INVESTIGATING THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND QUALITY OF LIFE IN ADULTS WITH SHOULDER PAIN

BAITHAT OLANREWAJU ADEYINKA

A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

GRADUATE PROGRAM IN KINESIOLOGY AND HEALTH SCIENCE

YORK UNIVERSITY

TORONTO, ONTARIO

AUGUST 2021

ABSTRACT

The most common cause of shoulder pain among older adults is rotator cuff-related shoulder pain (RCRSP). While exercise therapy is often recommended for RCRSP, the relationship between physical activity levels and symptoms related to quality-of-life (QoL) is unclear. This study investigated: i) whether higher physical activity levels were related to better self-reported QoL outcomes and ii) whether those who self-reported participation in exercises that target their painful shoulder have better self-reported QoL outcomes than those who report primarily whole-body exercise. 46 participants with RCRSP completed 16 self-reported QoL questionnaires. Physical activity levels (moderate-vigorous physical activity and average step-count) were also measured objectively using an accelerometer. Participants that regularly completed shoulder-specific exercise had significantly higher exercise self-efficacy than those who completed non-specific exercise ($p=0.0034$). This result suggests that strategies to boost exercise self-efficacy may be important in older adults with RCRSP, as this could potentially affect rehabilitation compliance in this population.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my supervisor, Dr. Jaclyn Hurley, for her tremendous support. This thesis would not have been possible without her dedication and guidance. Thank you for your willingness to revise my thesis project (several times) while we encountered uncertainty with COVID-19. I appreciate you spending time out of your maternity leave and cannot underscore your amazing work ethic. I have learned many valuable skills under your guidance that have helped me in academia and my personal life. I am truly fortunate to have had the pleasure to learn from you and could not have asked for a better experience.

I would also like to thank Dr. Janessa Drake, a member of my supervisory committee and a great mentor, for all of her suggestions and support. She has contributed to my growth as a person and as a scientist. I would also like to acknowledge physiotherapists, Dr. Kendal Marriott and Basit Adeyinka, for their contributions to this study. They provided recommendations to help modify the shoulder examinations and assisted with creating videos. I would like to acknowledge Dr. Anthony Gatti for helping with data analysis and providing statistical consulting.

I would like to acknowledge all of my past supervisors and mentors who have moulded me to think critically and made me a better scientist. I would like to thank all of my colleagues in the Biomechanics department for their support. Heather, thank you for being a great mentor and taking me under your wing. You helped me throughout the entire process and I am forever grateful for your patience and guidance. I would also like to thank my lab mates: Alex and Matt for helping with my thesis project and for their continual support. Thank you both for your support during presentations and for providing countless feedback – it means a lot to me!

Last but not least, I would like to thank my family: mom, dad, Basit, and Barry for all of their support and encouragement. Thank you for your patience while I spent countless hours in my room during the screening interviews. Thank you for being a great support system, especially during this past year.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

After low back and knee pain, shoulder pain is the third most common musculoskeletal complaint in primary care (Urwin et al., 1998). The most frequent cause of shoulder pain is subacromial impingement syndrome (SAIS) and/or rotator cuff dysfunction (Cadogan et al., 2011; Chard et al., 1991; Vincent et al., 2017). In fact, SAIS precedes 95% of rotator cuff tears (Neer, 1983). The incidence of rotator cuff tears increases with age, and degenerative morphological changes, particularly to the acromion, are a contributing factor (Wang and Shapiro, 1997). The incidence of type III acromion (hooked shaped) increases in adults greater than 50 years of age, suggesting that acromial morphology changes with the aging process (Wang and Shapiro, 1997). Type III acromion reduces the subacromial space and is subsequently associated with an increased incidence of rotator cuff tears in older adults. It has been suggested that traction on the coracoacromial ligament leads to bone spur formation causing the hooked shaped acromion (Nicholson et al., 1996).

Evidence also suggests that the degeneration of the rotator cuff is a normal part of the aging process (Teunis et al., 2014). In adults over 70 years of age who reported shoulder pain, approximately 70% were related to rotator cuff pathology (Chard et al.,1991; Lin et al., 2008). Shoulder pain can lead to impaired quality of life (QoL) and debilitating mental health (McRae et al., 2011). Various physical activity and exercise programs such as yoga and Pilates have been shown to improve pain, functionality, and psychological well-being in older populations with musculoskeletal conditions (Chopp-Hurley et al., 2017; Küçükçakır et al., 2013; Kuntz et al., 2018; Littlewood et al., 2012; Ruiz-Montero et al., 2019).

While several studies have explored the effect of exercise on QoL outcomes (i.e., pain, function, depressive symptoms, self-efficacy) among older adults with different musculoskeletal

conditions (including osteoarthritis and osteoporosis) (Chopp-Hurley et al., 2017; Küçükçakır et al., 2013; Kuntz et al., 2018), these relationships have not been explored among those with subacromial impingement and/or rotator cuff tears. There is also inconclusive evidence to support exercises specifically targeting the painful shoulder over general whole-body exercises in rehabilitation for the treatment of pain and function in patients with SAIS (Shire et al., 2017). In fact, Lewis (2016) suggests that providing a local shoulder-based treatment in isolation may be an ineffective strategy in managing rotator cuff-related problems. Lewis (2016) recommends a holistic exercise program that combines whole-body exercise and lower-limb exercise because many activities involving the shoulder require energy transfer from the lower to upper limbs. The inability to transfer energy from the lower limbs may result in increased demands on the shoulder. To our knowledge, the effects of exercise type (i.e., targets the injured shoulder vs general exercise) on self-reported health-related QoL has not been studied in patients with shoulder pain.

CHAPTER TWO: LITERATURE REVIEW

Rotator cuff related shoulder pain (RCRSP) is a term that encompasses a broad spectrum of shoulder conditions, including subacromial impingement syndrome, rotator cuff tendinopathy, and symptomatic partial and full rotator cuff tears (Lewis, 2016). Many studies have investigated the impact of RCRSP on QoL in older adults and there is significant evidence to suggest that RCRSP results in functional disability and lower QoL outcomes (Chipchase et al., 2000; MacDermid et al., 2004). The QoL of patients with shoulder pain is usually measured through one of three outcome measures: general physical health, shoulder functional disability, and psychological health.

2.1 General physical health-related QoL

General physical health is commonly measured using the physical component score of the Short Form-36 (SF-36) (Laucis et al., 2015; MacDermid et al., 2004; Wylie et al., 2010). The SF-36 questionnaire provides an indication of general health status and measures eight dimensions of general health, including physical function, bodily pain, general health, social functioning, and mental health (Ware and Sherbourne, 1992). The physical component score of the SF-36 (SF36-PCS) was found to be significantly correlated ($r = -0.38$ to -0.40, $p<0.01$) with strength measures (i.e., external rotation and internal rotation), where lower physical health was related to lower strength in patients with rotator cuff pathology (MacDermid et al., 2004). The same study showed that the presence of rotator cuff pathology was the only significant factor affecting general physical health QoL; 71% of the variation between subjects' health status was related to the presence of rotator cuff pathology (MacDermid et al., 2004). In addition, patients with chronic shoulder impingement (Chipchase et al., 2000) and rotator cuff tendinopathy and/or osteoarthritis (Wylie et al., 2010) had poor QoL, as measured using SF-36 and SF36-PCS, respectively. These studies illustrate that RCRSP has a significant impact on an individual's perception of health-related QoL. The impact of shoulder dysfunction on QoL demonstrates the need for effective treatment in this clinical population.

2.2 Shoulder functional disability

There are many shoulder specific QoL questionnaires that have been widely used in literature, such as the Shoulder Pain and Disability Index (SPADI), Disability of the Shoulder and Hand (DASH), Upper Extremity Functional Index (UEFI), Simple Shoulder Test (SST), University of Pennsylvania (PENN) shoulder score, American Shoulder and Elbow Surgeons (ASES), and the Western Ontario Rotator Cuff (WORC) Index (Angst et al., 2011). These questionnaires have been used to capture shoulder-related physical disability. For example, the

WORC and UEFI were used to assess the QoL of patients enrolled in physical therapy for rotator cuff related pathology (Razmjou et al., 2006). The WORC score was more correlated with a shoulder-specific scale (ASES) compared to a limb-specific scale (UEFI) (Razmjou et al., 2006). However, the UEFI had the highest sensitivity to change score among the three scales (Razmjou et al., 2006).

Patients with rotator cuff dysfunction have lower strength, greater pain, and disability. MacDermid et al. (2004) reported that patients with rotator cuff dysfunction had significantly lower internal ($p<0.0001$) and external shoulder ($p=0.001–0.004$) rotational strength than asymptomatic patients. The lower strength was significantly correlated to lower functional shoulder pain and disability (measured using the SPADI), with isometric external rotation showing the greatest correlation ($r= –0.56$, $p<0.01$) (MacDermid et al., 2004). In addition, lower functional disability measured using DASH was found to be moderately correlated with range of motion ($r=0.311$, $p<0.05$), strength ($r=0.320$, $p<0.05$), perceived pain ($r=0.372$, $p<0.05$), and depressive symptoms ($r=0.583$, $p<0.001$) in patients with chronic shoulder pain (Roh et al., 2012). Similarly, reduced shoulder specific QoL and functional disability have been reported in patients with subacromial impingement and rotator cuff dysfunction, measured using the SST and PENN shoulder specific questionnaire (Chipchase et al., 2000; Wylie et al. 2010). Many studies have validated the use of various shoulder specific QoL questionnaires, however few studies have examined the relationship between psychological health-related factors and shoulder specific health-related QoL, particularly for UEFI and WORC.

2.3 Psychological health-related factors

Shoulder pain can lead to debilitating mental health and psychological factors can influence the perception of pain. In fact, Wylie et al. (2016) reported that mental health has a stronger association with self-reported shoulder pain and function than tear size in patients with

rotator cuff tears. The psychosocial dimensions or the mental component score of the SF-36 (SF36-MCS) is often used to measure general psychological QoL in patients with RCRSP (Chipchase et al., 2000; Wylie et al., 2010; Wylie et al., 2016). Chipchase et al. (2000) reported that the psychosocial dimension of the SF-36 in patients with chronic shoulder impingement was significantly lower than the general population. Conversely, Wylie et al. (2010) found that the general psychological QoL was in the normal range for pre-operative patients with RCRSP. However, the authors reported that patients' psychological health was highly correlated with their shoulder specific QoL (Wylie et al., 2010). This result suggests that patients with greater shoulder functional disability report lower emotional status. As recommended by Wylie et al. (2010), these findings suggest that psychotherapy in patients with RCRSP may lead to better patient self-reported shoulder pain and function.

In older populations, the ability to perform activities of daily living is important for self-care and functional independence. Self-efficacy for patients with chronic pain is defined as their confidence in the ability to perform activities despite their pain, and is often measured using the Pain Self-efficacy Questionnaire (PSEQ) (Chester et al., 2019; Menendez et al., 2015; Nicholas, 2007). Self-efficacy may be used as a predictor of performance in specific activities because it has been correlated ($r = -0.49$ to -0.75, $p<0.01$) with performance (measured as completion of the task) in patients with chronic low back pain (Council et al., 1988). The patients with back pain predicted their performance on a scale of how far they expect to move (i.e., during a toe touch) and their subsequent performance was rated on the same scale by two independent raters (Council et al., 1988). A study that explored self-efficacy in patients with shoulder pain found that pain self-efficacy was a significant predictor of physiotherapy treatment outcomes (Chester et al., 2019). For patients with high baseline pain or disability (measured using the SPADI),

higher pain self-efficacy (PSEQ≥48) reduced their levels of pain and disability at 6-month follow-up (Chester et al., 2019). For patients with low baseline SPADI and pain scores, low pain self-efficacy increased the likelihood of persistent pain, and they had similar or worse outcomes on the SPADI pain subscale compared to patients with higher baseline pain but higher pain self-efficacy (Chester et al., 2019). A similar relationship was found by Menendez et al. (2015); they found that lower pain self-efficacy was associated with worse SPADI scores ($r = -0.45$, $p < 0.001$) in patients with shoulder pain. However, this relationship has not been explored in a cohort of older patients with RCRSP. Nonetheless, these studies suggest that self-efficacy may be a mediating factor in perceived pain and treatment outcomes in patients with RCRSP.

In patients with RCRSP, it is important to explore exercise-self efficacy as exercise is often prescribed as a non-surgical treatment. Exercise self-efficacy (ESE) is defined as the belief in one's ability to exercise regularly (most days of the week) (Everett et al., 2009). Exercise self-efficacy has been shown to be significantly correlated with exercise performance in cardiac rehabilitation patients (Everett et al., 2009) and in adults with congenital heart disease (Bay et al., 2018). Everett et al. (2009) measured exercise performance as distance walked during a six-minute walk test and reported that patients that walked more than 500m had significantly higher ESE scores than those who only walked up to 400m ($p=0.044$). Bay et al. (2018) reported that patients with higher ESE completed more shoulder flexions ($p=0.001$) and heel lift ($p=0.05$) repetitions compared to those with lower ESE. In a cohort with shoulder and neck pain, Andersen (2011) found that participants with low and medium ESE had lower exercise adherence to a 10-week exercise program in comparison to those with higher ESE. However, the relationship between exercise-self efficacy and performance has not been explored in patients with RCRSP.

In addition to self-efficacy, fear avoidance beliefs is another factor that is associated with disability in patients with chronic pain. Fear avoidance beliefs, such as fear of movement/re-injury, play an important role in the development and maintenance of chronic pain and in predicting pain related outcomes (Asmundson et al., 2006; Hapidou et al., 2012; Lethem et al., 1983; Sullivan et al., 1995; Wideman and Sullivan, 2011). Fear of movement/re-injury, termed kinesiophobia, may cause individuals to avoid exercise and physical activity which may lead to increased disability and pain (Asmundson et al., 2006; Hapidou et al., 2012; Sullivan et al., 1995; Wideman and Sullivan, 2011). In patients with subacromial shoulder pain, Kromer et al. (2014) found that fear-avoidance beliefs contributed significantly to baseline disability, but not to disability change scores after a 3-month follow-up. The authors suggested that using an unvalidated modified Fear-Avoidance Beliefs Questionnaire for their patient group may be a limitation of their study. The role of kinesiophobia in patients with RCRSP has been explored by various authors, with the majority of evidence indicating its negative impact on pain and disability (Clausen et al., 2017; Kromer et al., 2014; Luque-Suarez et al., 2020; Martinez-Calderon et al., 2018; Wolfensberger et al., 2016). Nicholas (2007) encouraged studying the relationship between self-efficacy and fear avoidance beliefs on exercise behaviour in patients with chronic pain. For example, an individual might be fearful of an activity, but whether they perform the activity may depend on how confident they feel (Nicholas, 2007). To our knowledge, the relationship between kinesiophobia and exercise self-efficacy has not been studied in older adults with RCRSP.

Symptoms of depression correlate with increased shoulder pain and disability. Compared to healthy controls, patients with shoulder pain had a higher prevalence of depression ($p=0.02$) (Cho et al., 2013a). Furthermore, studies have found a significant correlation between depressive

symptoms and pain, and perceived disability in patients with shoulder pain (Badcock et al., 2002; Menendez et al., 2015; Roh et al., 2012) and pre-operative rotator cuff patients (Cho et al., 2013b). The study by Badcock et al. (2002) found that patients with chronic pain at baseline and at 2-year follow-up had disability and depression scores – measured using Hospital Anxiety and Depression Scale (HADS) – that were significantly correlated with pain severity (disability vs pain $r=0.536$, $p<0.001$; depression vs pain $r=0.202$, $p=0.021$). Menendez et al. (2015) found that SPADI scores were correlated with depression scores on the Patient Health Questionnaire Depression Scale ($r=0.39$; $p < 0.001$). Roh et al. (2012) found that patients that reported lower disability and greater symptoms on DASH had greater perceived pain ($r=0.372$, $p<0.05$), and also reported greater depressive symptoms on the Center for Epidemiologic Studies-Depression (CES-D) scale ($r=0.583$, $p<0.001$). Cho et al. (2013b) reported that depression scores on the HADS was a stronger predictor of self-assessed functional disability health-related QoL compared to anxiety score, and depression scores were significantly correlated with pain scores ($r=0.191$, $p=0.048$). In addition, a longitudinal study by Kuo et al. (2019) showed that patients diagnosed with depression were at an increased risk of rotator cuff tears and rotator cuff repair surgery. These studies suggest a bidirectional relationship between shoulder pain and depression. Furthermore, depression has been identified as a predictive factor for exercise adherence for a shoulder pain rehabilitation program for head and neck cancer survivors (McNeely et al., 2012). These results suggest that a vicious cycle of depression may lead to reduced physical activity, which may result in increased pain. However, the relationship between physical activity levels and depression and their relationship to disability and pain has not been explored in patients with RCRSP.

2.4 Obesity and health-related QoL

There is inconclusive evidence regarding the relationship between body max index (BMI) and quality of life in patients with RCRSP. This relationship is important because obesity may play a role in decreased vasculature that leads to degeneration of the rotator cuff tendons (Wendelboe et al., 2004). A recent study found that higher subcutaneous fat (lower muscle quality) was related to lower functional outcomes (mobility, strength, and performance on a six-minute walk test) in older women with knee osteoarthritis (Chopp-Hurley et al., 2020). Similarly, fatty tissue has been reported to correlate with lower muscle quality in patients with rotator cuff tears (Watanabe et al., 2015) and has been shown to have a negative influence on the functional outcomes of shoulder surgery (Goutallier et al., 2003). One study in particular studied leg muscles and found an association between fat mass and muscle strength and aging, suggesting that a high degree of fat mass in older adults is associated with lower muscle quality and lower functional outcomes (Koster et al., 2011). These findings suggest that BMI may be related to muscle quality which is related to functional outcomes in older adults with musculoskeletal pain.

McRae et al. (2011) reported no correlation between BMI and shoulder specific health-related QoL in patients with rotator cuff pathology. Conversely, significant relationships have been reported between BMI and the SF36-MCS, and shoulder specific health-related QoL (Menendez et al., 2015; Wylie et al., 2010). A reason for the potential discrepancy is that McRae et al. (2011) performed their analysis using BMI as a continuous variable and the mean BMI for the patients was less than the obese threshold (<30 kg/m^2). The study by Wylie et al. (2010) examined BMI categorically (i.e., obese and non-obese) in patients with rotator cuff pathology and/or osteoarthritis. The study by Menendez et al. (2015) also reported BMI as a continuous variable, but their cohort group was a diverse group of patients with different sources of shoulder pain (i.e., impingement, RCT, acromioclavicular separation, etc.). While there has been

extensive literature on BMI and RCRSP, and the association of BMI on surgical outcomes, there is inconclusive evidence on the relationship between BMI and mental and physical health-related QoL.

2.5 Exercise and QoL

Exercise therapy is often recommended to patients with RCRSP to help reduce pain and improve function. The rotator cuff muscles are the prime movers in shoulder rotation and are also critical stabilizers of the shoulder (David et al., 2000). Exercise is known to increase serotonin levels (Mattson et al., 2004), which is an important neurotransmitter that helps with mood regulation and modulates pain (Millan, 2002). Brain-derived neurotrophic factor (BDNF) is also a neurotransmitter that increases with exercise and helps modulate nociception (Mattson et al., 2004). In premenopausal women with chronic low back pain, it was found that participants who completed a yoga intervention had decreased back pain and increased serum BDNF in comparison to the control group (Lee et al., 2014). In addition, the control group had decreased serotonin levels coupled with increased low back pain, but serotonin levels were maintained in the yoga group (Lee et al., 2014). These physiological mechanisms provide evidence to suggest that exercise can help modulate pain perception. Therefore, specific exercises targeting the rotator cuff are commonly prescribed to help regain normal shoulder function and biomechanics, and to improve functional abilities in older adults (Lewis, 2016; Lin et al., 2008).

Many studies have demonstrated that exercise targeting the rotator cuff can help decrease pain and increase functionality (Bernhardsson et al., 2011; Holmgren et al., 2012, Littlewood et al., 2012). For example, two studies published by Brox et al. showed that an exercise program that targets the injured shoulder equally improved rotator cuff diseases compared to surgical treatment, and it significantly improved outcomes in comparison to a placebo group undergoing laser treatment (Brox et al., 1993; Brox et al., 1999). The exercise program consisted of relaxed

repetitive movements of the shoulder: first rotation, then flexion-extension, and finally abduction-adduction for 1 hour on a daily basis. Resistance was gradually added to strengthen the short shoulder rotator and the scapular stabilizing muscles. However, there is insufficient evidence to support the optimal exercise regimen, frequency, and program for RCRSP (Lewis, 2016; Michener et al., 2007; Shire et al., 2017). Furthermore, there is no significant evidence to support the use of exercises that target the injured shoulder over general exercises (i.e., whole-body such as cardiovascular or other non-shoulder specific exercise) rehabilitation programs that aim to improve pain, strength and functionality (Lewis 2016; Shire et al., 2017). In fact, three previous systematic reviews found insufficient evidence to support the use of scapular focused treatment strategies (i.e., taping, specific exercises, mobilization techniques) in SAIS patients (Bury et al., 2016; Reijneveld et al., 2016; Shire et al., 2017).

A specific shoulder-based treatment in isolation may be an inefficient strategy in managing RCRSP (Lewis, 2016). Lewis (2016) recommends a holistic approach involving whole-body exercise and lower-limb exercises because many activities involving the shoulder require that energy be transferred from the lower to upper limbs through the trunk. Therefore, a specific exercise regimen may lead to the inability to transfer energy from the lower limbs and result in an increased stress on the shoulder (Kibler, 1995; Kibler and Chandler, 1995; Seroyer et al., 2010; Sciascia and Cromwell, 2012), thereby leading to increased pain and disability (Lewis, 2016). In addition, a recent study found that lower extremity aerobic exercise significantly decreased mechanically induced shoulder pain (Wassinger et al., 2020), suggesting potential benefits of whole-body exercises. However, the comparison of general exercises and exercise that targets the injured shoulder, on health-related QoL has not been studied in patients with

RCRSP. Therefore, there is a need for research on the optimal exercise type for this patient group.

2.6 Sex differences

Women report more pain in several musculoskeletal conditions (i.e., low back pain, knee pain) (Bartley and Fillingim, 2013; Stubbs et al., 2010), and this is consistent with shoulder pain (Bodin et al., 2012; Cadogan et al., 2011; Vincent et al., 2017). Also, women have reported lower functional scores (McRae et al., 2011; Roh et al., 2012; Wylie et al., 2010) even when controlling for morphologic disease severity (Wylie et al., 2010) and psychological factors (Stubbs et al., 2010). Studies have reported that while women report more pain, there were no sex differences in depression, catastrophizing, fear avoidance, and anxiety in patients with RCRSP (Kindler et al., 2011; Mintken et al., 2010). However, others have reported that women have higher depression scores in patients with shoulder pain ($p=0.02$) (Roh et al., 2012) and in patients scheduled for rotator cuff repair ($p=0.016$) (Cho et al., 2013b). Therefore, there is inconclusive evidence for sex differences on the relationship between psychological factors and perceived pain and functionality in patients with RCRSP. Additionally, it would be meaningful to explore whether differences in physical activity levels may be correlated to sex differences in mental and physical health-related QoL. Nonetheless, research on sex differences suggests that pain management strategies that target functional disability may be essential in treating women with pain (Stubbs et al., 2010).

2.7 COVID-19

The novel coronavirus (COVID-19) outbreak has brought unprecedented changes globally that include public health guidelines that recommend people to stay home and to avoid human interactions outside of their immediate households. These guidelines are enhanced for older adults who are considered a high-risk population, and these guidelines likely disrupt their

normal routine (Jiménez-Pavón et al., 2020; Marcos-Pardo et al., 2020). Isolation may exacerbate issues related to mental health and may result in increased levels of anxiety and depression in older adults (Freedman and Nicolle, 2020; Santini et al., 2020). In addition, it may result in higher sedentary levels and lower physical activity levels, which may intensify symptoms in older adults with chronic pain (Mani et al., 2019), and can increase the risk of developing chronic diseases (Owen et al., 2010). However, self-isolation may have resulted in less demanding activities on the shoulder (i.e., occupational-related shoulder activities), which may result in better self-reported outcomes. Therefore, it is meaningful to explore the relationship between COVID-19 and self-reported changes in physical activity levels, and other health-related QoL outcomes for different levels of self-isolation.

2.8 Summary

This literature review has demonstrated several physical and psychological factors that mediate QoL outcomes in patients with RCRSP. RCRSP can result in significant functional disability and worse mental and physical health-related QoL. There is evidence to suggest that self-efficacy may be a mediating factor in perceived pain in patients with shoulder pain, but this relationship has not been explored in a cohort of older patients with RCRSP. The relationship between kinesiophobia and exercise self-efficacy in older adults with RCRSP is unknown. Furthermore, research is needed to explore the relationship between physical activity levels and depression and their relationship to disability and pain. This review also highlighted that there is inconclusive evidence on the relationship between obesity and the magnitude of pain and its correlation with mental and physical health. There is inconclusive evidence on the optimal exercise type for patients with RCRSP. Research on sex differences suggests that pain management strategies that target functional disability may be critical in treating women with

pain. Lastly, the relationship between COVID-19 and physical activity levels, and other health-related QoL outcomes is unknown.

CHAPTER THREE: RESEARCH QUESTIONS AND HYPOTHESES

3.1 Primary questions and hypotheses

The primary purpose of this study was two-fold:

1. Determine whether self-reported outcomes (pain, function, depressive symptoms, fear of movement, self-efficacy, general mental and physical health) predict physical activity levels in older adults with RCRSP.

   It was hypothesized that self-reported outcomes (pain, function, depressive symptoms, fear of movement, self-efficacy, general mental and physical health) will explain a large amount of variance in physical activity levels (measured using self-reported questionnaires and accelerometry).

2. Determine whether regular self-reported participation in activities/exercises that target the painful shoulder have better self-reported outcomes than whole-body exercise or little/no exercise.

   It was hypothesized that participants who regularly participate in activities that target their injured shoulder (i.e., upper body) will have better self-reported outcomes (pain, function, depressive symptoms, fear of movement, and self-efficacy) than those who report primarily whole body exercise or no exercise.

3.2 Secondary questions and hypotheses

In addition to the primary research questions, we investigated five secondary questions:

1. Determine whether self-reported QoL outcomes (depressive symptoms, fear of movement, self-efficacy, shoulder disability and pain, general physical and mental

health) were different between those with obese versus non-obese body mass index (BMI) classifications.

It was hypothesized that those with lower BMI (i.e., non-obese, <30 kg/m^2) will report greater shoulder function, self-efficacy, mental health, and lower pain, depressive symptoms and fear of movement than obese individuals (BMI ≥ 30 kg/m^2).

2. Determine whether sex differences exist in shoulder pain and self-reported outcomes.

   It was hypothesized that women will report a greater fear of movement, depressive symptoms, pain, lower activity levels, function and self-efficacy than men.

3. Determine whether psychological factors (depressive symptoms, self-efficacy, fear of movement, general mental health) predict the perception of shoulder pain.

   It was hypothesized that depressive symptoms, fear of movement, self-efficacy and mental health will explain a large amount of variance in the perception of shoulder pain.

4. Determine whether physical activity levels and self-reported outcomes were affected by self-isolation related to COVID-19.

   It was hypothesized that higher pain, poorer mental and physical health, and lower physical activity levels will be reported post-COVID-19 compared to pre-COVID-19 in those that report higher levels of self-isolation.

5. Determine whether self-reported physical activity levels correlate with those quantified using an accelerometer.

   It was hypothesized that physical activity levels measured using the International Physical Activity Questionnaire (IPAQ) and Physical Activity Scale for the Elderly (PASE) will be correlated with average daily step count (AVGSTEP) and total daily moderate-vigorous physical activity (MVPA).

CHAPTER FOUR: METHODS

4.1 Recruitment

This study initially recruited 63 participants that underwent a one-on-one pre-screening interview with the investigator over a web-based video Zoom call to determine their eligibility (Appendix R and Appendix S). 48 participants were eligible, but two withdrew after screening. We collected data from 46 participants: 28 females and 18 males. All participants were recruited through electronic and local newspaper advertisements or through a snowball effect (Appendix Q). The study was approved by the York University Human Participants Review Committee (e2021-008) (Appendix S).

4.2 Inclusion criteria

To be eligible for our study, participants were at least 50 years of age, self-reported shoulder pain at least once a week, and for at least one year, as well as tested positive for at least three of the eight shoulder impingement or rotator cuff dysfunction tests. The eight clinical tests performed were: Yocum's test, belly press, modified drop-arm, resisted external rotation, painful arc, empty can, modified Hawkins-Kennedy, and lift-off test (Table 1). Due to COVID-19 restrictions, testing was conducted virtually. Therefore, a few of these tests were modified (i.e., self-resisted), based on consultation and recommendations from physiotherapists, to allow for self-testing. To minimize fatigue and to standardize testing, each test was randomly staggered based on the target muscle, with test order consistent across participants. However, lift-off was selected as the last test to limit discomfort based on recommendations from a physiotherapist.

Before performing each test, participants read instructions, watched the examiner perform the test, and were given the option to watch a video of the test. Most tests were classified as positive if the shoulder pain rating during the test was greater than the baseline rating (Table 1). The specificity and sensitivity for each test respectively are: painful Arc (67%, 75%), Yocum's

(40%, 79%), Hawkins-Kennedy (62%, 63%), empty can (87%, 50%), external rotation (87%, 56), drop-arm (96%, 24%), belly press (87%, 28%), and lift-off (94%, 22%) (Çalış et al., 2000; Jain et al., 2017; Michener et al., 2009; Park et al., 2005). The cut-off point of three or more positive tests was chosen because it was previously shown that three or more positive tests could confirm the diagnosis of SAIS, while less than 3 rules out SAIS (Michener et al., 2009). While chronic shoulder pain is typically defined as pain for at least six months (Burbank et al., 2008), our inclusion criteria specified one year in order to capture the quality of life changes due to COVID-19.

Table 1. The instructions for each test and the criteria used to determine if the participant was positive.
(Flynn et al., 2008; Gerber and Krushell, 1991; Gerber et al., 1996; Jobe and Moynes, 1982; Hawkins and Kennedy, 1980; Silva et al., 2008; Yocum 1983; Çalış et al., 2000)

RCRSP Test	**Instructions**	**Positive Criteria**
Yocum's test	1. Place your symptomatic hand on the opposite shoulder 2. Elevate your elbow, without raising your shoulder	Pain rating > baseline NPRS
Belly press	1. Place the palm of the hand on the upper abdomen with your elbow flexed at 90 degrees 2. Press the palm of your hand against the abdomen. This should result in your elbow moving forward (make sure your wrist is straight)	Pain rating > baseline NPRS
Modified drop-arm	1. Elevate/abduct your arm to the side with your palm facing upwards 2. Slowly lower your hand down to the side	Inability to slowly lower hand
Resisted external rotation	1. Place your arm to the side with your elbow in 90 degrees flexion and tucked into your side 2. Externally rotate your hand while using your other hand to resist the back of your forearm (near the wrist)	Pain rating > baseline NPRS

Painful arc	1. Slowly lift your symptomatic arm to the side and stop if it hurts (palm facing downwards) 2. If you stop: continue to lift your arm until the pain goes away 3. At the top: slowly lower your hand back down and stop if you feel pain on your way down 4. Lower your hand back to the rest position	Pain only in the 60-120 degrees range AND Pain rating > baseline NPRS
Empty can	1. Elevate your arm diagonally 2. Make sure your elbow is extended and rotate your arm such that the thumb points down like you are emptying a can 3. Use your other arm to push down on the forearm to resist your arm	Pain rating > baseline NPRS
Modified Hawkins-Kennedy	1. Put your forearm on a bottle with your elbow flexed at 90 degrees 2. Push down on your hand with the other hand providing resistance	Pain rating > baseline NPRS
Lift-off test	1. Place the back of your hand against the lower part (mid-lumbar) of your spine 2. Lift-off your hand away from your back	Pain rating > baseline NPRS OR Inability to lift the hand off the back

4.3 Exclusion criteria

Participants were excluded from the study if they met any of the following criteria: traumatic injury (i.e., car accident) resulting in structural shoulder damage (i.e., dislocation or fracture) on either shoulder, previous shoulder or hand surgery, physician restriction to physical activity (such as due to musculoskeletal or neurological conditions), and corticosteroid injection to the arm in the past year.

4.4 Study design

The study design involved three parts: an initial pre-screening interview, at-home questionnaires, and wearing of an activity tracker. During the pre-screening interview, participants were asked a series of questions to determine their eligibility for the study and

performed the eight clinical shoulder tests. If eligible, participants were told to complete 16 questionnaires in one week, in a randomized order (Table 2). During the same week, participants wore an activity tracker, ActiGraph GT9X Link 3-axis accelerometer (*ActiGraph*©, Pensacola, Florida). Participants were also given an Activity Journal to document their activities during the week.

Table 2. The 16 questionnaires and their outcome measure. *Note: SPADI appears twice and is divided into two subscales.*

Outcome Measure	Questionnaire
Function/Disability	Upper Extremity Functional Index (UEFI) Western Ontario Rotator Cuff Index (WORC) Disabilities of the Arm, Shoulder and Hand (DASH) Shoulder Pain and Disability Index (SPADI) —Disability Subscale
Physical Activity	Physical Activity Scale for the Elderly (PASE) International Physical Activity Questionnaire (IPAQ) Non-Standardized Exercise Questionnaire†
Pain	Numeric Pain Rating Scale (NPRS) Shoulder Pain and Disability Index (SPADI) —Pain Subscale
Depression	Center for Epidemiologic Studies Depression Scale (CES-D)
Self-Efficacy	Pain Self-Efficacy Questionnaire (PSEQ) Bandura's Exercise Self-Efficacy Scale (ESE)
Fear of Movement	Tampa Scale of Kinesiophobia (TSK-11)
Others	36-Item Short Form Survey (SF-36) Charlson Comorbidity Index (CCI) COVID-19 Related Questionnaire† Outside Events Report†

† Indicates non-standardized questionnaires developed for the purpose of this study. Thus, psychometric properties do not exist for these questionnaires and they have not been used in previous research.

4.5 Outcome measures

Along with demographic questions, participants were asked to complete 16 questionnaires that measured self-reported outcomes such as physical function, physical activity, pain, depressive symptoms, self-efficacy, comorbidity, and fear of movement (Table 2).

4.5.1 Physical function

Shoulder function was measured using four questionnaires: the Upper Extremity Functional Index (UEFI), Western Ontario Rotator Cuff (WORC) Index, the Disabilities of the Arm, Shoulder and Hand (DASH), and the disability subscale of the Shoulder Pain and Disability Index (SPADI-D).

The UEFI is a 20-item patient-reported questionnaire that is used to measure upper extremity function in individuals with hand and upper extremity disorders (Arumugam and MacDermid, 2018). Patients rate their ability to complete activities of daily living on a 0 to 4 scale, where 0 indicates extreme difficulty and 4 indicates no difficulty performing the task (Hefford et al., 2012). The maximum score is 80, which indicates excellent function. The UEFI has been validated in a variety of populations, such as post-surgical patients with shoulder, elbow, wrist and hand conditions (Arumugam and MacDermid, 2018; Hefford et al., 2012; Razmjou et al., 2006). In patients with shoulder disorders, such as shoulder impingement syndrome and post-operative rotator cuff repair, the UEFI was moderately correlated with WORC Index (r=0.78) and the Rotator cuff Quality of life questionnaire (r=0.67) (Razmjou et al., 2006). The UEFI has demonstrated excellent re-test reliability (ICC=0.85-0.94) in several studies with a sample of shoulder, elbow, wrist and hand musculoskeletal conditions (Arumugam and MacDermid, 2018; Chesworth et al., 2014; Hamilton et al., 2013; Hefford et al., 2012).

The WORC Index is a self-reported questionnaire that evaluates the symptoms and functional ability, specific to a rotator cuff pathology in the past week. It is made up of 21 visual analog scales (VAS) items that are organized into 5 subscales: physical symptoms, sports/recreation, work, lifestyle, and emotions (Raman and MacDermid, 2012). Patients are asked to indicate the extent of disability on a 100-mm line with the phrases “no pain” and “extreme pain” at the beginning and end, respectively (Raman and MacDermid, 2012). Scores

can be calculated from each subscale or summed for a score ranging from 0 to 2100, with a higher score indicating lower quality of life (Raman and MacDermid, 2012). The WORC has demonstrated good test-retest reliability (ICC= 0.84–0.96) in patients with rotator cuff pathology, impingement, and calcific tendinitis (Ekeberg et al., 2008, De Witte et al., 2012; Kirkley et al., 2003, Raman and MacDermid, 2012). The construct validity of WORC was tested in comparison to 13 other disability instruments and it showed high correlation (Longo et al., 2011). The WORC correlates well with the American Shoulder and Elbow Surgeons score (ASES) (r =0.68) and the DASH (r =0.63) (Kirkley et al., 2003).

The DASH is a 30-item questionnaire that evaluates symptoms and ability to perform certain upper extremity activities in the past week. All items are scored on a scale of 5; where 1=no difficulty, and 5=extreme difficulty (Angst et al., 2011). The total score ranges from 0 to 100, with 100 indicating the most disability. The DASH has shown excellent test-retest reliability (ICC=0.93–0.98) in a variety of upper limb disorders (Beaton et al., 2001; Raven et al., 2008; Schmitt and Di Fabio, 2004; Slobogean et al., 2010). It has also shown good construct validity to other assessments such as SPADI (r=0.79-0.93, 0.55) (Angst et al., 2004; Beaton et al., 2001; Staples et al., 2010) and ASES (r=0.79) (Angst et al., 2004)

The SPADI is a self-assessment questionnaire that measures pain severity and the ability to perform activities of daily living in the past week in patients with shoulder disorders. It measures two dimensions and contains 13 items: 5 items for pain and 8 items for disability. All items are scored on an 11-point numerical rating scale (0–10) with 0=no pain and 10=worst pain. In the present study, the disability scale of the SPADI (SPADI-D) was used to measure physical function. The total disability score ranges from 0 to 100, with 0 being the worst shoulder disability (Angst et al., 2011). The test-retest reliability for the SPADI-D (ICC=0.92) was high

and it was significantly correlated with strength measures in patients with chronic rotator cuff tendinitis or impingement (r= –0.31 to –0.42) (MacDermid et al., 2004). The internal consistency for the disability subscale was reported with high Cronbach's alpha scores (α = 0.90-0.93) (Hill et al., 2011; MacDermid et al., 2006). The SPADI-D has been reported as a valid measure of disability in patients with shoulder dysfunction in several validation studies (MacDermid et al., 2004; MacDermid et al., 2006; Hill et al., 2011).

4.5.2 Physical activity

Physical activity level was assessed using an activity tracker (ActiGraph GT9X Link 3-axis accelerometer) and three questionnaires: the Physical Activity Scale for the Elderly (PASE), the International Physical Activity Questionnaire (IPAQ), and a Non-standardized Exercise questionnaire.

The activity tracker was used to track the average daily step count (AVGSTEP) and average daily moderate-vigorous physical activity (MVPA) time. Participants were also provided with an Activity Journal to log daily activities and times when the tracker was on or off during the week. The journal assisted with processing the accelerometry data, specifically, to confirm days that the tracker was worn.

In addition to an objective measure of activity, participants were asked to complete three questionnaires. The PASE is a 10-item self-reported questionnaire that assesses activities typically performed by older adults (i.e., walking, recreational activities, exercise, housework, etc.). It measures the frequency, duration, and intensity level of different activities over the previous week. The final PASE activity score was determined by multiplying activity frequency (hr/week) by an item weight devised by the PASE authors (Washburn et al., 1993). The score ranges from 0 to 793, with higher scores indicating greater physical activity levels (Logan et al., 2013). The PASE has shown a moderate to strong test-retest reliability (r=0.68–0.84) over a 3-7

week interval, for mail and telephone administration (Washburn et al., 1993). PASE scores have been validated against physiologic and performance characteristics; the scores were significantly associated ($p<0.05$) with peak oxygen uptake ($r =0.20$), systolic blood pressure ($r = –0.18$) and balance score ($r =0.20$) (Washburn et al., 1999). However, the PASE is not recommended as a valid tool to examine physical activity in hip osteoarthritis and cancer patients (Liu et al., 2011; Svege et al., 2012). To our knowledge, the PASE has not been used in patients with RCRSP. The final PASE score was used as a measure of physical activity levels.

The IPAQ is a standardized questionnaire developed for young and middle-aged adults. It assesses the type and intensity of physical activity and sitting time during the past week. In a study that examined the reliability of the IPAQ from data collected from 12 countries, the short form IPAQ had an acceptable reliability, with 75% of the Spearman correlation coefficients above 0.65 ranging from 0.32–0.88 (Craig et al., 2003). In the same study, there was a fair to moderate agreement between the IPAQ and accelerometers (pooled $\rho=0.30$ 95%, CI 0.23–0.36) (Craig et al., 2003). It was concluded that the short form IPAQ was a reasonable measurement to monitor population levels of physical activity among adults 18 to 65 years. Patients with shoulder dysfunction showed similar activity patterns in the general population as measured using the Short IPAQ (Klintberg et al., 2011). However, the IPAQ has not been validated in patients with RCRSP. The outcome measure from the IPAQ was the total METs per week. An excel sheet developed by Cheng (2016) was used to score the IPAQ.

The Non-standardized Exercise questionnaire (Appendix A) was developed for this study to investigate whether regular self-reported participation in activities/exercises that target the symptomatic shoulder were correlated with better self-reported outcomes compared to whole-body exercises. The exercise questionnaire is a self-reported questionnaire that was designed to

assess physical activity level, shoulder pain before and after each reported activity, and type of activity (whole-body/lower, upper region). Shoulder pain before and after activity was measured on an 11-point NPRS. The main outcome from the questionnaire was to group participants into three groups (those that exercise their painful shoulder (shoulder specific exercise), those that perform non-specific exercises, and those that do not regularly exercise). Participants were asked whether they regularly (defined as most days of the week) participated in activities/exercises that target their symptomatic shoulder (Appendix A). As well, this questionnaire was developed to identify changes in shoulder pain scores from activities that target different regions of the body.

4.5.3 Pain

Shoulder pain was assessed using the pain subscale of SPADI (SPADI-P) and the Numeric Pain Rating Scale (NPRS). The SPADI-P consists of 5 items and the total score ranges from 0 to 100, with higher scores indicating a greater shoulder pain. MacDermid et al. determined that the pain subscale can be used reliably in patients with rotator cuff tendinopathy or impingement (2004) and in patients with shoulder pain (2006). The SPADI-P was reported to have high test-rest reliability (ICC=0.89) (MacDermid et al., 2004) and a high internal consistency measured using Cronbach's alpha (α=0.85-0.92) (Hill et al., 2011; MacDermid et al., 2006). The total score from the SPADI-P was used as an outcome measure of pain.

In addition to the SPADI-P, the NPRS was also used to assess shoulder pain. The NPRS is an 11-point scale with scores from 0 to 10 where 0=no pain and 10=worst possible pain. The NPRS has been used to assess shoulder pain under conditions such as pain at rest, pain with normal activities, average pain, least pain, and worst pain (Leggin et al., 2006; Michener et al., 2011; Mintken et al., 2009). The NPRS has shown moderate test-retest reliability in patients with a primary complaint of shoulder pain (ICC=0.74) (Mintken et al., 2009), which is similar to the reported values for back pain (Childs et al., 2005) and cervical radiculopathy (Cleland et al.,

2006). The NPRS significantly differed between stable and improved patients with shoulder pain (p=0.002) and it was significantly correlated with the Global Rating of Change in detecting change in score (r=0.26; p=0.01) (Mintken et al., 2009). For this study, participants rated their level of pain at rest, during normal activities, and during strenuous activities. The score from the three questions was summed to provide a total score ranging from 0 to 30, with a higher score indicating higher pain. The average score from the three scenarios was used as the pain outcome measure for analysis.

4.5.4 Depressive symptoms

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D). The CES-D is a 20-item questionnaire that asks patients to rate how often over the past week they experienced symptoms associated with depression. Each item is rated on a scale from 0 to 3 where 0=rarely or none of the time and 3=most or all the time (Radloff, 1977). The total score is from 0 to 60, with higher scores indicating more symptoms of depression. A score of 16 or greater is widely used as the cut-off value to estimate the prevalence of clinical depression (Radloff, 1977). The scale has produced high internal consistency (α=0.82), acceptable test-retest stability (T1–T2=0.52), good sensitivity (76%) and specificity (77%) in older adults (Lewinsohn et al., 1997). The CES-D has been used to study depressive symptoms in various clinical patients, such as shoulder pain (Roh et al., 2012) and knee or hip osteoarthritis (Chopp-Hurley et al., 2017). The total score from the CES-D was used as the outcome measure for depressive symptoms.

4.5.5 Self-efficacy

Two outcome measures were used to measure self-efficacy in this study: the Bandura's Exercise Self-Efficacy (ESE) Scale and the Pain Self-Efficacy Questionnaire (PSEQ). The ESE is an 18-term questionnaire that asks the rater how confident they are that they can get

themselves to exercise regularly (most days of the week) (Everett et al., 2009). The scale ranges from 0 to 10, where 0="I cannot do this activity at all" and 10="I am certain that I can do this activity successfully." The total score ranges from 0 to 180, with a higher score indicating greater exercise self-efficacy. In cardiac rehabilitation patients, the ESE has been reported with a high internal consistency (α=0.95), no floor or ceiling effects, and the change in ESE scores was significantly correlated with the change in the six-minute walk test (r=0.28, p =0.035) (Everett et al., 2009). Different versions of the ESE have been validated in healthy and clinical populations (Noroozi et al., 2011; Shin et al., 2001; Van der Heijden et al., 2014; Wilcox et al., 2005). For this study, the 18-item ESE developed by Everett et al. (2009) was used as an outcome measure of exercise self-efficacy.

The second outcome measure of self-efficacy in this study was the Pain Self-Efficacy Questionnaire (PSEQ). The PSEQ is a 10-item questionnaire whereby the rater is asked how confident they are at performing activities despite the pain. Each question is rated on a 7-point scale, where 0=not at all confident and 6=completely confident. A total score is the calculated sum of each of the 10 items, with a range from 0 to 60, where higher scores represent greater self-efficacy beliefs. The PSEQ has shown high internal consistency (α=0.92), moderate test-retest reliability (r=0.73, p<0.001), and has been validated against other pain assessments (r>0.40, p<0.001) in patients with chronic low back pain (Nicholas, 2007). For our study, participants were asked to rate each item specifically based on their shoulder pain, and the total score was used as an outcome measure of pain self-efficacy.

4.5.6 Fear of movement

Fear of movement was assessed using the Tampa Scale of Kinesiophobia (TSK). We used the 11-item (TSK-11) rather than the original 17-item. The TSK-11 has been shown to have better internal consistency (α=0.79) (Woby et al., 2005). The TSK-11 is scored on a 4-point scale

(1 to 4) with 1 indicating “strongly disagree,” and 4 indicating “strongly agree.” The total score ranges from 11 to 44, with higher scores representing increased fear of movement. Mintken et al. (2010) provided support for the validation of the use of TSK-11 to measure pain-related fear in patients with shoulder pain. The TSK-11 had high test-retest reliability (0.84, 95% CI, 0.69 – 0.91) and was significantly correlated with the SPADI-P ($r=0.272$, $p<0.05$) (Mintken et al., 2010). The total score from the TSK-11 was used to measure fear of movement and fear-avoidance beliefs.

4.5.7 Others

We created a COVID-19 Related Questionnaire (Appendix B) to measure whether there were changes in pain level, physical activity, function, physical and mental health since March of 2020. This questionnaire asks patients to rate whether their symptoms and activity levels have become worse, better, or stayed the same since March of 2020. The responses were used to determine whether self-isolation related to COVID-19 resulted in changes in pain, physical activity, occupational activity, sport activity, mental health and QoL. Self-isolation was measured on an 11-point scale with 0=not isolated and 10=completely isolated. For analysis, participants were grouped into three categories based on isolation score: 0-5=low isolation, 6-7=moderately isolated, 8≥ highly isolated. These cut-off points were chosen based on validated scores for musculoskeletal pain interfering with function (Boonstra et al., 2016)

The SF-36 is a 36-item questionnaire that was developed as an indicator of general health status (Ware and Sherbourne, 1992). It measures the eight dimensions of general health: physical function, the role of function-physical, bodily pain, general health, vitality, social functioning, role function-emotional, and mental health. The responses to the questions are summed to provide eight scaled scores and two summary scores, with higher scores indicating better health. The PCS and MCS scales range from 0 to 10, with 100 representing the highest level of

functioning possible (Ware et al., 1994). In the general population, the internal consistency for the PCS ranges from 0.92–0.94 and 0.87–0.89 for the MCS (Ware et al., 1994). The test-rest reliability for the PCS was 0.89 and 0.80 for the MCS. In addition, the PCS and MCS were correlated with the summary measure of the physical and psychophysiological symptoms in the Medical Outcome survey (r= –0.55 and –0.41, respectively) (Ware et al., 1994). The MCS and PCS scores have been used in RCRSP studies (MacDermid et al., 2004; Wylie et al., 2010; Wylie et al., 2016). For this study, the MCS and PCS were used as a measure of general mental and physical health-related QoL, respectively.

The Outside Events Report is an open-ended questionnaire that asks participants whether there was a change to their activities and events during the past week and current week of the study. Since most of the outcome measures (i.e., activity tracker, IPAQ, CES-D, etc.) pertain to the current or past week, the report assisted in identifying any irregularities in participants' answers.

Lastly, the participants were asked to complete the Charlson Comorbidity Index (CCI). The CCI is a self-reported questionnaire that asks patients if they have been diagnosed with a wide range of diseases such as stroke, AIDS, diabetes, depression, and heart attack (Chaudhry et al., 2005). The CCI was used to identify disorders/diseases that may impact our outcome measures.

CHAPTER FIVE: DATA ANALYSIS

5.1 Data processing

ActiGraph data was sampled at a rate of 30 Hz and collected in multi-axis. The raw data were downloaded in epoch lengths of 60 seconds. Data was processed using the wear time validation methods described by Choi et al. (2011). The Freedson Adult VM3 (2011) cut-off points were used for MVPA data scoring as recommended by the ActiGraph developers.

5.2 Statistical analysis

Statistical analysis was performed using STATA (Version 16.1, STATA Corporation, College Station, Texas). To address the first primary research question, five linear regression models (four categories of self-reported outcomes and covariate, Table 3) for each physical activity outcome (PASE, IPAQ, AVGSTEP, MVPA) were performed. Self-reported outcomes were subdivided into four categories: pain, function/disability, general physical/mental health, and confidence/fear of movement. Covariates included sex, age, BMI and self-isolation score. In addition, three linear regression models (mental health, confidence/fear avoidance, covariate, Table 3) for each pain outcome measure (NPRS, SPADI-P) were used to determine whether psychological factors were significant predictors of pain (*Secondary Objective #3*). Backward deletion was used for the regression models to determine significant predictors of the models. Regression model diagnostic tests were conducted, and plots were visually inspected to confirm normality, heteroskedasticity and lack of co-linearity (standardized normal probability [P-P] plot, quantiles of variable against quantiles of normal distribution [Q-Q] plot, residual-versus-fitted plot, histogram of Studentized residuals).

Table 3. Categories used for linear regression analysis.

Category	**Questionnaire**
Function/Disability	UEFI, WORC, DASH, SPADI-D
Pain	NPRS, SPADI-P
General Physical/Mental Health	CESD, SF36-MCS, SF36-PCS*
Confidence/Fear of Movement	PSEQ, ESE, TSK
Covariate	Sex, Age, BMI, Self-isolation

*SF36-PCS was included in regression analyses for Primary Objective #1, but not Secondary Objective #3, which was studying psychological factors only.

One-way ANOVAs with a Sidak correction for multiple comparisons were performed to determine the effects of each exercise type (*Primary Objective #2*), BMI (*Secondary Objective #1*), and sex (*Secondary Objective #2*) on self-reported outcomes and accelerometer data. All

continuous data were tested for normality using a Shapiro-Wilk test. Non-parametric (Kruskal Wallis) tests were performed for outcome measures that were not normally distributed.

A Kruskal Wallis test was used to determine the effect of level of isolation (low, moderate, and high level) on whether shoulder pain, physical activity, occupational activity, sport activity, mental health, and QoL changed (decreased, stayed the same, or increased) since March of 2020 (*Secondary Objective #4*). Finally, pairwise correlation analysis with a Sidak correction for multiple comparisons was used to determine whether self-reported physical activity levels correlate with those quantified using the accelerometer (*Secondary Objective #5*). An alpha of 0.05 was used to indicate statistical significance, except in cases where a corrected p-value for family wise error was calculated.

CHAPTER SIX: RESULTS

Shapiro-Wilk tests indicated that several variables were not normality distributed (Table 4). Further, visual inspection of diagnostic plots for regression models indicated that four outliers existed (n=2 MVPA, n=1 PASE, n=1 IPAQ) and were removed. Additionally, these plots suggested and confirmed that a logarithmic transformation of the IPAQ variable was appropriate. This transformed variable was used for regression and correlation analyses.

No participant indicated that they "do not regularly exercise" on the Non-Standardized Exercise Questionnaire, thus there were two groups (rather than three) in the ANOVA (shoulder specific exercise and non-specific exercise).

Table 4. Shapiro-Wilk test for normal data. $p<0.05$ is significant and non-normally distributed.

Variable	**Probability**
UEFI	0.03337*
WORC	0.20735
DASH	0.64031
SPADI-D	0.02533*
NPRS	0.58585

SPADI-P	0.17681
CESD	0.00001*
PSEQ	0.00068*
ESE	0.73790
TSK-11	0.76550
SF36-MCS	0.00004*
SF36-PCS	0.48237
PASE	0.12442
IPAQ	0.00002*
AVGSTEP	0.00055*
MVPA	0.02444*

6.1 Participants

46 participants were enrolled in the study (Tables 5 and 6). Of the 46 participants enrolled, 18 (39.13%) were males and 28 were females (60.87%) (Table 5). The average age of the participants was 64 (sd, 5.50) years old (Table 6).

Table 5. Summary statistics of participants for categorical data.

Variable	**Frequency**	**Percentage**
Sex:		
Female	28	60.87%
Male	18	39.13%
Exercise type:		
Non-specific	20	46.51%
Shoulder specific	23	53.49%
BMI:		
Non-obese	38	84.44%
Obese	7	15.56%
Self-isolation:		
High	16	34.78%
Low	15	32.61%
Moderate	15	32.61%

Table 6. Summary statistics of participants for continuous data.

Variable	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Age	64	5.50	52	74
Mass (kg)	70.56	15.65	31.82	104.55
Height (m)	1.67	0.081	1.52	1.82
BMI (kg/m^2)	25.14	5.22	12.12	42.02

PASE	129.73	56.43	22.34	239.14
IPAQ	2581.66	2149.09	240	9198
AVGSTEP (step/day)	6947.57	3311.27	2335.43	15388.86
MVPA (mins/day)	43.65	22.95	9.29	95.29
UEFI	61.78	10.76	24	80
WORC	57.62	16.51	23.38	93.52
DASH	25.57	11.68	5.83	58.33
SPADI-D	30.08	19.55	2.5	71.25
NPRS	3.76	2.01	0.33	8
SPADI-P	48.24	18.86	6	78
CESD	9.87	8.99	0	44
PSEQ	51.98	6.66	30	60
ESE	110.88	28.82	55	168
TSK-11	23.02	4.81	12	36
SF36-MCS	51.78	12.00	18.60	67.37
SF36-PCS	43.28	7.81	21.23	58.37

6.2 Primary objectives

Linear regression models indicated that shoulder function, pain, depressive symptoms, fear of movement, self-efficacy, general physical and mental health were not significant predictors of physical activity levels (Table 7). The covariate model revealed that sex, age, BMI, and isolation score were not significant predictors of physical activity levels (Table 7).

Table 7. Linear regression models for predicted physical activity. Variables for each predictor: Pain (NPRS, SPADI-P), Function/Disability (UEFI, WORC, DASH, SPADI-D), General Physical/Mental Health (CESD, SF36-MCS, SF36-PCS), Confidence/Fear of Movement (PSEQ, ESE, TSK-11), Covariate (Sex, Age, BMI, Self-Isolation).

Dependent Variable	**Predictors**	**Model Significance**	**Explained Variance (R^2)**
PASE	Pain	F(2,41)=0.26 p=0.77	0.012
	Function/Disability	F(4,38)=1.50 p=0.22	0.14
	General Physical/Mental Health	F(3,41)=0.58 p=0.63	0.041
	Confidence/Fear of Movement	F(3,38)=0.48 p=0.70	0.037
	Covariate	F(4,39)=1.23 p=0.32	0.11
IPAQ	Pain	F(2,40)=2.60	0.11

		p=0.087	
	Function/Disability	F(4,37)=0.66 p=0.62	0.067
	General Physical/Mental Health	F(3,40)=0.78 p=0.51	0.056
	Confidence/Fear of Movement	F(3,37)=0.35 p=0.79	0.027
	Covariate	F(4,38)=0.43 p=0.79	0.043
AVGSTEP	Pain	F(2,40)=0.41 p=0.67	0.020
	Function/Disability	F(4,37)=0.67 p=0.61	0.068
	General Physical/Mental Health	F(3,40)=0.63 p=0.60	0.045
	Confidence/Fear of Movement	F(3,37)=1.69 p=0.19	0.12
	Covariate	F(4,38)=1.88 p=0.13	0.17
MVPA	Pain	F(2,38)=2.04 p=0.14	0.097
	Function/Disability	F(4,35)=0.76 p=0.56	0.080
	General Physical/Mental Health	F(3,38)=0.40 p=0.75	0.031
	Confidence/Fear of Movement	F(3,35)=0.72 p=0.55	0.058
	Covariate	F(4,36)=0.26 p=0.90	0.028

Participants that regularly completed shoulder specific exercise did not have significantly different UEFI (p=0.70), WORC (p=0.29), DASH (p=0.41), SPADI-D (p=0.89), SPADI-P (p=0.89), NPRS (p=0.52), CESD (p=0.95), PSEQ (p=0.71), TSK-11 (p=0.98), SF36-MCS (p=0.28), and SF36-PCS (p=0.49) scores from those that completed non-specific exercise. However, those that reported completing shoulder specific exercise on their injured shoulder had significantly higher ESE scores than those who completed non-specific exercise (123.55 vs 97.58; p=0.0034) (Figure 1).

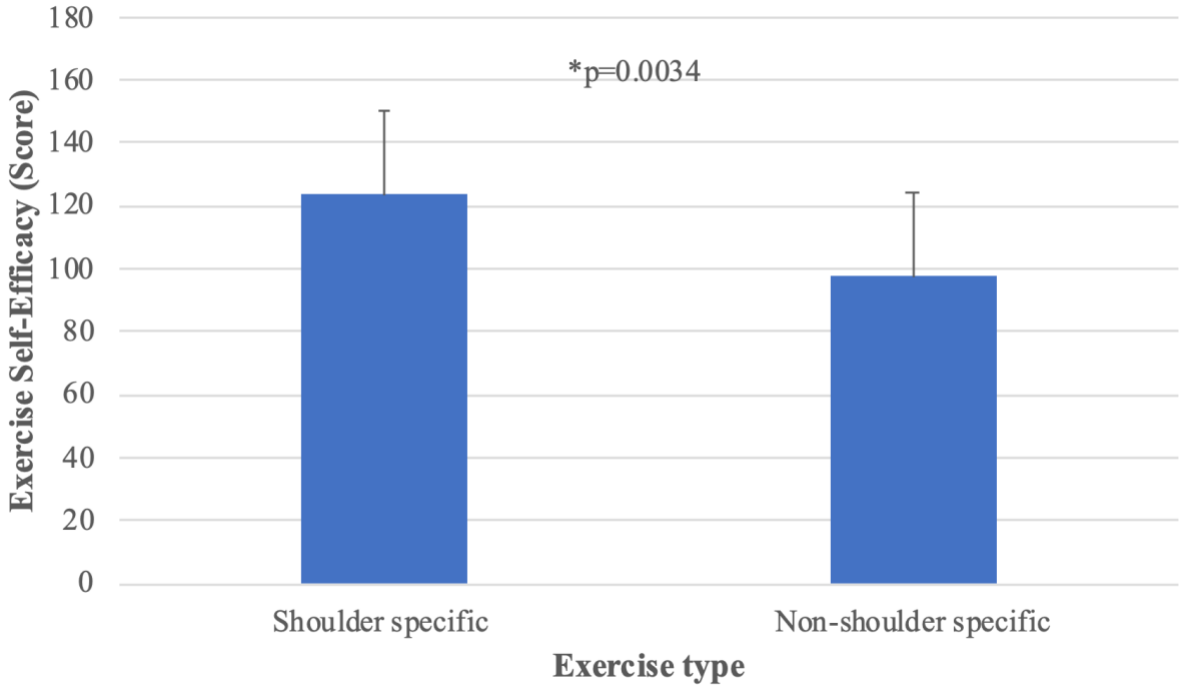


Figure 1. Exercise self-efficacy scores for participants who regularly performed shoulder specific exercise compared to those who performed non-shoulder specific exercise. A higher score indicates higher exercise self-efficacy.

6.3 Secondary objectives

Participants with obese BMI classification had significantly lower ESE than non-obese participants (90.29 vs 114.89, p=0.037, Figure 2). TSK-11 was significantly affected by sex, with males having higher fear of movement scores than females (25.33 vs 21.54, p=0.0074, Figure 3).

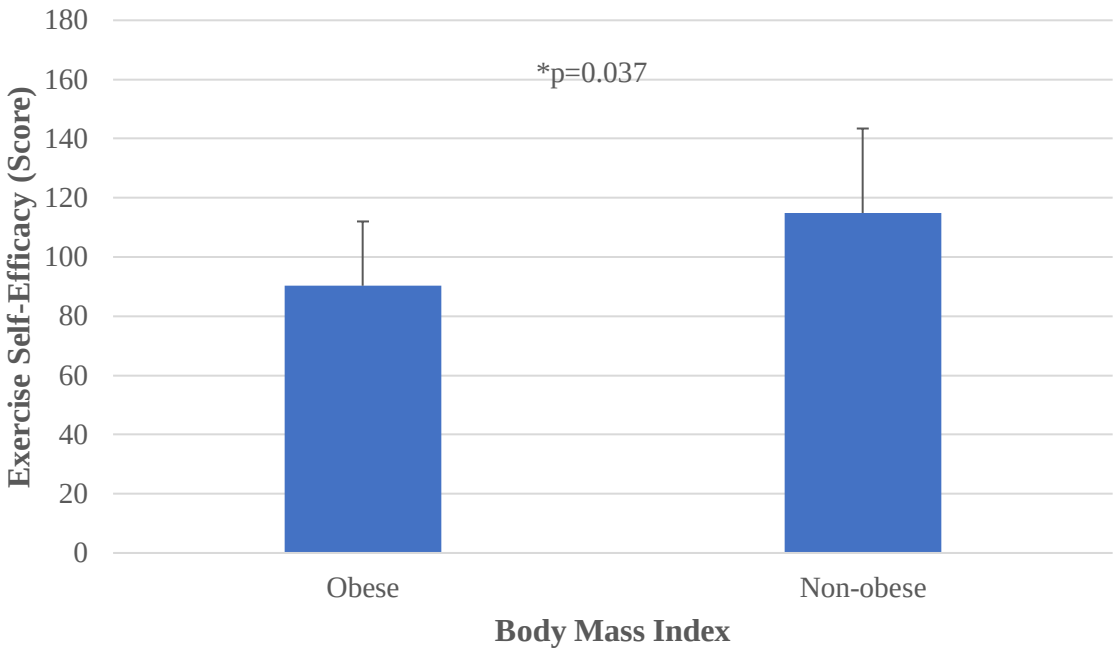


Figure 2. Exercise self-efficacy score for obese and non-obese participants. A higher score indicates higher exercise self-efficacy.

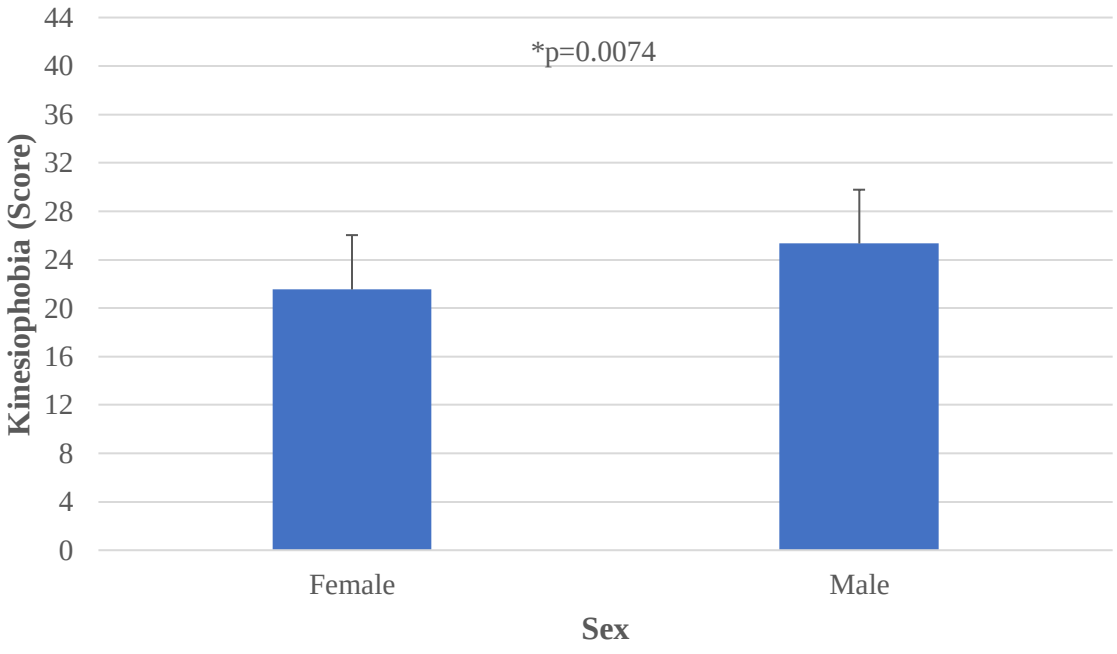


Figure 3. Kinesiophobia scores for male and female participants. A higher score indicates greater fear of movement.

The NPRS model was not significant for mental health ($F(2,42=2.32)$, $R^2 = 0.099$, $p=0.11$). The NPRS model was significant for confidence/fear of movement ($F(3,39)=4.74$, $R^2 = 0.27$, $p=0.0065$). PSEQ significantly ($p=0.004$, $\beta= -0.42$) explained variance in NPRS pain with lower PSEQ scores related to higher NPRS pain. The covariate model for NPRS was significant ($F(4,39)=2.86$, $R^2 = 0.23$, $p=0.036$). Age significantly ($p=0.0060$, $\beta=0.43$) explained variance in NPRS pain with higher age related to higher NPRS pain. Pain levels measured using the SPADI-P model was not significant for mental health ($F(2,43)=0.45$, $R^2 = 0.020$, $p=0.64$) and confidence/fear of movement ($F(3,39)=1.34$, $R^2 = 0.094$, $p=0.28$). However, the covariate model for SPADI-P explained a significant ($F(4,40)=2.61$, $R^2 = 0.21$, $p=0.0496$) amount of variance in SPADI-P pain, with higher age related to higher SPADI-P pain ($p=0.012$, $\beta=0.39$).

Self-isolation levels (low, moderate, high) related to COVID-19 did not have an effect on changes in pain ($p=0.86$), physical activity ($p=0.83$), occupational activity ($p=0.71$), sport activity ($p=0.84$), mental health ($p=0.084$), and quality of life ($p=0.53$).

Average step count and MVPA were highly correlated ($r=0.88$, $p<0.0001$). Average step count was not significantly correlated with IPAQ ($r=0.25$, $p=0.51$) and PASE ($r=0.17$, $p=0.87$). MVPA was not significantly correlated with IPAQ ($r=0.26$, $p=0.47$) and PASE ($r=0.098$, $p=0.99$). PASE and IPAQ were also not significantly correlated ($r=0.39$, $p=0.059$).

CHAPTER SEVEN: DISCUSSION

7.1 Self-efficacy and exercise type

Participants that regularly exercised their injured shoulder had higher exercise-related self-efficacy than those who did not. To our knowledge, this is the first study to explore exercise self-efficacy in patients with RCRSP. Previous literature has shown that exercise-self efficacy was significantly related to exercise performance in cardiac rehabilitation patients (Everett et al.,

2009) and in adults with congenital heart disease (Bay et al., 2018). Everett el. (2009) found that patients who walked more than 500 m at baseline during the six-minute walk test had significantly higher ESE scores (mean: 116.26, s.d.: 32.02 m) than those patients who only achieved up to 400 m at baseline (mean: 89.94, s.d.: 29.47 m) ($p = 0.044$). There was a positive and significant correlation between the change in scores on the ESE scale and the change in the six-minute walk test distance ($r = 0.28$, $p = 0.035$) after completing a 6-week cardiac rehabilitation program (Everett et al., 2009). These findings highlight the importance of boosting confidence to help with rehabilitation outcomes in clinical populations. In addition, age has been shown to be an important predictor of low exercise self-efficacy in adults with congenital heart disease (Bay et al., 2018). Bay et al. (2018) found that patients with low ESE were older (42.9 ± 15.1 vs. 32.0 ± 12.4 years, $p = 0.001$) and performed fewer shoulder flexions (32.5 ± 15.5 vs. 47.7 ± 25.0, $p = 0.001$) compared with those with high ESE. The authors' findings coincide with the present study as we found that ESE was important in our cohort of older adults.

The findings of the current study suggest that a lack of confidence or belief in participants' ability to complete exercises (lower self-efficacy) could have potentially led them to refrain from exercising their painful shoulder. In participants with neck and shoulder pain, Andersen (2011) found that those with low and medium ESE had lower adherence to a 10-week exercise program in comparison to those with high ESE. While exercise self-efficacy may not have been a causal factor, support of this hypothesis would have implications in physical therapy, as patients exhibiting lower exercise-self efficacy may be less likely to complete the clinically prescribed exercises, which may subsequently lead to diminished treatment success. This result suggests that strategies to boost exercise self-efficacy may be important in older adults with RCRSP.

While exercise-self efficacy was significantly related to exercise type, pain self-efficacy was not related to exercise type. Participants' confidence in their ability to perform activities despite pain was not related to their ability to perform shoulder specific exercise. However, pain self-efficacy has been shown to be related to performance in patients with low back pain (Council et al., 1988) and physiotherapy treatment outcomes in patients with shoulder pain (Chester et al., 2019). Chester et al. (2019) found that those with lower pain self-efficacy had worse physiotherapy treatment outcomes (i.e., pain) compared to those with higher pain self-efficacy. The results from their study would suggest that those with higher pain self-efficacy were able to complete more shoulder specific exercises, therefore resulting in better pain outcomes. The authors recruited participants 18 years and older for their study, while we recruited an older cohort group (50 years and older). With age previously shown to be an important factor for exercise self-efficacy (Bay et al., 2018), our results suggest that exercise self-efficacy may be more important than pain self-efficacy for shoulder specific-exercise in older populations.

7.2 Exercise type

Other than exercise self-efficacy, we did not find differences in self-reported QoL outcomes in participants that completed shoulder specific exercise compared to non-specific exercise. It was hypothesized that participants who regularly participated in shoulder specific exercise would have better self-reported outcomes (pain, function, depressive symptoms, fear of movement, and self-efficacy) than those who report primarily whole-body exercise. To our knowledge, this was the first study to make such comparisons in a clinical population with RCRSP. Our results suggest that there were no differences in pain, function, depressive symptoms, fear of movement, and pain self-efficacy between those who complete different exercise types. Therefore, suggesting that non-shoulder specific exercise may also be beneficial

for improving QoL outcomes. There is evidence in the literature that suggests that non-specific exercise may be beneficial for clinical populations. For example, non-traditional exercises such as yoga, Pilates, and aerobic exercises have been shown to improve self-reported QoL outcomes (pain, functionality, depression, self-efficacy) in patients with osteoarthritis (Chopp-Hurley et al., 2017; Kuntz et al., 2018), osteoporosis (Küçükçakır et al., 2013), and induced shoulder pain (Wassinger et al., 2020). Wassinger et al. (2020) found that lower extremity aerobic exercise significantly decreased mechanically induced pain of the infraspinatus in a sample of young healthy participants. Exercise has been shown to increase serotonin and brain-derived neurotrophic factor levels, which are neurotransmitters that help with mood regulation and pain modulation (Mattson et al., 2004; Millan, 2002). The aerobic exercise may have increased these neurotransmitters, which may have decreased the perception of shoulder pain.

It is important to note that due to the nature of our study design we cannot make causal relationships between exercise type and QoL outcomes. Future studies are needed to examine exercise interventions comparing shoulder specific versus non-specific exercise and its effects on QoL outcomes.

7.3 Physical activity levels and QoL

Our results indicated that self-reported QoL outcomes were not predictors of physical activity levels in older adults with RCRSP. Based on previous literature, it was hypothesized that greater self-reported QoL outcomes would explain a large amount of variance in physical activity levels. Contrary to our findings, many studies have demonstrated that exercise targeting the rotator cuff can help decrease pain and increase functionality (Bernhardsson et al., 2011; Holmgren et al., 2012; Littlewood et al., 2012). In addition to specific exercise, whole-body exercise such as lower extremity aerobic exercise has been shown to decrease shoulder pain (Wassinger et al., 2020). Yoga and Pilates have also been shown to improve psychological well-

being in osteoarthritis and osteoporosis patients (Chopp-Hurley et al., 2017; Küçükçakır et al., 2013; Kuntz et al., 2018). Therefore, there is evidence to suggest that physical activity levels can help improve QoL outcomes in clinical populations.

There are several reasons for the discrepancy between our findings and previous literature. First, we collected self-reported physical activity levels (i.e., IPAQ and PASE), which may not have reflected true activity levels. This assumption was reflected in our results, in which we found no significant correlation between self-reported activity levels and accelerometer measurements. Secondly, participants were asked to answer the QoL questionnaires based on how they felt about their symptomatic shoulders. However, physical activity questionnaires were based on whole-body activities (i.e., non-shoulder specific). The accelerometer was also worn on the waist and may not have accurately captured upper-limb exercise. Therefore, discrepancies between shoulder self-reported QoL outcomes and whole-body physical activity levels may be the reason for our results. To capture accurate data, it is recommended that participants wear upper-limb (i.e., wrist-worn) trackers. Furthermore, most of our participants were retired (n=33). With retirement, some adults may become more sedentary while others may have more time to participate in physical activity. The variation in adult activity levels may have led to non-significant results. Finally, participants were instructed to answer questionnaires assuming there were no COVID-19 restrictions which may have resulted in discrepancies between self-reported QoL outcomes and activity levels measured using the accelerometer.

The non-significant correlation between self-reported and accelerometry physical activity levels suggest that IPAQ may not be the best outcome measure assessing physical activity in older populations with RCRSP. It was previously concluded that the short form IPAQ was a reasonable measurement to monitor population levels of physical activity among adults 18 to 65

years (Craig et al., 2003). However, this study included participants ranging from 52-74 years of age. Therefore, the IPAQ may not be appropriate for adults over 65 years with RCRSP.

7.4 Perception of pain

Pain self-efficacy explained a significant amount of variance in the perception of shoulder pain measured using NPRS. This result suggests that psychological factors (notably self-efficacy) may influence the perception of pain in older adults with RCRSP. Previous studies such as Chester et al. (2019) and Menendez et al. (2015) found that lower pain-self efficacy increased the likelihood of perceived pain in patients over 18 years of age with shoulder pain. The present study supports previous literature and suggests that pain self-efficacy is also important in perpetuating shoulder pain in older adults. Thus, it is important for clinicians to consider psychological factors because debilitating pain can lead to functional disability.

7.5 Covariates

The covariate model revealed that age was an important predictor of pain. In fact, age significantly explained variance in both pain outcome measures (NPRS and SPADI-P). Rotator cuff pathology increases with age due to degenerative changes in asymptomatic and symptomatic patients (Teunis et al., 2014; Wang and Shapiro, 1997). Therefore, the progression of degenerative shoulder changes may be contributing to the higher perception of pain with aging.

There is evidence to suggest that obesity may be related to quality of life outcomes in patients with RCRSP. Obesity may play a role in decreased vasculature that leads to degeneration of the rotator cuff tendons (Wendelboe et al., 2004), and fatty tissue has been reported to correlate with lower muscle quality (Watanabe et al., 2015) and functional outcomes (Goutallier et al., 2003; Koster et al., 2011). We did not find such associations between obesity and function, which may be due to using self-reported disability questionnaires. However, we identified that obese participants had lower exercise self-efficacy than non-obese participants.

This finding coincides with Faghri et al. (2015), in which exercise self-efficacy was negatively associated with obesity. Their study also found that wrist pain mediated the relationship between obesity and ESE. The present study found that ESE was related to participation in shoulder specific exercise and obesity. Together, these results suggest that improving exercise self-efficacy may be important in obese individuals to help decrease pain and to increase compliance with shoulder specific exercise.

Research on sex differences indicates that women report more pain in several musculoskeletal conditions (Bartley and Fillingim, 2013; Stubbs et al., 2010), including shoulder pain (Bodin et al., 2012; Cadogan et al., 2011; Vincent et al., 2017). Various biological (i.e., sex hormones and menstrual cycle) and psychosocial mechanisms have been attributed to these sex differences (Bartley and Fillingim, 2013). Sociocultural beliefs about femininity and masculinity may be important in pain reporting as it is generally more socially acceptable for women to express their pain. Surprisingly, we did not find sex differences in our cohort, which may have been due to varying ethnicities and cultural beliefs among participants. Our results may also be explained by the age of our participants; we recruited women who were above the average age of menopause. Therefore, the effects of the menstrual cycle and cyclical hormones on pain perception would be reduced.

In addition, sex differences in shoulder pain-related disability (McRae et al., 2011; Roh et al., 2012; Wylie et al., 2010) have been reported, but there is contradicting literature on sex differences in psychological factors in patients with shoulder pain (Cho et al., 2013b; Kindler et al., 2011; Mintken et al., 2010; Roh et al., 2012). The present study found that men reported higher fear of movement scores compared to women. Conversely, a previous study on patients with shoulder pain, found there were no sex differences in TSK fear of movement scores (men,

9.2±2.7, vs women, 9.1±2.4) (Mintken et al., 2010). Mintken et al. (2010) recruited a different cohort; the participants were between ages 18 and 65 years and may have had non-related rotator cuff shoulder pain. As mentioned previously, our results on kinesiophobia may have also been due to varying ethnicities and cultural beliefs among participants. Therefore, our findings on sex differences may be specific to our cohort of older adults with RCRSP. Nonetheless, this suggests that interventions that target kinesiophobia may be particularly beneficial in older men with RCRSP as fear-avoidance behaviours have been identified as contributing to the development of chronic symptoms in patients with RCRSP (Clausen et al., 2017; Kromer et al., 2014; Luque-Suarez et al., 2020; Martinez-Calderon et al., 2018; Wolfensberger et al., 2016).

7.6 COVID-19 and self-isolation

The COVID-19 outbreak has introduced enhanced self-isolation guidelines for older adults who are considered a high-risk population. Isolation may exacerbate issues related to mental health and may result in increased levels of anxiety and depression in older adults (Freedman and Nicolle, 2020; Santini et al., 2020). We hypothesized that higher pain, poorer mental and physical health, and lower physical activity levels would be reported post-COVID-19 compared to pre-COVID-19 in those that report higher levels of self-isolation. Our study found that self-isolation levels (low, moderate, high) related to COVID-19 did not affect changes in pain, physical activity, occupational activity, sport activity, mental health, and quality of life. One reason for this finding might be that higher self-isolation levels during COVID-19 may have resulted in more time for self-care and physical activity for some participants. At the same time, other participants with higher self-isolation levels that prefer exercising in facilities and group settings would have been negatively affected. Therefore, the range of differences in participants' activity levels due to COVID-19 may have skewed the results of this study. We thought

categorizing participants by self-isolation levels may have reduced these differences. However, we were not specific about whether their primary source of activity was affected by COVID-19.

7.7 Study limitations

This study had certain limitations. Firstly, most of the data collected was self-reported data (i.e., BMI, shoulder function). As with any self-reported data, this may not have reflected true values. In addition, a few (n=6) participants wore the activity tracker during the week they received their COVID-19 vaccine, and side effects may have affected their activity levels. There were also a few activity tracker data that did not capture seven consecutive days due to technical issues (n=1) and participants' errors (n=2). As well, some participant also did not complete their questionnaires in one week and/or while wearing the activity tracker (n=4). While we tried to include participants with only RCRSP using clinical examinations, it is possible that participants with other shoulder pathologies may have been included due to false-positives. Results should also be interpreted cautiously as we quantified shoulder pain using questionnaires (NPRS and SPADI-P); we did not assess pain qualitatively. Lastly, we initially planned to analyze exercise type based on three categories (no/little exercise, shoulder-specific, non-shoulder specific), but none of the participants reported no/little exercise. Therefore, results based on exercise type can only be used to compare participants who completed shoulder-specific versus non-shoulder specific exercise.

CHAPTER EIGHT: CONCLUSION

Older adults are at an increased risk of RCRSP due to degenerative changes. RCRSP can lead to debilitating mental health, functional disability and the inability for older adults to care for themselves. The present study investigated: i) whether higher physical activity levels was related to better self-reported QoL outcomes, ii) whether those who self-report participation in exercises that target their painful shoulder have better self-reported QoL outcomes than those

who report primarily non-shoulder specific exercises. To our knowledge, this is the first study to explore these relationships in older adults with RCRSP. Our results suggest that self-reported QoL outcomes may not be related to physical activity levels in older adults with RCRSP. We also found that those who regularly exercised their injured shoulder had higher exercise self-efficacy than those who did not. This result suggests that strategies to boost exercise self-efficacy may be important in older adults with RCRSP, as this could potentially affect rehabilitation exercise compliance in this population. Psychological factors (namely pain self-efficacy) were important predictors of shoulder pain in older adults. Interventions that target self-efficacy may be important in older adults with RCRSP, as this could potentially improve their quality of life.

REFERENCES

Andersen, L. L. (2011). Influence of psychosocial work environment on adherence to workplace exercise. *Journal of Occupational and Environmental Medicine*, *53*(2), 182-184.

Angst, F., Pap, G., Mannion, A. F., Herren, D. B., Aeschlimann, A., Schwyzer, H. K., & Simmen, B. R. (2004). Comprehensive assessment of clinical outcome and quality of life after total shoulder arthroplasty: usefulness and validity of subjective outcome measures. *Arthritis Care & Research: Official Journal of the American College of Rheumatology*, *51*(5), 819-828.

Angst, F., Schwyzer, H. K., Aeschlimann, A., Simmen, B. R., & Goldhahn, J. (2011). Measures of adult shoulder function. *Arthritis Care and Research*, *63*(SUPPL. 11), 174–188.

Arumugam, V., & MacDermid, J. C. (2018). Clinimetrics: Upper Extremity Functional Index. *Journal of physiotherapy*, *64*(2), 125-125.

Asmundson, G. J., Norton, P. J., & Vlaeyen, J. W. (2004). Fear-avoidance models of chronic pain: an overview. *Understanding and treating fear of pain*, 3-24.

Badcock, L. J., Lewis, M., Hay, E. M., McCarney, R., & Croft, P. R. (2002). Chronic shoulder pain in the community: a syndrome of disability or distress?. *Annals of the rheumatic diseases*, *61*(2), 128-131.

Bartley, E. J., & Fillingim, R. B. (2013). Sex differences in pain: a brief review of clinical and experimental findings. *British journal of anaesthesia*, *111*(1), 52-58.

Bay, A., Sandberg, C., Thilén, U., Wadell, K., & Johansson, B. (2018). Exercise self-efficacy in adults with congenital heart disease. *IJC heart & vasculature*, *18*, 7-11.

Beaton, D. E., Katz, J. N., Fossel, A. H., Wright, J. G., Tarasuk, V., & Bombardier, C. (2001). Measuring the whole or the parts?: validity, reliability, and responsiveness of the

Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. *Journal of Hand Therapy*, *14*(2), 128-142.

Bernhardsson, S., Klintberg, I. H., & Wendt, G. K. (2011). Evaluation of an exercise concept focusing on eccentric strength training of the rotator cuff for patients with subacromial impingement syndrome. *Clinical rehabilitation*, *25*(1), 69-78.

Bodin, J., Ha, C., Chastang, J. F., Descatha, A., Leclerc, A., Goldberg, M., ... & Roquelaure, Y. (2012). Comparison of risk factors for shoulder pain and rotator cuff syndrome in the working population. *American journal of industrial medicine*, *55*(7), 605-615.

Boonstra, A. M., Stewart, R. E., Köke, A. J., Oosterwijk, R. F., Swaan, J. L., Schreurs, K. M., & Schiphorst Preuper, H. R. (2016). Cut-Off Points for Mild, Moderate, and Severe Pain on the Numeric Rating Scale for Pain in Patients with Chronic Musculoskeletal Pain: Variability and Influence of Sex and Catastrophizing. *Frontiers in psychology*, *7*, 1466.

Brox, J. I., Gjengedal, E., Uppheim, G., Bøhmer, A. S., Brevik, J. I., Ljunggren, A. E., & Staff, P. H. (1999). Arthroscopic surgery versus supervised exercises in patients with rotator cuff disease (stage II impingement syndrome): a prospective, randomized, controlled study in 125 patients with a 212-year follow-up. *Journal of shoulder and elbow surgery*, *8*(2), 102-111.

Brox, J. I., Staff, P. H., Ljunggren, A. E., & Brevik, J. I. (1993). Arthroscopic surgery compared with supervised exercises in patients with rotator cuff disease (stage II impingement syndrome). *British Medical Journal*, *307*(6909), 899-903.

Burbank, K. M., Stevenson, J. H., Czarnecki, G. R., & Dorfman, J. (2008). Chronic Shouler Pain Part I: Evaluation and Diagnosis. *American family physician*, *77*(4), 453-460.

Bury, J., West, M., Chamorro-Moriana, G., & Littlewood, C. (2016). Effectiveness of scapula-focused approaches in patients with rotator cuff related shoulder pain: a systematic review and meta-analysis. *Manual therapy*, *25*, 35-42.

Cadogan, A., Laslett, M., Hing, W. A., McNair, P. J., & Coates, M. H. (2011). A prospective study of shoulder pain in primary care: prevalence of imaged pathology and response to guided diagnostic blocks. *BMC musculoskeletal disorders*, *12*(1), 119.

Çalış, M., Akgün, K., Birtane, M., Karacan, I., Çalış, H., & Tüzün, F. (2000). Diagnostic values of clinical diagnostic tests in subacromial impingement syndrome. *Annals of the rheumatic diseases*, *59*(1), 44-47.

Chard, M., Hazleman, R., Hazleman, B. L., King, R. H., & Reiss, B. B. (1991). Shoulder disorders in the elderly: a community survey. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*, *34*(6), 766-769.

Chaudhry, S., Jin, L., & Meltzer, D. (2005). Use of a self-report-generated Charlson Comorbidity Index for predicting mortality. *Medical care*, 607-615.

Cheng, HL. A simple, easy-to-use spreadsheet for automatic scoring of the International Physical Activity Questionnaire (IPAQ) Short Form (updated November 2016). ResearchGate, 2016.

Chester, R., Khondoker, M., Shepstone, L., Lewis, J. S., & Jerosch-Herold, C. (2019). Self-efficacy and risk of persistent shoulder pain: results of a Classification and Regression Tree (CART) analysis. *British journal of sports medicine*, *53*(13), 825-834.

Chesworth, B. M., Hamilton, C. B., Walton, D. M., Benoit, M., Blake, T. A., Bredy, H., ... & Gravelle, T. (2014). Reliability and validity of two versions of the upper extremity functional index. *Physiotherapy Canada*, *66*(3), 243-253.

Childs, J. D., Piva, S. R., & Fritz, J. M. (2005). Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine*, *30*(11), 1331-1334.

Chipchase, L. S., O'Connor, D. A., Costi, J. J., & Krishnan, J. (2000). *Shoulder impingement syndrome: Preoperative health status. Journal of Shoulder and Elbow Surgery, 9(1), 12–15.*

Cho, C. H., Jung, S. W., Park, J. Y., Song, K. S., & Yu, K. I. (2013a). Is shoulder pain for three months or longer correlated with depression, anxiety, and sleep disturbance?. *Journal of shoulder and elbow surgery*, *22*(2), 222-228.

Cho, C. H., Seo, H. J., Bae, K. C., Lee, K. J., Hwang, I., & Warner, J. J. (2013b). The impact of depression and anxiety on self-assessed pain, disability, and quality of life in patients scheduled for rotator cuff repair. *Journal of shoulder and elbow surgery*, *22*(9), 1160-1166.

Choi, L., Liu, Z., Matthews, C. E., & Buchowski, M. S. (2011). Validation of accelerometer wear and nonwear time classification algorithm. *Medicine and science in sports and exercise*, *43*(2), 357.

Chopp-Hurley, J. N., Brenneman, E. C., Wiebenga, E. G., Bulbrook, B., Keir, P. J., & Maly, M. R. (2017). Randomized controlled trial investigating the role of exercise in the workplace to improve work ability, performance, and patient-reported symptoms among older workers with osteoarthritis. *Journal of occupational and environmental medicine*, *59*(6), 550-556.

Chopp-Hurley, J. N., Wiebenga, E. G., Bulbrook, B. D., Keir, P. J., & Maly, M. R. (2020). Evaluating the relationship between quadriceps muscle quality captured using ultrasound

with clinical severity in women with knee osteoarthritis. *Clinical Biomechanics*, *80*, 105165.

Clausen, M. B., Witten, A., Holm, K., Christensen, K. B., Attrup, M. L., Hölmich, P., & Thorborg, K. (2017). Glenohumeral and scapulothoracic strength impairments exists in patients with subacromial impingement, but these are not reflected in the shoulder pain and disability index. *BMC Musculoskeletal Disorders*, *18*(1), 1-10.

Cleland, J. A., Fritz, J. M., Whitman, J. M., & Palmer, J. A. (2006). The reliability and construct validity of the Neck Disability Index and patient specific functional scale in patients with cervical radiculopathy. *Spine*, *31*(5), 598-602.

Council, J. R., Ahern, D. K., Follick, M. J., & Kline, C. L. (1988). Expectancies and functional impairment in chronic low back pain. *Pain*, *33*(3), 323-331.

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., ... & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & science in sports & exercise*, *35*(8), 1381-1395.

David, G., Magarey, M. E., Jones, M. A., Dvir, Z., Türker, K. S., & Sharpe, M. (2000). EMG and strength correlates of selected shoulder muscles during rotations of the glenohumeral joint. *Clinical biomechanics (Bristol, Avon)*, *15*(2), 95–102. https://doi.org/10.1016/s0268-0033(99)00052-2

De Witte, P. B., Henseler, J. F., Nagels, J., Vliet Vlieland, T. P. M., & Nelissen, R. G. H. H. (2012). The Western Ontario Rotator Cuff Index in rotator cuff disease patients: A comprehensive reliability and responsiveness validation study. *American Journal of Sports Medicine*, *40*(7), 1611–1619.

Ekeberg, O. M., Bautz-Holter, E., Tveitå, E. K., Keller, A., Juel, N. G., & Brox, J. I. (2008). Agreement, reliability and validity in 3 shoulder questionnaires in patients with rotator cuff disease. *BMC musculoskeletal disorders*, *9*(1), 1-9.

Everett, B., Salamonson, Y., & Davidson, P. M. (2009). Bandura's exercise self-efficacy scale: validation in an Australian cardiac rehabilitation setting. *International Journal of Nursing Studies*, *46*(6), 824-829.

Faghri, P. D., Chin, W. S., & Huedo-Medina, T. B. (2015). The link between musculoskeletal pain, lifestyle behaviors, exercise self-efficacy, and quality of life in overweight and obese individuals. *International journal of physical medicine & rehabilitation*, *3*.

Flynn, T. W., Cleland, J., & Whitman, J. (2008). Users' guide to the musculoskeletal examination: fundamentals for the evidence-based clinician. *Louisville, KY: Evidence in Motion*.

Freedman, A., & Nicolle, J. (2020). Social isolation and loneliness: the new geriatric giants: Approach for primary care. *Canadian family physician Medecin de famille canadien*, *66*(3), 176–182.

Gerber, C., & Krushell, R. J. (1991). Isolated rupture of the tendon of the subscapularis muscle. Clinical features in 16 cases. *The Journal of bone and joint surgery. British volume*, *73*(3), 389-394.

Gerber, C., Hersche, O., & Farron, A. (1996). Isolated rupture of the subscapularis tendon. Results of operative repair. *JBJS*, *78*(7), 1015-23.

Gill, T. K., Shanahan, E. M., Allison, D., Alcorn, D., & Hill, C. L. (2014). Prevalence of abnormalities on shoulder MRI in symptomatic and asymptomatic older adults. *International journal of rheumatic diseases*, *17*(8), 863-871.

Goutallier, D., Postel, J. M., Gleyze, P., Leguilloux, P., & Van Driessche, S. (2003). Influence of cuff muscle fatty degeneration on anatomic and functional outcomes after simple suture of full-thickness tears. *Journal of shoulder and elbow surgery*, *12*(6), 550-554.

Hamilton, C. B., & Chesworth, B. M. (2013). A Rasch-validated version of the upper extremity functional index for interval-level measurement of upper extremity function. *Physical therapy*, *93*(11), 1507-1519.

Hapidou, E. G., O'Brien, M. A., Pierrynowski, M. R., de las Heras, E., Patel, M., & Patla, T. (2012). Fear and avoidance of movement in people with chronic pain: psychometric properties of the 11-Item Tampa Scale for Kinesiophobia (TSK-11). *Physiotherapy Canada*, *64*(3), 235-241.

Hawkins, R. J., & Kennedy, J. C. (1980). Impingement syndrome in athletes. *The American journal of sports medicine*, *8*(3), 151-158.

Hefford, C., Abbott, J. H., Arnold, R., & Baxter, G. D. (2012). The patient-specific functional scale: validity, reliability, and responsiveness in patients with upper extremity musculoskeletal problems. *Journal of orthopaedic & sports physical therapy*, *42*(2), 56-65.

Hill, C. L., Lester, S., Taylor, A. W., Shanahan, M. E., & Gill, T. K. (2011). Factor structure and validity of the shoulder pain and disability index in a population-based study of people with shoulder symptoms. *BMC musculoskeletal disorders*, *12*(1), 1-6.

Holmgren, T., Hallgren, H. B., Öberg, B., Adolfsson, L., & Johansson, K. (2012). Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomised controlled study. *Bmj*, *344*, e787.

IPAQ Research Committee. (2005). International Physical Activity Questionnaire (IPAQ) scoring protocol. Recuperado de http://www. ipaq. ki. se/scoring. pdf (accessed 01.05. 13).

Jain, N. B., Luz, J., Higgins, L. D., Dong, Y., Warner, J. J., Matzkin, E., & Katz, J. N. (2017). The diagnostic accuracy of special tests for rotator cuff tear: the ROW cohort study. *American journal of physical medicine & rehabilitation*, *96*(3), 176.

Jiménez-Pavón, D., Carbonell-Baeza, A., & Lavie, C. J. (2020). Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people. *Progress in cardiovascular diseases*.

Jobe, F. W., & Moynes, D. R. (1982). Delineation of diagnostic criteria and a rehabilitation program for rotator cuff injuries. *The American journal of sports medicine*, *10*(6), 336-339.

Kennedy, C. A., Beaton, D. E., Solway, S., McConnell, S., & Bombardier, C. (2011). Disabilities of the arm, shoulder and hand (DASH). *The DASH and QuickDASH outcome measure user's manual*, *3*.

Kibler, W. B. (1995). Biomechanical analysis of the shoulder during tennis activities. *Clinics in sports medicine*, *14*(1), 79-85.

Kibler, W. B., & Chandler, J. (1995). Baseball and tennis. Rehabilitation of the Injured Knee. St. Louis, MO: Mosby, 219-226.

Kindler, L. L., Valencia, C., Fillingim, R. B., & George, S. Z. (2011). Sex differences in experimental and clinical pain sensitivity for patients with shoulder pain. *European Journal of Pain*, *15*(2), 118-123.

Kirkley, A., Alvarez, C., & Griffin, S. (2003). The development and evaluation of a disease-specific quality-of-life questionnaire for disorders of the rotator cuff: The Western Ontario Rotator Cuff Index. *Clinical journal of sport medicine*, *13*(2), 84-92.

Klintberg, I. H., Karlsson, J., & Svantesson, U. (2011). Health-related quality of life, patient satisfaction, and physical activity 8-11 years after arthroscopic subacromial decompression. *Journal of shoulder and elbow surgery*, *20*(4), 598-608.

Koster, A., Ding, J., Stenholm, S., Caserotti, P., Houston, D. K., Nicklas, B. J., ... & Schwartz, A. V. (2011). Does the amount of fat mass predict age-related loss of lean mass, muscle strength, and muscle quality in older adults?. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *66*(8), 888-895.

Kromer, T. O., Sieben, J. M., de Bie, R. A., & Bastiaenen, C. H. (2014). Influence of fear-avoidance beliefs on disability in patients with subacromial shoulder pain in primary care: a secondary analysis. *Physical therapy*, *94*(12), 1775-1784.

Küçükçakır, N., Altan, L., & Korkmaz, N. (2013). Effects of Pilates exercises on pain, functional status and quality of life in women with postmenopausal osteoporosis. *Journal of bodywork and movement therapies*, *17*(2), 204-211.

Kuntz, A. B., Chopp-Hurley, J. N., Brenneman, E. C., Karampatos, S., Wiebenga, E. G., Adachi, J. D., ... & Maly, M. R. (2018). Efficacy of a biomechanically-based yoga exercise program in knee osteoarthritis: A randomized controlled trial. *PloS one*, *13*(4), e0195653.

Kuo, L. T., Chen, H. M., Yu, P. A., Chen, C. L., Hsu, W. H., Tsai, Y. H., ... & Chen, V. C. H. (2019). Depression increases the risk of rotator cuff tear and rotator cuff repair surgery: A nationwide population-based study. *PloS one*, *14*(11), e0225778.

Laucis, N. C., Hays, R. D., & Bhattacharyya, T. (2015). Scoring the SF-36 in Orthopaedics: A Brief Guide. *The Journal of bone and joint surgery. American volume*, *97*(19), 1628–1634.

Lee, M., Moon, W., & Kim, J. (2014). Effect of yoga on pain, brain-derived neurotrophic factor, and serotonin in premenopausal women with chronic low back pain. *Evidence-Based Complementary and Alternative Medicine*, *2014*.

Leggin, B. G., Michener, L. A., Shaffer, M. A., Brenneman, S. K., Iannotti, J. P., & Williams Jr, G. R. (2006). The Penn shoulder score: reliability and validity. *Journal of orthopaedic & sports physical therapy*, *36*(3), 138-151.

Lethem, J., Slade, P. D., Troup, J. D. G., & Bentley, G. (1983). Outline of a fear-avoidance model of exaggerated pain perception—I. *Behaviour research and therapy*, *21*(4), 401-408.

Lewinsohn, P. M., Seeley, J. R., Roberts, R. E., & Allen, N. B. (1997). Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. Psychology and aging, 12(2), 277.

Lewis, J. (2016). Rotator cuff related shoulder pain: assessment, management and uncertainties. *Manual therapy*, *23*, 57-68.

Lin, J. C., Weintraub, N., & Aragaki, D. R. (2008). Nonsurgical treatment for rotator cuff injury in the elderly. *Journal of the American Medical Directors Association*, *9*(9), 626-632.

Littlewood, C., Ashton, J., Chance-Larsen, K., May, S., & Sturrock, B. (2012). Exercise for rotator cuff tendinopathy: a systematic review. *Physiotherapy*, *98*(2), 101-109.

Liu, R. D., Buffart, L. M., Kersten, M. J., Spiering, M., Brug, J., van Mechelen, W., & Chinapaw, M. J. (2011). Psychometric properties of two physical activity questionnaires,

the AQuAA and the PASE, in cancer patients. *BMC medical research methodology*, *11*(1), 30.

Logan, S. L., Gottlieb, B. H., Maitland, S. B., Meegan, D., & Spriet, L. L. (2013). The Physical Activity Scale for the Elderly (PASE) questionnaire; does it predict physical health?. *International journal of environmental research and public health*, *10*(9), 3967-3986.

Longo, U. G., Vasta, S., Maffulli, N., & Denaro, V. (2011). Scoring systems for the functional assessment of patients with rotator cuff pathology. *Sports medicine and arthroscopy review*, *19*(3), 310-320.

Ludewig, P. M., & Borstad, J. D. (2003). Effects of a home exercise programme on shoulder pain and functional status in construction workers. *Occupational and environmental medicine*, *60*(11), 841-849.

Luque-Suarez, A., Martinez-Calderon, J., Navarro-Ledesma, S., Morales-Asencio, J. M., Meeus, M., & Struyf, F. (2020). Kinesiophobia Is Associated With Pain Intensity and Disability in Chronic Shoulder Pain: A Cross-Sectional Study. *Journal of Manipulative and Physiological Therapeutics*.

MacDermid, J. C., Ramos, J., Drosdowech, D., Faber, K., & Patterson, S. (2004). The impact of rotator cuff pathology on isometric and isokinetic strength, function, and quality of life. *Journal of Shoulder and Elbow Surgery*, *13*(6), 593-598.

MacDermid, J. C., Solomon, P., & Prkachin, K. (2006). The Shoulder Pain and Disability Index demonstrates factor, construct and longitudinal validity. *BMC musculoskeletal disorders*, *7*(1), 12.

Mani, R., Adhia, D. B., Leong, S. L., Vanneste, S., & De Ridder, D. (2019). Sedentary behaviour facilitates conditioned pain modulation in middle-aged and older adults with persistent musculoskeletal pain: a cross-sectional investigation. *Pain Reports*, *4*(5).

Marcos-Pardo, P. J., Espeso-García, A., López-Vivancos, A., Lamela, T. A., & Keogh, J. W. (2020). COVID-19 and Social Isolation: A Case for Why Home-Based Resistance Training Is Needed to Maintain Musculoskeletal and Psychosocial Health for Older Adults. *Journal of Aging and Physical Activity*, *1*(aop), 1-7.

Martinez-Calderon, J., Struyf, F., Meeus, M., & Luque-Suarez, A. (2018). The association between pain beliefs and pain intensity and/or disability in people with shoulder pain: a systematic review. *Musculoskeletal Science and Practice*, *37*, 29-57.

Mattson, M. P., Maudsley, S., & Martin, B. (2004). BDNF and 5-HT: a dynamic duo in age-related neuronal plasticity and neurodegenerative disorders. *Trends in neurosciences*, *27*(10), 589-594.

McNeely, M. L., Parliament, M. B., Seikaly, H., Jha, N., Magee, D. J., Haykowsky, M. J., & Courneya, K. S. (2012). Predictors of adherence to an exercise program for shoulder pain and dysfunction in head and neck cancer survivors. *Supportive Care in Cancer*, *20*(3), 515-522.

McRae, S., Leiter, J., Walmsley, C., Rehsia, S., & MacDonald, P. (2011). Relationship between self-reported shoulder function/quality of life, body mass index, and other contributing factors in patients awaiting rotator cuff repair surgery. *Journal of shoulder and elbow surgery*, *20*(1), 57-61.

Menendez, M. E., Baker, D. K., Oladeji, L. O., Fryberger, C. T., McGwin, G., & Ponce, B. A. (2015). Psychological distress is associated with greater perceived disability and pain in patients presenting to a shoulder clinic. *JBJS*, *97*(24), 1999-2003.

Michener, L. A., Snyder, A. R., & Leggin, B. G. (2011). Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. *Journal of sport rehabilitation*, *20*(1), 115-128.

Michener, L. A., Walsworth, M. K., & Burnet, E. N. (2004). Effectiveness of rehabilitation for patients with subacromial impingement syndrome: a systematic review. *Journal of hand therapy*, *17*(2), 152-164.

Michener, L. A., Walsworth, M. K., Doukas, W. C., & Murphy, K. P. (2009). Reliability and diagnostic accuracy of 5 physical examination tests and combination of tests for subacromial impingement. *Archives of physical medicine and rehabilitation*, *90*(11), 1898-1903.

Millan, M. J. (2002). Descending control of pain. *Progress in neurobiology*, *66*(6), 355-474.

Mintken, P. E., Cleland, J. A., Whitman, J. M., & George, S. Z. (2010). Psychometric properties of the Fear-Avoidance Beliefs Questionnaire and Tampa Scale of Kinesiophobia in patients with shoulder pain. *Archives of physical medicine and rehabilitation*, *91*(7), 1128-1136.

Mintken, P. E., Glynn, P., & Cleland, J. A. (2009). Psychometric properties of the shortened disabilities of the Arm, Shoulder, and Hand Questionnaire (QuickDASH) and Numeric Pain Rating Scale in patients with shoulder pain. *Journal of Shoulder and Elbow Surgery*, *18*(6), 920-926.

Neer, C. S. (1983). Impingement lesions. *Clinical Orthopaedics and Related Research (1976-2007)*, *173*, 70-77.

Nicholas, M. K. (2007). The pain self-efficacy questionnaire: taking pain into account. *European journal of pain*, *11*(2), 153-163.

Nicholson, G. P., Goodman, D. A., Flatow, E. L., & Bigliani, L. U. (1996). The acromion: morphologic condition and age-related changes. A study of 420 scapulas. *Journal of shoulder and elbow surgery*, *5*(1), 1-11.

Noroozi, A., Ghofranipour, F., Heydarnia, A. R., Nabipour, I., Tahmasebi, R., & Tavafian, S. S. (2011). The Iranian version of the exercise self-efficacy scale (ESES) Factor structure, internal consistency and construct validity. *Health Education Journal*, *70*(1), 21-31.

Owen, N., Sparling, P. B., Healy, G. N., Dunstan, D. W., & Matthews, C. E. (2010, December). Sedentary behavior: emerging evidence for a new health risk. In *Mayo Clinic Proceedings* (Vol. 85, No. 12, pp. 1138-1141). Elsevier.

Park, H. B., Yokota, A., Gill, H. S., El Rassi, G., & McFarland, E. G. (2005). Diagnostic accuracy of clinical tests for the different degrees of subacromial impingement syndrome. *JBJS*, *87*(7), 1446-1455.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied psychological measurement*, *1*(3), 385-401.

Raman, J., & Macdermid, J. C. (2012). Western Ontario Rotator Cuff Index. *Journal of Physiotherapy*, *58*(3), 201. https://doi.org/10.1016/S1836-9553(12)70115-7

Raven, E. E., Haverkamp, D., Sierevelt, I. N., Van Montfoort, D. O., Pöll, R. G., Blankevoort, L., & Tak, P. P. (2008). Construct validity and reliability of the disability ofArm,

shoulder and hand questionnaire for upper extremity complaints in rheumatoid arthritis. The Journal of rheumatology, 35(12), 2334-2338.

Razmjou, H., Bean, A., van Osnabrugge, V., MacDermid, J. C., & Holtby, R. (2006). Cross-sectional and longitudinal construct validity of two rotator cuff disease-specific outcome measures. *BMC musculoskeletal disorders*, *7*(1), 1-7.

Reijneveld, E. A., Noten, S., Michener, L. A., Cools, A., & Struyf, F. (2017). Clinical outcomes of a scapular-focused treatment in patients with subacromial pain syndrome: a systematic review. *British Journal of Sports Medicine*, *51*(5), 436-441.

Roh, Y. H., Lee, B. K., Noh, J. H., Oh, J. H., Gong, H. S., & Baek, G. H. (2012). Effect of depressive symptoms on perceived disability in patients with chronic shoulder pain. *Archives of orthopaedic and trauma surgery*, *132*(9), 1251-1257.

Ruiz-Montero, P. J., Ruiz-Rico Ruiz, G. J., Martín-Moya, R., & González-Matarín, P. J. (2019). Do Health-Related Quality of Life and Pain-Coping Strategies explain the relationship between older women participants in a Pilates-Aerobic program and bodily pain? A multiple mediation model. *International journal of environmental research and public health*, *16*(18), 3249.

Santini, Z. I., Jose, P. E., York Cornwell, E., Koyanagi, A., Nielsen, L., Hinrichsen, C., Meilstrup, C., Madsen, K. R., & Koushede, V. (2020). Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. *The Lancet. Public health*, *5*(1), e62–e70. https://doi.org/10.1016/S2468-2667(19)30230-0

Schmitt, J. S., & Di Fabio, R. P. (2004). Reliable change and minimum important difference (MID) proportions facilitated group responsiveness comparisons using individual threshold criteria. *Journal of clinical epidemiology*, *57*(10), 1008-1018.

Sciascia, A., & Cromwell, R. (2012). Kinetic chain rehabilitation: a theoretical framework. *Rehabilitation research and practice*, *2012*.

Seroyer, S. T., Nho, S. J., Bach, B. R., Bush-Joseph, C. A., Nicholson, G. P., & Romeo, A. A. (2010). The kinetic chain in overhand pitching: its potential role for performance enhancement and injury prevention. *Sports health*, *2*(2), 135-146.

Shin, Y., Jang, H., & Pender, N. J. (2001). Psychometric evaluation of the exercise self-efficacy scale among Korean adults with chronic diseases. *Research in Nursing & Health*, *24*(1), 68-76.

Shire, A. R., Stæhr, T. A., Overby, J. B., Dahl, M. B., Jacobsen, J. S., & Christiansen, D. H. (2017). Specific or general exercise strategy for subacromial impingement syndrome–does it matter? A systematic literature review and meta analysis. *BMC Musculoskeletal Disorders*, *18*(1), 158.

Silva, L., Andreu, J. L., Munoz, P., Pastrana, M., Millán, I., Sanz, J., ... & Fernández-Castro, M. (2008). Accuracy of physical examination in subacromial impingement syndrome. *Rheumatology*, *47*(5), 679-683.

Slobogean, G. P., Noonan, V. K., & O'Brien, P. J. (2010). The reliability and validity of the Disabilities of Arm, Shoulder, and Hand, EuroQol-5D, Health Utilities Index, and Short Form-6D outcome instruments in patients with proximal humeral fractures. *Journal of shoulder and elbow surgery*, *19*(3), 342-348.

Staples, M. P., Forbes, A., Green, S., & Buchbinder, R. (2010). Shoulder-specific disability measures showed acceptable construct validity and responsiveness. *Journal of clinical epidemiology*, *63*(2), 163-170.

Stratford, P. W. (2001). Development and initial validation of the Upper Ectremity Functional Index. *Physiother Can*, *52*, 259-267.

Stubbs, D., Krebs, E., Bair, M., Damush, T., Wu, J., Sutherland, J., & Kroenke, K. (2010). Sex differences in pain and pain-related disability among primary care patients with chronic musculoskeletal pain. *Pain Medicine*, *11*(2), 232-239.

Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. *Psychological assessment*, *7*(4), 524.

Svege, I., Kolle, E., & Risberg, M. A. (2012). Reliability and validity of the Physical Activity Scale for the Elderly (PASE) in patients with hip osteoarthritis. *BMC musculoskeletal disorders*, *13*(1), 26.

Teunis, T., Lubberts, B., Reilly, B. T., & Ring, D. (2014). A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age. *Journal of shoulder and elbow surgery*, *23*(12), 1913-1921.

Urwin, M., Symmons, D., Allison, T., Brammah, T., Busby, H., Roxby, M., ... & Williams, G. (1998). Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. *Annals of the rheumatic diseases*, *57*(11), 649-655.

Van der Heijden, M. M. P., Pouwer, F., & Pop, V. J. M. (2014). Psychometric properties of the exercise self-efficacy scale in Dutch primary care patients with type 2 diabetes mellitus. *International journal of behavioral medicine*, *21*(2), 394-401.

Vincent, K., Leboeuf-Yde, C., & Gagey, O. (2017). Are degenerative rotator cuff disorders a cause of shoulder pain? Comparison of prevalence of degenerative rotator cuff disease to prevalence of nontraumatic shoulder pain through three systematic and critical reviews. *Journal of shoulder and elbow surgery*, *26*(5), 766-773.

Wang, J. C., & Shapiro, M. S. (1997). Changes in acromial morphology with age. *Journal of shoulder and elbow surgery*, *6*(1), 55-59.

Ware, J. E., Jr, & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical care*, *30*(6), 473–483.

Ware, J. E., Kosinski, M., & Keller, S. (1994). SF-36 physical and mental health summary scales. *A user's manual*, 1994. Boston: The Health Institute, New England Medical Center.

Washburn, R. A., McAuley, E., Katula, J., Mihalko, S. L., & Boileau, R. A. (1999). The physical activity scale for the elderly (PASE): evidence for validity. *Journal of clinical epidemiology*, *52*(7), 643-651.

Washburn, R. A., Smith, K. W., Jette, A. M., & Janney, C. A. (1993). The Physical Activity Scale for the Elderly (PASE): development and evaluation. *Journal of clinical epidemiology*, *46*(2), 153-162.

Wassinger, C. A., Lumpkins, L., & Sole, G. (2020). Lower extremity aerobic exercise as a treatment for shoulder pain. *International journal of sports physical therapy*, *15*(1), 74–80.

Watanabe, T., Terabayashi, N., Fukuoka, D., Murakami, H., Ito, H., Matsuoka, T., & Seishima, M. (2015). A pilot study to assess Fatty infiltration of the supraspinatus in patients with

rotator cuff tears: comparison with magnetic resonance imaging. *Ultrasound in Medicine & Biology*, *41*(6), 1779-1783.

Wendelboe, A. M., Hegmann, K. T., Gren, L. H., Alder, S. C., White Jr, G. L., & Lyon, J. L. (2004). Associations between body-mass index and surgery for rotator cuff tendinitis. *JBJS*, *86*(4), 743-747.

Wideman, T. H., & Sullivan, M. J. (2011). Differential predictors of the long-term levels of pain intensity, work disability, healthcare use, and medication use in a sample of workers' compensation claimants. *PAIN®*, *152*(2), 376-383.

Wilcox, S., Sharpe, P. A., Hutto, B., & Granner, M. L. (2005). Psychometric properties of the self-efficacy for exercise questionnaire in a diverse sample of men and women. *Journal of Physical Activity and Health*, *2*(3), 285-297.

Woby, S. R., Roach, N. K., Urmston, M., & Watson, P. J. (2005). Psychometric properties of the TSK-11: a shortened version of the Tampa Scale for Kinesiophobia. *Pain*, *117*(1-2), 137-144.

Wolfensberger, A., Vuistiner, P., Konzelmann, M., Plomb-Holmes, C., Léger, B., & Luthi, F. (2016). Clinician and patient-reported outcomes are associated with psychological factors in patients with chronic shoulder pain. *Clinical Orthopaedics and Related Research*, *474*(9), 2030-2039.

Wylie, J. D., Bershadsky, B., & Iannotti, J. P. (2010). The effect of medical comorbidity on self-reported shoulder-specific health related quality of life in patients with shoulder disease. *Journal of shoulder and elbow surgery*, *19*(6), 823-828.

Wylie, J. D., Suter, T., Potter, M. Q., Granger, E. K., & Tashjian, R. Z. (2016). Mental health has a stronger association with patient-reported shoulder pain and function than tear size in patients with full-thickness rotator cuff tears. *JBJS*, *98*(4), 251-256.

APPENDICES

Appendix A: Non-standardized Questionnaire

Exercise Questionnaire

*Please answer all questions considering your Symptomatic Shoulder

Mindfulness (Yoga/Pilates/Tai chi)

These activities are usually concerned with meditation and being aware of what you are sensing and feeling in the moment, but also about focusing on what is happening in the body. These usually involve using breathing methods and other practices to relax the body and mind and help reduce stress. These are usually low impact and include Tai Chi, Yoga, or Pilates.

https://www.physiospot.com/

Strength Training

This type of activity involves using muscle force against

https://evelo.com/

resistance. It involves resistive weights (i.e., dumbbells, therabands/tubing) or other 'gym' equipment (i.e., resistance machines) to strengthen muscles in different areas of the body. It also includes isometric exercises which involves holding a static position under resistance (i.e., wall-sits). It typically consists of performing a certain number of repetitions/sets for each exercise.

Cardiovascular/Aerobics (running/walking/biking/swimming)

This involves activities where you repeatedly move large muscles (i.e legs, arms, hips) in your body. Your heart rate increases and you breathe faster and more deeply. This includes walking, jogging, or cycling on a stationary bike.

https://www.istockphoto.com/

Athletics (Recreational/competitive sports)

These include sporting activities such as tennis, golfing, or playing basketball. They can be done in a structured environment (sports team/coach) and/or with friends.

http://clipart-library.com/

Rehabilitation/Physiotherapy

This may include therapy for any-body part that is done in a structured treatment with a clinician (i.e., physician, physiotherapist, occupational therapist, chiropractor) and/or at-home exercises prescribed by a clinician.

https://www.pthealth.ca/

What type of physical activities do you participate in?

- ☐ Mindfulness: Yoga/Pilates/Tai chi
- ☐ Strength training
- ☐ Cardiovascular/Aerobics (running/walking/biking/swimming)
- ☐ Athletics (recreational/competitive sports)
- ☐ Rehabilitation/Physiotherapy
- ☐ _____ Other

*Answer the following questions for each activity that you currently involved in. If you are involved in more than 8 activities, please choose the **top 8** activities that you spend **most of your time**.*

Activity #1

What is the name of this activity?

What category is it in?

- » Mindfulness: Yoga/Pilates/Tai chi
- » Strength training
- » Cardiovascular/Aerobics (running/walking/biking/swimming)
- » Athletics (recreational/competitive sports)
- » Rehabilitation/Physiotherapy
- » Other

On average, how many times per week do you participate?

- Seldom (1-2 days)
- Sometimes (3-4 days)
- Often (5-7 days)

On average, how long is each session?

- Less than 30 minutes
- 30 minutes but less than 1 hour
- 1 hour but less than 2 hours
- 2-4 hours
- More than 4 hours

What is the perceived intensity?

- Low
- Moderate
- High

Is this physical activity structured (supervised) or non-structured (unsupervised)?

- ○ Structured
- ○ Non-structured

How long have you been participating in this exercise?

(answer in week/months/or years) [ ]

What part of the body do you feel the activity primarily targets?

- ○ Upper body
- ○ Whole/Lower body

On this scale of 0 to 10, where *0=no pain* and *10=the worst possible pain*, how much pain do you feel in your shoulder...

**Please make sure to drag the slider. If your rating is the starting position, you must click the slider and drag it to starting position to record a response.*

	No pain					Moderate pain					Worst possible pain
	0	1	2	3	4	5	6	7	8	9	10
before each session											[ ]
after each session											[ ]

Would you like to add another activity?

- ○ Yes
- ○ No

Activity #2

What is the name of this activity?

[ ]

What category is it in?

Overall, do you regularly (most days of the week) participate in activities/exercise that specifically target your symptomatic shoulder?

- ○ Yes, I regularly exercise my injured/painful shoulder
- ○ No, I do not regularly exercise my injured/painful shoulder
- ○ No, I do not regularly exercise

Is there any additional information regarding your participation in physical activity that you would like to tell us?

Appendix B: COVID-19 Related Questionnaire

COVID-19 Related Questionnaire

This questionnaire asks about changes in your activity and health before and after March 2020 when COVID-19 related restrictions were first imposed.

*Please answer all questions considering your Symptomatic Shoulder

Isolation

On a scale of 0 to 10, where *0="not isolated at all"* and *10="completely isolated"*, please rate how isolated you feel.

**Please make sure to drag the slider. If your rating is 5, you must click the slider and drag it to 5 to record a response.*

	Not Isolated				Moderately Isolated				Completely Isolated		
	0	1	2	3	4	5	6	7	8	9	10
How isolated do you feel you have been from your community, workplace, extracurricular activities, family/friends/social gatherings, since March 2020?											

Additional Comments:

Pain: *Questions refer to your symptomatic shoulder*

Using the following 0-10 scale, where *0=no pain* and *10=worst possible pain*, how much pain do/did you feel...?

**Please make sure to drag the slider. If your rating is 5, you must click the slider and drag it to 5 to record a response.*

	No pain 0	1	2	3	4	Moderate Pain 5	6	7	8	9	Worst possible pain 10	
Currently												☐
During the past week												☐
During the past month												☐
Between March 2020 and present												☐
Between September 2019 & March 2020 (6 months Pre-Covid-19)												☐
At the time of initial injury												☐

How has your shoulder pain changed since March 2020?

- ○ It has been worse
- ○ It has been the same
- ○ It has been better

If your shoulder pain has gotten worse or better since March, what (or what do you suspect) is the reason?

How has your overall physical activity level changed since March 2020?

- It has decreased
- It has stayed the same
- It has increased

How has your sport and recreational physical activity level changed since March 2020?

- » It has decreased
- » It has stayed the same
- » It has increased

How has your occupational physical activity level changed since March 2020?

- » It has decreased
- » It has stayed the same
- » It has increased

How has your ability to perform activities of daily living (for example, activities around the house, getting dressed, etc.) changed since March 2020?

- » It has decreased
- » It has stayed the same
- » It has increased

How has your mental health changed since March 2020?

- » It has decreased
- » It has stayed the same
- » It has increased

What physical activity have you been involved in between March 2020 and presently? (list top 3)

Activity #1

Name of activity

How many times per week?

How long is each session?

Activity #2

Name of activity

How many times per week?

How long is each session?

Activity #3

Name of activity

How many times per week?

How long is each session?

Do you feel that any other aspects of your health and physical activity have changed since March 2020? If so, please describe:

You have completed one of the 16 questionnaires. You may proceed to the next one now (click the "arrow" at the bottom of this survey), or you may return to the survey at a later time by clicking the link. Your survey response will be automatically saved.

Appendix C: Center for Epidemiologic Studies Depression Scale (CES-D)

Center for Epidemiologic Studies Depression Scale (CES-D Scale)

Patient Name: _____ **Date:** _____

Instructions: Please read each question carefully, then **circle** one of the numbers to the right to indicate how you have felt or behaved **during the past week,** including today.

	RARELY OR NONE OF THE TIME (LESS THAN 1 DAY)	SOME OR A LITTLE OF THE TIME (1–2 DAYS)	OCCASIONALLY OR A MODERATE AMOUNT OF TIME (3–4 DAYS)	MOST OR ALL OF THE TIME (5–7 DAYS)
1. I was bothered by things that usually don't bother me.	0	1	2	3
2. I did not feel like eating; my appetite was poor.	0	1	2	3
3. I felt that I could not shake off the blues even with help from my family or friends.	0	1	2	3
4. I felt that I was just as good as other people.	0	1	2	3
5. I had trouble keeping my mind on what I was doing.	0	1	2	3
6. I felt depressed.	0	1	2	3
7. I felt that everything I did was an effort.	0	1	2	3
8. I felt hopeful about the future.	0	1	2	3
9. I thought my life had been a failure.	0	1	2	3
10. I felt fearful.	0	1	2	3
11. My sleep was restless.	0	1	2	3
12. I was happy.	0	1	2	3
13. I talked less than usual.	0	1	2	3
14. I felt lonely.	0	1	2	3
15. People were unfriendly.	0	1	2	3
16. I enjoyed life.	0	1	2	3
17. I had crying spells.	0	1	2	3
18. I felt sad.	0	1	2	3
19. I felt that people dislike me.	0	1	2	3
20. I could not get "going."	0	1	2	3

Appendix D: Disabilities of the Arm, Shoulder and Hand (DASH)

The Disabilities of the Arm, Shoulder and Hand (DASH) Score

Clinician's name (or ref) _____ **Patient's name (or ref** _____

INSTRUCTIONS: This questionnaire asks about your symptoms as well as your ability to perform certain activities. Please answer *every question* , based on your condition in the **last week.** If you did not have the opportunity to perform an activity in the past week, please make your *best estimate* on which response would be the most accurate. It doesn't matter which hand or arm you use to perform the activity; please answer based on you ability regardless of how you perform the task.

Please rate your ability to do the following activities in the last week.

1. Open a tight or new jar	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
2. Write	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
3. Turn a key	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
4. Prepare a meal	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
5. Push open a heavy door	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
6. Place an object on a shelf above your head	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
7. Do heavy household chores (eg wash walls, wash floors)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
8. Garden or do yard work	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
9. Make a bed	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
10. Carry a shopping bag or briefcase	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
11. Carry a heavy object (over 10 lbs)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
12. Change a lightbulb overhead	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
13. Wash or blow dry your hair	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
14. Wash your back	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
15. Put on a pullover sweater	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
16. Use a knife to cut food	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
17. Recreational activities which require little effort (eg cardplaying, knitting, etc)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (eg golf, hammering, tennis, etc)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
19. Recreational activities in which you move your arm freely (eg playing frisbee, badminton, etc)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**

20.	Manage transportation needs (getting from one place to another)	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
21.	Sexual activities	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **Unable**
22.	During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	○ **Not at all**	○ **Slightly**	○ **Moderately**	○ **Quite a bit**	○ **Extremely**
23.	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	○ **Not limited at all**	○ **Slightly limited**	○ **Moderately limited**	○ **Very limited**	○ **Unable**
	Please rate the severity of the following symptoms in the last week					
24.	Arm, shoulder or hand pain	○ **None**	○ **Mild**	○ **Moderate**	○ **Severe**	○ **Extreme**
25.	Arm, shoulder or hand pain when you performed any specific activity	○ **None**	○ **Mild**	○ **Moderate**	○ **Severe**	○ **Extreme**
26.	Tingling (pins and needles) in your arm, shoulder or hand	○ **None**	○ **Mild**	○ **Moderate**	○ **Severe**	○ **Extreme**
27.	Weakness in your arm, shoulder or hand	○ **None**	○ **Mild**	○ **Moderate**	○ **Severe**	○ **Extreme**
28.	Stiffness in your arm, shoulder or hand	○ **None**	○ **Mild**	○ **Moderate**	○ **Severe**	○ **Extreme**
29.	During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	○ **No difficulty**	○ **Mild difficulty**	○ **Moderate difficulty**	○ **Severe difficulty**	○ **So much I can't sleep**
30.	I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	○ **Strongly disagree**	○ **Disagree**	○ **Neither agree nor disagree**	○ **Agree**	○ **Strongly agree**

Thank you very much for completing all the questions in this questionnaire.

Appendix E: Western Ontario Rotator Cuff Index (WORC)

University of Washington
Orthopaedics and Sports Medicine

THE WESTERN ONTARIO ROTATOR CUFF INDEX (WORC)

The following questions concern the **physical symptoms** you have experienced, how your shoulder has affected your **work, sports or recreational activities**, the amount that your shoulder has affected or changed your **lifestyle**, and your **emotions** with regards to your shoulder. Please answer these questions based on how you have felt in the **past week**. For each question, enter to what degree you have experienced these factors with a **slash " / "**.

PHYSICAL SYMPTOMS

1. How much sharp pain do you experience in your shoulder?
   No pain — Extreme pain
2. How much constant, nagging pain do you experience in your shoulder?
   No pain — Extreme pain
3. How much weakness do you experience in your shoulder?
   No weakness — Extreme weakness
4. How much stiffness do you experience in your shoulder?
   No stiffness — Extreme stiffness
5. How much clicking, grinding, or crunching do you experience in your shoulder?
   None — Extreme
6. How much discomfort do you experience in your neck because of your shoulder?
   No discomfort — Extreme discomfort

SPORTS/RECREATION

7. How much has your shoulder affected your fitness level?
   Not affected — Extremely affected
8. How much has your shoulder affected your ability to throw hard or far?
   Not affected — Extremely affected
9. How much difficulty do you have with someone or something coming in contact with your shoulder?
   No fear — Extremely fearful
10. How much difficulty do you experience doing push-ups or other strenuous shoulder exercises because of your shoulder?
    No difficulty — Extreme difficulty

WORK

11. How much difficulty do you experience in daily activities about the house or yard?

No difficulty — Extreme difficulty

12. How much difficulty do you experience working above your head?

No difficulty — Extreme difficulty

13. How much do you use your uninvolved arm to compensate for your injured one?

Not at all — Constant

14. How much difficulty do you experience lifting heavy objects from the ground or below shoulder level?

No difficulty — Extreme difficulty

LIFESTYLE

15. How much difficulty do you have sleeping because of our shoulder?

No difficulty — Extreme difficulty

16. How much difficulty have you experienced with styling your hair because of your shoulder?

No difficulty — Extreme difficulty

17. How much difficulty do you have "roughhousing or horsing around" with family and friends?

No difficulty — Extreme difficulty

18. How much difficulty do you have dressing or undressing?

No difficulty — Extreme difficulty

EMOTIONS

19. How much frustration do you feel because of your shoulder?

No frustration — Extreme frustration

20. How "down in the dumps" or depressed do you feel because of your shoulder?

None — Extreme

21. How worried or concerned are you about the effect of your shoulder on you occupation or work?

Not at all — Extremely concerned

Appendix F: Upper Extremity Functional Index (UEFI)

Upper Extremity Functional Index

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your upper limb problem for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, do you or would you have any difficulty at all with:

	Extreme Difficulty or unable to perform activity	Quite a Bit of Difficulty	Moderate Difficulty	A little bit of Difficulty	No Difficulty
Any of your usual work, housework, or school activities	○	○	○	○	○
Your usual hobbies, recreational or sporting activities	○	○	○	○	○
Lifting a bag of groceries to waist level	○	○	○	○	○
Lifting a bag of groceries above your head	○	○	○	○	○
Grooming your hair	○	○	○	○	○

	Extreme Difficulty or unable to perform activity	Quite a Bit of Difficulty	Moderate Difficulty	A little bit of Difficulty	No Difficulty
Pushing up on your hands (eg from bathtub or chair)	○	○	○	○	○
Preparing food (eg peeling, cutting)	○	○	○	○	○
Driving	○	○	○	○	○
Vacuuming, sweeping or raking	○	○	○	○	○
Dressing	○	○	○	○	○
Doing up buttons	○	○	○	○	○
Using tools or appliances	○	○	○	○	○
Opening doors	○	○	○	○	○
Cleaning	○	○	○	○	○
Tying or lacing shoes	○	○	○	○	○
Sleeping	○	○	○	○	○
Laundering clothes (eg washing, ironing, folding)	○	○	○	○	○
Opening a jar	○	○	○	○	○
Throwing a ball	○	○	○	○	○
Carrying a small suitcase with your affected limb	○	○	○	○	○

You have completed one of the 16 questionnaires. You may proceed to the next one now (click the "arrow" at the bottom of this survey), or you may return to the survey at a later time by clicking the link. Your survey response will be automatically saved.

Appendix G: International Physical Activity Questionnaire (IPAQ)

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

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***

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

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.

7. 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.

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

Appendix H: Physical Activity Scale for the Elderly (PASE)

Instruction

Please complete this questionnaire by either circling the correct response or filling in the blank. Here is an example:

During the past 7 days, how often have you seen the sun?

[0.] NEVER

[1.] SELDOM (1-2 DAYS)

[2.] SOMETIMES (3-4 DAYS)

[3.] OFTEN (5-7 DAYS)

Answer all items as accurately as possible. All information is strictly confidential.

Leisure Time Activity

1. Over the past 7 days, how often did you participate in sitting activities such as reading, watching TV, or doing handcrafts?

[0.] NEVER (go to question 2)

[1.] SELDOM (1-2 DAYS) (go to question 1.a and 1.b)

[2.] SOMETIMES (3-4 DAYS) (go to question 1.a and 1.b)

[3.] OFTEN (5-7 DAYS) (go to question 1.a and 1.b)

1.a What were these activities? (open end question)

1.b On average, how many hours did you engage in these sitting activities?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

2. Over the past 7 days, how often did you take a walk outside your home or yard for any reason? For example, for fun or exercise, walking to work, walking the dog, etc

[0.] NEVER (go to question 3)

[1.] SELDOM (1-2 DAYS) (go to question 2.a)

[2.] SOMETIMES (3-4 DAYS) (go to question 2.a)

[3.] OFTEN (5-7 DAYS) (go to question 2.a)

2a. On average, how many hours per day did you spend walking?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

3. Over the past 7 days, how often did you engage in light sport or recreational activities such as bowling, golf with a cart, shuffleboard, fishing from a boat or pier or other similar activities?

[0.] NEVER (go to question 4)

[1.] SELDOM (1-2 DAYS) (go to question 3.a and 3.b)

[2.] SOMETIMES (3-4 DAYS) (go to question 3.a and 3.b)

[3.] OFTEN (5-7 DAYS) (go to question 3.a and 3.b)

3.a What were these activities? (open end question)

3.b On average, how many hours did you engage in these light sport or recreational activities?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

4. Over the past 7 days, how often did you engage in moderate sport and recreational activities such as doubles tennis, ballroom dancing, hunting, ice skating, golf without a cart, softball or other similar activities?

[0.] NEVER (go to question 5)

[1.] SELDOM (1-2 DAYS) (go to question 4.a and 4.b)

[2.] SOMETIMES (3-4 DAYS) (go to question 4.a and 4.b)

[3.] OFTEN (5-7 DAYS) (go to question 4.a and 4.b)

4.a What were these activities? (open end question)

4.b On average, how many hours did you engage in these moderate sport or recreational activities?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

5. Over the past 7 days, how often did you engage in strenuous sport and recreational activities such as jogging, swimming, cycling, singles tennis, aerobic dance, skiing (downhill or cross-country) or other similar activities?

[0.] NEVER (go to question 6)

[1.] SELDOM (1-2 DAYS) (go to question 5.a and 5.b)

[2.] SOMETIMES (3-4 DAYS) (go to question 5.a and 5.b)

[3.] OFTEN (5-7 DAYS) (go to question 5.a and 5.b)

5.a What were these activities? (open end question)

5.b On average, how many hours did you engage in these strenuous sport or recreational activities?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

6. Over the past 7 days, how often did you do any exercises specifically to increase muscle strength and endurance, such as lifting weights or pushups, etc.?

[0.] NEVER (go to question 7)

[1.] SELDOM (1-2 DAYS) (go to question 6.a and 6.b)

[2.] SOMETIMES (3-4 DAYS) (go to question 6.a and 6.b)

[3.] OFTEN (5-7 DAYS) (go to question 6.a and 6.b)

6.a What were these activities? (open end question)

6.b On average, how many hours did you engage in these strenuous sport or recreational activities?

[0.] Less than 1 hour

[1.] 1 but less than 2 hours

[2.] 2 - 4 hours

[3.] more than 4 hours

Household Activity

7. During the past 7 days, have you done any light housework, such as dusting or washing dishes?

[1.] NO
[2.] YES

8. During the past 7 days, have you done any heavy housework or chores, such as vacuuming, scrubbing floors, washing windows, or carrying wood?

[1.] NO
[2.] YES

During the past 7 days, did you engage in any of the following activities? Please answer YES or NO for each item.

a. Home repairs like painting, wallpapering, electrical work, etc.

b. Lawn work or yard care, including snow or leaf removal, wood chopping, etc.

c. Outdoor gardening

d. Caring for another person, such as children, dependent spouse, or another adult

Work-related Activity

10. During the past 7 days, did you work for pay or as a volunteer?

[1.] NO
[2.] YES (go to questions 10.a and 10.b)

10a. How many hours per week did you work for pay and or as a volunteer? ____ hours

10b. Which of the following categories best describes the amount of physical activity required on your job and or volunteer work?

1. Mainly sitting with some slight arm movement (Examples: office worker, watchmaker, seated assembly line worker, bus driver, etc.)
2. Sitting or standing with some walking (Examples: cashier, general office worker, light tool and machinery worker)
3. Walking with some handling of materials generally weighing less than 50 pounds (Examples: mailman, waiter/waitress, construction worker, heavy tool and machinery worker)
4. Walking and heavy manual work often requiring handling of materials weighting over 50 pounds (Ex: lumberjack, ston mason, farm or general labourer)

Appendix I: Pain Self-Efficacy Questionnaire (PSEQ)

PAIN SELF EFFICACY QUESTIONNAIRE (PSEQ)

M.K.Nicholas (1989)

NAME: _____ DATE: _____

Please rate how **confident** you are that you can do the following things at present, **despite the pain**. To indicate your answer circle **one** of the numbers on the scale under each item, where 0 = not at all confident and 6 = completely confident.

For example:

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

Remember, this questionnaire is **not** asking whether of not you have been doing these things, but rather **how confident you are that you can do them at present, despite the pain.**

---

1. I can enjoy things, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

2. I can do most of the household chores (e.g. tidying-up, washing dishes, etc.), despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

3. I can socialise with my friends or family members as often as I used to do, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

4. I can cope with my pain in most situations.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

5. **I can do some form of work, despite the pain. ("work" includes housework, paid and unpaid work).**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

6. **I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

7. **I can cope with my pain without medication.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

8. **I can still accomplish most of my goals in life, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

9. **I can live a normal lifestyle, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

10. **I can gradually become more active, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

Appendix J: Shoulder Pain and Disability Index (SPADI)

Shoulder Pain and Disability Index (SPADI)

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

Pain scale

How severe is your pain?

Circle the number that best describes your pain where: 0 = no pain and 10 = the worst pain imaginable.

At its worst?	0	1	2	3	4	5	6	7	8	9	10
When lying on the involved side?	0	1	2	3	4	5	6	7	8	9	10
Reaching for something on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Touching the back of your neck?	0	1	2	3	4	5	6	7	8	9	10
Pushing with the involved arm?	0	1	2	3	4	5	6	7	8	9	10

Disability scale

How much difficulty do you have?

Circle the number that best describes your experience where: 0 = no difficulty and 10 = so difficult it requires help.

Washing your hair?	0	1	2	3	4	5	6	7	8	9	10
Washing your back?	0	1	2	3	4	5	6	7	8	9	10
Putting on an undershirt or jumper?	0	1	2	3	4	5	6	7	8	9	10
Putting on a shirt that buttons down the front?	0	1	2	3	4	5	6	7	8	9	10
Putting on your pants?	0	1	2	3	4	5	6	7	8	9	10
Placing an object on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Carrying a heavy object of 10 pounds (4.5 kilograms)	0	1	2	3	4	5	6	7	8	9	10
Removing something from your back pocket?	0	1	2	3	4	5	6	7	8	9	10

Appendix K: Numeric Pain Rating Scale (NPRS)

Numeric Pain Rating Scale

This is a scale for your symptomatic shoulder pain. On this scale, ranging from 0 to 10, where 0 represents no pain and 10 represents the worst possible pain, how much pain do you feel…?

i. At rest _____
ii. When doing activities of daily living (for example, activities around the house, getting dressed, etc.) _____
iii. When doing strenuous activities (for example, exercise, heavy domestic duties, etc.)_____

Appendix L: Bandura's Exercise Self-Efficacy Scale (ESE)

Bandura's Exercise Self-Efficacy Scale

Participant ID_____

Instructions:
Please rate how sure you are that you can get yourself to exercise regularly (most days of the week). The scale ranges from 0 to 10, where 0=I cannot do this activity at all and 10=I am certain that I can do this activity successfully.

How sure are you that you can get yourself to exercise regularly (most days of the week) if:

	I cannot do this activity at all										I am certain that I do this activity successfully
1. When I am feeling tired	0	1	2	3	4	5	6	7	8	9	10
2. When I am feeling under pressure from work	0	1	2	3	4	5	6	7	8	9	10
3. During bad weather	0	1	2	3	4	5	6	7	8	9	10
4. After recovering from an injury that caused me to stop exercising	0	1	2	3	4	5	6	7	8	9	10
5. During or after experiencing personal problems	0	1	2	3	4	5	6	7	8	9	10
6. When I am feeling depressed	0	1	2	3	4	5	6	7	8	9	10
7. When I am feeling anxious	0	1	2	3	4	5	6	7	8	9	10
8. After recovering from an illness that caused me to stop exercising	0	1	2	3	4	5	6	7	8	9	10

9. When I feel physical discomfort when I exercise	0	1	2	3	4	5	6	7	8	9	10
10. After a holiday	0	1	2	3	4	5	6	7	8	9	10
11. When I have too much work to do at home	0	1	2	3	4	5	6	7	8	9	10
12. When visitors are present	0	1	2	3	4	5	6	7	8	9	10
13. When there are other interesting things to do	0	1	2	3	4	5	6	7	8	9	10
14. If I don't reach my exercise goals	0	1	2	3	4	5	6	7	8	9	10
15. Without support from my family or friends	0	1	2	3	4	5	6	7	8	9	10
16. During a holiday	0	1	2	3	4	5	6	7	8	9	10
17. When I have other time commitments	0	1	2	3	4	5	6	7	8	9	10
18. After experiencing family problems	0	1	2	3	4	5	6	7	8	9	10

Appendix M: Tampa Scale of Kinesiophobia (TSK)

Tampa Scale-11 (TSK-11) **Name:** **Date:**

This is a list of phrases which other patients have used to express how the view their condition. Please circle the number that best describes how you feel about each statement.

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
1. I'm afraid I might injure myself if I exercise.	1	2	3	4
2. If I were to try to overcome it, my pain would increase.	1	2	3	4
3. My body is telling me I have something dangerously wrong.	1	2	3	4
4. People aren't taking my medical condition serious enough.	1	2	3	4
5. My accident/problem has put my body at risk for the rest of my life.	1	2	3	4
6. Pain always means I have injured my body.	1	2	3	4
7. Simply being careful that I do not make any unnecessary movements is the safest thing I can do to prevent my pain from worsening.	1	2	3	4
8. I wouldn't have this much pain if there wasn't something potentially dangerous going on in my body.	1	2	3	4
9. Pain lets me know when to stop exercising so that I don't injure myself.	1	2	3	4
10. I can't do all the things normal people do because it's too easy for me to get injured.	1	2	3	4
11. No one should have to exercise when he/she is in pain.	1	2	3	4

Appendix N: 36-Item Short Form Survey (SF-36)

RAND HEALTH CARE

RAND > RAND Health Care > Surveys > RAND Medical Outcomes Study > 36-Item Short Form Survey (SF-36) >

36-Item Short Form Survey Instrument (SF-36)

RAND 36-Item Health Survey 1.0 Questionnaire Items

Choose one option for each questionnaire item.

1. In general, would you say your health is:

- ○ 1 - Excellent
- ○ 2 - Very good
- ○ 3 - Good
- ○ 4 - Fair
- ○ 5 - Poor

---

2. **Compared to one year ago**, how would you rate your health in general **now**?

- ○ 1 - Much better now than one year ago
- ○ 2 - Somewhat better now than one year ago
- ○ 3 - About the same
- ○ 4 - Somewhat worse now than one year ago
- ○ 5 - Much worse now than one year ago

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

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	○ 1	○ 2	○ 3
4. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○ 1	○ 2	○ 3
5. Lifting or carrying groceries	○ 1	○ 2	○ 3
6. Climbing **several** flights of stairs	○ 1	○ 2	○ 3
7. Climbing **one** flight of stairs	○ 1	○ 2	○ 3
8. Bending, kneeling, or stooping	○ 1	○ 2	○ 3
9. Walking **more than a mile**	○ 1	○ 2	○ 3
10. Walking **several blocks**	○ 1	○ 2	○ 3
11. Walking **one block**	○ 1	○ 2	○ 3
12. Bathing or dressing yourself	○ 1	○ 2	○ 3

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

	Yes	No
13. Cut down the **amount of time** you spent on work or other activities	○ 1	○ 2
14. **Accomplished less** than you would like	○ 1	○ 2
15. Were limited in the **kind** of work or other activities	○ 1	○ 2
16. Had **difficulty** performing the work or other activities (for example, it took extra effort)	○ 1	○ 2

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

	Yes	No
17. Cut down the **amount of time** you spent on work or other activities	○ 1	○ 2
18. **Accomplished less** than you would like	○ 1	○ 2
19. Didn't do work or other activities as **carefully** as usual	○ 1	○ 2

---

20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

○ 1 - Not at all

○ 2 - Slightly

○ 3 - Moderately

○ 4 - Quite a bit

○ 5 - Extremely

---

21. How much **bodily** pain have you had during the **past 4 weeks**?

○ 1 - None

○ 2 - Very mild

○ 3 - Mild

○ 4 - Moderate

○ 5 - Severe

○ 6 - Very severe

---

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

- ○ 1 - Not at all
- ○ 2 - A little bit
- ○ 3 - Moderately
- ○ 4 - Quite a bit
- ○ 5 - Extremely

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the **past 4 weeks**...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
24. Have you been a very nervous person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
25. Have you felt so down in the dumps that nothing could cheer you up?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
26. Have you felt calm and peaceful?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
27. Did you have a lot of energy?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
28. Have you felt downhearted and blue?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
29. Did you feel worn out?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
30. Have you been a happy person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
31. Did you feel tired?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6

---

32. During the **past 4 weeks**, how much of the time has **your physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?

- ○ 1 - All of the time
- ○ 2 - Most of the time
- ○ 3 - Some of the time
- ○ 4 - A little of the time
- ○ 5 - None of the time

How TRUE or FALSE is **each** of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	○ 1	○ 2	○ 3	○ 4	○ 5
34. I am as healthy as anybody I know	○ 1	○ 2	○ 3	○ 4	○ 5
35. I expect my health to get worse	○ 1	○ 2	○ 3	○ 4	○ 5
36. My health is excellent	○ 1	○ 2	○ 3	○ 4	○ 5

Appendix O: Charlson Comorbidity Index (CCI)

Charlson Comorbidity Index

Chart review version

Components of classical Charlson Comorbidity Index[1]

1. Has the patient had a myocardial infarction? (MI)
   ___ No
   ___ Yes

Criteria: Myocardial infarction includes patients with one or more definite or probable myocardial infarction. These patients should have been hospitalized for chest pain or an equivalent clinical event and have had electrocardiographic and/ or enzyme changes. Patients with electrocardiographic changes alone who have no clinical history are not designated as having had an infarction.

2. Has the patient been hospitalized or treated for heart failure? (CHF)
   ___ No
   ___ Yes

Criteria: Congestive heart failure includes patients who have had exertional or paroxysmal nocturnal dyspnea and who have responded symptomatically (or on physical examination) to digitalis, diuretics, or afterload reducing agents. It does not include patients who are on one of those medications but who have had no response and no evidence of improvement of physical signs with treatment.

3. Does the patient have peripheral vascular disease? (PVD)
   ___ No
   ___ Yes

Criteria: Peripheral vascular includes patients with intermittent claudication or those who had a bypass for arterial insufficiency, those with gangrene or acute arterial insufficiency, and those with a treated or untreated thoracic or abdominal aneurysm (6 cm or more).

4. Has the patient had a CVA or transient ischemic disease? (CVA)
   ___ No
   ___ Yes

Criteria: Cerebrovascular disease includes patients with a history of a cerebrovascular accident with minor or no residua, and patients who have had transient ischemic attacks. If the CVA resulted in hemiplegia, code only hemiplegia.

[1] Charlson, ME, Ales, KA, Pompei, P, MacKenzie, CR. A new method of classification of prognostic comorbidity for longitudinal studies: development and validation. J Chron Disease. 1987; 40(5): 373-383

16

5. Does the patient have hemiplegia? (PLEGIA)
___ No
___ Yes

Criteria: This includes patients with a hemiplegia or paraplegia, whether it occurred as a result of a cerebrovascular accident or other condition.

6. Does the patient have asthma, chronic lung disease, chronic bronchitis or emphysema? (COPD)
___ No
___ Yes

Criteria: Pulmonary disease includes patients with asthma, chronic bronchitis, emphysema, and other chronic lung disease who have ongoing symptoms such as dyspnea or cough, with mild or moderate activity. This includes patients who are dyspneic with slight activity, with or without treatment and those who are dyspneic with moderate activity despite treatment, as well as patients who are dyspneic at rest, despite treatment, those who require constant oxygen, those with CO_2 retention and those with a baseline PO_2 below 50 torr.

7. Does the patient have diabetes that requires treatment? (DM)
___ No
___ Yes

Criteria: Diabetes includes all patients with diabetes treated with insulin or oral hypoglycemic, but not diet alone. Diabetes during pregnancy alone is not counted.

7a. Does the patient have end organ damage from diabetes? (DMENDORGAN)
___ No
___ Yes

Criteria: This includes patients with retinopathy, neuropathy, or nephropathy attributable to diabetes.

8. Does the patient have moderate or severe renal disease? (RENAL)
___ No
___ Yes

Criteria: Moderate renal insufficiency includes patients with a serum creatinine >3 mg/dl. Severe renal disease includes patients on dialysis, those who had a transplant, and those with uremia.

9. Does the patient have a chronic liver disease? (MILDLIVER)
___ No
___ Yes

Criteria: Mild liver disease consists of chronic hepatitis (B or C) or cirrhosis without portal hypertension.

9a. Does the patient have moderate to severe liver disease? (SEVERELIVER)
___ No
___ Yes

Criteria: Moderate liver disease consists of cirrhosis with portal hypertension, but without bleeding. Severe liver disease consists of patients with ascites, chronic jaundice, portal hypertension or a history of variceal bleeding or those who have had liver transplant.

10. Has the patient had gastric or peptic ulcers? (ULCER)
___ No
___ Yes

Criteria: Peptic ulcer disease includes patients who have required treatment for ulcer disease, including those who have bled from ulcers.

11. Has the patient had cancer (other than basal cell skin cancer)? (CANCER)
___ No
___ Yes
If yes, which:
___ Lymphoma?
___ Leukemia?
___ Solid tumor (which?)_____

Criteria: Lymphoma includes patients with Hodgkins, lymphosarcoma, Waldenstrom's macroglobulinemia, myeloma, and other lymphomas. Leukemia includes patients with acute and chronic myelogenous leukemia, acute and chronic lymphocytic leukemia, and polycythemia vera. Solid tumor consists of patients with solid tumors without documented metastases, including breast, colon, lung, prostate, and a variety of other tumors.

11a. Has the patient had a metastatic solid tumor? (METASTASES)
___ Breast
___ Colon
___ Prostate
___ Lung
___ Melanoma
___ Other _____

Criteria: Metastatic cancer includes patients with metastatic solid tumors, including breast, lung, colon and other tumors

12. Does the patient have Alzheimer's, dementia from any etiology or any serious cognitive impairment? (DEMENTIA)
___ No
___ Yes

Criteria: Dementia includes patients with moderate to severe chronic cognitive deficit resulting in impaired function from any cause.

13. Does the patient have any rheumatic or connective tissue disease? (RHEUMATIC)
___ No
___ Yes

Criteria: Rheumatologic disease includes patients with systemic lupus erythematous, polymyositis, mixed connective tissue disease, rheumatoid arthritis, polymyositis, polymyalgia rheumatica, vasculitis, sarcoidosis, Sjogrens syndrome or any other systemicvasculitis

14. Does the patient have HIV or AIDS? (HIV)
___ No
___ Yes

Criteria: Acquired immune deficiency syndrome includes patients with definite or probable AIDS, i.e. AIDS related complex, and those who are HIV positive and asymptomatic.

Additional components of Charlson Comorbidity Index adapted to predict cost[2]

15. Does the patient have hypertension? (HBP)
___ No
___ Yes

Criteria: Hypertension includes patients who have systolic pressures >140 mm Hg and/ or diastolic pressures >90 mm Hg if without diabetes or renal disease, as well as controlled hypertensives; or patients with diabetes or renal disease who have systolic pressures >140 mm Hg or diastolic pressures >80 mm Hg.

[2] Charlson, ME, Charlson RE, Briggs, W. Hollenberg, J Can disease management target patients most likely to generate high costs? The impact of comorbidity. J Gen Intern Med. 2007; 22(4): 464-469

16. Has the patient had decubitus ulcers, peripheral skin ulcers or repeated episodes of cellulitis? (SKINULCER)
___ No
___ Yes

Criteria: Partial thickness loss of skin over legs or back with open ulcers or two or more episodes of cellulitis requiring treatment with antibiotics, regardless of etiology.

17. Does the patient have depression? (DEPRESSION)
___ No
___ Yes

Criteria: Patients who are currently receiving treatment for depression, whether pharmacologic or psychotherapy, or cognitive behavioral therapy, or notes indicating that the patient has probable or definite depression.

18. Is the patient on warfarin or coumadin? (WARFARIN)
___ No
___ Yes

Appendix P: Outside Events Report

Outside Events Report

Participant ID _____

This question is to be completed during the week that you wore the activity tracker and completed the questionnaires.

During this week and/or last week, were there any events or activities that resulted in a significant alteration of your usual activities, your physical and/or mental health, or how you might have responded to questions. If yes, would you mind briefly describing?

Appendix Q: Recruitment Poster

Do you have shoulder pain?

Participants are needed to explore the relationship between physical activity and quality of life in adults with shoulder pain

We are recruiting participants who meet the following criteria:

- At least 50 years of age
- At least 1 year of shoulder pain
- No history of shoulder surgery
- No history of traumatic shoulder injury

Everything can be done in the comfort of your own home!

Participants will receive $20 Gift Cards!

For more information Email:

Yorkmskbiomechlab@gmail.com

YORK UNIVERSITÉ UNIVERSITY

Appendix R: Pre-screening Questionnaire

Participant ID: _____
Eligibility: ___YES___NO
Date: _____

Initial Pre-screening Data Collection Sheet

1. Can you please spell your first and last name? _____
2. What is your birth date? _____ (dd/mm/yy) _____
3. Do you have pain in your right shoulder, left shoulder or both? ____ RIGHT ____LEFT _____ BOTH
    i. If both, which is the most symptomatic side? _____

Impingement tests:

4. This a scale for your *(symptomatic)* shoulder pain. On this scale, ranging from 0 to 10, where 0 represents no pain and 10 represents the worst possible pain, how much pain do you feel right now? (baseline NPRS) _____
    ii. Positive for Yocum's? _____ YES _____NO
    Yocum NPRS Rating _____
    _____
    _____
    iii. Positive for Belly press? _____ YES _____NO
    Belly press NPRS Rating _____
    _____
    _____
    iv. Positive for Drop-arm? _____ YES _____NO
    Drop-arm NPRS Rating _____
    _____
    _____
    v. Positive for Resisted External Rotation? _____ YES _____NO
    Resisted External Rotation NPRS Rating _____
    _____
    _____

*For the following questions, please answer while thinking of your (*symptomatic*) side

5. Do you experience shoulder pain at least once a week? ___YES ___ NO
6. How long have you been experiencing pain in this shoulder? _____
7. Has a medical professional ever diagnosed you with a specific shoulder injury? ____ YES ___ NO
    i. if yes, do you know what the specific diagnosis/injury/condition was?
    _____

Share screen for NPRS Scale

8. **This a scale for your *(symptomatic)* shoulder pain. On this scale, ranging from 0 to 10, where 0 represents no pain and 10 represents the worst possible pain, how much pain do you feel…?**
    i. At rest _____
    ii. When doing activities of daily living (for example, activities around the house, getting dressed, etc.) _____
    iii. When doing strenuous activities (for example, exercise, heavy domestic duties, etc.)_____

9. Have you ever had shoulder or hand surgery on either side? _____ YES _____NO
10. Have you had corticosteroid injection in your shoulder in the past year on either side? _____ YES _____NO
11. Have you sought out any rehabilitation or treatment for your shoulder pain? _____ YES _____NO
    ii. If yes, please describe:
    _____
    _____
12. Do you have a current history of neck pain? _____ YES _____NO
    iii. If yes, please clarify:
    _____
    _____
13. Other than the shoulder pain we have discussed, do you have any pain in that arm (elbow or hand)? _____ YES _____NO
    iv. If yes, please describe:
    _____
    _____
14. Do you have any neurological conditions? _____ YES _____NO
    v. If yes, do you know what the specific diagnosis is?
    _____
15. Have you had a traumatic injury (i.e., athletic injury, car accident) to either shoulder resulting in structural damage (dislocation, fracture)? _____ YES _____NO
16. Has a physician limited or restricted your participation in physical activity? _____ YES _____NO
    vi. If yes, are you able to share the reason for these restrictions?
    _____
    _____
17. Do you currently have any other conditions that you feel impact your day-to-day life? _____ YES _____NO
    vii. If yes, what are they?
    _____

<u>Impingement tests (continued)</u>

i. Positive for Painful Arc? _____ YES _____NO
   Painful Arc NPRS Rating _____
   _____
   _____
ii. Positive for Empty can? _____ YES _____NO
   Empty can NPRS Rating _____
   _____
   _____
iii. Positive for Hawkins-Kennedy? _____ YES _____NO
   Hawkins-Kennedy Rating _____

_____
_____

iv. Positive for Lift-off? _____ YES _____NO
Lift-off NPRS Rating _____

_____
_____

Overall tests passed: _____

Would you like to enroll in our study? _____ YES _____NO

If yes, can you please provide your mailing address?

_____
_____

Preferred email address for questionnaires: _____

Week arranged to send the Actigraph

_____
_____
_____
_____

Not Eligible

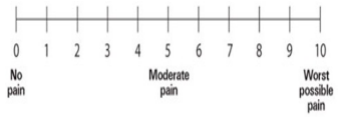
Email for future contact:

_____

Appendix S: Pre-screening Slides

Baseline pain rating

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain do you feel right now?



Yocum's Test

- Completed in 2 simple steps
  1. Place your symptomatic hand on the opposite shoulder
  2. Elevate your elbow, without raising your shoulder

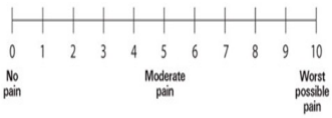
Yocum's Test

Place your symptomatic hand on the opposite shoulder

Yocum's Test

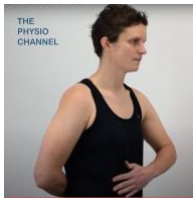
Elevate your elbow, without raising your shoulder

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



Belly press

- Completed in 2 simple steps
  1. Place the palm of the hand on the upper abdomen with your elbow flexed at 90 degrees
  2. Press the palm of your hand against the abdomen. Should result in your elbow moving forward (make sure your wrist is straight)



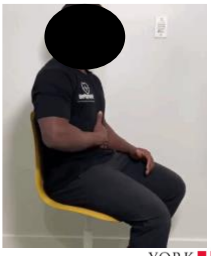
Belly press

Place the palm of the hand on the upper abdomen with your elbow flexed at 90 degrees

Belly press

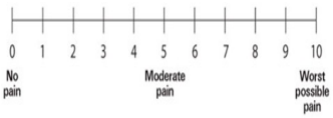
Press the palm of your hand against the abdomen.

Should result in your elbow moving forward (make sure your wrist is straight)



YORK U

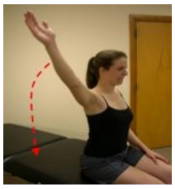
On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



YORK U

Drop-arm test

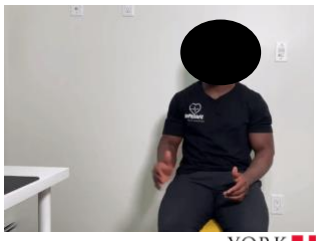
- Completed in 2 simple steps
  1. Elevate/abduct your arm to the side with your palm facing upwards
  2. Slowly lower your hand down to the side



YORK U

Drop-arm test

Elevate/abduct your arm to the side with your palm facing upwards

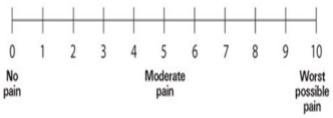


YORK U

Drop-arm test

Slowly lower your hand down to the side

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



Resisted External Rotation

- Completed in 2 simple steps
  1. Place your arm to the side with your elbow in 90 degrees flexion and tucked into your side
  2. Externally rotate your hand while you use your other hand to resist the back of your forearm (near the wrist)

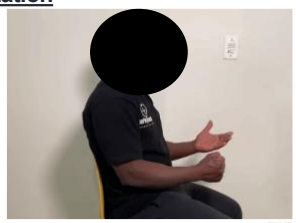
Resisted External Rotation

Place your arm to the side with your elbow in 90 degrees flexion and tucked into your side

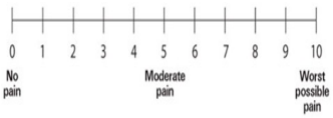
*Make sure your elbow is tucked in

Resisted External Rotation

Externally rotate your hand while you use your other hand to resist the back of your forearm near the wrist

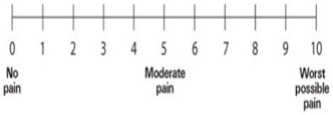


On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



NPRS

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain do you feel…?



Painful Arc Test

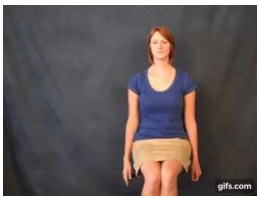
- Completed in 4 simple steps
  1. Slowly lift your symptomatic arm to side and stop if it hurts
  2. If you stop: Continue to lift your arm until the pain goes away
  3. At the top: Slowly lower your hand back down and stop if you feel pain on your way down
  4. Lower your hand back to the rest position

YORK UNIVERSITÉ UNIVERSITY

Painful Arc Test

Slowly lift your symptomatic arm to side and stop if it hurts

*palms facing downwards



YORK UNIVERSITÉ UNIVERSITY

Painful Arc Test

If you are able, continue to lift your arm until the pain goes away

YORK UNIVERSITÉ UNIVERSITY

Painful Arc Test

Slowly lower your hand back down and stop if you feel pain on your way down

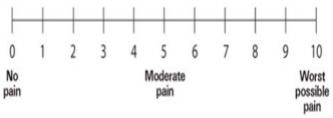
YORK UNIVERSITÉ UNIVERSITY

Painful Arc Test

Lower your hand back the to rest position

YORK U

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



YORK U

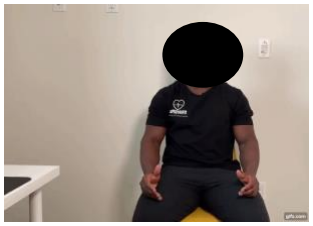
Empty Can

- Completed in 3 simple steps
  1. Elevate your arm diagonally
  2. Make sure your elbow is extended and rotate your arm such that the thumb points down like you are emptying a can
  3. Use your other arm to push down on the forearm to resist your arm

YORK U

Empty Can

Elevate your arm in the scapular plane (diagonally)



YORK U

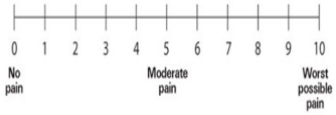
Empty Can

Make sure your elbow is extended and rotate your arm such that the thumb points down like you are emptying a can

Empty Can

Use your other arm to push down on the forearm to resist your arm

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



Hawkins-Kennedy

- Completed in 2 simple steps
  1. Put your forearm on a bottle with your elbow flex at 90 degrees
  2. Push down on your hand with the other hand providing resistance

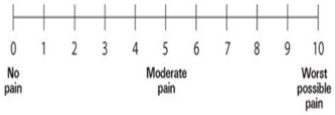
Hawkins-Kennedy

Put your forearm on a bottle with your elbow flexed at 90 degrees

Hawkins-Kennedy

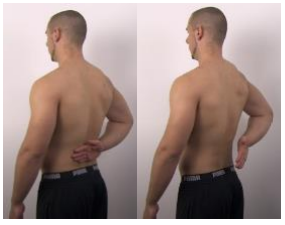
Push down on your hand with the other hand providing resistance

On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



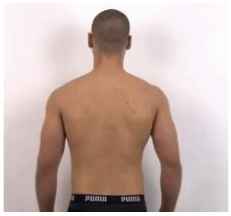
Lift-off test

- Completed in 2 simple steps
  1. Place the back of your hand against the lower part (mid-lumbar) of your spine
  2. Lift-off your hand away from your back



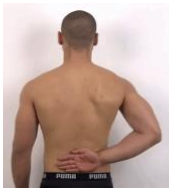
Lift-off test

Place the back of your hand against the lower part (mid-lumbar) of your spine

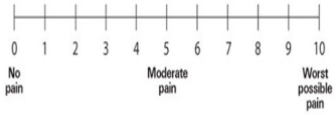


Lift-off test

Lift-off your hand away from your back



On this scale, ranging from 0 to 10, where *0=no pain* and *10=the worst possible pain,* how much pain did you feel during the test?



Appendix T: Informed Consent Form

Informed Consent Form: Verbal and Online Questionnaire

Date: _____

Study Name: Investigating the relationship between physical activity and quality of life in adults with shoulder pain

Researchers:
Dr. Jaclyn Hurley (PhD), Kinesiology and Health Science, York University, jnhurley@yorku.ca
Baithat Adeyinka (Master's Student), Kinesiology and Health Science, York University, baithata@yorku.ca

Purpose of the Research: Shoulder pain is the third most common cause of musculoskeletal complaint in primary care. The most frequent cause of shoulder pain are problems related to rotator cuff tears and subacromial impingement. The incidence of rotator cuff tears increases with age, with degenerative changes being a contributing factor to shoulder pain. Shoulder pain can result in poor quality of life and inability for older populations to care for themselves. Physical activity can improve symptoms in older adults with muscle and/or joint disorders. However, the optimal exercise regimen is unknown. For these reasons, we will be exploring several relationships between physical activity and shoulder pain in older adults.

The main objectives of this study are:
1) Determine if there is a relationship between physical activity and self-reported outcomes (pain, function, depressive symptoms, fear of movement, and self-efficacy) in older adults
2) Determine whether upper extremity-specific exercise or non-specific exercise is related to better self-reported symptoms

It is hypothesized that greater physical activity level and activity targeting the painful shoulder will result in better self-reported outcomes (pain, function, depression, fear of movement, and self-efficacy).

What You May Be Asked to Do in the Research:
Your participation in this study will involve three parts: an initial pre-screening interview, at-home questionnaires, and wearing an activity tracker. The pre-screening will be completed first to determine study eligibility. The questionnaires will be completed during the same week that you wear the activity tracker. Each part will be as follows:

Initial Pre-screening
The pre-screening interview will be completed via a web-based video call (Zoom). During this interview, you will first be asked to review this information and consent form with the researcher after which (if you choose to participate) a verbal informed consent will be obtained. The session should take approximately 45 minutes. The following will then take place:

- You will be asked a series of questions to determine your eligibility for the study
- You will perform up to 8 clinical shoulder tests (will be evaluated via webcam)

At-Home Questionnaires
If you are eligible to participate in the study, you will be asked to complete 16 questionnaires on an online database called Qualtrics. If you are unable to complete the questionnaires online, we can alternatively mail you the questionnaires to complete and mail back with the activity tracker (see below). (Note: postage will be supplied). The questionnaires may be completed at your leisure, but we ask that they are completed during the week that you are wearing the activity tracker, and the order of the questionnaires will be assigned. These questionnaires will ask you questions regarding your shoulder pain and physical function, depressive symptoms, fear of movement, self-efficacy, comorbidity, and physical activity participation. **There are no right/wrong answers to these questions and there is no incorrect interpretation of the questions.** You may answer them the best you can. The following is a list of the questionnaires and the estimated completion time:

- Upper Extremity Functional Index – 5 minutes
- Wester Ontario Rotator Cuff Index – 7 minutes
- Disabilities of the Arm, Shoulder and Hand – 10 minutes
- Shoulder Pain and Disability Index – 7 minutes
- Center for Epidemiologic Studies Depression Scale – 5 minutes

- Pain Self-Efficacy Questionnaire – 5 minutes
- Physical Activity Scale for the Elderly – 5 minutes
- International Physical Activity Questionnaire – 8 minutes
- Exercise Questionnaire – 5 minutes
- Bandura's Exercise Self-Efficacy Scale – 5 minutes
- Tampa Scale of Kinesiophobia – 5 minutes
- Numeric Pain Rating Scale – 2 minutes
- 36-Item Short Form Survey – 10 minutes
- Charlson Comorbidity Index – 10 minutes
- COVID-19 Related Questionnaire – 5 minutes
- Outside Events Report – 5 minutes

Approximate Total Time: 1 hr 40 min

Activity Tracker
You will be mailed an activity tracker to wear for a one-week period. This activity tracker is similar to a Fitbit, and will record your activity (i.e., step count). When you receive the activity tracker there will be a detailed set of instructions outlining exactly how to put it on and how it will be worn over course of the week. This is the same week that you will be completing the questionnaires. During this week, we ask that you resume your activities as you normally would. You will also be given an Activity Journal to document your activity during the week. You will be required to mail back the activity tracker and postage will be provided. The data from the activity tracker will be confidential and used in an anonymized form that cannot be connected to you.

Risks and Discomforts:
Impingement Tests
You will be asked to perform up to 8 physical tests to confirm a positive impingement or rotator cuff injury. There is a minor risk of discomfort during each of these physical tests as shoulder pain during the test would indicate a "positive" test.

Emotional Discomfort
While answering some of the questionnaires, it is possible that you may feel some emotional discomfort due to the nature of some of the questions that include quality of life, self-efficacy and depressive symptoms. At any point, you can choose not to answer those questions, or the entire questionnaire.

Besides the risks listed above, there are no other known risks for our study.

Benefits of the Research and Benefits to You: By participating in this study, you may further your knowledge and understanding of experimental procedures commonly used in biomechanics research. You may also learn more about yourselves when answering the questionnaires. You will be compensated $20 for your time.

Voluntary Participation and Withdrawal: Your participation in the study is completely voluntary and you may choose to stop participating at any time. Your decision not to volunteer, to stop participating, or to refuse to answer particular questions will not affect your relationship with the researchers, York University, or any other group associated with this project. In the event you withdraw from the study, all associated data will be immediately destroyed wherever possible, unless you provide permission to retain the data for analysis. If you decide to withdraw from the study, you will still receive $20 for your time spent.

Security: This study will use *Zoom* and Qualtrics to collect data, which is an externally hosted cloud-based service. When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers).
Further, while York University researchers will not collect or use IP address or other information which could link your participant to your computer or electronic devices without informing you, there is a small risk with any platform such as this of data that is collected on external servers falling outside the control of the research team. If you are concerned about this, we would be happy to make alternative arrangements (where possible) for you to participate, perhaps via telephone. Please contact baithata@yorku.ca for further information.
Please note that it is the expectation that participants agree not to make any unauthorized recordings of the content of a meeting / data collection session.

Confidentiality: All information obtained during the study will be held in strict confidence to the fullest extent possible by law. In no case will your personal information be shared with any other individuals or groups without your expressed written consent. The experimental data acquired in this study may, in an anonymized form that cannot be connected to

you, be used for teaching purposes, be presented at meetings, published, shared with other scientific researchers or used in future studies. Your name or other identifying information will not be used in any publication or teaching materials without your specific permission. All other data will be safely stored in a locked facility and/or password protected computer, and only be accessed by Dr. Hurley's research team members.

Future Research Purposes: The data collected in this research project may be used – in an anonymized form - by members of the research team in subsequent research investigations exploring similar lines of inquiry. Such projects will still undergo ethics review by the HPRC, our institutional REB. Any secondary use of anonymized data by the research team will be treated with the same degree of confidentiality and anonymity as in the original research project.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact Dr. Hurley either by telephone at (416) 736-2100, extension 22137 or by e-mail (jnhurley@yorku.ca). This research has received ethics review and approval by the Human Participants Review Sub-Committee, York University's Ethics Review Board and conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process, or about your rights as a participant in the study, please contact the Sr. Manager & Policy Advisor for the Office of Research Ethics, 5th Floor, Kaneff Tower, York University (telephone 416-736-5914 or e-mail ore@yorku.ca).

Legal Rights and Signatures:

I_____ *(print your name here)*, consent to participate in *Investigating the relationship between physical activity and quality of life in adults with shoulder pain* conducted by principal investigator Dr. Jaclyn Hurley. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

Name of Participant:	
Signature of Participant:	
Date:	

Name of Principal investigator:	Dr. Jaclyn Hurley
Signature of Principal Investigator:	
Date:	