthcare facility, or not seeking treatment for their chronic pain at all. During the recruitment process, it was found that some patient's contact details were either incorrect, old details, or that of a relative or friend. This limits the recruitment process as these individuals may be lost to the recruitment process as they cannot be contacted. In the current study, this was accounted for by bringing these facts to the administrative staff of the CPMP and following up on correcting contact details of those patients referred to the CPMP. Future studies should include recruitment of participants from other primary healthcare facilities, as well as advertisement in widely-distributed media for inclusion in the study. This may also help with increasing the sample size, as well as diversifying the population sample for these studies.

Limitations regarding data collection and measurement bias can include the use of the IPAQ Short Version in this study, which has limited validity in small sample sizes Another factor is that the IPAQ uses "last 7 days" recall which patients have to subjectively respond to. This can cause patients to misrepresent data reported to investigators in order to sound 'likeable' or what they think the investigator wants them to answer. Participants have been shown to over-estimate their levels of moderate- to vigorous physical activity when subjectively reporting these levels (Lee, et al., 2011; Fillipas, et al., 2010; Medina, et al., 2013; Oyeyemi, et al., 2014). In the current study, this was accounted for in that the IPAQ Short Version has been shown to have adequate reliability and validity in a South African context (Craig, et al., 2003) as well as using objective measuring tools to correlate the change in physical activity of these individuals. Future studies may find it helpful to have patients keep a 'physical activity journal' one week prior to completing the IPAQ Short Version, so as to eliminate biases where they may answer favourably, or where data may be misrepresented when reporting this.

A problem which was encountered at initial phase of testing, as well as later into the study, was that of injuries and external factors. One participant twisted his ankle during the final week of the CPMP, but could carry on with the post-CPMP testing. Another participant was injured during the weeks of the CPMP and so could not complete testing. These factors can skew data and results particularly with the small sample. A number of patients were scheduled for surgery or another

medical procedure during the CPMP. These events interrupted the flow of the CPMP, as each week covers a different topic in the management of chronic pain. An improvement to this would be to ensure that those who are referred to the CPMP do not have any surgeries or medical procedures scheduled which could interrupt the attendance to the CPMP.

Heterogeneity, a common problem in chronic pain studies, was an issue in this study, (Meucci, et al., 2015), as females were predominant in the sample group. This was discussed earlier, where it was shown that females tend to seek treatment for chronic pain more often than males, as well as having a different chronic pain experience to males. A more representative population sample of males to females would be prudent in future studies.

Lastly, poor follow up of participants over the course of the CPMP, as well as the post-CPMP testing needs to be addressed in future studies. This will allow for a complete data set which can be used to improve the generalisability of future studies.

It would seem that improved training in the use of pedometers and improved monitoring of pedometer usage is indicated in a study of this type. The use of accelerometers would improve the quality of data collected. Accelerometers rectify and integrate acceleration from all three planes of movement over one-minute intervals, providing greater details about physical activity than a simple pedometer (Bousema, et al., 2007). Accelerometers have been shown to provide information on sedentary behaviour as well as physical activity. Increased training will be needed for these devices, as they are more complicated to use than pedometers (Lee, et al., 2011).

Lastly, poor follow up of participants over the course of the CPMP, as well as the post-CPMP testing needs to be addressed in future studies. This will allow for a complete data set which can be used to improve the generalisability of future studies.

Chapter 6: CONCLUSION

This study aimed to evaluate the differences in levels of physical activity and physical performance of patients suffering from chronic pain before and after participating in a CPMP run by the CPMC at Groote Schuur Hospital in Observatory, Cape Town. The objectives of the study include: determining the levels of physical activity one week (Seven days) before and one week (Seven days) after participation in the CPMP, whether physical activity levels changed after participation in the CPMP and whether self-report levels of physical activity correlate with actual physical activity levels measured with a pedometer among these patients suffering from chronic pain.

The levels of physical activity changed markedly, yet not significantly after participation in the CPMP (Figure 5). Objectively tested and self-reported physical activity levels changed significantly in those suffering from chronic pain after participation in a CPMP (Table 4.5 and table 4.3 respectively). A significant improvement in Pain Severity Scores (Figure 4.2) and Pain Interference Scores (Figure 4.3) was found after participation in a CPMP. The last objective found that there was convergent validity between self-reported levels of physical activity and objectively-tested physical activity in those suffering from chronic pain who took part in a CPMP. (Figure 6 and 7).

As physiotherapists, we have the knowledge and means to encourage increased physical activity in our patients, especially those with chronic pain, to improve their lives and decrease their burden of disease. The CPMP at GSH should be seen as the beginning of a greater movement towards increasing physical activity in the chronic pain sphere and more widespread research in more public healthcare facilities is needed in order to implement these strategies of knowledge, education and pacing strategies across South Africa.

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Chapter 8: APPENDICES

Appendix 1: Brief Pain Inventory

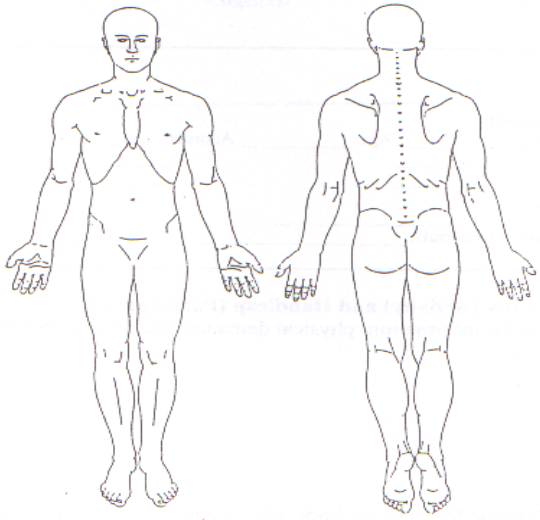
BRIEF PAIN INVENTORY

Name: _____ **Date:** _____

1. Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these everyday kinds of pain during the last week?

Yes No

2. On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.



3. Please rate your pain by circling the one number that best describes your pain at its ***worst*** in the last week.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

4. Please rate your pain by circling the one number that best describes your pain at its ***least*** in the last week.

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

5. Please rate your pain by circling the one number that best describes your pain on the ***average.***

0	1	2	3	4	5	6	7	8	9	10
No										Pain as bad as

Pain you can imagine

6. Please rate your pain by circling the one number that tells how much pain you have ***right now.***

0	1	2	3	4	5	6	7	8	9	10
No Pain										Pain as bad as you can imagine

7. What treatments or medications are you receiving for your pain?

_____

8. In the last week, how much ***relief*** have pain treatments or medications provided? Please circle the one percentage that most shows how much *relief* you have received.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
No Relief										Complete Relief

9. Circle the one number that describes how much, during the past week, pain has ***interfered with*** you're:

A. ***General Activity***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

B. ***Mood***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

C. ***Walking Ability***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

D. ***Normal Work*** (includes both work outside the home and housework)

0	1	2	3	4	5	6	7	8	9	10

Does not interfere										Completely interferes

E. ***Relations with other people***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

F. ***Sleep***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

G. ***Enjoyment of life***

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

Scoring:

Pain Severity Score = Mean of items 3–6 (pain at its worst, pain at its least, average

Pain Interference Score = Mean of items 9A–9G (interference of pain with: general activity, mood, walking, normal work, relations, sleep, and enjoyment of life)

Appendix 2: International Physical Activity Questionnaire – Short Version

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

(August 2002)

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation

Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week** →

☐ No vigorous physical activities ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week** →

☐ No moderate physical activities ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week** ➞

☐ No walking ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

1. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix 3: Participant Information Sheet

Department of Health and Rehabilitation Sciences
Faculty of Health Sciences
Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building, Groote Schuur Hospital,
Observatory 7925
Tel: +27 (0) 21 406 6401 Fax: +27 (0) 21 406 6323

Dear Participant

I (Damian James Swartz) am an MPhil. Exercise & Sports Physiotherapy Candidate from the University of Cape Town. I am currently conducting a study to investigate the amount of physical activity done by people living with chronic pain before and after completing a five (5) week Chronic Pain Management Program. We are interested in finding out the amount of physical activity (exercise) people with chronic pain do after taking part in the five (5) week Chronic Pain Management program, comparing initial baseline testing to post-testing.

Description of the Research

There will be two questionnaires, namely the Brief Pain Inventory (to identify the extent of your pain) and the International Physical Activity Questionnaire "Short Version" (To assess your current level of physical activity). There will also be two (2) physical tests which we will ask you to complete, namely: The 6-Minute Walk Test and the Timed repeated sit-to-stand Test. These tests and questionnaires will form the baseline (initial measurement) which will be used to compare to the tests after the Chronic Pain Management Program.

After the above-mentioned tests and questionnaires, you will be asked to wear a pedometer (described in the Informed Consent Form) for seven (7) consecutive days, all the while maintaining the activities you normally do during the week. The pedometer will track the number of steps you have taken during the day and so the investigator will call you every evening while you are wearing the pedometer to collect information about the distances walked. Once you have worn the pedometer for seven (7) days, you will be asked to return it to the University of Cape Town at Groote Schuur Hospital.

Taking part in this research study is **completely voluntary** and you may stop taking part in the

study at any time, with no negative effect to you with regards to your participation in the Chronic Pain Management Program, or any other treatment you receive at Groote Schuur Hospital. There are very few risks involved in the study, as you may feel some Delayed Onset Muscle Stiffness (DOMS), but this is projected to be minimal and there is no danger involved in taking part in this study. If you experience this phenomenon, you will be assessed by the physiotherapist on the programme and, if needs be, will be referred to the GSH Physiotherapy Department for treatment. You will be supervised by a qualified physiotherapist at all times during your Chronic Pain Management Program Contact Sessions, as well as during the tests and questionnaires.

Confidentiality with regards to all personal information will be stored in a password-protected computer program and will not be used for any other purpose other than for those outlined in this study.

Benefits of Taking Part in the Study

There is no remuneration for being part of the study, but you will be given R30 when you come to GSH to cover your transport costs for study-related testing and questioning. You will get information on your activity levels after the study and recommendations on how to increase them, if needs be. You will also be given information on the benefits of physical activity and what you can do to increase your physical activity. Taking part in this study will help to add to the body of knowledge surrounding chronic pain. It will also help physiotherapists treat chronic pain more effectively in future and help us gain a greater understanding of the effects of chronic pain in relation to physical activity and the Chronic Pain Management Program.

If you have any questions at any time, please phone me, on **0769034188.**

Thank you

Regards,

Damian James Swartz

Student number: SWRDAM001

Appendix 4: Informed Consent Form

Department of Health and Rehabilitation Sciences
Faculty of Health Sciences
Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building, Groote Schuur Hospital,
Observatory 7925
Tel: +27 (0) 21 406 6401 Fax: +27 (0) 21 406 6323

Study: Levels of Physical Activity in People living with Chronic Pain: Do they change after participating in a Chronic Pain Management Program

Dear Participant.

The following form is a consent form for the study of ***'Levels of Physical Activity in People living with Chronic Pain: Do they change after participating in a Chronic Pain Management Program****?' The study will be conducted by Damian James Swartz of the University of Cape Town, Faculty of Health Sciences, Division of Physiotherapy, in partial completion of the MPhil. Exercise & Sports Physiotherapy degree. This form details the purpose of the study, the expectations of the participant and the participant's rights as it relates to the study.*

The purpose of the study is:

- To evaluate the difference in the levels of physical activity (exercise) and performance in a battery of tests of participants who partake in a Chronic Pain Management Program, comparing these to baseline testing before and after the Chronic Pain Management Program.

The Benefits of the research will be:

- There is no remuneration for being part of the study, but you will be given R30 when you come to GSH to cover your transport costs for study-related testing and questioning. You will get information on your activity levels after the study and recommendations on how to increase them, if needs be. You will also be given information on the benefits of physical activity and what you can do to increase your physical activity. Taking part in this study will help to add to the body of knowledge surrounding chronic pain. It will also help physiotherapists treat chronic pain more effectively in future and help us gain a greater understanding of the effects of chronic pain in relation to physical activity and the Chronic Pain Management Program.

The Risks of the Research will be:

- There are very few risks involved in the study, as you may feel some Delayed Onset Muscle Stiffness (DOMS), but this is projected to be minimal and there is no danger involved in taking part in this study. If you experience this phenomenon, you will be assessed by the physiotherapist on the program and, if needs be, will be referred to the GSH Physiotherapy Department for treatment. You will be supervised by a qualified physiotherapist at all times during your Chronic Pain Management Program Contact Sessions, as well as during the tests and questionnaires.

- Confidentiality with regards to all personal information will be stored in a password-protected computer program and will not be used for any other purpose other than for those outlined in this study.

The methods used to collect the data:

- Initial telephonic introduction to the study
- Initial Contact Session to obtain Written Informed Consent and to explain study to participants
- Medical Screening for safe participation in exercise (ACSM, 2013)
- Brief Pain inventory Questionnaire Outcome Measure
- International Physical Activity "Short Version" Questionnaire
- Timed Repeated Sit to Stand Test
- 6 Minute Walk Test
- Wearing a pedometer for seven days prior to- and immediately after the Chronic Pain Management Program

<u>What is a pedometer?</u>

A Pedometer is a small electronic device that is attached to your belt. It measures the number of steps you take through the movement of your hips. The device keeps track of your steps taken and the total distance you have walked in a day, measured in meters or kilometers. The pedometers are battery-operated and therefore do not require any charging during the days which you will use them.

<u>What will you be asked to do with regard to use of the pedometer?</u>

You will be asked to wear the pedometer on your hip, usually attached onto your belt/pants for seven (7) consecutive days. Pedometers will need to be worn from morning until evening, in order to get accurate readings each day. The pedometer should only be worn while you are awake and should be put on before you get out of bed in the morning and once you get into bed at night. **The**

device is not waterproof and the device must be removed before any water-based activities (Showering, bathing, swimming). The pedometer should be re-attached immediately after these activities are completed.

After completing the seven (7) days of wearing the pedometer, please **return the pedometer** to the investigator at Groote Schuur Hospital at a time arranged between the investigator and yourself. You will receive a phone call from the investigator at approximately 20h00 (or the best time for you) for each day that you wear the pedometer. The investigator will ask you to report back on the reading on the pedometer screen, which will then be recorded. Please do not reset the device at any time during the seven (7) days of wearing the pedometer. If you accidentally do reset the device, please notify the investigator as soon as possible. All personal details will be kept anonymous throughout the study and you may ask questions at any point during the study. Please note that all components of this study are purely voluntary and **you may withdraw from the study at any point in time without any negative effect or repercussions to your involvement in the Chronic Pain Management Program.**

Should any significant deterioration in health or well- being as a result of being part of this study occur, the University of Cape Town (UCT) will provide you with immediate medical care.

Given the very minimal risks associated with taking part in this study, no insurance is required, as advised by the Human Research Ethics Committee.

<u>As a participant:</u>

- I volunteer to participate in a research study conducted by Damian James Swartz from the University of Cape Town.
- I understand the purpose of the study as explained in the information sheet.
- I understand that my participation in this study is **voluntary** and I will not receive any money for my participation. I will only receive R30 to cover transport costs for getting to- and from Groote Schuur Hospital
- I understand that I may withdraw from the study at any point in time and that should I withdraw it will not negatively affect my future healthcare, nor my participation in the Chronic Pain Management Program

<u>When using the Pedometer:</u>

- I understand the purpose of wearing the pedometer as explained above
- I understand the requirements of wearing a pedometer, as described above
- I understand that I will need to return the pedometer after seven (7) days to the investigators mentioned in this document, as it may be used in future studies.
- I understand my rights regarding this device.

For further questions, please contact Damian James Swartz on damian@sspc.co.za, or 0769034188 (investigator) or the Faculty of Health Science's Human Research Ethics Council on shuretta.thomas@uct.ac.za (ethical queries).

By signing this consent form ~~I,~~ _____ agree to the participation in this study and use of the pedometer.

"The University of Cape Town and its team of researchers, who are working under the mandate of the university, will be responsible for treating any adverse or untoward events arising from participation in this research study."

Signed at.....on this ..... day

of ..... 20.....

Participant: .....

I understand the conditions of the Informed Consent Form as explained and interpreted to me and accept it voluntarily.

Investigator: .....

WITNESSES:

1……..

2.……

Investigator contact details

Damian Swartz
The Sport Science Physiotherapy Centre
Sport Science Institute of South Africa
Boundary Road
Newlands
Cape Town
7700
Tel: 021 659 5684
Fax: 021 659 5654
Email: damian@sspc.co.za

Supervisors:
Dr Romy Parker

Division of Physiotherapy
Department of Health and Rehabilitation Sciences
University of Cape Town
Groote Schuur Hospital
Anzio Road
Observatory
7725
Tel: 021 406 6431
Email: Romy.parker@uct.ac.za

Human Research Ethics Committee:
Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory
7925
Tel: 021 406 6492
Email: Sumayah.ariefdien@uct.ac.za

Appendix 5: Data Sheets

Outcome Measures

IPAQ Score	BPI Score	6-Minute Walk Test	Timed Sit-to-Stand Test	Steps (total per week)

Pedometer readings per day

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7

Appendix 6: University of Cape Town HREC approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

11 October 2016

HREC REF: 546/2016

A/Prof R Parker
Division of Physiotherapy Division
Health & Rehab
OMB

Dear A/Prof Parker

PROJECT TITLE: LEVELS OF PHYSICAL ACTIVITY IN PEOPLE LIVING WITH CHRONIC PAIN: DO THEY CHANGE AFTER PARTICIPATING IN A CHRONIC PAIN MANAGEMENT PROGRAM? (MPhil-candidate-D Swartz)

Thank you for your response letter dated 4 October 2016, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 October 2017.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

We acknowledge that the student, D Swart will also be involved in this study.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

HREC 546/2016

Appendix 7: Groote Schuur Hospital HREC Approval

Western Cape Government
Health

GROOTE SCHUUR HOSPITAL
Enquiries: Dr Bernadette Eick
E-mail : Bernadette.Eick@westerncape.gov.za

Associate Professor R. Parker
Division of Physiotherapy
E-Flocr – Old Main Building

E-mail: Swartz.physio@gmail.com

Dear A/Professor Parker

RESEARCH PROJECT: Levels Of Physical Activity In People Living With Chronic Pain: Do They Change After Participating In A Chronic Pain Management Programme (MPhil Candidate D. Swartz)

Your recent letter to the hospital refers.

You cre hereby granted permission to proceed with your research which is valid until **30 October 2017.**

Please note the following:

a) Your research may not interfere with ncrmal patient care.
b) Hospital staff may not be asked to assist with the research.
c) No additional costs to the hospital should be incurred i.e. Lab. consumables or stationary.
d) **No patient folders may be removed from the premises or be inaccessible.**
e) Please discuss the study with the HOD before commencing.
f) Please introduce yourself to the person in charge of an area before commencing.
g) Please provide the research assistant/field worker with a copy of this letter as verification of approval.
h) Confidentiality must be maintained at all times.
i) Should you at any time require photographs of your subjects, please obtain the necessary indemnity forms from our Public Relations Office (E45 OMB or ext. 2187/2188).
j) Should you require additional research time beyond the stipulated expiry date, please apply for an extension.
k) On completion of your research, please forward any recommendations/findings that can be beneficial to us to take further action that may inform redevelopment of future policy/review guidelines.
l) Kindly submit a copy of the publication or report to this office on completion of the research.

I would like to wish you every success with the project.

Yours sincerely

DR BERNADETTE EICK
CHIEF OPERATIONAL OFFICER
Date: 30th November 2016

C.C. Mr L. Naidoo, Ms C. Davids

G46 Management Suite, Old Main Building
Observatory 7925

Tel: +27 21 404 6288 fax: +27 21 404 6125

Private Bag X,
Observatory, 7935

www.capegateway.go.v.za