OPTIMISING MUSCULOSKELETAL HEALTH: FOCUS ON EXERCISE THERAPY AND PSYCHOSOCIAL INTERVENTIONS

OPTIMISING MUSCULOSKELETAL HEALTH: FOCUS ON EXERCISE THERAPY AND PSYCHOSOCIAL INTERVENTIONS

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LAY ABSTRACT

Bone and joint injuries are very common in orthopedic practice and massive burden to individuals and society at large. Many patients are given exercises as part of their treatment to reduce pain and improve function. Unfortunately, many individuals continue to struggle with attending therapy sessions and doing exercises by themselves. Starting and continuing exercises are required to maximize the benefits from exercise recommendations. However, many barriers continue to make exercising a challenge. Research is needed to identify the challenges of starting and continuing exercises from the perspectives of both patients and healthcare professionals.

In some situations, some patients with bone and joint injuries such as hand injuries continue to have pain and reduced function even after the original injury has healed. The weak relationship between the initial injury and present experience of pain and reduced function means other reasons like the mental, emotional, and social factors need to be considered in clinical practice. Healthcare professionals have reported several difficulties when dealing with psychosocial problems and want to learn strategies and skills for dealing with the mental, emotional, and social challenges affecting recovery after injuries to bones and joints. The use of the web-based coping skills training for managing psychosocial problems in individuals with bone and joint conditions has shown positive results. However, these strategies are yet to be explored in individuals with injuries to the hand and upper limb.

This thesis includes four papers with the first two papers aimed at examining the literature on adherence to therapeutic exercise. Findings from these papers showed the interactions among the five factors influencing adherence to exercise according to the World Health Organization’s model: patient, health condition, treatment plan, health system, and socioeconomic factors. The third paper sought to understand the opinion of clinicians working in hand therapy about the mental, emotional, and social issues of patients. The result showed that participant's beliefs, attitudes, knowledge and behavior concerning the assessment and management of psychosocial issues are shaped by several factors organized into six themes. The final paper reports on the steps involved in the making of a new internet coping skill program developed for use in individuals with hand and upper limb conditions. Review of the website by technology experts and clinicians showed areas for improvement which were subsequently amended until the participants reported satisfaction with the system. The clinicians expressed interest in using the online coping skill program in their hand therapy practice.

ABSTRACT

Musculoskeletal disorders are a considerable burden to the individual and the society at large. Therapeutic exercise and psychosocial interventions are longer-term therapies for relieving pain, improving function and outcomes after musculoskeletal disorders, and for enabling patients to manage their conditions. Healthcare professionals such as physiotherapists and occupational therapists widely use therapeutic exercise as part of a single or complex intervention. However, adherence to supervised or home exercise remains low among patients with musculoskeletal disorders. Understanding the barriers and facilitators of exercise adherence has the potential to improve the delivery of exercise programs and the design of interventions to improve adherence.

Similarly, psychosocial interventions are recommended as a supplement to exercise therapy for the management of prolonged pain and disability after musculoskeletal disorders. Several psychosocial factors have been linked to prolonged pain and disability after hand injuries. However, while clinicians believe they have a role in managing psychosocial problems in hand therapy, barriers such as limited access and lack of knowledge pose a challenge to delivering psychosocial interventions. Current evidence shows that online-based coping skill programs provide cost-effective and accessible options for delivering psychosocial interventions in musculoskeletal care. However, there is a dearth of literature on the design, development, and implementation of online-based psychosocial interventions in hand therapy.

This thesis includes four manuscripts with three overarching objectives. The first objective was to synthesize the qualitative evidence on barriers and facilitators of therapeutic exercise towards closing the gaps in adherence literature. The second objective was to understand the beliefs, attitude, knowledge and practice behavior of clinicians with regarding to

managing psychosocial problems in hand therapy. The third objective was to provide a report on the design and development of a web-based coping skill training program for psychosocial problems specific to hand therapy. The fundamental aim is to provide toolkits that can be used to increase the knowledge and clinical practice behavior of physiotherapists and occupational therapists to optimize musculoskeletal health using therapeutic exercise and psychosocial interventions.

The second and third manuscripts are a protocol and completed meta-synthesis of qualitative literature outlining the factors influencing adherence to therapeutic exercise in individuals with musculoskeletal disorders from the perspective of patients and healthcare professionals. We identified numerous factors influencing adherence to therapeutic exercise, which were organized according to the World Health Organization (WHO) multidimensional adherence framework. Based on the meta-ethnography line of argument, interpretation of identified themes: personal and lifestyle characteristics, health status and illness perception, nature of the program, health system, and social/environmental resources, showed that while some factors interact, others could be conceptualized as being on a continuum. These findings expanded the original model introduced by the WHO.

The fourth manuscript presents a qualitative descriptive study designed to understand the knowledge, attitude, beliefs, and practice behavior of hand therapists practicing in Ontario with regards to psychosocial problems. The findings informed by the Theoretical Domains Framework provide insights into factors influencing the decision of clinicians to assess and manage psychosocial interventions in hand therapy. Addressing factors such as knowledge, attitudes, and beliefs about psychosocial factors at the individual and organizational level has the

potential to increase the capacity of clinicians to adopt a clinical practice behavior that promotes the assessment and management of psychosocial problems in hand therapy.

The fifth manuscript is a mixed-methods study describing the design, development, and usability testing of Hand Therapy Online COping Skills (HOCOS) training online program to support hand therapists in the management of psychosocial problems. Using a three-step process that involved needs assessment, heuristic testing, and user testing, we sought feedback from Information and Communication Technology experts and clinicians in hand therapy to develop the HOCOS prototype using iterative cycles. The results revealed heuristic violations and usability related to task performance, navigation, design aesthetics, content, functionality, and features and desire for future use. All violations were corrected in the final prototype, and participants expressed a high degree of satisfaction with using the final prototype in practice. The next phase of HOCOS design would require user testing by patients with hand injuries.

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Finally, a profound appreciation for the study participants who participated in this project. Thank you for taking the time to sit for hours on end to be interviewed so we can make health care better for patients with hand and upper limb conditions.

Now unto the King eternal, immortal, invincible, the only wise God. Be all blessings and glory and honor and dominion and power forever. Thank you for giving me the knowledge, understanding, and wisdom to complete this work.

DECLERATION OF ACADEMIC ACHIEVEMENT

For all manuscripts, Folarin Babatunde conceptualized the research questions, designed the studies (and the coping skills program evaluated), collected the data, analyzed the data, and wrote the initial drafts of all manuscripts.

Chapters 2 & 3 - Dr. MacDermid helped to refine the objectives and methods, provided guidance for data collection and analysis, and edited the manuscripts. Dr. Grewal, Dr. Macedo, and Dr. Szekeres helped with the appraisal of the study qualities, reviewed the study objectives, and design and edited the manuscript.

Chapter 4 – Dr. MacDermid helped to refine the objectives and methods, provided feedback on the protocol manuscript. Dr. Grewal, Dr. Macedo, and Dr. Szekeres reviewed the objectives and methods and provided feedback on the manuscript.

Chapter 5 – Dr. MacDermid helped to refine the research objectives and design. Dr. Grewal, Dr. Macedo, and Dr. Szekeres provided content expertise on the design of the coping skills training for psychosocial issues and provided feedback on the manuscript.

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LIST OF ABBREVIATIONS

Musculoskeletal disorders (MSD)

Musculoskeletal (MSK)

Non-steroidal anti-inflammatory drugs (NSAIDs)

Transcutaneous electrical nerve stimulation (TENS)

World Health Organization (WHO)

Home exercise programs (HEP),

Healthcare professional (HCP)

Cognitive-behavioural therapy (CBT)

Distal radius fracture (DRF)

Disabilities of the Arm, Shoulder and Hand (DASH)

Acceptance and Commitment Therapy (ACT)

Technology Acceptance Model (TAM)

Hand Therapy Online COping Skills (HOCOS)

Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ)

Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)

Sample, Phenomenon of Interest, Design, Evaluation, and Research Type (SPIDER)

Critical Appraisal Skills Program (CASP)

Human Research Ethics Committee (HREC)

Hand and upper limb injuries (HULI)

Theoretical Domains Framework (TDF)

Analysis/Assessment, Design, Development, Implementation and Evaluation (ADDIE)

Information and Communication Technology (ICT)

Physiotherapists (PT)

Occupational therapists (OT)

Health Literacy Online (HLO)

Do It Yourself (DIY)

System Usability Scale (SUS)

INTRODUCTION TO THE THESIS

The Burden of Musculoskeletal Conditions

Musculoskeletal disorders (MSD) are a significant source of disability globally (Vos et al., 2012) and second only to mental health conditions (Vos et al., 2017). MSD such osteoarthritis, neck pain, back pain and hand injuries and their pain sequelae (Blyth et al., 2019) directly cause individual activity limitations and participation restrictions (Palazzo et al., 2012) and impacts the society indirectly through work loss, disability pensions, early retirement and increased social support (Guo et al., 1999; Boonen et al., 2005). The actual global burden of MSD appears underestimated due to a lack of equivalent, up-to-date, and accurate epidemiological data from Central America, South America, and Sub-Saharan Africa (Lewis et al., 2019).

The new global burden of diseases shows that musculoskeletal (MSK) conditions are the leading cause of years lived with disability and the primary driver of non-communicable disease disability burden (Hay et al., 2017). The global burden of MSD related pain is estimated to continue to rise considerably due to increased pain with age, multimorbidity, and reduced physical activity related to MSD pain (Blyth et al., 2019). Multimorbidity or 'co-morbidity' signifies the co-existence of at least two different long-term health conditions in the same individual (Willadsen et al., 2016). MSD is synonymous with multimorbidity due to their high prevalence, shared risk factors, and pathogenic processes and impact on the reduced quality of life, increase work disability, increased treatment burden, and healthcare costs (Dufflield et al., 2017).

Currently, 23% of the global burden of disease occurs in older adults 65 years and older with a diagnosis of chronic diseases and multimorbidity, which represents half the burden of disease in high-income countries and one-fifth of the burden in developing countries (Prince et al., 2015). The magnitude of the problem calls for swift action commensurate with the magnitude of MSK pain burden. The United Nations Sustainable Development Agenda and Decade of Healthy Aging 2020 – 2030 calls for swift action and policy response through local, national and global action to reduce global disability from MSK pain (Briggs et al., 2018).

Biopsychosocial Model

Early models of health for the treatment of physical illnesses presented a dualistic model that emphasized the separation between the mind and body and resultant division between physical and psychological treatments (Wade and Halligan, 2004; Wade, 2006). Engel (1977) proposed the biopsychosocial model due to the limitations of the traditional biomedical model of illness or disease. The biomedical, organ-based perspective focuses on disease mechanisms and assumes that the psychological and social aspects of health are not essential to understanding disease and managing patients (Lane, 2014). Biopsychosocial model of health integrates physical, psychological and social factors (Turk, 1996). There is increased understanding that a dualism approach to physical rehabilitation should be abandoned and more attention given to the emotional factors and external stressors contributing to impairment in physical function (Wade, 2006). The National Institute for Health and Clinical Excellence has advocated for an increased consideration of the biopsychosocial model in the management of patients with MSK conditions (Savigny et al, 2009).

However, the integration of the biopsychosocial approach into everyday healthcare remains elusive and remains challenging for the foreseeable future due to less interaction between patients and HCP and the biomedical nature of healthcare encounters and reimbursements (Lane, 2014).

Conceptualizing biopsychosocial theory in Musculoskeletal Rehabilitation

A key contributor to the burden of MSK problems is poor quality of healthcare (Buchbinder et al, 2018) due to significant gap exists between emergent or revised theories and changes in clinical practice (Jones et al, 2002). The evidence-to-practice gaps may arise due to reluctance on the part of clinicians learning new knowledge, unlearning old and outmoded knowledge and clinical decision-making skills (Ubel and Acah, 2015; van Bodegom-Vos et al, 2016). The successful application of new knowledge and change in clinical practice behaviour requires appropriate organization of knowledge where new concepts like the biopsychosocial model can be integrated and a critical, reflective clinical reasoning processes for applying new knowledge (Jones et al, 2002).

Within the broad field of MSK medicine, a biopsychosocial approach includes aspects of anatomy, pathoanatomy, biomechanics, brain representation of the injury, the nervous system's processing of information, psychological issues associated with pain, evolutionary biology and fear avoidance. Conceptual models of health such as the mature organism model (Gifford, 1998) and the Main's model of disability (2000) may be required to create a broad framework where clinical knowledge and basic science can be integrated to facilitate application in practice (Jones et al, 2002). The mature organism model (Figure 1) depicts the interactions of the fundamental pathways into and out of the central nervous system that contribute to maintaining health and the development and continuation of poor health. The model was developed to assist therapists (and patients) openly consider the several factors and multiple levels involved in all pain presentations.

It offers a broad conceptual framework from which all elements of the biopsychosocial model (e.g. tissue mechanisms, pain mechanisms, effector mechanisms and psychosocial factors) and their relevant clinical features or inter-relationships can be further explored.

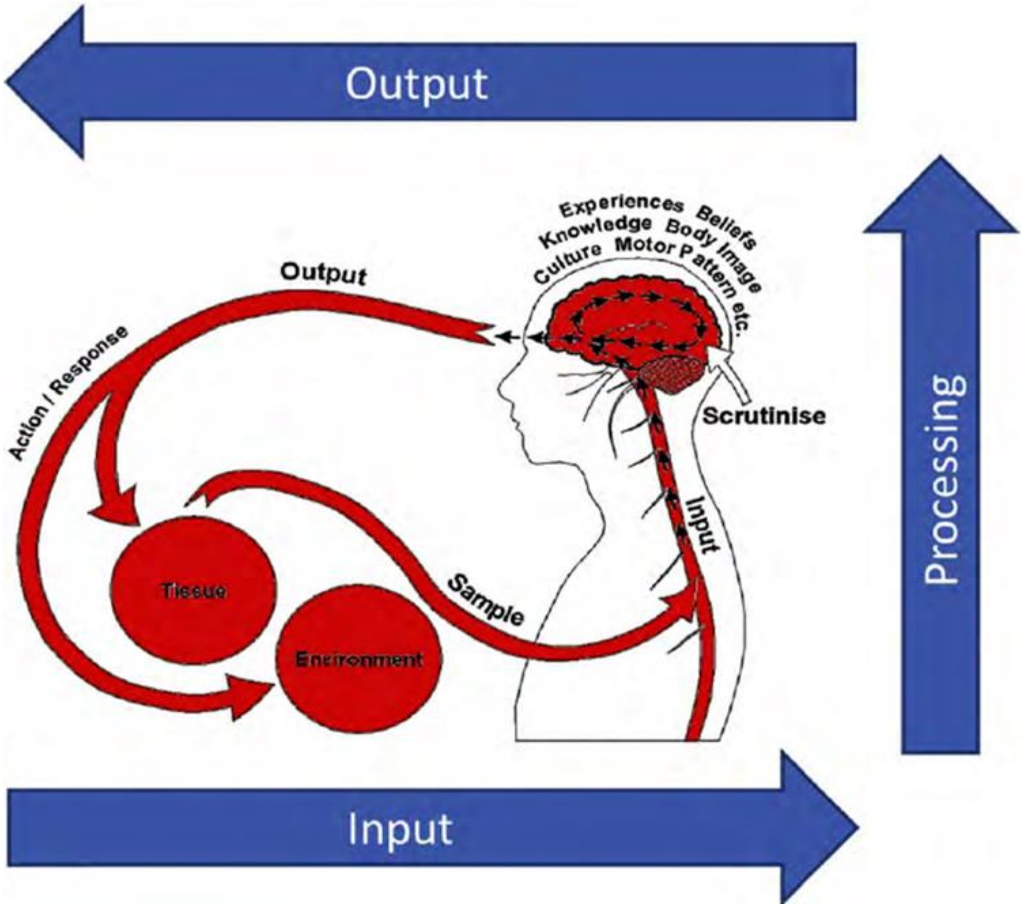


Figure 1: The Mature Organism Model (Gifford, 1998).

The model by Main et al. (2000) further explain the psychosocial influences represented in the Mature Organism Model (Gifford, 1998) by exemplifying the interactions between factors such as pain and deconditioning, fear and avoidance, depression, anger and frustration, iatrogenics, family, socioeconomic and occupational factors. These interactions portray the breadth and depth of knowledge required to effectively use the knowledge of biopsychosocial model in practice and understand the range of factors including associated cognitive, behavioural and emotional, that should be considered when assessing and managing patients with MSK conditions (Jones et al, 2002).

Recently, Lane (2014) recommended an approach of using mentalization to conceptualize the biopsychosocial model since the brain-body interaction is more understandable than mind-body interactions. Expanding the role of the mind-body could also increase the ease of communicating with key decision-makers in healthcare such as funders and policy makers. Mentalization is described as the cognitive skill of understanding the reasons for people's actions and applies to both thoughts and emotions (Frith and Frith, 2006; Stonnington et al, 2013). Several therapies including cognitive-behavioural therapy (Beck, 2011) and emotion-focused therapy (Greenberg, 2010) benefit from and seek to promote self-awareness. Mentalizing includes self-awareness from a psychological perspective (Lane, 2014). The extent to which the causal pathways among social events, psychological processes, brain mechanisms, autonomic, neuroendocrine and organ-specific disease mechanisms are linked through specific biological mechanisms will increase understanding of the biopsychosocial model (Lane, 2014). Mentalization provides the opportunity to bridge the gap between biomedical and biopsychosocial approach to MSK rehabilitation.

Self-Management

Managing a chronic disease is a very complex process and several programs have been developed based on the Chronic Care Model (CCM) (Wagner, 1998) to support individuals with chronic MSK conditions and help them self-manage their conditions as effectively as possible. Self-management describes what an individual does to manage his/her disease, while self-management support refers to what healthcare professionals, healthcare practices and the healthcare system provide to help patients achieve self-management (Von et al, 1997). CCM (Wagner, 1998) Figure 2 highlights the six key interdependent components of the CCM including "Self-Management Support"–providing patients the knowledge, confidence, and skills for self-management of their health condition. CCM positions chronic care in the context of the community where the person will receive healthcare services and with the health systems involved in their care (Gee et al, 2015). Current research evidence supports CCM as a useful framework for patient empowerment, self-management support, and improving clinical and behavioral outcomes (Tsai et al, 2005; Stellefson et al, 2013). CCM has also been modified to integrate eHealth technology components (Gee et al, 2015).

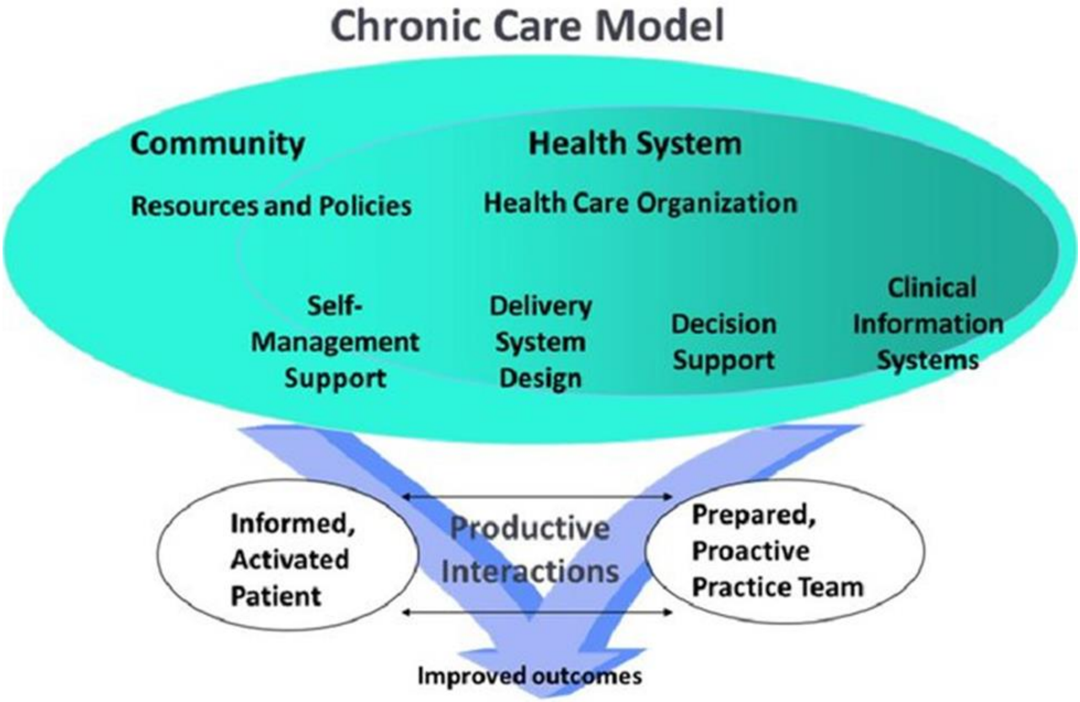


Figure 2: The Chronic Disease Model. Developed by MacColl Institute, © ACP-JSIM Journals and Books.

According to the Institute of Medicine, (Curry and Corrigan, 2003) self-management support is defined as “the systematic provision of education and supportive interventions by health care staff to increase patients’ skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.” This definition emphasizes the fact that self-management support is more than just education, and illustrates the primary causal mechanism of self-efficacy underlying many modern self-management support programs for chronic diseases including Parkinson’s disease (Kessler and Liddy, 2017), diabetes (Chatterjee et al, 2018), cancers (Boland et al, 2018), chronic obstructive pulmonary disease (Barrecheguren and Bourbeau, 2018), chronic low back pain (Du et al, 2017) and arthritis (McBain et al, 2018). Self-management programs primarily and secondarily lead to changes in self-efficacy (i.e., an individual’s confidence in managing his/her condition), and health care behaviour respectively. It is assumed that changes in self-efficacy directly affects health status which then influences health care utilization (Lorig et al, 1989).

Theoretical and conceptual self-management research provided frameworks for developing and investigating intervention programs in MSK rehabilitation. One of the most successful and renown self-management program is the Arthritis Self-Management Program (ASMP) (Lorig et al, 1993). ASMP program evaluation has been linked to reduced pain and disability, increased perceived self-efficacy and quality of life and less visits to physicians which were sustained for at least 4 years following initial participation in the program (Lorig et al, 1993). The ASMP was the precursor for the development of the community-based Stanford Patient education Research Centre Chronic Disease Self-Management Program (CDSMP) for people living with chronic diseases including heart disease, lung disease, stroke, arthritis, and multimorbidity (Lorig et al, 1999). CDSMP was designed to close the gaps in daily management of chronic conditions and maintaining daily activities with proven success at improving health behaviors and health status leading to overall fewer hospitalizations (Lorig et al, 1999) and reduced healthcare costs (Lorig et al, 2001a; 2001b).

Strategies for Optimising Musculoskeletal Health

The recommended conservative management for MSD includes nutritional management, weight control, pain management, and disease-modifying agents, and physical rehabilitation (Harper et al., 2017). Treatment often begins with pain management, including accurate diagnosis and assessment of pain (Austine et al., 2016). Many patients often use medications such as paracetamol or non-steroidal anti-inflammatory drugs (NSAIDs) or topical creams, but barriers to optimal medication management include patient compliance, self-medication, and lack of clinician monitoring (Lewis et al., 2019). Treatments such as acupuncture (Li et al., 2019), ultrasound (Aiyer et al., 2019), and transcutaneous electrical nerve stimulation (TENS) (Gibson et al., 2019) are useful for pain relief in the short term. However, the methodological quality of many studies shows considerable variability in participants, interventions and outcomes and significant publication bias (Babatunde et al., 2017). However, when found to be beneficial, medication and modalities only offer short term pain relief. Therefore, other treatment options are necessary to overcome the challenges associated with appropriate pain control and side effects from prolonged pain medication use (Mandegaran et al., 2013).

Physical rehabilitation and psychosocial interventions are longer-term therapies for relieving pain, improving function and outcomes, and empowering patients to manage their conditions (Babatunde et al., 2017; Lewis et al., 2019). Psychosocial interventions include self-management, cognitive and behavioral changes targeting emotional and psychological well-being impairment that affects cognitive or social functioning which makes it difficult to cope with the demands of daily life including pain, other activities like exercise and the ability to work effectively and proficiently (Heron and Greenberg,2013). Several studies have associated mental health and somatization, the propensity to worry about common somatic symptoms with the incidence and chronicity of MSD pain and disability (Vargas-Prada and Coggon, 2015). Physical rehabilitation includes treatment techniques such as passive range of motion, therapeutic exercise, and modalities designed to slow disease progression and improve daily physical activity to decrease disability. Therapeutic exercise describes controlled movements where patients perform a dynamic range of motions to achieve tissue metabolic and physical effects (Dycus et al., 2017). Exercise has been shown to be effective in slowing down disease progression in conditions such as arthritis through increased muscle tone, which stabilizes the joint and lead to reduced pain levels. Although these therapies will not cure chronic MSD, improving the bone and joint characteristics and increased blood flow enable patients to stay active for longer (Lewis et al., 2019) and attain near-normal function in acute and sub-acute conditions. The studies reported in this thesis are focused on meeting existing gaps in the exercise therapy and psychosocial interventions literature for MSD rehabilitation.

Exercise Therapy and Adherence

Several recent clinical and best practice guideline updates continue to recommend the use of exercise programs for MSD (Oliviera et al., 2018; Lin et al., 2018; 2019) due to the consistent beneficial effects of different types of exercise for vital clinical outcomes such as pain, physical function and quality of life (Fuentes et al., 2011; Francen et al., 2014; 2015) and cost benefits (Fenocchi et al., 2018). According to the World Health Organization (WHO, 2003), adherence is "the extent to which a person's behavior corresponds with agreed recommendations from a healthcare provider" (WHO, 2003) and generally measured in four ways: completion or retention, attendance, duration and intensity (Visek et al., 2011). It is an essential pre-requisite for the success of exercise programs (Sherrington et al., 2011) with improved treatment outcomes including pain, physical function, physical performance, and self-perceived effect of exercise (Pisters et al., 2010) and reduced recurring or disabling MSD (Lin et al., 2018). An adherence level of at least 80% to 85% is typically suggested if the results of exercise interventions are to be satisfactory and result in therapeutic value (Miranda et al., 2014).

Within physical rehabilitation, patient adherence relates to attending appointments, following advice, and undertaking prescribed exercise in the clinic or at home (Martin et al., 2011). Adherence to home exercise programs in patients with MSK is between 22% and 72% (Beinart et al., 2013; Rizzo, 2015) and as low as 14% to 17% in the elderly (Taylor et al., 2007). Nonadherence to exercise can negatively affect treatment effectiveness, duration, personnel and equipment efficiency, therapeutic relationship, wait times and care cost (Martin et al., 2005; Weinger et al., 2005). Moreover, since exercise prescription is crucial to the integrity of intervention studies, the knowledge of its determinants will maximize the validity of scientific results (Visek et al., 2011) and improve understanding of nonsignificant outcomes in clinic-based research (Baumgartner et al., 2018). For example, a recent review of supervised home-based exercises for hip fractures (Kuijlaars et al., 2019) concluded that most studies showed poor outcomes and demonstrated low therapeutic validity due to absence of a rationale for how and when adherence data were collected. Based on the definitions of adherence, the measurement of adherence will differ based on the HCP recommendation to attend a supervised session or complete unsupervised patient activities. Current methods for measuring adherence include the use of home diaries, single item questionnaires, or multi-item questionnaires (Hall et al., 2015).

Determinants of Adherence to Exercise:

Various factors influence adherence to exercise based on existing literature with evidence for more than 200 factors but no consensus on factors that are most important for maximizing exercise treatment effects (Miranda et al., 2014). This prompted the World Health Organization (WHO, 2003) to propose the multidimensional adherence model (Figure 3) to describe the five dimensions of adherence, namely, patient-related, condition-related, intervention-related, social-related and health system-related factors. In terms of adherence to home exercise programs (HEP), Beinart et al (2013) showed that individual factors; higher health locus of control and intervention factors; participation in an exercise program, incorporating motivational strategies were associated with increased adherence. According to Peek et al, (2016) interventions that aid adherence to HEP include activity monitoring and feedback system, written exercise instructions, behavioural therapies, booster sessions and goal setting. Similarly, Essery et al (2017), showed that individual factors such as intention to engage, self-motivation, self-efficacy, previous adherence behaviour and social support were predictive of adherence to HEP. Healthcare professionals have a huge role to play in improving adherence to exercise by increasing intrinsic motivation where exercise is performed based on interest and enjoyment instead of dependence on the healthcare professional (HCP) (Chan et al., 2009).

Gaps in the Exercise Adherence Literature

Adherence definition

Defining therapeutic exercise adherence explicitly related to MSK conditions remains a challenge (Bailey et al., 2018). In the absence of a clear definition, it would be hard for both HCP and patients to achieve shared adherence goals and measures to monitor its variability. Sackett and Haynes (1976) original definition used the term 'compliance' and focused on medication regimens as opposed to therapeutic exercise. The WHO's (2003) definition of adherence was developed with a focus on adherence to chronic health conditions other than MSD pain, including HIV, hypertension, epilepsy, and tuberculosis. Both definitions are primarily concerned with pharmacological interventions, lack specific without parameters on what should be measured and how to complete measurement (Bailey et al., 2018). More recently, Frost et al. (2017) defined adherence specific to therapeutic exercise for MSD. The definition was, however, informed by stroke rehabilitation (Page et al., 2012), falls prevention (Simeck et al., 2012), public health (Pollock, 1988) and exercise instruction (Smith et al., 2005) and may not reflect perceptions of patients with and HCP in MSK rehabilitation. The operational terms (frequency, duration, intensity, and accuracy) proposed for measuring adherence by Frost et al. (2017) remains different from those commonly used in MSK literature (Bailey et al., 2018). Hence, the concept of adherence to therapeutic exercise for MSD requires further refinement.

Adherence Parameters

There are several parameters of adherence to therapeutic exercise, including exercise frequency, session attendance, exercise time, sessions completed, exercise exertion (subjective), exercise replication, exercise intensity (objective), and behavioral component (Bailey et al., 2018). However, there is no consensus on the relevance or importance within the context of MSK rehabilitation. Frequency represents the most common parameter and most straightforward to measure (repetitions per day per week). However, the quality and accuracy of exercise performance have received less attention in research even though it is one of the most common parameters in MSK clinical practice (McLean et al., 2017). HCP observation is a feature of some commonly used outcome measures (Brewer et al., 2000) and included in recommendations on how to effectively measure adherence (Bassett, 2003). Unfortunately, observation presents unique challenges due to personal constraints and costs implications (Bailey et al, 2018).

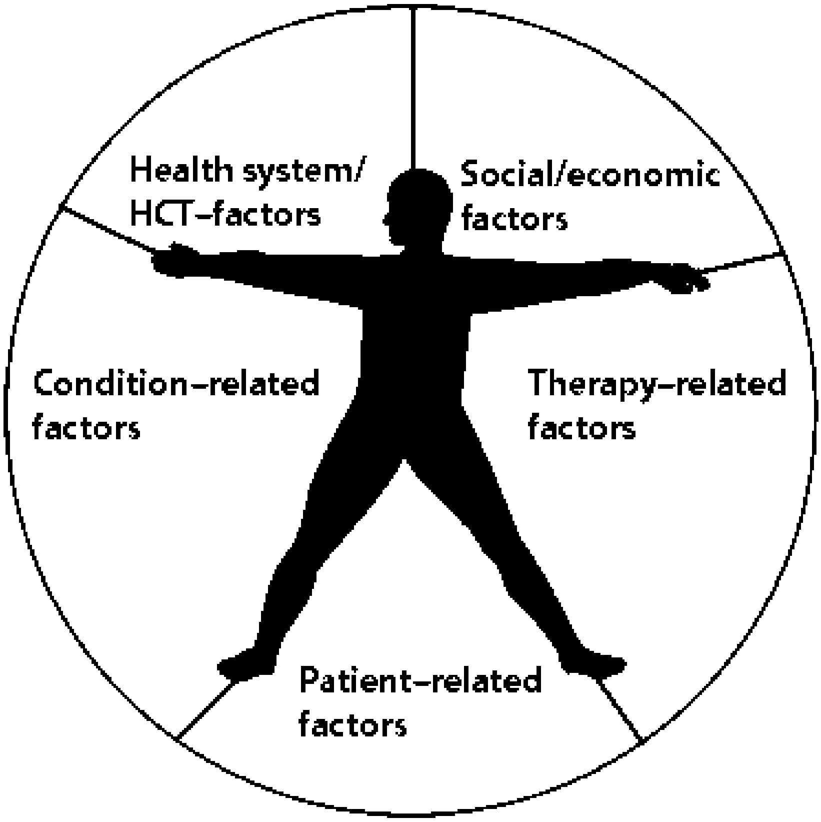


Figure 3: The World Health Organization (WHO) Multidimensional Adherence Model; the five dimensions of adherence (Sabate, 2003).

The use of technology, including movement monitors (Zandwijk et al., 2015), is an objective parameter of adherence to therapeutic exercise (Verbrugge et al., 2018). Limitations to its implementation in MSK rehabilitation includes high-level operational expertise, cost of equipment, setting up complex exercise interventions, acceptability to patients, and impact of overt monitoring on social versus natural adherence behavior (Bailey et al., 2018, Van Koppen et al., 2016). The use of self-reported barriers to adherence (Van Koppen et al., 2016; Zandwijk et al., 2015) is another approach based on barriers as modifiers of adherence. This view presents opportunities to examine the role of barriers in assessing adherence since higher perceived barriers are associated with poor treatment adherence (Jack et al., 2010).

Measuring Adherence

Currently, several methods exist for measuring adherence, such as self-report logs, attendance records, and measurement scales (Bollen et al., 2014; Hall et al., 2015; McLean et al., 2017). Based on the multidimensional nature of adherence and imprecise guidance from the WHO (2003), different measures are reported across studies for similar adherence parameters. Unfortunately, it remains challenging to compare the relative effectiveness of exercise interventions across studies due to the absence of a single tool with reputable psychometric properties, considerable variability in time points of adherence measurement, poor reporting of adherence measurement timing and lack of reporting on the interval between intervention delivery and adherence measurement (Bailey et al., 2018).

Psychosocial factors and Musculoskeletal Conditions

Despite having the same physical impairment, two individuals may experience different levels of disability (van der Molen et al., 2003). Also, there is often a weak or lack of association between impairment or objective pathophysiology and disability (Ramond et al., 2011; Nunez et al., 2010). Given that the primary focus of hand therapy interventions is in preventing prolonged pain and reducing the level of disability, understanding the relationship between impairment and disability is crucial during patient assessment (Farzad et al., 2015; Cheng and Cheng, 2019). Individuals with more disability than expected may respond to treatments based on cognitive-behavioral therapy (CBT) (Cheng and Cheng, 2019; Beck, 2011). There is mounting evidence that psychosocial factors (mindset and circumstances) are important determinants of disability than objective impairment (Vargas-Prada and Coggon, 2015). Psychological factors have been reported as predictors of surgical outcomes and very important to the patient's recovery despite accounting for clinical factors. (Rosenberger et al., 2006; Wylde et al., 2017; Ozkan et al., 2017). Clinical factors like pain are widely reported as dominant predictors of upper extremity health status during recovery (Souer et al., 2008).

Psychological factors also explain a substantial aspect of the variability in disability seen with similar levels of impairment (Vranceanu et al., 2009; Asenlof et al., 2005). Ineffective coping strategies are probably important factors in explaining prolonged symptoms and disability, as shown in recent studies (MacDermid et al., 2018). Patients may benefit from a multidisciplinary approach that optimizes mindset and coping strategies (Das De et al., 2013) due to the consistent and predominant role of several modifiable psychological factors in disability.

Impact of Psychosocial factors in Hand Therapy

Recently, the relative contribution of ineffective coping skills such as catastrophizing, and kinesiophobia, psychological distress such as depression and anxiety, other psychosocial factors such as culture and partner violence, and objective impairment such as pain on perceived disability has received much attention. For example, Souer et al. (2008) showed pain dominates the patient's perception of function after recovery from an operatively treated distal radius fracture (DRF) as measured by self-report and physician rating. However, the limited correlation between impairment and disability underscores the importance of personal factors other than pathophysiology including physical factors (pain, injured hand), conditional factors (time since surgery) or psychological factors (depression and adaptation) in human illness behavior and different in patients (Farzad et al., 2015). Many psychosocial factors such as catastrophic thinking, symptoms of depression, pain anxiety, fear of movement, and heightened illness concern are significant modifiable predictors of disability and pain intensity for several hand and upper limb pain conditions, ranging from nonspecific pain to fractures (Ring et al., 2006).

Roh et al. (2014) reported that preoperative pain catastrophizing and pain anxiety was significantly associated with delayed recovery. At four weeks post volar plate fixation in patients with a DRF, increases in pain catastrophizing and pain anxiety was associated with decreases in grip strength, range of motion and hand function at four weeks postoperatively. Pain anxiety was the only factor associated with grip strength and hand function after three months (Roh et al., 2014). Similarly, Gong et al. (2011) reported that depression was associated with pain scores at baseline and six months and hand function at six weeks. Moradi et al. (2015) examined the relationship between the total are marked on pain and thumb diagrams and psychosocial factors and reported a correlation with depression, pain catastrophizing, and health anxiety. Catastrophizing was the sole predictor of marked pain area and accounted for 10% of the variance in the hand diagram. The authors concluded that more extensive symptom markings on hand diagrams could be indicative of less effective coping strategies.

In another study, Das De et al. (2013) investigating the contribution of partner violence to the variation in upper-extremity-specific disability, showed that hand pain and function correlated significantly with depression, catastrophic thinking, kinesiophobia, and pain anxiety but not with perceived partner support. The best multivariable model of factors accounting for 55% of the variation linked to significant arm-specific disability included sex, diagnosis, employment status, catastrophic thinking, and kinesiophobia. Roh et al. (2015) reported that preoperative poor coping skills, as measured by high catastrophization and anxiety, were associated with weaker grip strength, decreased range of motion, and increased disability after surgical treatment for hand fractures at three months. However, poor coping skills did not show persistent effects beyond six months. Similarly, Vranceanu et al. (2010) reported that depression was the sole predictor of both disability and pain intensity after minor surgery and accounted for 26% of the variance in Disabilities of the Arm, Shoulder, and Hand (DASH) scores and 25% of the variance in pain intensity, after removing the influence of preoperative DASH and diagnosis, which only accounted for 14% variance.

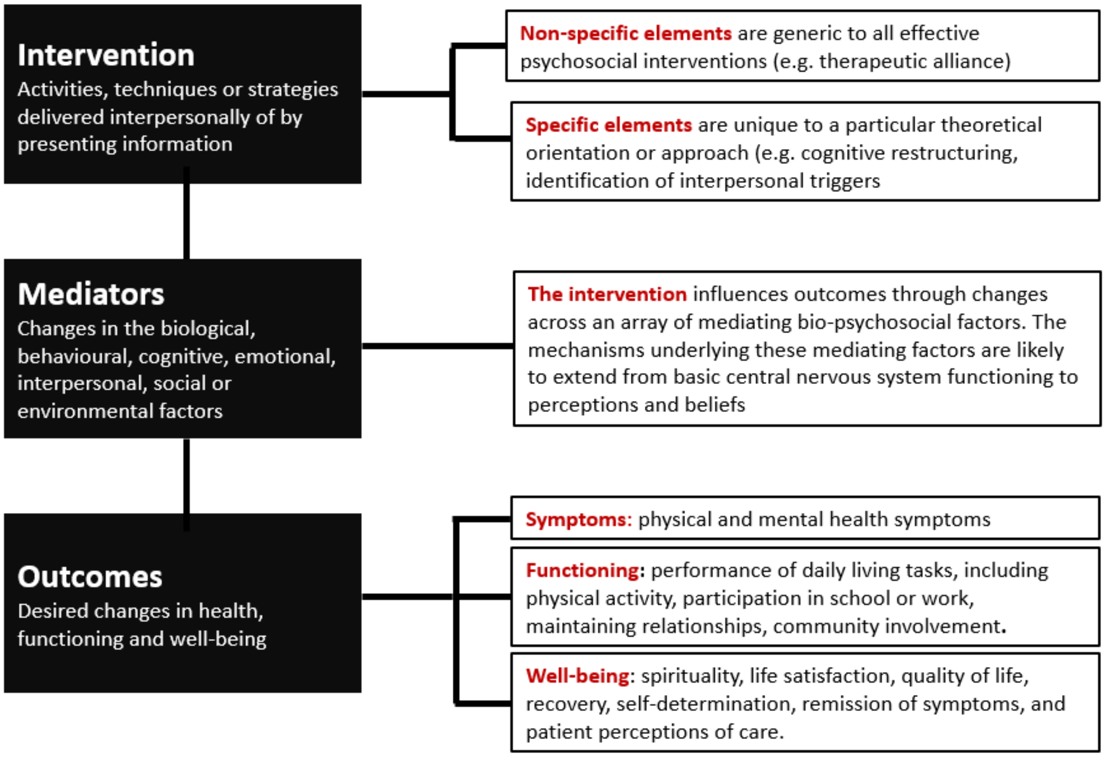
Psychosocial Interventions

Psychosocial factors are psychological sensations or experiences associated with an individual's physical and social status (Ng et al., 2019) and includes the psychological (automatic thoughts and emotions, distress, coping mechanisms), sociological (culture, social support, external stressors) and behavioral (automatic behaviors or physical reactions, habits) aspects of hand and upper limb injuries (Schindeler et al., 2011). Psychosocial interventions are strategies that address biological, behavioral, cognitive, emotional, interpersonal, social, or environmental factors to improve health functioning and well-being (England et al., 2015). Psychosocial interventions denote a broad term applied to many interventions and include psychotherapies, community-based treatments, vocational rehabilitation, peer support, and integrated care interventions from several theoretical orientations (England et al., 2015). Current theoretical orientations applied in MSK rehabilitation include Cognitive Behavioural Therapy (CBT) (Turk and Burwinkle, 2005; Beck, 2011), Acceptance and Commitment Therapy (ACT) (Hayes et al., 2004; 2012), Patient Health Engagement model (Graffigna and Barello, 2018), the European framework for psychosocial risk management (Leka et al., 2011).

Three main concepts are essential to understand psychosocial interventions; action, mediators, and outcomes (England et al., 2015). See Figure 4. Actions are activities, techniques, or strategies delivered interpersonally or using information. Many psychosocial interventions include learning methods such as self-monitoring, relaxation, cognitive restructuring, exposure, and activity pacing (Motoya et al., 2017). Mediators described how psychosocial interventions lead to a specific outcome through changes that explain or mediate the outcome (Kraemer et al., 2002). For example, CBT treatment increased the prefrontal cortex gray matter associated with reduced pain catastrophizing in chronic pain (Seminowicz et al., 2013). In ACT treatment, pain impairment beliefs and pain reactivity mediate the differential effects of treatment on outcomes for chronic pain (Wicksell et al., 2011). The outcomes of psychosocial interventions involve changes in symptoms, functioning, and well-being (England et al., 2015). In their systematic review of CBT for low back pain, Hall et al. (2018) reported that compared to education and exercise interventions, CBT had a more significant effect on reducing disability, pain, and moderate-quality evidence of little difference in the quality of life.

Application of Psychosocial Interventions

Psychosocial interventions are applicable across a wide array of settings, formats, providers, and patient groups in MSK rehabilitation. The use of nontraditional HCP in various settings is necessary for improved access due to the growing need for psychological care among individuals with MSK conditions (Kraus-Schuman et al., 2015). However, structured training programs are recommended to ensure the successful implementation of psychosocial interventions (Scott et al., 2017; Hall et al., 2018).



Intervention
Activities, techniques or strategies delivered interpersonally of by presenting information

Non-specific elements are generic to all effective psychosocial interventions (e.g. therapeutic alliance)

Specific elements are unique to a particular theoretical orientation or approach (e.g. cognitive restructuring, identification of interpersonal triggers

Mediators
Changes in the biological, behavioural, cognitive, emotional, interpersonal, social or environmental factors

The intervention influences outcomes through changes across an array of mediating bio-psychosocial factors. The mechanisms underlying these mediating factors are likely to extend from basic central nervous system functioning to perceptions and beliefs

Outcomes
Desired changes in health, functioning and well-being

Symptoms: physical and mental health symptoms

Functioning: performance of daily living tasks, including physical activity, participation in school or work, maintaining relationships, community involvement.

Well-being: spirituality, life satisfaction, quality of life, recovery, self-determination, remission of symptoms, and patient perceptions of care.

Figure 4: Three main concepts in the definition of psychosocial interventions (England, 2015)

Settings and format: Psychosocial interventions can be delivered in various settings such as outpatient clinics (Ekelad et al., 2016), primary care clinics (Dorflinger et al., 2016), patient homes (Goode et al., 2018), hospitals, schools (Eiraldi et al., 2016), workplace (Cullen et al., 2018) and community settings. Traditionally, most interventions are delivered using face-to-face contact between HCPs and patients. Currently, real-time delivery formats include 'synchronous' delivery using the telephone (Fraser et al., 2019), digital gadgets, or video conferencing (Portelli and Eldred, 2016). 'Asynchronous' delivery occurs through the use of workbooks and online formats (Dear et al., 2017) with minimal face-to-face interactions (Fisher et al., 2015; England et al., 2015). Options for combining formats also exist (Dear et al., 2013), and research suggests increased use of group programs involving other patients or spousal partners (Harris et al., 2017).

Providers: Several HCP other than psychologists and psychiatrists are capable of delivering psychosocial interventions including physiotherapists (Nielsen et al., 2014; Bryant et al., 2014), physicians (Dear et al., 2015), primary care nurses (Rutledge et al., 2018), lay and peer providers (Greenwood et al., 2015), occupational therapists (Amini et al., 2018; Siegel et al., 2018) and social workers (Trowbridge and Mische, 2016)and mostly in interdisciplinary settings (Lindgreen et al., 2016).

Patient groups: The MSK patient population targeted by psychosocial interventions is diverse. Current evidence supports the treatment of conditions such as chronic pain (Bawa et al., 2015; Peters et al., 2017), neck pain (Monticone et al., 2015), chronic low back pain (Cherkin et al., 2016), lumbar spine surgery (Lindgreen et al., 2016), osteoarthritis (Allen et al., 2018; Karp et al., 2019), rheumatoid arthritis (Sharpe, 2016), total joint arthroplasty (Cai et al., 2018), MSD related insomnia (Smith et al., 2015) with CBT based and mindfulness focused therapies. Psychosocial interventions are cost-effective, leading to less personal and societal financial burdens (Herman et al., 2017).

Gaps in Psychosocial Factors Literature in Hand Therapy

Health Care Professionals and Clinical Practice

A recent survey of occupational therapists and certified hand therapists showed that many therapists appear to be biomechanically oriented, experienced therapists were less likely to refer for psychosocial services and a general lack of psychosocial assessments, interventions and referral services usage by participants (Chown et al., 2018). Similarly, hand therapy services for rural and remote patients with hand injuries revealed that a lack of expert knowledge on physical and psychosocial factors affecting recovery is a barrier to effective service delivery (Kingston et al., 2015). Furthermore, a survey of hand surgeons (Vranceanu et al., 2017) showed that most are likely to notice and discuss psychological factors but less likely to formally screen or refer for psychological treatment. Barriers to referral for psychological treatment include lack of time, being unsure of how to refer patients, discomfort with discussing psychological illness, and fear of upsetting patients.

Psychosocial Interventions in Hand Therapy

Research into the use of psychosocial interventions in hand therapy is gaining momentum. According to Westenberg et al. (2018), a 60-second interactive, personalized mindfulness video is feasible in the orthopedic practice, acceptable for patients with upper extremity injuries, and showed detectable improvement in pain, anxiety, depression, and anger compared with an educational pamphlet. Beks et al. (2018) also showed that mindfulness was linked to lower pain intensity following non-traumatic upper extremity conditions. Although the results from available studies look promising, gaps in the literature limit the role hand therapists and surgeons can play in addressing psychosocial issues. However, Goudie et al. (2018) reported no benefit to the use of a psychological workbook in patients with a DRF. The observed discrepancies in findings may be due to lack of information on intervention development, the study design and subgroup of patients most likely to respond to the intervention and how to intervene.

Psychosocial interventions are complex interventions 'built up from several components, which may act both independently and inter-dependently (Campbell et al., 2000). Complexity is a characteristic of many aspects of healthcare, including the intervention, condition, patient, system, and the context of intervention delivery (Lysdahl and Hofman, 2016). The Medical

Research Council (MRC) released the framework for development and evaluation of RCTs for complex interventions to improve health in 2000 (Campbell et al., 2000) with a follow-up revision in 2008 and 2015 (Craig et al., 2008; Moore et al., 2015). The focus on complexity was informed by the necessity to develop further the evidence base on healthcare interventions' effectiveness and the awareness of the challenge involved in evaluating interventions as they move along the continuum from 'simple' to complex (Craig et al., 2008). Furthermore, answering the question about when, why, how, and in what circumstances an intervention works is as important as knowing if the intervention works (Moore et al., 2013; 2014).

In developing the structure of an online coping skills program in hand therapy and selecting the specific treatment ingredients, we took into consideration the following recommendations as suggested by Bennell et al. (2011): (1) current understanding of the impact of psychosocial factors on pain and disability in hand and upper limb conditions; (2) existing evidence for the effects of CBT for musculoskeletal conditions; (3) hand and upper limb conditions as a broad diagnosis ranging from acute to chronic and the need to incorporate management into a biopsychosocial framework; and (4) practical issues related to the delivery of the intervention based on the Technology Acceptance Model (TAM) (Figure 5) (Holden and Karsh, 2010) which was developed from the Theory of Reasoned Action (Fishbein and Ajzen, 1975).

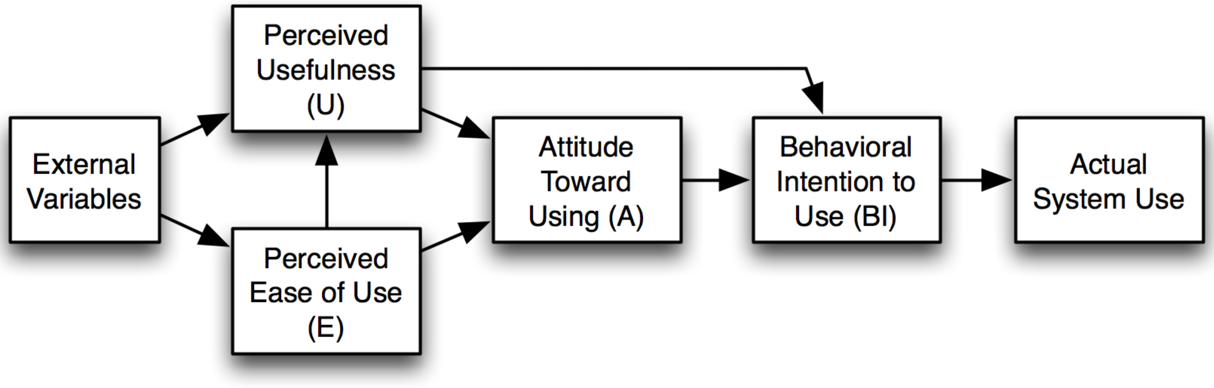


Figure 5: Technology Acceptance Model (Holden and Karsh, 2010)

Table 1 highlights each of these aspects. This evidence led to the development of an internet intervention called Hand Therapy Online COping Skills (HOCOS) training program, which incorporates cognitive and behavioral strategies into a therapist-led program. HOCOS provides a toolkit for therapists to choose a suitable coping mechanism for patients to manage psychological problems affecting recovery in hand injuries using five self-directed modules.

Table 1: Steps in the process of developing a complex intervention

Steps	**Content**
Develop the theoretical framework	▪ Understanding of the psychosocial issues affecting pain, disability and recovery after a hand and upper limb injury
Assimilate evidence (direct and indirect) regarding interventions	▪ Systematic reviews ▪ Clinical practice guidelines ▪ Expert opinion ▪ Survey of practice ▪ Seek opinion from other researchers regarding experiences and emerging findings
Incorporate biopsychosocial approaches	▪ Develop education content and encourage coping skill strategies using Cognitive Behavioural Therapy principles
Establish the practical issues that need to be considered	▪ Delivery constraints ▪ Acceptability to physical therapists, occupational therapists and hand therapists
Determine and prioritize the interventions to be included	▪ Establish core interventions ▪ Provide optional interventions and the circumstances when they are to be included
Provide the intervention framework	▪

Reference: Bennell KL, Egerton T, Pua YH, Abbott JH, Sims K, Buchbinder R. Building the rationale and structure for a complex physical therapy intervention within the context of a clinical trial: a multimodal individualized treatment for patients with hip osteoarthritis. Physical therapy. 2011;91:1525-41.

Objectives of Thesis

The specific objectives of this project were:

1. To appraise, summarize, and synthesize the evidence from qualitative studies evaluating the **barriers and facilitators of adherence to therapeutic exercise** in individuals with MSK pain and disability.
2. To **gain an understanding of the knowledge, attitudes, beliefs, and clinical practice behavior of hand therapists** with regards to screening, assessing, and managing psychosocial issues.
3. To provide a **brief overview of design, development, and usability testing of HOCOS** using feedback from Information Technology Experts and clinicians practicing in the field of hand therapy.

Outline of Included Manuscripts

The first manuscript (Chapter 2) is titled "Barriers and facilitators of adherence to therapeutic exercise and physical activity for musculoskeletal conditions: protocol for a meta-ethnography." As stated in the introduction, there is a dearth of qualitative evidence on barriers and facilitators of adherence to therapeutic exercise and physical activity in individuals with MSD. The protocol outlines the plan to review and synthesis the evidence on factors limiting and facilitating adherence to therapeutic exercise described in Chapter 3. The meta-synthesis followed the seven stages of meta-ethnography and summarized the perspectives of both patients with musculoskeletal conditions completing a therapeutic exercise program as recommended by HCP. Chapter 3 presents the findings of the meta-synthesis. The recently published eMERGe reporting guidelines (France et al., 2019) for meta-ethnography was used to guide the development of the protocol.

The second manuscript (Chapter 3) is titled "A meta-ethnography of barriers and facilitators of adherence to therapeutic exercise and physical activity for musculoskeletal conditions." Chapter 3 aims to improve our knowledge in this area by locating, appraising, and synthesizing qualitative studies examining the factors influencing adherence to therapeutic exercise. The WHO (WHO 2003) proposed five variables (patient, condition, treatment, health care system, therapy-related) as crucial determinants of adherence. However, the interaction among these variables remains poorly understood. Using meta-ethnography, this study summarized existing evidence from qualitative studies using the WHO model as a framework.

The third manuscript (Chapter 4) is titled "Knowledge, attitude, beliefs and practice behavior of therapists concerning managing the psychosocial aspects of pain and disability for patients with hand injuries: a qualitative study." The purpose of this qualitative description was to understand the knowledge, attitudes, beliefs, and practice behavior of physiotherapists and occupational therapists practicing in the area of hand therapy. Qualitative description allows researchers to gain firsthand knowledge of experiences with a topic of interest. Moreover, qualitative description studies are relevant to clinicians and policymakers because they can be used to inform future interventions, practice, and clinical projects based on the multidimensional understanding of a phenomenon of interest.

The fourth manuscript (Chapter 5) is titled "Development and Usability Testing of the Hand therapy Online Coping Skills program (HOCOS) for managing psychosocial problems in hand and upper extremity rehabilitation." This study was designed to describe the development and assess the usability of HOCOS website to assist hand therapists in the management of psychosocial problems. The website evaluation was completed using usability testing on Information and Communication Technology experts and clinicians practicing in the area of hand therapy. Usability testing is crucial in the development of online interventions and involves getting feedback to understand what is positive or negative about a system and identify existing gaps in content or functionality using iterative cycles of prototype alteration.

Together, the findings of these four manuscripts contribute to the existing knowledge about adherence to exercise for various musculoskeletal conditions and the management of psychosocial issues in people with hand and upper limb injuries. The three manuscripts contribute vital knowledge to help improve adherence to therapeutic exercise after MSK conditions, including hand and upper limb injury, and how clinicians can better manage psychosocial issues in hand therapy. This knowledge includes improved understanding of how the factors proposed by the WHO, namely; patient-, treatment-, condition-, healthcare system- and socio-economic-related factors interact to influence adherence to therapeutic exercise after MSD such as a hand and upper limb injury, therapists perspective on how to better screen, assess and manage psychosocial issues in hand therapy and the usability of a website for managing psychosocial issues in hand therapy.

The final chapter (Chapter 6) provides a discussion that summarizes how these manuscripts advance the science of adherence in broad musculoskeletal care and managing and designing an online intervention targeting psychosocial problems in individuals with patients with hand and upper limb injuries, the clinical and research implications of this work, and the existing limitations of this body of work.

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CHAPTER 2: STUDY PROTOCOL OF A META-ETHNOGRAPHY OF BARRIERS AND FACILITATORS OF ADHERENCE TO THERAPEUTIC EXERCISE AND

PHYSICAL ACTIVITY IN INDIVIDUALS WITH MUSCULOSKELETAL CONDITIONS

As submitted to:

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ABSTRACT

Background: Therapeutic exercise plays a significant role in the prevention and treatment of several musculoskeletal (MSK) conditions. Adherence to exercise programs is key to the success of therapeutic exercise and improvement in factors such as pain, physical function, physical performance and the self-perceived effect of exercise is higher in adherent patients. Non-adherence to exercise prescriptions has negative impact on treatment effectiveness, duration, efficiencies, patient-therapist relationships, wait times and cost of care.

Objectives: This qualitative meta-synthesis was designed to appraise and synthesize the evidence on barriers and facilitators of adherence to therapeutic exercise and physical activity as described by adults with MSK conditions and healthcare professionals in MSK rehabilitation.

Methods: This qualitative review will be searching the following databases: OVIDMedline, Embase, PsychINFO, AMED (Allied and Complementary Medicine Database) and CINAHL. We will also consult reference lists of a sample of systematic reviews and search relevant organizational websites in order to identify appropriate grey literature. The search strategy will include keywords and database specific subject heading related to exercise, adherence, barriers, facilitators and musculoskeletal. Authors will independently screen, appraise data quality and extract data for synthesis. Inclusion and exclusion criteria would follow SPIDER. Study findings will be synthesized thematically using meta-ethnography.

Discussion: This review will focus on qualitative studies that examine factors influencing adherence to therapeutic exercise from the perspective of patients and healthcare professionals in musculoskeletal rehabilitation. The overall aim is to expand the conceptualization of factors influencing adherence proposed by the World Health Organization.

Keywords: Meta-ethnography, Adherence, Therapeutic Exercise, Influencing Factors

Background

Therapeutic exercise coves a range of targeted physical activities that produce numerous systemic and local effects through improved muscle strength, neuromotor control, joint range of motion and aerobic fitness (Fransen et al., 2015) to reduce pain and improve physical function (Bennell et al., 2008; Fransen et al., 2015). Therapeutic exercise plays a significant role in the prevention and treatment of several musculoskeletal (MSK) conditions (Pedersen and Saltin, 2015) such as low back pain (van Middelkoop et al., 2010), osteoarthritis (Fransen et al., 2015; Osteras et al., 2017), chronic pain (Geneen et al., 2017), tendinopathies (Challoumas et al., 2019) and prevention of their debilitating effects (Beck et al., 2017; Steffens et al., 2016; McDonald et al., 2019). These benefits are essential to mitigate the overall burden of MSK on individuals and cost implications of MSK conditions to the society at large (March et al., 2014; Blyth et al., 2019). Furthermore, prevention and early treatment of MSK conditions and targeting associated chronic disease risk factors in individuals with long-standing MSK conditions may prevent other chronic diseases (Williams et al., 2018).

Adherence is the degree to which a person's behavior corresponds to recommendations from a healthcare provider (HCP) (Sabate, 2003) and synonymous with compliance (Oldrigde, 1982) and concordance (Chewning and Wiederholt, 2003). Compliance is the "extent to which a person's behavior coincides with the medical or health advice" (Oldrigde, 1982). Concordance represents an agreement reached after negotiation between a patient and HCP and respects the beliefs and wishes of the patient in determining whether, when and how interventions are taken and the HCP's recognition of the patient's decision about taking the recommended intervention (Chewning and Wiederholt, 2003; Treharne et al., 2006). Adherence is more suited to exercise therapy compared to the traditional term 'compliance' which implies that patients are required to follow HCP recommendations passively (Taube, 2016) or the newer term 'concordance' which remains limited in widespread use in both research and practice due to measurement challenges (McDonald et al., 2019). Adherence to exercise programs is central to the success of therapeutic exercise (Bennell et al., 2011) and improvement in factors such as pain, physical function, physical performance and self-perceived effect of exercise is higher in adherent patients (Pisters et al., 2010; Room et al., 2017).

Adherence to exercise is often reported in terms of attendance, completion of prescribed number of exercise sessions or number of exercises during each session, the intensity of exercise within a session or the duration (time taken to exercise) to complete the exercise session (Jack et al., 2010; Hawley-Hague et al., 2016). McLean et al. (2017) and Visek et al. (2011) discussed four outcome measures of exercise adherence based on one or more of the four adherence constructs, namely attendance, completion, intensity, and duration of the exercise. Adherence to therapeutic exercise estimates is reported to be between 25% and 72% (McLean et al., 2013; Peek et al., 2016). Reviews of community-based group exercise programs for older people revealed favorable adherence outcomes, with rates between 69 –75% (Farrance et al., 2016). Adherence levels of 80-85% have been recommended to obtain satisfactory intervention results and therapeutic value (Pisters et al., 2010).

Non-adherence to exercise prescriptions negatively impacts treatment effectiveness, duration, efficiencies, patient-therapist relationships, wait times, and cost of care (Holden et al., 2014). The WHO (Sabate, 2003) proposed the multidimensional adherence model to summarize the evidence on more than 200 factors influencing adherence. The model advocates five dimensions of adherence, namely; personal, interventional, condition, socio-economic, and health system-related factors (Sabate, 2003). Several quantitative reviews (Jack et al., 2010;

Jordan et al., 2010; Beinart et al., 2013; Aitken et al., 2015; Ezzat et al., 2015; Dobson et al., 2016; Essery et al., 2017; Meade et al., 2019) have examined factors influencing adherence to exercise in MSK conditions. Qualitative reviews answer questions about impact and context using methods that address theories and processes (Gough, 2015). Qualitative reviews explain the mechanisms by which interventions might achieve their effect, explain differences in effects between different population groups, and can be used to identify the outcomes that are most important to patients, HCP, and other stakeholders (Booth, 2016). Significant limitations in available reviews of adherence to exercise using meta-ethnography limits translation to MSK rehabilitation. Many of the existing reviews are focused on oncology (Fox et al., 2019) and cardiorespiratory health systems (Robinson et al., 2018), interventions like recreational physical activity (Kavanaki et al., 2017), more selective participant characteristics (Koshoedo et al., 2015; Ige-Elegbede et al. 2019) or various clinical populations (Davenport et al., 2019).

Therefore, a comprehensive, high qualitative review of barriers and facilitators to therapeutic exercise adherence in MSK rehabilitation is necessary for a greater understanding of why patients adhere to different therapeutic exercise programs based on the opinions of both patients and HCPs to foster the development and evaluation of adherence improving strategies.

Study Objectives

This meta-ethnography review was designed to search, critically appraise and synthesize the on perceived barriers and facilitators of adherence to therapeutic exercise and physical activity in individuals with MSK conditions from the perspective of patients and HCP. Therapeutic exercise is the systematic, planned performance of bodily movements, postures, or physical activities intended to provide patients or clients with the means to remediate or prevent impairments; improve, restore, or enhance physical function; prevent or reduce health-related risk factors, or optimize overall health status, fitness or sense of well-being (APTA, 2014).

METHODS

Synthesis Methods and Methodology

This qualitative meta-synthesis was submitted to the International Prospective Register of Systematic Reviews (PROSPERO) for registration (ID:124643). We will report the findings of this study in line with the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement (Tong et al., 2012). The search strategy results will be expressed using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram (Moher et al., 2009). We will also consult a university librarian in designing the protocol.

Meta-ethnography

This review is nested in an interpretivist paradigm of meta-ethnography. Interpretivism is a branch of epistemology that strives for the comprehension of reality through subjective meaning (Atkins et al., 2008). Meta-ethnography is the most broadly used qualitative evidence synthesis method in health and social care research (Hannes and Macaitis, 2012; Ring et al., 2011) and influences other qualitative evidence synthesis methods (Uny et al., 2017). Meta-ethnography is applied to produce new conceptual understanding or higher interpretations and used to develop theory from multiple studies compared to traditional narrative reviews (Atkins et al., 2008; Campbell et al., 2011). Noblit and Hare (1988) proposed a framework for meta-ethnography using seven key steps. Although this framework has been criticized for failing to give clear guidelines on the assessment of rigor and quality appraisal (Finfgeld-Connett and Johnson, 2013). This has prompted the recent development of the eMERGe reporting guidance (France et al., 2019) to increase confidence in meta-ethnography findings, which could then inform evidence-based policy and practice in health and social care (Lewin et al., 2015). This review will adopt the initial framework proposed by Noblit and Hare (1988) and will include an assessment of rigor according to the eMERGe guidelines (France et al., 2019) and appraisal of study quality (Toye et al., 2013).

Step 1: Getting started

FB identified the focus of this meta-ethnography after reviewing the state of evidence from systematic reviews and qualitative synthesis on exercise adherence. We were also motivated to explain the interactions among the five dimensions of adherence (WHO, 2003) from the perspective of both patients and HCP to shape future interventions to promote adherence in MSK rehabilitation. The phenomenon of interest and the primary objective of the review was conceived and refined by the review team.

Step 2: Deciding what is relevant

We will complete his stage in 3 phases: establishing the focus of the synthesis, locating relevant studies; making decisions on inclusion, and quality assessment (Atkins et al., 2008).

1. **Defining the focus of the synthesis:** We will focus on qualitative studies using known qualitative methods to inform the design of interventions to improve adherence to therapeutic exercise and physical activity in multiple settings and described adherence from the perspective of patients and HCP.

2. **Locating relevant studies**: This step focuses on the literature search strategy and selection of eligible studies following quality assessment. We will perform initial exploratory text searches using the keywords: therapeutic AND (exercise OR physical activity) AND (adherence OR concordance OR compliance). This initial step provides an overview of the topic and ensures an adequate number of citations are available to determine a search strategy for reviews on complex topics (Graneheim et al., 2014). The keywords and phrases identified in titles and abstracts and the MeSH/thesaurus terms would be used for a full database search across the following databases; OVIDMedline, CENTRAL, Embase, PsychINFO, AMED (Allied and Complementary Medicine Database) and CINAHL from inception to 2018 by FB. See Appendix for sample of the search strategies. The list of citations will be screened for duplicates using the citation manager "Mendeley." Mendeley has been shown to yield a lower rate of false-positive (deleting papers that should have been included) and false-negative results (including papers that should have been deleted) (Kwon et al., 2015).

Citation searching and Traditional Pearl Growing will be used to supplement the electronic search (Schlosser et al., 2006). Traditional Pearl Growing involves the following process: (1) find a relevant article; (2) find the terms under which the article is indexed in database-1; (3) find other relevant articles in database-1 by using the index terms in a Building query; (4) repeat 2 and 3 in other databases; (5) repeat steps 1 – 4 for other relevant articles; and (6) end then articles retrieved provide diminishing relevance. FB will complete the screening of title and abstract, and all articles that meet the requirements for this review will undergo screening and appraisal. The reference list of selected articles would also be used to identify additional relevant studies for the review.

3. **Making decisions on Inclusions:** We will employ the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, and Research Type) to determine studies that are eligible for this review (Table 1). SPIDER is regarded as a more suitable strategy for generating search terms for qualitative research and returning a higher rate of relevant articles for systematic qualitative reviews compared to PICO (Cooke et al., 2012). FB will individually screen study titles and abstracts to ensure they meet the study inclusion criteria. After the screening process, the team will meet to discuss which studies should be included or excluded from the study. The reviewers will discuss until a consensus is reached by much of the team when there is any disagreement. When the team unanimously conclude that a study is unclear, FB will contact the study author for clarification. The author will have three weeks to reply before the article is excluded based on insufficient information. Any new study identified through citation searching and traditional pearl growing will be reviewed by FB to ensure they meet the inclusion criteria outlined above. Where multiple reports of the same study are found, the articles would be compared and only selected if each article presents distinct findings based on different study aims and questions using the same materials.
4. **Quality Appraisal:** Included studies must meet at least two of the four quality reporting criteria developed by Carroll et al. (2012) regarding study design, participant selection, methods of data collection, and data analysis to assist in the internal validity of this review. FB will complete this initial stage, and the characteristics of excluded studies will be reported but not included in the synthesis. The remaining studies would be independently assessed for comprehensive and explicit reporting using the Critical Appraisal Skills Program (CASP) checklist for qualitative studies (CASP, 2006). We

chose the CASP checklist because it facilitates quick evaluation with a 10-item tool and can be easily applied to different types of qualitative designs. FB, LM, RB, and MZ will assess the quality of each study independently. Any discrepancies will be resolved using a discussion, and the team members and JM would serve as a mediator when a consensus was not achieved after the team discussion. The quality assessment criteria would be used to find the balance between the relevance of the insights and flaws in methodology because methodologically weak studies may offer new insights that may not be present in studies with robust methodology (Campbell et al., 2011; Hannes, 2011; Edwards et al., 2006). None of the selected studies will be eliminated based on quality assessment alone due to the potential risk of eliminating valuable insight from a methodologically weak study.

Stage 3: Reading the studies

The individual studies would be entered into the systematic review software EPPI-Reviewer 4 by FB. Each study would be read and reread individually by FB until the key themes or concepts are identified (Noblit and Hare, 1988). Emerging themes will be coded into EPPI-Reviewer 4, and an essential list of phrases, ideas, and concepts would be created on an Excel datasheet (Noblit and Hare, 2006). Adequacy of data would also be addressed at this stage. This will involve team discussions to determine if the saturation of key ideas or concepts has occurred while considering the extent to which additional data are likely to alter the findings. A data extraction form will be created on Microsoft Excel from each qualitative study on study setting, population, phenomena of interest, study design, methods, findings, and comments. FB will extract data regarding population, sample size (patient, HCP), aims, intervention, data source, analysis, and results from each study. Studies would be tabulated in chronological order from the earliest to the most recent.

Step 4: Determine how the studies are related

According to Noblit and Hare (2006), studies must be 'put together' by creating a list of key concepts for each study and comparing this across all studies to identify the relationship among all studies. The aim of step four is to identify and describe the 'metaphors' or concepts in studies and translate or compare them with those from other studies (Toye et al., 2013). During this phase, FB will create a list of important metaphors, phrases, ideas, and or concepts (Noblit and Hare, 1988) after an initial tentative assumption about the relationship between studies is established. We will use the definition of concepts, "a meaningful idea that develops by comparing particular instances and explains but not just describe the data" proposed by Toye et al. (2013). The tabulated data extraction sheet will enable the identification of second-order and first-order concepts from each study. First-order constructs are the original view of the participants in the included studies, and second-order constructs are interpretations of first-order narratives by the original authors of the included studies (Atkins et al., 2008). We will only include concepts that are well articulated without reorganizing the findings and exclude data from analysis when unable to decipher a concept. The team will meet to discuss and develop a collaborative interpretation of each second-order constructs. To ensure interpretations are clear and precise, we will use the author's description of the second-order constructs when described briefly and clearly or our interpretation of the original construct when unclear and lengthy (Toye et al., 2013).

Step 5: Translating studies into each other

This stage involves exploring how second-order constructs are related to each order, translating studies into each other (Noblit and Hare, 1988). We will complete this stage using the constant comparative method of constant comparison (Charmaz, 2006), whereby concepts would be compared to each other repeatedly to identify similarities and differences and organize them into further abstracted conceptual categories that have shared meaning (Toye et al., 2013). FB will code and organize the second-order constructs into categories or 'piles' with their description using Nvivo 12 software. Since the included studies would range over a period, this process will be conducted in chronological order starting with the earliest publication (Atkins et al., 2008). The translation would involve comparing themes and concepts from article 1 with article 2 and the synthesis of these two papers with article 3 and continue until the most recent article. An analogy will be selected by FB, which encapsulates the themes, key findings, and concepts of each study and their relationship to one another during this phase. We will complete synthesis in a way that allows translation to protect the individual themes by paying attention to the influence of context to the study (Jennings et al., 2018). Where analogies cannot be identified easily, reviewers will re-evaluate the relationship between studies and the individual themes since the comparisons with each other can be a potential source of confusion (Noblit and Hare, 2006). Afterward, the team will meet to discuss the translated categories and definitions. We will also pay attention to deviant cases within the key concepts.

Step 6: Synthesizing the translation

This step involves making sense of the process of translation, and the relationship between studies will determine the specific synthesis to be used. Meta-ethnography moves beyond traditional narrative review to generate higher-order theories about experiences using three methods of synthesis; reciprocal translation to identify overarching concepts (similar concepts that are named differently), reputational synthesis to explore contradictions between studies and line of argument synthesis to build a picture of the whole (Atkins et al., 2008; Hannes, 2001; Noblit and Hare, 1998). We intend to develop a line of argument synthesis by constantly comparing concepts and suggesting an interpretive order. In this phase, FB will list the translated themes and subthemes in a table, juxtaposed with secondary themes derived from second-order constructs to create third-order constructs (reviewer interpretation). The team will meet to discuss the overarching model that linked the translations and interpretations together to generate a line of argument. This model will bring translations and themes together and formulate them into a whole greater than their different parts (Noblit and Hare, 2006; Britten et al., 2002).

Step 7: Expressing the synthesis

We will present the overarching model of factors influencing adherence in a narrative summary and use a diagram to depict the relationships. This review is an attempt to express the synthesis. The potential audiences for this type of synthesis include physicians, clinicians, exercise physiologists, Kinesiologists, gym instructors, and the general population. This audience continues to seek strategies for improving adherence to exercise.

DISCUSSION

The evidence derived from individuals with MSK conditions can inform person-centered improvements in exercise and physical activity recommendations. This review will deliver evidence-informed recommendations for person-centered inpatient, outpatient, and community-based exercise prescriptions that include the experiences, needs, and preferences of patients. These recommendations may improve the mitigation of barriers to therapeutic exercise and physical activity adherence during a course of rehabilitation. These improvements further have the potential to influence exercise prescription for quantitative research on the management of MSK conditions. This study will systematically synthesize information derived directly from patients and HCP regarding their experiences, needs, and preferences for improving adherence during the completion of supervised or unsupervised therapeutic exercise programs.

CONCLUSION

The findings from this review will be dependent on the quality of the original studies. Quality appraisal for qualitative data is particularly challenging to perform with the risk of including data from flawed studies that may bias the findings from this review (Tong et al., 2012). We will use a structured approach to examine and appraise the limitations and strengths of findings as proposed by Lewis et al. (2015) to enhance the consistency and transparency of this review. The four components of confidence, namely methodological limitations, relevance, coherence, and adequacy of data will be assessed. Limitations in methodology and study relevance will be assessed by using the Critical Appraisal Skills Program (CASP) guidelines for qualitative data synthesis (CASP, 2006). The assessment and explanation of this appraisal will be presented in the review appendices (Lewin et al., 2015). To ensure the coherence of the synthesis, an analogy that encompasses all findings of the review must be found. Failure to find coherence means the relationship between studies was misinterpreted and will be reviewed (Nobit and Hare, 1988).

The richness and quantity of data are reflected by the adequacy of data and will be noted in the review. Meta-ethnography uses theoretical sampling until data saturation is achieved. However, this is a criticism of meta-ethnography since it can be unclear how saturation was achieved with limited access to first-order constructs (Atkins et al., 2008). FB and JM will determine thematic saturation by considering the extent to which additional research findings are likely to change the findings of the review. Inadequacy of data set may be observed where qualitative studies use descriptive titles that were indexed inappropriately, use of narrow review questions, or more primary research needs to be conducted in the substantive area (Lewin et al., 2015). The quality of this review will be strengthened by involving multiple reviewers at all stages of the review process to ensure consensus, consistency, and a person-centered focus. The findings will be distributed and made publicly available in peer-reviewed publications and presentations.

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Table 1: SPIDER Table of study inclusion and exclusion criteria

Terms	**Inclusion criteria**	**Exclusion Criteria**
[S]Sample	• Adults older than 18 years diagnosed with a musculoskeletal condition affecting the axial skeleton and peripheral joints • Health care professionals recommending supervised or unsupervised therapeutic exercise	• Adults living in institutional settings (e.g., long term care/nursing homes). • Studies using healthy volunteers.
[PI] Phenomenon of interest	• Studies about adherence to therapeutic exercise in inpatient, outpatient, private practice, community or home settings	• Studies examining adherence to recreational physical activity.
[D] Design	• Qualitative or mixed-methods studies (e.g., grounded theory, phenomenology, ethnography) • Reporting primary qualitative data (e.g., interviews, focus groups, participant observation, field notes) a • Reporting qualitative analysis (content analysis, thematic analysis)	• Studies reporting only quantitative data (e.g., cross-sectional, case-control, cohort studies, clinical trials)
[E] Evaluation	• Qualitative analysis of experiences, feelings, views, opinions and plans	• Evaluation reporting quantitative methods only
[R] Research type	• Peer reviewed journal articles • Available full text in English only.	• Systematic reviews, protocols, theoretical work, editorials, opinion pieces, and dissertations

Table 2: Medline Search Strategy

OVID Medline Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present
1 Adhere.mp. (184154)*
2 compliance.mp. or "TREATMENT ADHERENCE AND COMPLIANCE"/ (144509)*
3 concordance.mp. (37584)*
4 behaviour.mp. (178023)
5 BEHAVIOR/ or behavior.mp. (1026957)
6 1 or 2 or 3 or 4 or 5 (1473721)
7 exercise.mp. (300206)
8 exercise therapy.mp. or Exercise Therapy/ (35263)
9 physical activity.mp. or Exercise/ (150001)
10 Movement/ or Exercise Therapy/ or movement therapy.mp. or Upper Extremity/ (108371)
11 Exercise Therapy/ or therapeutic exercise.mp. or Exercise/ (119787)
12 physiotherapy.mp. (16166)
13 physical therapy.mp. (44941)
14 7 or 8 or 9 or 10 or 11 or 12 or 13 (464440)
15 athletic injuries.mp. or Athletic Injuries/ (24525)
16 sport injuries.mp. (423)
17 musculoskeletal conditions.mp. (1524)
18 musculoskeletal diseases.mp. or Musculoskeletal Diseases/ (11902)
19 Tendons/ or Fractures, Bone/ or orthopedic conditions.mp. or Musculoskeletal Diseases/ (94947)
20 orthopaedic conditions.mp. (270)
21 chronic pain.mp. or Chronic Pain/ (34524)
22 15 or 16 or 17 or 18 or 19 or 20 or 21 (153427)
23 6 and 14 and 22 (900)
24 barriers.mp. (107781)
25 enablers.mp. (1487)
26 facilitators.mp. (10214)
27 influencers.mp. (222)
28 determinants.mp. (136362)
29 correlates.mp. (147387)
30 24 or 25 or 26 or 27 or 28 or 29 (389868)
31 23 and 30 (51)
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CHAPTER 3: A META-ETHNOGRAPHY OF BARRIERS AND FACILITATORS OF ADHERENCE TO THERAPEUTIC EXERCISE AND PHYSICAL ACTIVITY FOR MUSCULOSKELETAL CONDITIONS.

As submitted to:

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TITLE:

A META-ETHNOGRAPHY OF BARRIERS AND FACILITATORS OF ADHERENCE TO THERAPEUTIC EXERCISE AND PHYSICAL ACTIVITY FOR MUSCULOSKELETAL CONDITIONS.

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ABSTRACT

Background**:** The benefits of exercise interventions depend on adherence. Unfortunately, non-adherence is a persistent problem that acts as a barrier to achieving optimal health outcomes. Given the complex nature of adherence, qualitative methods may provide a more in depth understanding of factors associated with exercise adherence.

Methods**:** This qualitative meta-synthesis was conducted in three stages: (1) a systematic literature search of OVIDMedline, Embase, PsychINFO, AMED (Allied and Complementary Medicine Database) and CINAHL from inception to December 2018 was conducted and appraised for eligible qualitative studies was completed. Qualitative studies designed to identify factors influencing adherence to therapeutic exercise and physical activity in individuals with musculoskeletal conditions were included, (2) A meta-ethnography was conducted following Noblit and Hare's method for translating key themes from patient's and healthcare professionals perspectives on adherence and using the framework of the World Health Organization model of adherence, (3) a line-of argument approach was used to synthesize and interpret key concepts associated with barriers and facilitators of adherence to therapeutic exercise.

Results: Our search identified 1811 citations and 37 articles published between 2001 and 2018 articles met the inclusion criteria. Most studies originated from the UK (37%), examined low back pain (35%) using grounded theory (18%) and phenomenology (18%) design and thematic analysis (32%). Facilitators and barriers to exercise adherence were identified across patient and healthcare professional perspectives and synthesized into 5 themes: personal and lifestyle characteristics, nature and structure of the program, care provider style, clinical skills and supportive roles, real and perceived fear of worsening the condition, and social and environmental challenges to exercise adherence.

***Conclusion*:** Patient and healthcare system-related factors account for most of the enablers and barriers to adherence. Exercise programs must be individualized and designed in a way that is not perceived as burdensome to patients. Personal traits, beliefs and the ability to manage scare resources all affect adherence. We propose a model that expands the interplay between the five factors influencing adherence described by the WHO.

Keywords: Adherence, Barriers, Facilitators, Therapeutic exercise, Meta-ethnography

INTRODUCTION

Individuals with musculoskeletal disorders (MSD) conditions are typically prescribed structured exercise and encouraged to participate in physical activity [1]. Prescribed home exercises, home activities, and physical activity programs form an essential aspect of rehabilitation therapies such as physiotherapy and occupational therapy [2]. Physical activity and structured exercise offer a range of physical and physiological benefits for all individuals with MSD [1]. Musculoskeletal (MSK) rehabilitation fosters active participation in therapy and focuses on functionally relevant goals [3, 4], maximizing patient engagement, and self-management [5, 6]. The concept of adherence is multidimensional and relates to a variety of behaviors, including attending therapy, changing health behaviors or activities, correctly using assistive or health devices, and performing exercises as prescribed [7]. The benefits of health promotion, self-management, or rehabilitative interventions depend on continued participation. However, making the needed changes in lifestyle to adhere to exercise remains difficult for people with MSD [8].

Adherence to therapeutic exercise accounts for better treatment outcomes of pain, self-reported physical function, physical performance, and self-perceived effect in individuals with MSK conditions [9, 10, 11]. However, there is evidence that non-adherence remains high in this patient group. Studies on exercise adherence demonstrate a range between 22% and 60% adhere depending on the setting, the type of participants (e.g., adult or older adults), and whether participants are partially or fully compliant [8, 12, 13, 14]. The World Health Organization [15] identified more than 200 barriers to adherence and developed a multifactorial model under five general factors: healthcare team and system-related, patient-related, condition-related, and social and economic-related factors. Understanding how these factors influence patient's adherence to exercise could facilitate the identification of barriers and help clinicians and researchers maximize exposure to factors enhancing adherence [7].

Several systematic reviews [7, 17, 18, 19] have examined factors influencing adherence. However, most reviews are quantitative [8, 17], focused on one major MSD [8, 19], older adults [8], and adherence to home exercise programs [17, 18]. Most studies consider adherence as a secondary outcome or moderating variable and not specifically designed or powered to assess adherence [14, 19]. Moreover, the role of health care professionals (HCP) in facilitating therapeutic exercise uptake and adherence remains poorly understood [20]. Given the complex nature of adherence, qualitative methods may provide a more in-depth understanding of factors associated with exercise adherence. Identifying barriers and facilitators of adherence from the perspective of both patients and HCP would better inform the development, refinement, and implementation of strategies designed to improve adherence.

AIMS

This qualitative synthesis review located, appraised, and synthesized qualitative studies evaluating the barriers and facilitators of adherence to therapeutic exercise in individuals with MSK pain and disability. "Therapeutic exercise is the systematic performance or execution of planned physical movements or activities intended to enable the patient or client to remediate or prevent impairments of body functions and structures, enhance activities and participation, reduce risk, optimize overall health, and enhance fitness and well-being" [21]. In MSK rehabilitation, therapeutic exercise may include endurance training; agility training; body mechanics training; muscle lengthening; movement pattern training; range of motion exercises and soft tissue stretching; relaxation exercises; and strength, power, and endurance exercises

[21]. Thus, it differs from physical activity, which is defined as any bodily movement generated by skeletal muscles [22].

METHODS

Design

This study utilized meta-ethnography, a potentially theory-generating, interpretive method of qualitative synthesis described initially by Noblit and Hare [23]. Meta-ethnography is designed to produce interpretations transcending study findings [24] by systematically comparing conceptual data from primary studies to identify and develop new overarching concepts theories and models [25]. The overall aim of this synthesis approach is to identify unifying features common to or disputed across several sources and to create new findings and develop a new conceptualization of the investigated phenomenon following a seven-stage framework (Noblit and Hare, 1988, 21, 23). Meta-ethnography involves the translation of individual qualitative studies into one another through the re-interpretation and transformation of their analytic and theoretical concepts [26,27,28,]. This review adopted the original framework proposed by Noblit and Hare (1988) following the eMERGe guidance for conducting meta-ethnographies [25]. Meta-ethnography is a systematic method for synthesizing qualitative research through selecting eligible empirical studies to be synthesized, reading them repeatedly, and highlighting key concepts (interpretive metaphors) following seven phases [23,27].

***Step 1**: getting started*

This stage is focused on developing a well-defined research question [29]. The research idea for this review evolved based on the need to review and understand the barriers and facilitators of adherence to TE among adults with MSD and HCP in the practice area of MSK rehabilitation. We employed the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) search tool [30] to develop the research questions and search strategy (Table 1). SPIDER is more suited for generating search terms for qualitative research and returning a higher rate of relevant articles for systematic qualitative reviews than PICO or PICOS [31].

Step 2*: deciding what is relevant to initial interest*

This stage involves identifying the scope for the review and requires justifying studies that should be included or excluded from the review. Eligible studies were required to meet the inclusion criteria described in Table 1.

Electronic Search strategy: We followed the search strategy proposed for qualitative meta-synthesis [32]. A structured search for published literature on five databases [OVIDMedline, CINAHL, Embase, PsychINFO and AMED (Allied and Complementary Medicine Database)] was completed from inception to December 2018 by FB. (Appendix 1). FB individually screened study titles and abstracts to ensure they met the study inclusion criteria. The team met to discuss the studies that should be included in the review. A hand search of reference lists and google scholar searching was also completed to identify grey literature. When multiple reports of the same study were observed, the articles were compared and only selected if each article presented distinct findings, was based on different studies aim to answer questions about the same data material. A university librarian was consulted in designing the protocol. See Figure 1 for the flow of the search strategy.

Quality Assessment and Data Extraction

FB completed a preliminary appraisal based on every article meeting two of the four quality reporting criteria; study design, participant selection, methods of data collection, and data analysis to improve the internal validity of this review [33]. After that, 38 articles were found eligible for this study and were further appraised comprehensively using the most cited tool in qualitative studies synthesis; the Critical Appraisal Skills Program (CASP) checklist [34] (Table 2). Each article was rated on ten items based on "yes," "no," and "not clear." We did not exclude any articles based on quality. The studies included were independently assessed by FB (37 articles), and LM (15 articles), RG (15 articles) and MZ (10 articles). There was an agreement between the reviewers after the independent appraisal for most papers. Discrepancies were resolved by a third reviewer (JM). The individual studies were entered into the systematic review software EPPI-Reviewer. FB extracted the following information from each study: authorship, year of publication, study setting, population, phenomena of interest, study design, aims, methods of data collection, and results to create a comprehensive summary table as shown in Table 3.

Subsequently, qualitative data from a few articles were extracted to assess consistency by FB. The views expressed by interviewees in the original studies or 'first-order' constructs and the interpretations of primary authors or 'second-order' constructs were documented. We focused on articles with a "yes" on all items of the CASP scale [33] to act as the first studies from which concepts were translated into other studies and shape the analysis [34]. Also, the interpretation provided through a synthesis of one study into another or 'third-order' constructs by FB was documented [21, 24]. This enabled the identification of related concepts that were used to develop a reciprocal translation analysis [23]. A table was also created to highlight the details about the exercise program from each study. (Table 4).

Step 3: *reading the studies*

Following the recommendation from Noblit and Hare [23], the studies included in this review were read several times to ensure familiarity with the common concepts, themes, and ideas.

RESULTS

Thirty-seven studies [35 - 71] published between 2001 and 2018 and involving 1015 participants (969 patients, 46 professionals) met the inclusion criteria and passed the critical appraisal process (Table 1). Studies were included from a diverse range of high-income countries in North America, Europe, and Australasia, with the UK having the most representation (37%). Low back pain was the most studied condition (35%). Most of the studies were designed using grounded theory (18%) and phenomenology (18%) and analyzed with thematic analysis (32%) (Table 2). Table 3 highlights the exercise programs described in the studies. Several combinations of exercise programs, including home exercise and clinic-, hospital- and community-based exercises, were described. Only one study utilized one type of exercise program. Physiotherapy exercises (72%) were the most utilized programs, and exercise instruction from professionals such as chiropractors, osteopaths, trained exercise instructors were described in 8 studies (21%).

***Step 4**: determining how studies are related*

Noblit and Hare [23] proposed creating a list of key concepts for each study and comparing this across all studies to identify the relationship between studies. As common themes, concepts, and ideas began to emerge; we used the tabulated data extraction sheet to identify all the second-order constructs from all studies. A summary table of second-order concepts was then developed (Table 5).

***Step 5**: translating studies into one another*

We used constant comparison method [72] to compare studies to each other starting from the first publication to the last Second-order constructs are the foundational elements of meta-ethnography and lead to the development of third-order constructs [27]. Completing phase 3 and 4 revealed that the findings were mostly reciprocal [23] (Table 6). Meta-ethnography uses three methods of synthesis; reciprocal translation to identify overarching concepts (similar concepts that are named differently), reputational synthesis to explore contradictions between studies and line of argument synthesis to build a picture of the whole [23,27].

***Step 6:** synthesizing the translations*

We compared the similarities and contradictions between concepts, which led to the overriding adoption of existing concepts or the generation of new concepts that provided a fuller account of the phenomenon of adherence to TE and resolved any contradictions using the constant comparative method from Grounded theory (Straus and Corbin, 1990). This process involved systematically and sequentially comparing concepts using recorded study characteristics detailed in step 2 as the context for the comparisons. Comparison of both the first-and second-order constructs led to the development of original "third-order constructs" by one of the authors (FB), which was then sent to other team members for feedback and refining until an agreeable and new understanding of the adherence to TE was conceptualized. Twenty-one concepts were identified from the original participant descriptions and matched to the MSD examined (Table 5).

***Step 7**: expressing the synthesis*

Theoretical propositions, as derived from the adherence literature [15], were utilized to understand how and why participants with MSD adhere to exercise. The twenty-one concepts highlighting perceived barriers and facilitators of adherence to TE based on first- and second-order constructs were summarized using reciprocal translation into five third-order themes: (1) personal and lifestyle characteristics, (2) nature and structure of the exercise program, (3) real and perceived impact of the condition, (4) social and environmental resources, and (5) care provider style, clinical skills, and supportive roles. We determined thematic saturation by considering the degree to which additional research findings were likely to change the findings of the review. See Table 6 for original descriptions (quotes) describing the themes.

Reciprocal translation of patient and healthcare professional's study

1. Personal and lifestyle characteristics

Motivation and self-discipline affect commitment to exercise

Patients reported that low motivation for exercise [52, 61, 67, 70, 71] was due to a lack of interest [61], choosing to delegate the responsibility to exercise to others [54, 58] and preference for passive treatments that require no active movement [50, 52, 54]. Patients commented that taking personal responsibility increased adherence and requires being accountable, [35, 58, 62] choosing to be active and not passive about one's health, [35, 36, 38, 39, 48, 63, 71] and taking control of associated disability current or comorbid conditions [37, 49, 56]. Patients reported that improved self-efficacy for exercise increases motivation and leads to a sense of independence [66]. Planning exercises properly [41, 42, 48, 57], especially with guidance from the therapist [43, 48, 50, 62], were a way to build confidence and commit to exercise. Furthermore, patients reported that interest and commitment to exercise improved with more positive exercise experiences from doing preferred and simple exercises, [44, 45, 49] and a strong desire to resume normal daily activities [43, 49].

Prioritizing exercise for routine practice

Conflicts between exercise plans and daily routines affect exercise adherence [35]. Several reasons for placing exercise at the bottom of patient's daily plan included being unable to problem-solve to schedule exercise into daily routine [41, 61, 62, 64] being forgetful [42, 52, 63] and having other priorities like work, childcare and rest [35, 37, 43, 46, 57, 66, 67, 72] including work and family commitments. A lack of self-discipline was reported as a reason for not prioritizing exercises [41, 63, 64]. HCPs noted that prioritizing rest over-exercise during recovery also reduces the desire for exercise [51]. Prioritizing exercises also reduce when treatment expectations remain unfulfilled. For example, it was difficult for patients whose primary concern was pain relief to recognize the value of exercise adherence when immediate tangible results were not observed [35]. Patients agreed on the importance of valuing exercise for recovery [52] by assigning lower priorities to other activities and [57, 66] scheduling exercise into daily routine [66, 71]. Similarly, it is necessary to establish and maintain a daily routine despite interruption to proposed plans [36, 37, 41, 56, 57]. According to patients, scheduling supervised sessions based on working patterns and life roles [66, 69] and developing personalized goals facilitates the adaptation of exercise to daily plans [39, 44, 55, 62, 66]. However, goals must be developed without undue pressure or push from HCP, family members, or peers to be effective [62]. HCPs reported that collaboration with patients [36, 64] is necessary to find ways around external demands or pressure and for designing individualize exercise [41].

Illness and health beliefs influence adherence behavior

According to some patients, the perception of predictability from the immutable nature of chronic health condition [36, 37, 61], poor health status [56, 57], and the physical impact of the current diagnosis [52] may reduce adherence to exercise. Having false beliefs about exercise worsening the MSK condition or convictions that health problems are some sort of 'punishment' [61] can reduce intention to exercise adherence [58]. Negative illness perception due to feeling despondent or hopeless [61], persistent fatigue [42], and lack appreciable improvement in general health [57] can lead to reduced adherence. Personal preference for passive treatment compared to function-based treatment programs [54, 63] or expecting therapist-led or hands-on treatment alone after an injury [58] can negatively impacts adherence. Furthermore, HCP's acknowledged that unhelpful patient characteristics such as having a negative emotional response to health problems, laxity with physical activity, making excuses, being laid back and keen on incentives [40], vulnerability to relapse [42, 54] and having unrealistic expectations [54] all contribute to reduced adherence.

Adaptive attributes and traits are required for exercise execution

A resilient attitude towards the diagnosis [49], faith and religious beliefs [55, 67], having a cheerful disposition [49], and normalizing the diagnosis [36] create a positive outlook on life which patients linked to improved adherence. Both patients [49] and HCP [40, 58] believed that adaptive attitudes, including the drive to succeed and being adaptable, organized, and responsible, foster exercise adherence. Adaptive thoughts developed from being knowledgeable about the injury, planned treatment, proposed benefits, and required commitments create a positive perspective on illness [40, 58] and promote adherence. Furthermore, personal traits of taking control [58], being able to fit the diagnosis into one's self-image [49], a general positivism personality, positive, cheerful, and failure to linger on negative circumstances also enhance adherence [49].

2. The nature and structure of the exercise program

Planning exercise programs to achieve adherence and fidelity

Patients struggle to adherence when exercises are boring, [41, 44, 52, 65, 66] monotonous or onerous, [60, 61, 67] offer few choices [34, 37, 41, 59, 66] and needlessly complex [50, 52, 61, 67]. Exercises that are too simplistic [58, 60] too hard and provokes pain [43, 47, 50, 54, 57, 65, 67, 70] were also linked to poor adherence. Exercises that are engaging, memorable and pleasurable, [35, 44, 49, 53, 61, 66, 67, 69, 70] well-directed [37, 60, 64, 66] and associated with positive experiences [35, 41, 69, 70] improve adherence. Furthermore, patients wanted exercise plans that were convenient [37, 60, 64, 66, 69] focused on health promotion [44], included motivational activities [49] and matched to patient abilities and skills [44] in informal settings and locations like local gyms [66]. Ongoing support from a health care provider was always welcome [59, 61, 64, 67, 69] to foster exercise adherence. HCPs noted that prescribing a manageable dose of exercise [50, 52], individually tailored, [63] adaptable to the patient's lifestyle, [40] and disease progression [41] while remaining fun and engaging [40, 65] were the keys to exercise managing habitual inactivity, lack of time or exercise-related pain concerns [65].

Exercise instructions must build competence and confidence to promote adherence

Failure to observe patient performance while exercising or inadequate education on exercise techniques often lead to insecurity and low confidence to complete supervised and home exercise adherence. Patients reported that ambiguous or contradictory exercise instructions [37, 54, 67, 70] were difficult to follow, which eventually led to reduced adherence. Some female patients reported that gendered messages [65] targeted at women due to perceived lack of muscle strength reduced adherence to exercise. Furthermore, adherence reduces when language barriers and cultural differences cause misunderstanding and limit the patient's ability to comprehend exercise instruction [51, 54]. Exercises that were easy to follow and remember [50, 58, 67, 69] and supported by visual cues [61] to guide completion without fear of relapse [42] were regarded as pivotal to promote adherence. Similarly, HCPs suggested using simple and few (less than four) exercises, [65] delivered with clarity, easy to complete [40], and credible [64] to improve adherence.

Perceived benefits of exercise stimulate adherence

Patients reported that motivation by results [43] exercises that result in improved physical and mental symptoms [35, 37, 38, 42, 44, 49, 50, 52, 53, 57, 58, 59, 61, 64, 70, 71], increased physical function [48, 49, 53, 56, 59]. HCPs noted that skepticism about exercise intervention arises from the failure to see benefits and may reduce confidence and trust in the therapist [40]. In addition to the health benefits, patients felt they adhered better due to the opportunities to socialize with others when exercising [53, 67].

3. Real and perceived fear of worsening the condition

The direct and indirect impact of physical symptoms

Many patients were afraid that exercise could do more damage to their body and often stopped exercise at the first experience of pain [37, 50, 61, 62, 67], worsening of symptoms [36], and in the absence of tangible results when the primary concern is pain [38]. Ongoing pain from adverse effects and comorbidities [43] often made it difficult to adapt exercise to daily variable pain patterns and reduces adherence [35, 42, 49, 50]. Fear of relapse [42] or physically demanding jobs that aggravate symptoms from physically demanding jobs further compromise adherence to exercise [67]. However, for some patients, ongoing symptoms were a motivation to continue exercise [59]. Despite choosing to discontinue exercises to relieve pain [51], progressing exercise without unrealistic expectations of having no pain should remain the focus [54]. Therefore, the patient's clinical knowledge about the diagnosis, exercise goals, rationale for exercise [54], and the impact of exercise on pain are critical to adherence [50, 52]. According to HCPs, patients need to learn how to master the body's response to exercise, differentiate between 'good' (successful exercising) and 'bad' (worse or aggravated) pain, and recognize their physical capability to exercise safely [44].

Psychological barriers limit intention to exercise

Psychological sequelae including depression, kinesiophobia, fear, anxiety [57], and the negative psychological influence of pain can cause feelings of disability, social isolation, [52, 67] negative self-identity and low confidence which reduced adherence to both homes [52] and supervised exercises [71]. Negative emotional response to exercise can result from maladaptive thoughts about the injury and treatment process, impedes adherence [40, 54]. Furthermore, the chronicity of symptoms and uncertainty about recovery could induce despondency in patients who experienced a resurgence of symptoms despite good adherence [61]. Impairments in memory [52] also lead to frustration from forgetting or getting confused about what exercises to complete [42, 52, 63].

4. Social and environmental challenges to exercise

Access to financial incentives and favorable environmental conditions prompt adherence

Considerable financial strain associated with exercise programs [59], transportation for distant clinic visits [49], and parking are some of the barriers to attending supervised exercise programs [59] and make adherence difficult [54, 62]. High expectations from family members and financial responsibility [54] make these factors even more challenging. Self-pay [40] or access to health insurance [44] for exercise improved adherence due to the perceived need to utilize the services paid for [40]. Environmental barriers negatively affecting adherence included hazardous weather from high wind and icy conditions [56, 57, 67] unhelpful home environment [40, 63] and older facilities [46, 63] lack of information about exercise classes [57], non-user-friendly equipment or inadequate access to training facilities [59]. Poor weather engagement in outdoor exercises and prevents attending supervised sessions [49, 56, 57, 67] Increased access, ease-of-use and the ability to adapt equipment to a small space led to improved adherence [70]. Proximity, sufficient resources at home, attending exercise classes at recreational centers, and newer facilities outside the healthcare setting prompted adherence [42, 59, 61, 66, 69, 70].

Social support can enable or act as a secondary motivation

Patients stated that the kind of support from friends and families had more influence on adherence to home exercises [42]. Adherence was always a challenge when patients had to justify to family members the need to devote specific time for exercise [49]. A patronizing and paternalistic approach from friends and families [67] often leads to constant encouragement to rest instead of exercising [54]. The perceived indifference from friends and families meant some patients decided not to disclose their exercise plans [66]. Some patients, especially females, reported they did not have enough free time for themselves due to double workload from jobs and household-related duties [54, 67]. HCPs also recounted the adverse effect of social networks on adherence behavior [40]. For example, pressure from parents and peers exerted a negative influence on the patient's rehabilitation when they pressure the patient and do not fully understand the rehabilitation process. Poor continuity of care also leads to feeling abandoned by the patient [44]. Characteristics of the environment, such as external demands from family, job, social groups, or being in an unhelpful environment where it was challenging to complete rehabilitation exercises at work, or home was detrimental to adherence [40].

Both patients and HCP acknowledged the importance of social support, which could be a task, material, emotional, and practical oriented [43, 55, 57, 62, 66]. Patients suggested the use of entertainment to create a fun atmosphere during exercise to improve adherence [62]. Emotional support comes from exercising in groups to create a sense of camaraderie [37, 41, 44, 47, 46, 59, 61, 62, 66, 69] and shared motivation [67]. Gestures such as making use of the family car available for clinical visits and assistance with domestic duties and caring was a source of material support. Peers were a big source of practical and emotional support in terms of managing flares [66], provided incentives, reminders, and feedback to stimulate further engagement when progress was slow [42, 66, 70]. HCPs reiterated that a facilitative environment that allows ample time for rehabilitation without undue pressure, adequate resources, space, equipment, and scheduled rehabilitation time are important to improve adherence [40, 42].

5. Care provider style, clinical skills, and supportive roles

Using therapist personality and style to support adherence.

Having a great personality [69], engendering trust [63], and building confidence [44] increased the patient's commitment to exercise. Other therapist qualities that patients linked to better adherence included showing genuine interest [60], encouraging, [49] showing empathy [44] active listening [44, 45, 69], and open communicating with patients [51]. Feeling valued as a person increased trust in the therapist [38] and treatment program [51]. Being non-judgmental, attentive, evoking warmth, having a sense of humor, sharing a common interest, and projecting confidence are some of the characteristics HCPs linked to adherence [44, 60, 69]. However, some patients feel a sense of accountability and adhere because they do not want to disappoint the HCP during the early phase of therapy [35, 52, 60]. Furthermore, adherence improves when mutual inquiry, problem-solving, patient values, preferences, and lifestyle were used to establish mutual goals [69]. Negotiating realistic plans that are relevant to treatment goals [51] and having a tailored approach requires being supportive, sympathetic, attentive to patient needs [52, 65, 69].

Perception of high competency and clinical skills shape interest in exercise

Patients alluded to the fact that exercise adherence was sometimes predicated on the clinical skills and competencies of their therapists [52, 70]. Patients reported that providing reminders [44, 50, 52] giving constructive feedback [44, 50, 58, 69] and planning for follow-up and monitoring progress [38, 40, 60, 50, 66, 67] helped them meet treatment goals by adhering better to exercise recommendations. Patients also felt their adherence to exercise was influenced by therapists dedicating time to instill knowledge about the diagnosis and treatment plans [52, 61, 63, 66, 69] modeling the correct exercises [59, 67, 50] and providing clear exercise instructions [38, 69, 44, 55, 50, 66, 69, 52, 58, 61, 64, 69]. HCPs suggested providing information on pain, clinical diagnosis, treatment options, and coping strategies [42, 43, 50, 51, 60]. Planning exercise programs using an individualized approach that contextualizes the treatment also improved adherence [52]. Some HCPs believed that conflict resolution was crucial to adherence and required being able to negotiate with patients [51, 65] and communicating effectively [51, 54, 61] using a motivational style [52]. Also, increasing self-efficacy for exercise was enhanced by creating a positive injury and rehabilitation experience [51], building confidence [40], establishing and meeting expectations when possible, and reinforcing positive factors [42].

The supportive roles of therapists are essential to fostering exercise behavior.

Providing both individual and practical support [37, 38, 41, 43, 64] increases the motivation to exercise independently. Lack of therapist's support and guidance during therapy [43, 44, 50, 52, 61, 64, 66, 69] and lack of proper follow-up upon discharge [45, 61, 63] were cited as reasons for poor adherence by many patients. Feeling unsupported led to feeling less confident to exercise [54, 64, 64]. Situations where therapists made all the decisions for the patients [39] or demonstrated a lack of knowledge about the diagnosis or treatment plan [45, 49, 52, 53, 57, 61, 63] increased the feeling of less support. Some therapists felt that having a lower hierarchy in the health system reduced how much support they could give to patients [51]. For example, patients may perceive therapists to be less skilled than physicians and disregard exercises because of conflicting messages [51]. This overriding action sometimes pushed therapists to focus only on hands-on treatment to gain professional power in the patient's view and differentiate themselves from others. The indirect consequence of manualized treatment only was reduced interest in exercise therapy in the near term and feeling less supported in the long term [51, 54]. Similarly, patients failed to continue exercise when they perceive HCPs to be pursuing a personal agenda or intolerant of the uncertainties around pain [65]. Patients reported that adherence was fostered by shared power and collaboration with HCPs [36, 45, 46, 69].

Line of Argument

Line-of-argument translation of the five third-order constructs synthesized from "patient" and "healthcare professionals" studies showed that the factors affecting adherence do not occur or act in isolation. Instead the factors interact to affect a patient’s ability to adhere to therapeutic exercise. Figure 2 depicts the interaction between factors and show that both within and across factor categories may interact to affect adherence. For example, under the personal and lifestyle characteristics, the ability of patients to prioritize exercise is influenced by how HCP plan home exercises and the benefits perceived from exercising (Nature and structure of the program). The patient is required to balance taking personal responsibility and a lack of discipline, having knowledge or lacking insight and being forgetful, having adaptive qualities such as positive beliefs and attitudes, self-efficacy or negative individual characteristics or developing adaptive thoughts or experiencing a negative emotional response to injury and the rehab process and different levels of exercise abilities and style. Across the categories, care provider style, skill and role can increase patient motivation for exercise in many ways. For example, through assistance with finding ways around external demands and pressure, improving patient knowledge about the diagnosis, exercise goals and rationale and planning supervised treatment programmes.

The synthesis also showed that the factors affecting adherence to therapeutic exercise may be conceptualized as being on a continuum where factors reflect degrees of positive or negative influence. Figure 3 shows exemplars of factors on the continuum. For example, rapport could lead to therapists making all the decisions (barrier) or collaborating with the patient (facilitator) and inspiring trust and confidence to exercise (facilitator) or encouraging passivity to seek a ‘quick fix’(barrier), increasing patient access to programs through flexible timing (facilitator) or lack of follow-up and monitoring following discharge (barrier). Similarly, the patient needs to must manage MSK physical symptoms such as stiffness and pain and the psychological symptoms such as fear and anxiety from the MSK problem. For example, the perception that pain is an adverse effect or a provocation from movement or belief in the inevitability of MSK problem may reduce motivation to exercise (barrier). Regarding the nature of the program, the experience of treatment benefits motivated some patients to continue exercise until results are maximized compared to situations when exercise was stopped when short term pain-related goals were achieved. Social support when present may be seen as a facilitator when supportive (exercising with friends and families, family support to access transportation to appointments), or a barrier when patients feel unsupported (pressure from peers, complaining about time spent exercising) or somewhere in between when gestures to exercise may be perceived as condescending, irritating or invasive.

DISCUSSION

This review synthesized the existing literature on barriers to facilitators to therapeutic exercise in individuals with MSK pain and disability. The findings from this synthesis suggest that adhering to therapeutic exercise is a multifactorial construct that involves several interdependent factors. The first stage of the meta-ethnographic analysis, reciprocal translation, revealed the themes that explain the reasons for adherence exercise according to patients and HCPs. Meta-ethnography moves beyond traditional narrative review to generate higher-order theories about experiences [73]. Thus, the subsequent line of argument approach enabled us to develop an explanatory model that shows that adherence to TE requires management of the tension that enhances or limits adherence at five levels; of the individual, their health condition, the exercise program, the healthcare system, and process and the resources available to them. The evidence derived from individuals with MSK conditions and their carers can inform person-centered strategies for improving adherence to therapeutic exercise and physical activity recommendations. These recommendations may improve the mitigation of barriers to exercise and physical activity adherence during a course of rehabilitation. These improvements further have the potential to influence exercise prescription for quantitative research on the management of MSD. The findings from this study reflect some of the findings reported by Dobson et al. [20] on barriers and facilitators of adherence to exercise in individuals with hip and knee osteoarthritis. This current meta-ethnography is interpretive and explains how the factors identified in the study by Dobson et al. [20] influence adherence rather than mainly presenting a narrative review of the literature. More importantly, the findings of this study corroborate the findings from systematic reviews [7, 8, 16, 17, 18, 19] examining barriers and facilitators of adherence to exercise.

The study by Jack et al., [7] was focused on barriers to exercise with conclusions that most of the research synthesized targeted patient factors. Although patient factors also accounted for most of the findings in this current study, we further highlighted how healthcare professionals and health systems influence adherence in a positive or negative way. Essery et al. [74] reported that factors linked to home-based exercise adherence in individuals with arthritis included intention, self-motivation, self-efficacy, previous exercise-related behaviors, and social support. Similarly, Beinart et al. [17] synthesized intervention and intervention-related factors affecting adherence to home exercise low back pain and found moderate evidence for health locus of control, supervision, participation exercise programs, and behavior change programs incorporating motivational strategies. Interestingly, participants in this current review revealed that these factors also affect supervised exercise or physical activity programs in the clinic or community centers and for other MSK conditions.

In another systematic review, Ezzat et al. [19] concluded there was limited evidence that knowledge-based and motivation-based interventions such as can improve adherence. However, the authors reported several flaws in the design of the appraised studies, including adherence not examined as a primary outcome, inadequate attention to sample size calculation, and studies been underpowered to detect a difference between the interventions and the control groups. This current study fills some of the gaps in the existing literature with patients and healthcare professionals, agreeing that adequate education and exercise instruction was a key facilitator of adherence to exercise. In their Cochrane review, Jordan et al. [16] concluded that supervised or individual exercise therapy that incorporates self-management techniques might enhance adherence to exercise in individuals with chronic MSK pain. Some of the self-management techniques reported by patients and healthcare providers in the current study included learning the body's response to pain, developing self-efficacy, and developing time-management skills to prioritize exercise and avoid wasting time. Picorelli et al. [8] explored how the program characteristics and personal factors influence adherence to exercise in older adults. Although the study focused mainly on community-based physical activities, findings showed that key person-level factors including demographic factors, health status, physical and psychological factors. According to the WHO [15], the multidimensional model of adherence was developed to overcome the challenges of managing more than two hundred factors influencing adherence. The model describes how five factors, condition-related, therapy-related, patient-related, social and economic-related, and health system-related affect adherence. This current review synthesized the literature and included all the five dimensions of adherence suggested by the WHO [15].

Limitations and Strengths

The findings from any review are dependent on the quality of the original studies. Quality appraisal for qualitative data is particularly challenging to perform with the risk of bias from including data from flawed studies [75]. To enhance the consistency and transparency of this review, we utilized a structured approach to examining and appraising the limitations and strengths of findings as proposed by Lewis et al. [76]. We ensured that the four components of confidence, namely methodological limitations, relevance, coherence, and adequacy of data, were assessed [21] The assessment and explanation of this appraisal is presented in Appendix 2. We developed a line of argument based on an analogy that encompasses all findings of the review to ensure the coherence of the synthesis. Inadequacy of data set may be observed where qualitative studies use descriptive titles that were indexed inappropriately; use of narrow review questions or more primary research needs to be conducted in the substantive area [77]. The richness and quantity of data are reflected by the adequacy of data and was noted throughout this review. Meta-ethnography uses theoretical sampling until data saturation is achieved. However, this is a criticism of meta-ethnography since it is unclear how saturation was achieved when access to first-order constructs is limited [78]. Most of the studies included were from high-income countries, and the findings may not be translatable to patients from low-income countries.

CONCLUSION

In summary, we report the complex interplay among personal, health condition, therapy, healthcare system, and resources (social, economic, environmental) factors acting as barriers and facilitators of adherence to TE in individuals with MSD. This review enumerates the perspectives of both patients and HCP across a broad range of practice settings, from supervised care to community-based therapeutic interventions. Considering the burden of MSK conditions and the importance of adherence to successful treatment outcomes, it necessary to make personal and system changes that will have a positive effect on adherence. Future research is required to explore how the adherence model proposed in this review can be used to identify patients at risk of poor adherence and develop behavioral interventions to address the factors reported in this review. More, qualitative evidence is also required from low-to-moderate income societies to obtain a better global picture of factors influencing adherence to TE. The tension among the themes identified implies the need for ongoing facilitation and monitoring of adherence that considers the five WHO dimensions of adherence.

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Table 1: Inclusion and exclusion criteria based on SPIDER search tool

Terms	**Inclusion Criteria**	**Exclusion Criteria**
Sample (S)	Adults (>18 years) with pain or disability affecting the axial skeleton or peripheral joints in the lower or upper extremity Surgical or conservative treatment Setting including tertiary hospitals (inpatient or outpatient rehabilitation), general practice, private practice and community health centres	Adults living in institutional settings (e.g., long term care/nursing homes). Healthy volunteers
Phenomenon of interest (PI)	Studies about adherence[1] to therapeutic exercise; supervised therapeutic exercise programs, self-management home-based exercise programs and/or community-based physical activity programs.	Adherence to passive therapies such as patient education, modalities, orthosis fabrication or advice only without an active component of therapeutic exercise were excluded.
Design (D)	Qualitative or mixed-methods studies (e.g., grounded theory, phenomenology, ethnography) Reporting primary qualitative data (e.g., interviews, focus groups, direct observation, action research and questionnaires that allow free text) Reporting qualitative analysis (content analysis, thematic analysis)	Studies reporting only quantitative data (e.g., cross-sectional, case-control, cohort studies, clinical trials)
Evaluation (E)	Qualitative analysis of experiences, feelings, views, opinions and plans	Evaluation reporting quantitative methods only
Research Type (R)	Peer reviewed journal articles Available full text in English only.	Systematic reviews, protocols, theoretical work, editorials, opinion pieces, and dissertations

[1] This review will consider studies that report adherence as the extent to which individuals undertake a prescribed behavior accurately and at the agreed frequency, intensity and duration [2].

Table 2: Methodological Quality of Included Studies (n=37)

Quality Criterion	**Agreed Assessment for Each Study**		
	Met Criterion	**Did Not Meet Criterion**	**Unclear**
Was there a clear statement of the aims of the research?	37	0	0
Is a qualitative methodology appropriate?	34	0	3
Was the research design appropriate to address the aims of the research?	36	0	1
Was the recruitment strategy appropriate to the aims of the research?	28	4	5
Was the data collected in a way that addressed the research issues?	31	2	4
Has the relationship between researcher and participants been adequately considered?	21	6	10
Have ethical issues been taken into consideration?	34	0	4
Was the data analysis sufficiently rigorous?	26	5	6
Is there a clear statement of findings?	37	0	0
How valuable is the research?	37	0	0

Table 3: Characteristics of included studies in the meta-synthesis.

Study (Author, Year)	Setting (Country)	Population	Age (years)	Sex (%)		Study Aims	Program details	Data Source	Methods (Framework and Analysis)
				Male	Female				
Campbell et al [35] (2001)	Community UK	Knee osteoarthritis (n=20)	57.5	6	14	To understand reasons for compliance and non-compliance with a home-based exercise regimen	Complex Physiotherapy Intervention	Interviews	Grounded theory Thematic analysis
Dean et al [36] (2005)	Primary care UK	Low back pain (n=9)	39.5	NR	NR	To explore patients' and physiotherapists' perceptions of exercise adherence.	Individually tailored unsupervised exercise and recreational types of exercise (swimming and walking)	Interviews	Interpretative Phenomenological
Hendry et al [37] (2006)	General practice UK	Knee osteoarthritis (n=22)	65.08	6	16	To examine the views of primary care patients with OA knee towards exercise, explore factors that determine the acceptability and motivation to exercise, and to identify barriers that limit its use.	Supervised exercise	Focus group	Framework method
Liddle et al [38] (2007)	Primary care New Zealand	Chronic low back pain (n=18)	48	4	14	To explore the experiences, opinions and treatment expectations of chronic low back pain patients to identify what components of treatment they consider as being of most value.	Supervised exercise.	Focus groups	Narrative study
Veenhof et al [39] (2006)	Primary care Netherland	Osteoarthritis (n=12)	69.75	4	8	To understand why patients who have received a behavioural graded activity program successfully integrate activities into their daily lives.	Behavioral graded activity with exercise	Open-ended in-depth interviews	Grounded theory
Niven [40] (2007)	Outpatient UK	Physiotherapists (n=9)	35.1	NR	NR	To draw on sport physiotherapists expert knowledge to increase understanding of adherence issues in practice and identify factors that influence	Sports Medicine	Semi-structured interviews	Inductive content analysis

						adherence and strategies that can be used to enhance adherence.			
Swardh et al [41] (2008)	Primary health care Sweden	Rheumatoid arthritis (n=18)	60	4	14	To explore and describe ways of understanding exercise maintenance among individuals with RA who had already started to exercise.	Ongoing PT intervention	Interviews	Phenomenography
Medina-Mirapeix et al [42] (2009)	Primary care Spain	Chronic neck or low back pain (n=34)	48	11	23	To identify the beliefs and perceptions of patients that influence adherence to home exercise during exacerbation and/or remission of pain.	Supervised PT based clinic and home exercises.	Focus groups	Phenomenography
Levy et al [43] (2009)	Private practice UK	Tendonitis-related injury (n=6)	31	4	2	To investigate recreational participants' experiences of adhering to a sport injury rehabilitation program	Supervised physiotherapy; 10 weeks.	Interviews	Interpretative phenomenology
Slade et al [44] (2009a)	Community Australia	Nonspecific chronic low back pain (n=18)	51	6	12	To investigate and summarize participant experience of exercise programmes and the effects of these experiences on exercise participation and engagement.	Supervised exercise programs	Focus groups	Grounded theory
Slade et al [45] (2009b)	Community Australia	Chronic low back pain (n=18)	51	8	10	To understand the factors that participants in exercise programs perceive to be important to engage and participate	Community rehabilitation programs	Interviews with focus groups	Grounded theory
Sokunbi et al [46] (2009)	Primary care UK	Chronic low back pain (n=9)	42	6	3	To explore the experiences of individuals with chronic low back pain participating in a spinal stabilisation exercise program.	Physiotherapist led spinal stabilisation exercises.	Focus groups	Thematic analysis
Hurley et al [47] (2010)	Primary Care UK	Chronic knee pain (n=23)	67	6	17	To explore the health beliefs, experiences, treatment expectations of people with chronic knee pain, and investigate if, how and why these change after taking part on an integrated exercise-based rehabilitation programme	Out-patient supervised rehabilitation program (6 weeks)	Interviews	Grounded theory Thematic analysis
Bamford and Walker [48] (2010)	Outpatient clinic	Distal radius fracture	43	2	4	To explore the experiences of working age people with	Home exercise	Interviews	Phenomenology Thematic analysis

	UK	(n=6				dominant side wrist fracture in terms of the impact on their lives from the resulting loss of hand function, and the role that hand therapy plays in the rehabilitation process.			
Petursdottir et al [49] (2010)	Outpatient Iceland	Osteoarthritis (n=12) Hip/knee (n=10) Vertebral column (n=9) Hands (6) Other joints (3)	67	3	9	To increase knowledge and understanding of the experience of exercising among individuals with osteoarthritis and to determine what they perceive as facilitators and barriers to exercising.	Community exercise programs	Open-ended questions	Phenomenology
Escolar-Reina et al [50] (2010)	Community Spain	Chronic neck or low back pain(n=34)	48	11	23	To explore perceptions of people about pain and the characteristics of home exercise programs and care-provider style during clinical encounters may affect adherence to exercises.	Supervised PT programs	Interviews	Grounded theory
Karnad and McLean [51] (2014)	Primary care UK	Therapists; PT (n=5)	NR	5	0	To explore PT's perception of exercise adherence and interventions used in clinical practice.	NA	Semi-structured interviews	Interpretative phenomenology
Marshall et al [52] (2012)	Unspecified UK	Lower limb, back and sport injury 2 weeks to 1 year (n=8)	30	5	3	To explore athletes' perceptions of the factors that they feel may affect their adherence to a physiotherapy intervention	Home exercise	Semi-structured interviews	Phenomenological Thematic analysis
Moody et al [53] (2012)	Community New Zealand	Lower extremity osteoarthritis (n=17)	74	4	13	To report participant ideas for sustaining an aquatic program at low cost and what constituted a good group program.	Water based 12-week program	Focus groups	General inductive approach
Scheermesser et al [54] (2012)	Primary care Switzerland	Chronic low back pain (n=13) Physical therapist (n=6) Occupational therapists (n=6)	50	9	4	To explore possible barriers to successful rehabilitation	Function-centred rehabilitation	Semi structured interviews and focus groups	Content analysis
Tung et al [55] (2012)	Community Australia	Total knee replacements (n=6)	78.5	7	8	To explore how older people maintained and improved	Home rehabilitation	Semi structured interviews	Thematic analysis

		Total hip replacements (n=6) Neck of femur injury, hip hemi-arthroplasty, hip pinning (n=3) (n=15)				their self-efficacy in managing home rehabilitation and their adherence to rehabilitation exercise programmes following orthopaedic surgery.			
Gorman et al [56] (2013)	Community Canada	Hip fracture (n=32)	82	10	22	To identify exercise patterns and perceived barriers, enablers, and motivators to engaging in exercise for older adults following hip fracture.	Community based exercise program	Open-ended questions	Thematic analysis
McPhail et al [57] (2014)	Primary care Outpatient Australia	Musculoskeletal conditions (n=217)	53	113	104	To investigate perceived barriers and facilitators to undertaking physical activity reported by patients accessing ambulatory hospital clinics for musculoskeletal disorders	Nonsurgical ambulatory rehabilitation	Open-ended questions	Content analysis
Littlewood et al [58] (2014)	Private practice UK	Rotator cuff tendinopathy (n=6) PTs (n=2)	64.7	3	3	To increase knowledge and understanding of the experience of exercising and determine perception of facilitators and barriers to exercise.	Private PT treatment.	Interviews	Phenomenology Framework analysis
Fisken et al [59] (2015)	Community New Zealand	Osteoarthritis (hips, knees, ankles, spine and fingers) (n=15)	72.4	1	14	This study aimed to (a) identify factors that motivate older adults to participate in aqua-based exercise; (b) identify potential barriers; and (c) compare perceptions	Aqua-based exercise	Focus groups	General inductive approach
Hinman et al [60] (2015)	Community Australia	Knee osteoarthritis (n=6) (patients) Physiotherapists (n=10)	62	3	3	To explore how patients, PTs and telephone coaches experienced, and made sense of an integrated program of PT-supervised exercise and telephone coaching.	Structured exercise and physical activity program 4-6 lower limb exercise.	Semi-structured interviews	Grounded theory Symbolic interactionism
Palazzo et al [61] (2016)	Primary care France	Chronic low back pain (n=29)	54	12	17	To assess views of patients concerning barriers to home-based exercise program adherence and to record expectations regarding new technologies	Supervised physical therapy	Semi-structured interviews	Thematic analysis

Withall et al [62] (2016)	Primary care UK	Rheumatoid arthritis (n=15)	59.9	4	15	To explore patient's views on approaches to delivering physical activity programmes and inform a program to maximize functional mobility through long-term engagement.	Physical activity ESCAPE – 6 weeks. TREAD – 6 to 8 months. PEPA-RA – 12 weeks.	Focus groups	Inductive thematic analysis
Bernhardsson et al [63] (2016)	Outpatient clinic Sweden	Musculoskeletal Problems (n=20)	48	10	10	To explore patient's preferences for physiotherapy treatment and participation in decision making.	Physiotherapy treatment	Semi-structured interviews	Content analysis
Maiers et al [64] (2016)	Outpatient clinic USA	Back related leg pain (n=181)	57	66	115	To explore BRLP patients' perceptions of spinal manipulative therapy and home exercise with advice.	Home exercise program	Semi-structured interviews	Deductive and inductive content analysis
Stenner et al [65] (2016)	Outpatient clinic UK	Physiotherapists (n=8)	NR	NR	NR	To explore how shared decision making and patient partnership are addressed by physiotherapists in the process of exercise prescription for patients with low back pain	Physiotherapy	Semi structured interview	Thematic analysis
Bearne et al [66] (2017)	Primary care UK	Rheumatoid arthritis (n=12)	58	2	10	To explore participants, experience of exercise to inform intervention development and implementation of a program into practice.	Supervised Physiotherapy sessions	Semi structured interviews	Thematic analysis
Boutevillain et al [67] (2017)	Primary care France	Chronic low back pain (n=29)	49	10	19	To identify potential barriers and facilitators of adherence to physical activity	Outpatient rehabilitation	Focus groups Semi-structured interviews	Grounded theory
Stone and Baker [68] (2017)	Primary care Canada	Knee and hip osteoarthritis (n=15)	54.6	6	9	To investigate the potential facilitators and barriers to physical activity for adults with osteoarthritis	Community exercise programs	Semi-structured interviews	Interpretational analysis
Holopainen et al [69] (2017)	Primary care Finland	Chronic or episodic low back pain (n=17)	43.9	5	12	To identify and describe the contextual nature of conceptions of patients with low back pain about their encounters in the healthcare system	Physiotherapy	Open recall interviews	Phenomenography
Pauwels et al [70] (2018)	In- and out-patients France	Lumbar spinal stenosis (n=15)	70.9	6	9	To assess barriers and facilitators to home-based	Home cycling	Semi structured interviews	Thematic analysis

						cycling in older patients with lumbar spinal stenosis.			
Pellegrini et al, [71] (2018)	Orthopedic rehabilitation USA	Total knee arthroplasty (n=20)	64.7	11	9	To identify patient-reported barriers and facilitators to healthy eating and physical activity among patients before or after knee arthroplasty.	Supervised and home exercise programs	Open-ended questions	Constant comparison

Table 4: Description of exercises programmes prescribed in selected studies.

Study	**Exercise professional**	**Program Components**	**Program structure**				
			Clinic based (individual)	**Home Program**	**Hospital based Exercise Classes**	**Community Exercise Classes**	**Self-managed with exercise**
Campbell et al [35] (2001)	Physiotherapist	Strengthening of the vastus medialis; 30mins x 9 sessions x 8 weeks	X	X			
Dean et al [36] (2005)	Physiotherapist Fitness Instructors	General fitness; hospital department or sports centre Specific exercises and daily activities; 3-10 bouts x 2-5 mins		X		X	X
Hendry et al [37] (2006)	Physiotherapist Exercise Instructor	Exercise – aerobic training, sports, therapeutic exercise	X	X	X	X	X
Liddle et al [38] (2007)	Physiotherapy Osteopath Chiropractic	Outpatient exercise programme	X	X			
Veenhof et al [39] (2006)	Physiotherapist	12-wk graded activity; 18 sessions, 5 booster sessions	X				X
Niven [40] (2007)	Physiotherapist	Sport injury rehabilitation	X				
Swardh et al [41] (2008)	Physiotherapist	Planned and structured activities; 30 mins x 2 times a week	X	X		X	X
Medina-Mirapeix et al [42] (2009)	Physiotherapist	ND	X	X			
Levy et al [43] (2009)	Physiotherapist	Sports Injury Rehabilitation	X	X			
Slade et al [44] (2009a)	Physiotherapist	Unloaded movement facilitation Trunk strengthening	X	X			
Slade et al [45] (2009b)	Physiotherapist	Outpatient exercise program	X	X			
Sokunbi et al [46] (2009)	Physiotherapist	Spinal stabilization program – supervised spinal stabilisation exercises, education video, and feedback session.	X	X			
Hurley et al [47] (2010)	Physiotherapist	12 sessions x 6 weeks; 30-45 mins Strength, balance, coordination, home programs, self-help classes, community exercise classes.	X	X		X	X
Bamford and Walker [48] (2010)	Occupational therapist	Hand therapy			X		

Petursdottir et al [49] (2010)	Physiotherapist Physician	ND	X	X		X	X
Escolar-Reina et al [50] (2010)	Physiotherapist	ND	X	X			
Karnad and McLean [51] (2014)	Physiotherapist	ND		X			
Marshall et al [52] (2012)	Physiotherapist	Sports injury rehabilitation	X	X			
Moody et al [53] (2012)	Trained aqua-aerobics instructor	Water-based exercise, 2 (20-60mins) sessions x 12 weeks (stretching, balance, strengthening, cardio)				X	
Scheermesser et al [54] (2012)	Physical therapists Occupational therapists	Outpatient rehabilitation – Function centred rehabilitation program	X	X			
Tung et al [55] (2012)	Physiotherapist	Orthopedic rehabilitation	X	X			
Gorman et al [56] (2013)	Physiotherapist	Extended physiotherapy program	X	X			
McPhail et al [57] (2014)	Physiotherapist	Ambulatory care: Aquatic therapy, strengthening, stretching, balance; Moderate-to-vigorous physical activity; 150 mins x 5 sessions.	X	X	X		X
Littlewood et al [58] (2014)	Physiotherapist	Self-management: Stretching, Strengthening; 20-40 minutes		X			X
Fisken et al [59] (2015)	Trained Instructors	Aqua-based exercise; 2-3 times per week.				X	
Hinman et al [60] (2015)	Physiotherapist Telephone coach	30min, 5 sessions; knee extensor and hip abductor strengthening, walking	X	X	X		
Palazzo et al [61] (2016)	Physiotherapist	Supervised exercises Brochure of prescribed exercises	X	X			
Withall et al [62] (2016)	Physiotherapist Trained Educator	Group sessions; guided exercise Face-to-face sessions Individual exercise sessions	X		X	X	X
Bernhardsson et al [63] (2016)	Physiotherapist	Outpatient physiotherapy	X	X			
Maiers et al [64] (2016)	Chiropractor Exercise Therapist	Home exercise and advice – position and stabilization exercises Supervised exercise over 4-20 weeks	X	X			
Stenner et al [65] (2016)	Physiotherapist	Outpatient musculoskeletal rehabilitation	X				
Bearne et al [66] (2017)	Physiotherapist	Standardized exercise warm-up, personalized exercise circuit of 6 upper extremity exercises selected from a core set of 16 functional/strengthening exercises and an exercise cool down.	X	X			
Boutevillain et al [67] (2017)	Physiotherapist	Functional spine rehabilitation program	X	X			

Stone and Baker [68] (2017)	Physiotherapist	Supervised exercise Physical activity	X	X	X	X	
Holopainen et al [69] (2017)	Physiotherapist	Outpatient rehabilitation	X	X			
Pauwels et al [70] (2018)	Physiotherapist	Inpatient and outpatient rehabilitation	X		X		
Pellegrini et al, [71] (2018)	Physiotherapist	Inpatient and outpatient orthopedic rehabilitation, Home exercise	X	X	X		
Total			30	29	8	9	9

Table 5: Distribution of concepts across articles, by disease types

	PR	KI	AT	SE	MT	PD	IR	PS	PB	PQ	TC	CR	EI	TS	MF	SN	FC	AE	PM	IP	DC	
Campbell et al [35] (2001)	●		●				●		●				●	●					●	●		OA
Hendry et al [37] 2006	●				●				●			●	●			●			●	●		OA
Veenhof et al [39] 2006	●	●												●								OA
Hurley et al [47] 2010				●				●	●													OA
Petursdottir et al [49] 2010			●				●	●	●		●					●	●	●	●			OA
Moody et al [53] 2012		●				●			●													OA
Fisken et al [59] 2015									●						●	●	●	●				OA
Hinman et al [60] 2015						●						●	●	●								OA
Stone and Baker [68] 2017		●		●			●					●		●					●			OA
Tung et al [55] 2012		●	●													●				●		TJA
Pellegrini et al [71] 2018	●								●										●			TJA
Swardh et al [41] 2008	●			●	●	●		●			●											RA
Withall et al [62] 2016					●						●				●	●			●		●	RA
Bearne et al [66] 2017	●	●		●		●	●	●			●		●		●	●		●				RA
Dean et al [36] 2005					●	●								●					●	●		LBP
Liddle et al [38] 2006	●								●		●			●	●				●	●		LBP
Slade et al [44] 2009a						●	●	●			●			●		●		●			●	LBP
Slade et al [45] 2009b		●		●				●			●		●	●		●						LBP
Sokunbi et al [46] 2009					●						●			●							●	LBP
Scheermesser et al [54] 2012			●	●			●	●	●	●		●		●		●	●			●		LBP
Palazzo et al [61] 2016					●	●		●	●		●		●	●	●	●		●	●	●		LBP
Boutevillain et al [67] 2017			●		●	●	●	●			●	●			●	●		●	●			LBP
Holopainen et al [69] 2018					●						●		●	●	●			●				LBP
Pauwels et al [70] 2018					●				●		●				●	●		●				LBP
Maiers et al [64] 2016	●				●				●		●		●									LBP
Medina-Mirapeix et al [42] 2009				●	●				●							●		●	●	●		LBP

Escolar-Reina et al [50] 2010		●		●	●	●			●		●		●		●				●			NLBP
Niven [40] 2007							●			●		●		●		●	●	●				MSK
Karnad and McLean [51] 2011												●		●					●			MSK
Marshall et al [52] 2012		●				●		●	●		●		●	●		●			●	●		MSK
McPhail et al [57] 2014	●				●			●	●			●				●		●	●			MSK
Bernhardsson et al [63] 2016	●	●	●		●						●		●		●			●	●		●	MSK
Stenner et al [65] 2016													●	●					●		●	MSK
Levy et al [43] 2009				●	●		●							●		●			●			Ten
Littlewood et al [58] 2014	●		●		●				●	●	●		●									Ten
Bamford and Walker [48] 2010	●			●					●													HF
Gorman et al [56] 2013	●				●				●									●	●			WF
(n=)	13	9	7	10	17	10	10	12	19	3	17	9	14	17	10	17	4	13	19	9	5	

Key:

PR- Personal Responsibility; KI – Knowledge and Insight;
AT – Attitude; SE – Self-efficacy;
MT – Managing time; PD – Program Description;
IR – Injury and Rehab Experience; PS – Preference and style;
PB – Perceived Benefits, PQ – Patient qualities;
TC – Therapist Competencies; CR – Communication and Rapport;
EI – Exercise Instruction; TS – Therapist Support;
MF – Monitoring and Follow-up; SN – Social networks;
FC – Financial Concerns; AE – Access and Environment;
PM –Physical and Mental Health; IP – Illness Perception;
DC – Decision Making
OA – Osteoarthritis, TJA – Total Joint Arthroplasty, RA – Rheumatoid arthritis
LBP – Low back pain, NLBP – Neck and low back pain
TEN – Tendinopathy, MSK – Various MSK conditions
HF – Hip fracture, WF – Wrist fracture

Table 6: Reciprocal translations of “patient” and “professional” studies

Third Order Construct	**Second-order construct**	**Original description**
Personal and lifestyle characteristics	Motivation and self-discipline affect commitment	“I can’t do the exercises. I know it depends on my willpower to have a routine, but when I wake up I go directly to do the things I have to do, and I don’t stop to exercise… A woman who tells herself to take care of herself or that she needs to exercise, she finds the time” [42] “I was driven to get rid of this pain really, so I thought I’m...going to give this a really good go and do it properly.” [58] “I think it’s nice at the start, but then I think, you can manage it, once you have found out the way you should do it. Then, you have to keep going and, really, no one but you yourself can do that.” [41] “It was boring. Every day, every other day, when you do the same thing, it’s very hard to get motivated, it was a bit boring. Some of the exercises were OK, but some of the exercises. . .just thought of throwing in the towel virtually, but then I thought the pain versus this, and then it will balance everything out” [60]
	Illness and health beliefs influence adherence behaviour	“Being in pain must mean that something is wrong. So, I said to myself at the start of rehab that if I felt too much pain, I wouldn’t continue with the program purely to prevent my injury from getting worse. This is the last thing I want; I don’t want to be crippled by this injury” [43] “Although I experience the same level of pain, I have learned to continue with my activities, and I realize that I achieve more because of that.’ [39]
	Prioritizing exercise for routine practice	Doing your exercises twice a day or whatever. Finding the time in the morning and find the time in the evening. It’s er, you know, that’s something I’m, I’m not yet sort of managing to, to do regularly enough I think to, to really make the difference. There’s always a thousand things that need to be done and somehow doing exercises . . . tends to fall further and further down the list” [36] “Caring for my 16-month old daughter”, “business of life in general”, “family and work commitments”, “keeping up at home” with domestic duties. “Exercise is the first thing to go when things get busy.” [57] You have to schedule it, and you have to stick to the time. You have to do it just when you’ve planned to and not put it off at all.” [41]
	Adaptive attributes and traits are required for execution	“It’s just excuses when it comes down to basics. I mean you know you could get up in the morning and do it between 6 or 7 or something like that.” [35] I stuck the sheet that I was given on the fridge, so it was there in the kitchen to remind me every day.” [58] “If you don’t exercise you’re never going to be able to manage the pain...Gentle exercise actually relieves the pain, and it means that you should be able to cut down [analgesia] and that the answer is not necessarily knee replacement...”. [47] “People who have a history of injury (adhere) because they know from experience what they need to do to get better and perhaps listen more and comply” [40]
Real and perceived fear of worsening the condition	Direct and indirect impact of physical symptoms	“Pain was something I was concerned about during rehab, because sometimes doing the prescribed exercises was painful, which put doubt in my mind if I should be doing them or not.” [43] “Being in the house I usually forget to do exercises because I am doing other things, I am very busy and when I finish I want to sit or lay down because I am tired” [42] “They (the exercises) were good because you could just work your way up, you know, and make them harder. They weren’t so difficult that you couldn’t do them, and you didn’t want to do them.” [60]
	Psychological barriers limit intention to exercise	“I think that general positivism is part of your health; if you think constantly about pain and aches, then you get really sick” [49] “Difficult of having to constantly adapt the exercise pattern to pain that could vary from day to day and even be too intense to be able to exercise at all.” [49]
Nature of the program	Perceived benefits of exercise	I think that when you find that they’re not making a great deal of improvement, you’re less inclined to erm continue it.’ [58] “I was disappointed, because I hoped, I just hoped...but it didn’t sort of do what I wanted it to do for my knees and I don’t think anything will... I think your age, as you get older, you know, you get a bit dodgy.” [47] “Reduced pain, improved strength and range of movement made it easy to exercise. [58] I know that when I’m done, I feel better. That’s what I’m constantly after” [49] “I know personally that with both of my knee replacements this just keeps me going you know, just keeps me mobile and I know if I didn’t do it I wouldn’t be able to do anything.” [59]
	Exercise instructions must build competence and confidence to promote adherence	“I wanted to do exercises for at least two weeks at the centre, but she only gave me instructions on the first day, and she did not tell me if I was doing it correctly or not. In my house I was alone, and I had pain, and I did not know if I was making a mistake with the exercises or if I was doing them too hard" [50] “We explain them (exercises) correctly, they (patients) don’t get it correctly… accents pose a problem, accents and dialects…” [51] I don’t really think I got a full rationale, in terms of saying if you do this, this will work on improving certain muscle areas. Didn’t really get that kind of explanation at all” [52] “How you communicate that advice across is very important and how easy is it for that patient to communicate with you…… We started using physio tools but again that’s very fixed. Started to draw pictures that became a little bit easier I think… for the patient” [51]
	Planning exercises to achieve adherence and fidelity	“Patients too really do have a busy life and therapist advising them to do these 5 exercises 3 times a day, (smiles) It ain’t gonna happen.” [51] “Tailoring treatment towards the activities that are meaningful to the patient engenders a sense of increasing ability”. [48]

		Everybody's an individual and you cannot make one size fit all, and most of us have probably found we have been put in 'one size fits all'. [45] "Easy and beautiful pictures, and I never had a patient come back doing them wrong because they were so well explained." [62] "And I think that it is important when people choose which exercises to do, that you enjoy it, that you feel it is rewarding . . . these positive factors have to be present" [49] Looking at different backgrounds with exercise and finding out where somebody comes from, so you can actually base the program on what people are used to" [45] "With it being such an easy exercise it. became part of a routine I would do, it was short, short and sweet. So it wasn't a case of having to find time to do it, it just naturally fell into a little sort of routine that I have." [58]
Care provider personality and style and supportive roles	Using therapist personality and style to support adherence	"I often find though, the first time that you spend with patients is the most important time because if you're going to win them over you're going to win them in that time . . . they seem to remember how you were on the first time, if that makes sense" [36] "You'll be informed and guided, so you perform the things right. Well, it's the competence; you have to trust them, so to speak" [41] From the patient's point of view, it's the first time someone has listened or perhaps explored in depth and taken the time and then that seems to make a big difference in the relationship with that patient." [36] Trust in where you go. Personability, how they react to you, and be non-judgmental; not you're an idiot for doing that or how did you get to this situation" [44] They're actually treating you like a person and not just a body that's on the table" [52]
	Perception of high competency and clinical skills shape interest in exercise	"Adequate exercise instruction was essential to gain confidence, perform the exercises efficiently, and to adhere to the exercise regimen". [50] "There were techniques for how to motivate yourself to do the exercises, and that was good, that was very good, because as I said, knowing that someone's assessing you, I suppose, makes you more, made me more, responsible for doing the exercises." 62] Yes, I think the instructor was sort of aware of our capabilities and kept the challenge up. And it made it more interesting that way, because if you did the same thing over and over at the same level, it would be boring." [53]
	The supportive roles of therapists are essential to fostering exercise behaviour	"If patients feel abandoned and alone then the compliance isn't going to be good". 40] "So, it's hard to get . . . if there is some sort of . . . way that you weren't just left on your own to try and work out what's available and what's appropriate. Cause I mean you're left to . . . like I tried the physiotherapy and they just said well do the exercises . . . you know . . . and see ya". 38] "The guidance and support from the physiotherapist are particularly motivating when in the rehabilitation centre. He spurs you on when the exercises get tough. The absence of his [the physiotherapist] motivating influence at home makes it even more difficult to do exercises and as a result, I mostly avoided doing home-based exercises" 43] "There's always been patients who can't, don't do their exercises… you need to negotiate with your patients as to how many exercises they think they can fit in". [51]
Social and environmental resources	Social support can enable or act as secondary motivation	"I feel "Everybody is at a different level and you have a group and you start discussing well you should be doing this . . . I would feel there was pressure on me to do something that I didn't want to do." [62] "[the experience of lack of support] was, just, what. Should I say, totally pathetic? I guess men are not all equally understanding" [49] "The backing I got from my family both mentally and financially was very good, simple things like rearranging the use of the car so I could get here really helped, I couldn't get here [the rehabilitation centre] without the car." [43]
	Access to financial incentives prompt adherence	You are going (to the gym) with someone who understands what you can do and they could help you with a programme…. you could…feel a little bit more confident" [62] "At [name of facility] just a single class is something like US$18 if you're not a senior . . . and I thought, no wonder we don't have any young people doing those classes. I think the parking cost is also a big issue" [59] "I love group exercise because you've got other people around you. That can motivate you." [44] "I went to rehabilitation every day for two months; I had that much time off work and my health fund paid the lot" [44]
	Favorable environmental conditions prompt adherence	Weather controls almost totally how I feel. I feel good when it's warm, but horrible when it's cold and damp. And I'm miserable during high winds" [49] "If I don't go to a gym or a recreation centre then I don't exercise, and if I do it's boring, unless I turn on the TV, a record or have a partner" [42]

FIGURES

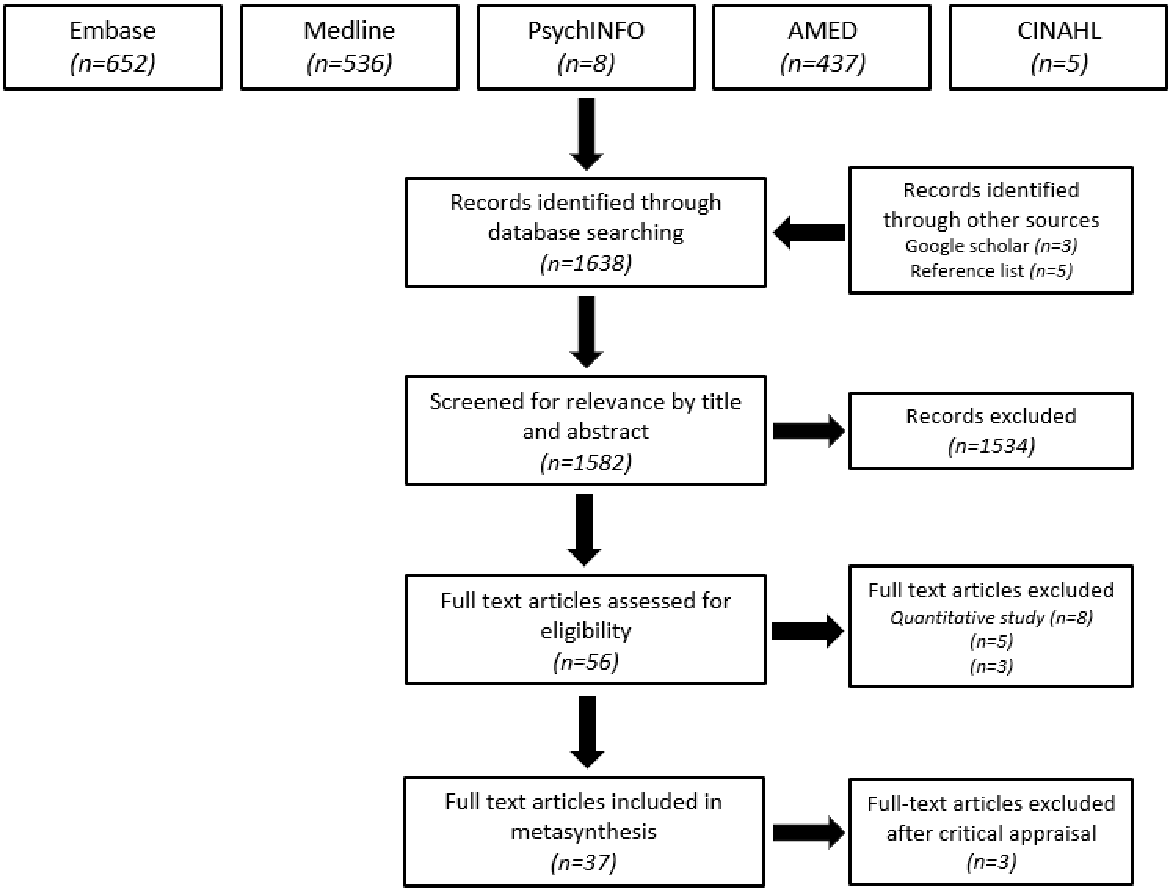

Figure 1: Search Flow Diagram

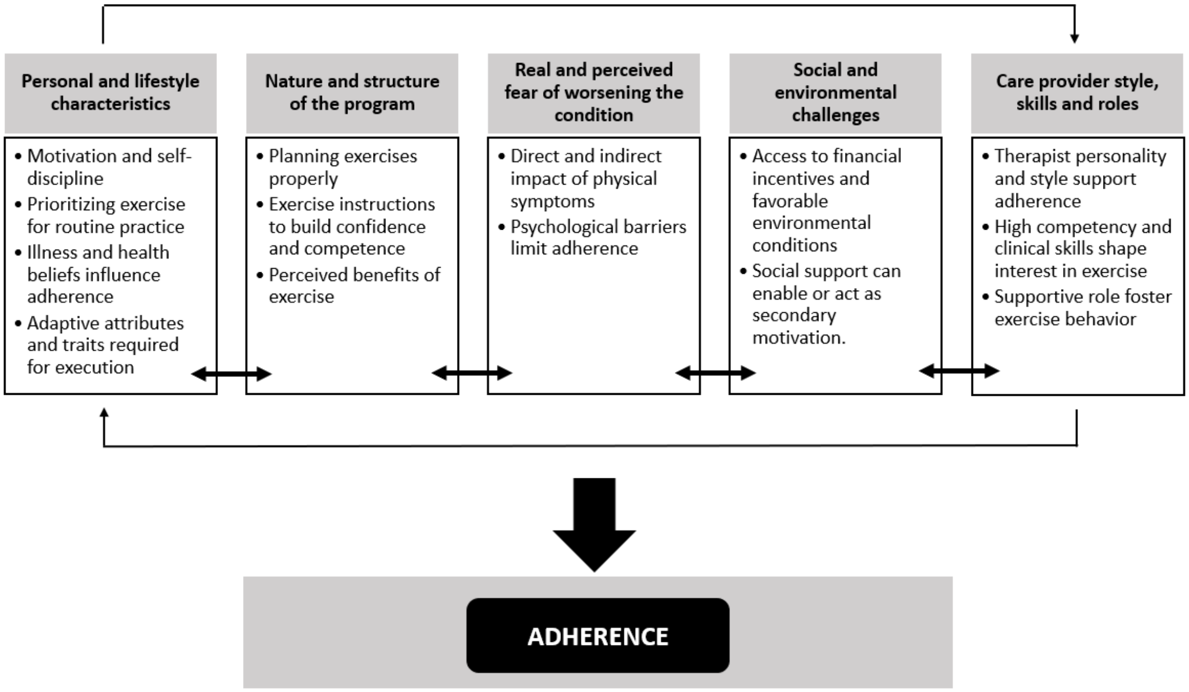

Figure 2: Factors influencing adherence to therapeutic exercise

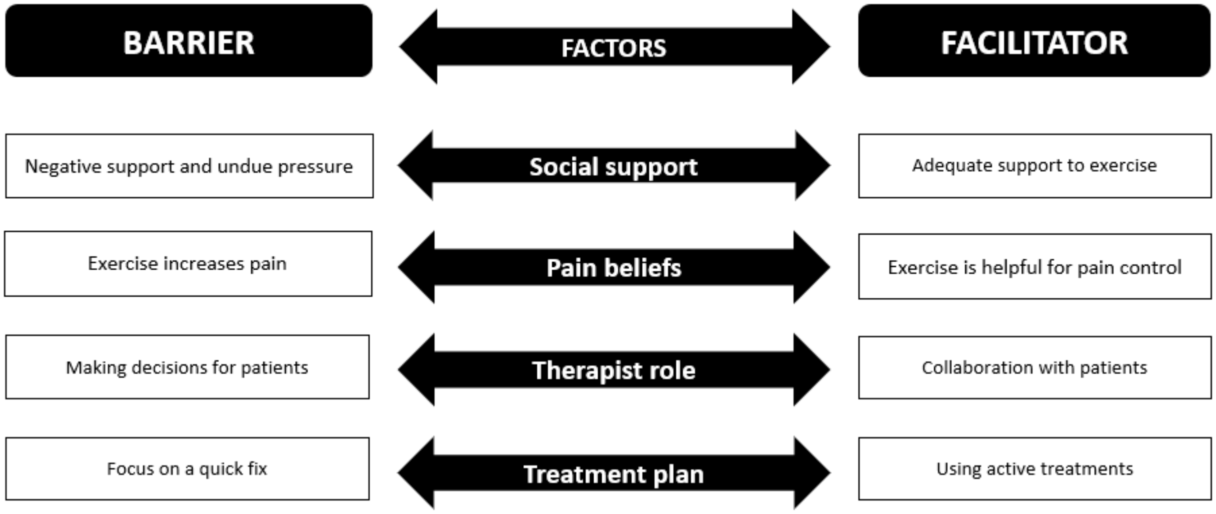

Figure 3: Continuum of some of the factors affecting adherence to therapeutic exercise.

SUPPLEMENTARY INFORMATION.

APPENDIX 1: Database Search strategies

Medline Search Strategy

Database: OVID Medline Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present
Search Strategy:
----
1 Adhere*.mp. (178744)
2 Adherence.mp. (122069)
3 compliance*.mp. (143230)
4 behavior/ or behavior.mp. (1002426)
5 behaviour.mp. or behavior/ (199709)
6 concordance.mp. (35941)
7 engage*.mp. (114040)
8 engagement.mp. (42066)
9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 (1524787)
10 exp rehabilitation/ (267659)
11 physiotherapy.mp. or physiotherapy/ (15486)
12 physical therapy.mp. or physiotherapy/ (43991)
13 exercise*.mp. (318479)
14 exercise therapy.mp. or kinesiotherapy/ (34793)
15 therapeutic exercise.mp. or kinesiotherapy/ (837)
16 motor activity.mp. or motor activity/ (100155)
17 exercise movement.mp. (593)
18 weight training.mp. (965)
19 aerobic training.mp. (1952)
20 balance training.mp. (963)
21 flexibility training.mp. (165)
22 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 (638411)
23 9 and 22 (102076)
24 MSK.mp. (759)
25 musculoskeletal conditions.mp. (1438)
26 exp musculoskeletal disease/ (991210)
27 Musculoskeletal disorder.mp. or musculoskeletal disease/ (11252)
28 soft tissue injury.mp. or soft tissue injury/ (5969)
29 sport injury*.mp. (266)
30 arthritis.mp. or arthritis/ (200084)
31 musculoskeletal pain.mp. or musculoskeletal pain/ (5787)
32 tendinopathy.mp. or tendinitis/ (6603)
33 degenerative joint disease.mp. or osteoarthritis/ (34681)
34 fracture/ or fracture.mp. (174444)
35 spinal pain.mp. or spinal pain/ (1213)
36 muscular pain.mp. (566)
37 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 (1170702)
38 23 and 37 (3691)
39 limit 38 to (human and english language and english and article and adult <18 to 64 years> and last 20 years) [Limit not valid in Ovid MEDLINE(R),Ovid MEDLINE(R) Daily Update,Ovid MEDLINE(R) In-Process,Ovid MEDLINE(R) Publisher; records were retained] (2691)
40 limit 39 to "qualitative (best balance of sensitivity and specificity)" (536)
41 limit 40 to "qualitative (best balance of sensitivity and specificity)" (536)

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Embase Search Strategy

Database: Embase <1980 to 2017 Week 18>
Search Strategy:
----
1 Adhere*.mp. (211905)
2 Adherence.mp. (146935)
3 compliance*.mp. (250647)
4 behavior/ or behavior.mp. (1180019)
5 behaviour.mp. or behavior/ (319694)
6 concordance.mp. (50588)
7 engage*.mp. (129647)
8 engagement.mp. (48618)
9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 (1837622)
10 exp rehabilitation/ (302139)
11 physiotherapy.mp. or physiotherapy/ (78822)
12 physical therapy.mp. or physiotherapy/ (78091)
13 exercise*.mp. (410008)
14 exercise therapy.mp. or kinesiotherapy/ (27284)
15 therapeutic exercise.mp. or kinesiotherapy/ (26474)
16 motor activity.mp. or motor activity/ (48665)
17 exercise movement.mp. (76)
18 weight training.mp. (1151)
19 aerobic training.mp. (2721)
20 balance training.mp. (1310)
21 flexibility training.mp. (192)
22 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 (791770)
23 9 and 22 (125802)
24 MSK.mp. (1536)
25 musculoskeletal conditions.mp. (1722)
26 exp musculoskeletal disease/ (1844156)
27 Musculoskeletal disorder.mp. or musculoskeletal disease/ (23620)
28 soft tissue injury.mp. or soft tissue injury/ (7906)
29 sport injury*.mp. (25635)
30 arthritis.mp. or arthritis/ (276269)
31 musculoskeletal pain.mp. or musculoskeletal pain/ (10355)
32 tendinopathy.mp. or tendinitis/ (9478)
33 degenerative joint disease.mp. or osteoarthritis/ (71550)
34 fracture/ or fracture.mp. (296774)
35 spinal pain.mp. or spinal pain/ (3293)
36 muscular pain.mp. (780)
37 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 (1924084)
38 23 and 37 (11078)
39 limit 38 to (human and english language and english and article and adult <18 to 64 years> and last 20 years) (3190)
40 limit 39 to "qualitative (best balance of sensitivity and specificity)" (652)

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PsychINFO Search Strategy

Database: PsycINFO <1806 to May Week 1 2018>
Search Strategy:
----
1 musculoskeletal disease*.mp. (167)
2 musculoskeletal condition*.mp. (202)
3 Musculoskeletal disorder*.mp. (3129)
4 sport injury*.mp. (180)
5 ortho*.mp. (25297)
6 1 or 2 or 3 or 4 or 5 (28752)
7 exp exercise/ (23675)
8 exp physical activity/ (36375)
9 exp physical therapy/ (2536)
10 physiotherapy.mp. or exp Physical Therapy/ (3708)
11 physical rehabilitation.mp. (490)
12 exp Occupational Therapy/ (5723)
13 therapeutic exercise.mp. (111)
14 7 or 8 or 9 or 10 or 11 or 12 or 13 (45503)
15 exp health behavior/ (26351)
16 exp treatment barriers/ (4066)
17 motivation/ or extrinsic motivation/ or intrinsic motivation/ or behavioral intention/ or enthusiasm/ or goal setting/ or motivation measures/ or motivation training/ or planned behavior/ or reasoned action/ (59515)
18 treatment outcomes/ (30913)
19 facilitators.mp. (7495)
20 15 or 16 or 17 or 18 or 19 (125687)
21 exp treatment compliance/ (13848)
22 patient adherence.mp. or exp Treatment Compliance/ (14125)
23 21 or 22 (14125)
24 6 and 14 and 20 and 23 (8)

****

AMED Search Strategy

Database: AMED (Allied and Complementary Medicine) <1985 to April 2017>, PsycINFO <1987 to April Week 4 2017>
Search Strategy:
----
1 Adhere*.mp. (28893)
2 Adherence.mp. (23759)
3 compliance*.mp. (30393)
4 behavior/ or behavior.mp. (635503)
5 behaviour.mp. or behavior/ (88019)
6 concordance.mp. (5218)
7 engage*.mp. (128455)
8 engagement.mp. (49417)
9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 (800774)
10 exp rehabilitation/ (107933)
11 physiotherapy.mp. or physiotherapy/ (14819)
12 physical therapy.mp. or physiotherapy/ (20748)
13 exercise*.mp. (76112)
14 exercise therapy.mp. or kinesiotherapy/ (7416)
15 therapeutic exercise.mp. or kinesiotherapy/ (302)
16 motor activity.mp. or motor activity/ (5991)
17 exercise movement.mp. (44)
18 weight training.mp. (332)
19 aerobic training.mp. (450)
20 balance training.mp. (457)
21 flexibility training.mp. (78)
22 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 (193731)
23 9 and 22 (36305)
24 MSK.mp. (76)
25 musculoskeletal conditions.mp. (362)
26 exp musculoskeletal disease/ (27305)
27 Musculoskeletal disorder.mp. or musculoskeletal disease/ (2350)
28 soft tissue injury.mp. or soft tissue injury/ (113)
29 sport injury*.mp. (228)
30 arthritis.mp. or arthritis/ (9312)
31 musculoskeletal pain.mp. or musculoskeletal pain/ (1885)
32 tendinopathy.mp. or tendinitis/ (608)
33 degenerative joint disease.mp. or osteoarthritis/ (1527)
34 fracture/ or fracture.mp. (5412)
35 spinal pain.mp. or spinal pain/ (303)
36 muscular pain.mp. (107)
37 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 (40846)
38 23 and 37 (744)
39 limit 38 to (human and english language and english and article and adult <18 to 64 years> and last 20 years)] (644)
40 limit 39 to "qualitative (best balance of sensitivity and specificity)" [Limit not valid in AMED; records were retained] (437)
41 limit 40 to "qualitative (best balance of sensitivity and specificity)" [Limit not valid in AMED; records were retained] (437)

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CINAHL Search Strategy

#	Query	Limiters/Expanders	Last Run Via	Results
S17	S5 AND S8 AND S12 AND S16	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	5
S16	S13 OR S14 OR S15	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	37,158
S15	"patient assessment"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	10,787
S14	"outcome assessment"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	19,165
S13	"outcome measure"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	8,112
S12	S9 OR S10 OR S11	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	37,194
S11	"physical therapy"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	33,303
S10	"physiotherapy"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	8,774
S9	"exercise therapy"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases	639

			Search Screen - Advanced Search Database - CINAHL	
S8	S6 OR S7	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	5,130
S7	"musculoskeletal disorders"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	1,628
S6	"Musculoskeletal diseases"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	4,279
S5	S1 OR S2 OR S3 OR S4	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	176,801
S4	"compliance" OR (MH "Patient Compliance")	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	42,122
S3	"adherence"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	18,890
S2	"behavior"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	118,136
S1	"behaviour"	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	17,828

Appendix 2: CERQUAL Qualitative Evidence Profile of included studies

Review finding	**Assessment of Methodological Limitations**	**Assessment of Relevance**	**Assessment of Coherence**	**Assessment of Data Adequacy**	**Overall CERQual Assessment of Confidence**	**Explanation of Judgement**
Personal and Lifestyle Characteristics	Minor methodological limitations (five studies with minor and five studies with moderate methodological limitations)	No concerns about relevance	Minor concerns about coherence (data reasonably consistent within and across all studies)	No concerns about adequacy	**High evidence**	This finding was graded as high confidence because of no concerns or minor concerns regarding methodological limitations and coherence.
Nature and structure of the program	Minor methodological limitations (seven studies with minor and one study with moderate methodological limitations)	No concerns about relevance	Minor concerns about coherence (data reasonably consistent within and across all studies)	No concerns about adequacy	**Moderate evidence**	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, and relevance.
Real and perceived fear of worsening the condition	No concerns about methodology	No concerns about relevance	Moderate concerns about coherence (data reasonably consistent within all studies)	Minor concerns about adequacy	**Moderate evidence (few studies that together offered moderately rich overall data)**	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, and relevance.
Care provider style, clinical skills and supportive roles	Minor methodological limitations (Six studies with minor and four studies with moderate methodological limitations)	No concerns about relevance	Minor concerns about coherence (data reasonably consistent within and across all studies)	No concerns about adequacy	**High evidence**	This finding was graded as high confidence because of no concerns or minor concerns regarding methodological limitations and coherence.
Social and environmental challenges to exercise adherence	Minor methodological limitations (eight studies with minor and three studies with moderate methodological limitations)	No concerns about relevance	Minor concerns about coherence (data reasonably consistent within and across all studies)	No concerns about adequacy	**Moderate evidence**	This finding was graded as moderate confidence because of minor concerns regarding methodological limitations, and relevance.

CHAPTER 4: KNOWLEDGE, ATTITUDE, BELIEFS AND PRACTICE BEHAVIOUR OF THERAPISTS WITH RESPECT TO MANAGING THE PSYCHOSOCIAL ASPECTS OF PAIN AND DISABILITY FOR PATIENTS WITH HAND INJURIES: A QUALITATIVE STUDY

As submitted to:
Scandinavian Journal of Occupational Therapy

Authors:

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TITLE

KNOWLEDGE, ATTITUDE, BELIEFS AND PRACTICE BEHAVIOUR OF THERAPISTS WITH RESPECT TO MANAGING THE PSYCHOSOCIAL ASPECTS OF PAIN AND DISABILITY FOR PATIENTS WITH HAND INJURIES: A QUALITATIVE STUDY

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ABSTRACT

***Background*:** Hand and upper limb injuries are very common in orthopaedic settings with substantial burden to the individual and society. Psychosocial factors account for prolonged recovery and long-term disability in these injuries. Hand therapists can enhance psychosocial adjustment by screening at risk individuals, providing psychoeducation or refer for psychological support.

***Aims/Objectives**:* To gain an understanding of the knowledge, attitudes and beliefs and practice behavior of managing psychosocial issues in hand therapy.

Material and Methods – In this qualitative description study; semi-structured interviews were conducted on Occupational therapists and physiotherapists therapists practicing in hand therapy using the Theoretical Domains Framework as interview guide.

Results: Eighteen participants (females: 78%, occupational therapists: 83%) were interviewed. Five main themes emerged; there are concerns about the detrimental impact of psychosocial issues, attitudes towards psychosocial issues influences clinical practice; increased knowledge is core to building the capacity to address psychosocial issues; leveraging patient and therapist resources to foster psychosocial adjustment, and understanding influencing factors are crucial to psychosocial adjustment.

Conclusions and Significance: Varied knowledge in terms of awareness and familiarity, diverse attitudes towards psychosocial issues and several barriers to implementing psychosocial adjustment programs were reported. Hand therapists require additional training, tools or guidelines to support patients.

***Keywords*:** Hand and Upper limb, Psychosocial factors, Hand Therapy, Qualitative description

INTRODUCTION

Hand and upper limb injuries (HULI) are one of the most common problems seen in orthopedic settings [1, 2], account for 20% of all emergency department presentations [3] and are associated with significant impact on physical recovery, psychosocial challenges, functional abilities, employment and relationships of affected individuals [4,5]. Many people regain full function, but some will require prolonged recovery and rehabilitation and. A subset of these individuals faces the potential of long-term disability despite the adequate recovery of the bone and tissues [6,7]. The burden of hand and upper limb injuries is a substantial burden to individuals and society due to the direct medical and indirect and intangible costs [8,9].

Psychological factors such as catastrophic thinking, depression, pain anxiety, and heightened illness concern explain a large part of the variability in disability associated with similar levels of impairment and disability after a hand and upper limb injury [10,11,12,13]. Similarly, perceived stress, self-efficacy, social support, and attitude have all been proposed as factors that influence clinical outcome and rehabilitation after hand and upper limb injuries [14,15,16]. It has been estimated that most individuals with a hand and upper limb injury will experience some symptoms of anxiety, depression, trauma or adjustment difficulties [11,17] with some studies reporting that up to 90% of patients experience these symptoms in the immediate period after the initial injury [18]. Approximately 13% of patients presenting to hand surgeons have untreated or undertreated symptoms of depression enough that place them in the category of people with a diagnosis of major depression [19]. These findings show that hand and upper limb pain and disability are multidimensional constructs influenced by physical impairment, activity, participation in life roles, environmental and personal factors, and requires a multidisciplinary treatment approach [20].

It has been suggested that surgeons and hand therapists attend to the patient's coping strategies in addition to the underlying pathophysiology [12]. For example, surgeons can improve postoperative outcomes by assessing mood, understanding, and resiliency before elective hand surgery [21]. Conversely, therapists can screen for risk of poor adjustment and provide routine psychoeducation or refer for psychological support as needed [5]. Given the importance of psychosocial factors in HULI pain and disability, screening, and assessing psychosocial issues at all levels of care is warranted [22,23]. Hand therapists should also be motivated to obtain more training on how to help patients develop resiliency through effective pain management and coping strategies [24]. Preliminary studies show that cognitive and behavioral therapies are useful tools that can be used alone or in conjunction with treatments offered by surgeons, hand therapists, and physiatrists [25]. Motivational interviewing also offers an approach for managing behavioral challenges that patients with hand and upper limb injuries present with during recovery [26].

Hand therapists can enhance psychosocial adjustment using these techniques to decrease catastrophic thinking and optimize self-efficacy preoperatively and ameliorate symptom intensity and disability during treatment for hand and upper limb injuries [27]. Many allied health professionals, such as Occupational therapists apply a broad biopsychosocial view in practice due to their background in mental health [28]. However, receiving a biomedical-focused training/education often shapes therapist's attitudes and beliefs towards such that less attention is given to psychosocial factors affecting musculoskeletal health [29,30]. Therapists should be mindful of the impact of their attitudes and beliefs on their patients' attitudes and beliefs, which, in turn, affects patients' behavior and treatment adherence [31,32]. Current evidence [33] shows that allied health care professionals require additional training to incorporate psychosocial interventions in practice to optimize treatment benefits for long-lasting results.

OBJECTIVES

The objective of this study was to gain an understanding of the knowledge, attitudes, beliefs, and practice behavior of physiotherapists and occupational therapists practicing in hand therapy with regards to screening, assessing, and managing psychosocial issues in patients with hand injuries.

METHODS

Design

This study was a qualitative descriptive study [34] methodology with analytic procedures of thematic analysis [35, 36] to explore the knowledge, attitude, beliefs, and practice behavior of hand therapists with regards to psychosocial issues in clinical practice. Qualitative description is a useful qualitative method aimed at gaining firsthand knowledge of patients', relatives' or professionals' experiences with a specific topic [37]. It draws from naturalistic inquiry and offers techniques for ensuring the phenomenon of choice is presented in a natural state [34]. Qualitative description studies are relevant to clinicians and policymakers because they can be used to inform future interventions, practice, and clinical projects based on the multidimensional understanding of a phenomenon of interest [34].

Framework

We used the Theoretical Domains Framework (TDF) [38] (Table 1) to construct the semi-structured interview guide [See Additional file 1], which underwent revision after piloting the interview with two hand therapists. TDF was used to categorize and explore emergent themes by domain. TDF provides a theoretical lens through which to view the cognitive, affective, social, and environmental influences on behavior [38] and the Behavior Change Wheel, a method for characterizing and designing behavior change interventions [39].

Study participants

We used purposive sampling to recruit therapists from a variety of health care services with a variable experience in hand therapy and a broad range of backgrounds and job roles to allow for broad insights. Purposeful sampling is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest and effective use of resources [40,41]. We searched the Canadian Society of Hand Therapists website for a register of clinicians registered in Ontario and specifically targeted clinicians in Ontario practicing in private or public (acute care, inpatient rehabilitation, outpatient rehabilitation) for face-to-face interviews. This provided a broad representation of the different hand therapy practice setting.

Ethics Approval, Consent, Permissions

The University of Western Ontario (UWO) Human Research Ethics Committee, London approved the protocol for this study (HREC) Reference: 108064). A research assistant contacted potential participants via email to explain the purpose of the interviews and provided copies of the information sheet and consent form upon request. All participants provided written informed consent before or at the time of the interview. Participants were assured of confidentiality and anonymity. Participation was optional, and participants were free to withdraw from the study at any time without prejudice. In order to ensure anonymity, all were assigned numbers and gender-specific pseudonyms that are presented alongside the quotes.

Data collection

Data were collected between September 2018 and March 2019. A total of eighteen individual interviews were conducted, taking place face-to-face (n=10) or via telephone (n=8) and conducted by the lead author, FB. The interviews lasted between 45mins and 90 mins with questions underpinned by literature review and domains of the TDF [38]. The questions were designed to elicit, context, and experiences of challenges, enablers, perceived needs of clinicians involved in hand therapy. We chose individual interviews because they enable participants to provide more detailed insights into less explored topics as targeted in this study [42]. Using a semi-structured interview format ensured that key topics were covered but also allowed for the flexibility to discuss issues introduced independently by the participant [43]. After the first six interviews, the interview guide was modified to include a discussion of emerging themes. Theoretical data saturation was reached when additional transcripts did not generate new themes and were determined using the principles of information power [44,45].

We conducted a pilot interview to establish an estimate of the interview length, clarity of questions, and determine the need for further probes. The topic guide was modified as interviews were conducted based on reflexive practice and interview duration [46]. All interviews were audio-recorded and rendered anonymous during verbatim transcription. Maintaining a reflexive approach using a field note throughout the research process enabled the recognition of nonverbal data and management of data collection and analysis process [47, 48].

Data analysis

Basic demographics were collected from participants (Table 2). We used a deductive and inductive analytical approach where extracted attitudes, beliefs, knowledge, and management practices were deductively coded using the pre-existing domains based on TDF technique and inductively analyzed for emergent themes using thematic analysis [35]. Digital recordings were transcribed verbatim directly into NVIVO™ software [49]. Analysis began with familiarization with the data using an iterative process of reading and rereading transcribed text to identify repeated ideas and issues related to the study aim. Next, we coded the data extracts from all interviews using NVIVO software by tagging and naming selections of text with each data item. The codes were subsequently arranged and ordered into overarching categories, to enable the visualization of potential themes. Thematic maps were produced to refine the themes further and visualize any connections. After that, two authors (FB and JCM) met to agree upon key themes that followed a coherent pattern; what are the different themes, how they fit together, and the overall picture they portray about the data. Finally, each theme and accompanying data extracts were analyzed independently to define more precisely the essence of each theme and provide sufficient evidence of the sub-themes encompassed within each theme [35].

RESULTS

Participants

Eighteen individuals completed the study, and most of the participants were female (n=14) and had an entry-level master's degree (n=13) (Table 2). Thirteen individuals had a background in Occupational therapy. Various practice settings were reported including private practice (n=4), inpatient rehab (n=6) and outpatient rehab (n=10). Two of the participants had a PhD. in Rehabilitation Science with research focused on hand therapy as members of a University faculty. Two participants were clinical researchers experienced in hand therapy outcome measure development, and four clinicians were practice leaders.

Themes and Subthemes

Five main themes emerged from the interviews; 1) concern about the detrimental impact of psychosocial issues, 2) attitudes towards psychosocial issues influences clinical practice, 3) increased knowledge is core to building the capacity to address psychosocial issues, 4**)** leveraging patient and therapist resources is required to foster psychosocial adjustment**,** and 5) understanding influencing factors is crucial to psychosocial adjustment. The model shown (Figure 1) is a visual representation of the summary of the themes and subthemes.

Concern about the detrimental impact of psychosocial issues

Two organizing themes related to awareness and familiarity with psychosocial issues.

Recognizing the burden of psychosocial issues

Therapists believed psychosocial factors including low mood, fear of movement, anxiety, prolonged pain, social stigma, and loss of life roles were a significant burden to patients and negatively impacted overall health, perceived disability, return to work, and quality of life. This awareness sometimes informed the therapist's decision to address psychosocial factors in practice in some capacity to mitigate patient suffering:

"I find depending on the work environment impacts their healing just because there is such a psychological component to healing, especially in hands when they are incapable of using their dominant right hand or the left hand or just being one hand short and having, having the pressure of getting back to work and that is something that patients often discuss as weighing upon" (P005)

"The mental comes first, and then you can work with a physical hand and almost more important than function sometimes. So, I tend to focus more on the state of mind…to make sure patients can process and put their mind to get things done" (P011)

"They might even comment on, um, they do not want to go out and do the things that they would have done before. They might say, I cannot sleep or having a flashback to when they got injured. Alternatively, even the sound of the saw or whatever injured them that bothered them since they

got injured, if they have kids, maybe the child is afraid of them. They may also say they are more irritable with that…" (P014)

Opportunities for intervention during hand therapy visits

Therapists reported that hand therapy provides opportunities to address psychosocial issues due to the frequent interaction with patients and the opportunity to develop trust in the therapist. Some therapists also felt they could play a crucial role in guiding patients to facilitate referral to appropriate mental health services based on their scope of practice:

"I think there are things we can do as therapists to help our patients…we are with them day in, day out and get to know things that they may not feel comfortable telling their doctor" (P007)

"My role is to direct them to the right services like psychology, psychiatry, and social worker…to help the right professional make the right call to streamline and prioritize which clients need their services first" (P018)

However, participants highlighted the inherent risk associated with intervening when therapists are not well prepared or lack a point person to take on the responsibility of following up with identified psychosocial issues:

"I mean, therapists can help build people. We can also bring people down. So, if you are not careful, especially with delicate patients that are not mentally sound, you can maybe harm them and no intentionally either" (P011)

"I mean if you work in a partner or team situation and sometimes that you do not feel like addressing that situation, so you are hoping your partner and can address that situation and they may not even see the things you saw. The patient may just fall through the cracks" (P003)

Attitude towards psychosocial issues influences clinical practice

Two fundamental attitudes towards psychosocial issues were expressed, and the identified themes were clustered based on their confidence or apprehension about the therapist's perceived role.

Having the confidence to intervene in psychosocial issues

Some participants felt confident in their role to deal with psychosocial issues and were more enthusiastic about exploring the psychosocial needs of patients in hand therapy. Participants reported that recognizing the gaps in accessing conventional psychotherapy resulted in a desire to step in and mitigate patient circumstances. Some participants felt that newly employed staff were more open to the challenges inherent in providing both physical and psychosocial treatment in hand therapy:

"I think it is your role as a therapist. If a patient has anxiety and depression, it is going to come out in everything and activity that they do. So, instead of denying it, learn to deal with it" (P003)

"It has been nice to have the new blood coming in to try to create that spark with the older staff. So, I think there is a difference also between I am more a newer staff and the more experienced

staff." What I see with the newer group (staff) is that they are much more open or the discussion about things like they want to learn the new stuff." (P007).

Participants reported that to support patients presenting with psychosocial issues adequately, they needed to be confident in their ability to initiate and follow-up with conversations about the issues confronting patients. Extreme psychological scenarios such as suicidal ideation were mainly regarded as a reason for shirking away from these responsibilities. Feeling inadequate to deal with the complexities current or premorbid psychosocial problems sometimes led to therapist inaction to foster psychosocial adjustment despite being willing:

"What deters me sometimes is when I feel cannot handle it…it's too big a problem. For example, where the person is actively suicidal, I cannot handle that. I need help" (P018)

"Patients come to us with serious mental health issues besides the diagnosis on the chart, and it is hard to separate the longstanding problem form the present. These are not situations that I feel equipped to deal with" (P011)

Having some apprehension about psychosocial issues

Some participants were apprehensive about addressing psychosocial issues during routine hand therapy due to fear of failing to meet patient expectations despite their belief that opportunities exist in routine hand therapy. For other therapists, the reluctant attitude of the team secondarily affected their desire to address the patient's psychosocial needs:

"Because people come to us with serious mental health issues besides the diagnosis on the chart and it is hard to separate the longstanding problem form the present. These are not situations that I feel equipped to deal with" (P001)

Participants also reported feeling deterred from unsuccessful attempts to facilitate psychosocial adjustment despite access to psychotherapy and support from the primary care team. Reluctance often led some participants to attach less priority to psychosocial issues and instead focus on physical impairments or facilitate referrals for psychotherapy services:

I think all the time and effort is certainly worth it when we see successful outcomes. However, there are patients that I have been treating who are receiving psychology but are not getting better. And it is just not going anywhere" (P013)

Some therapists felt that introducing psychosocial issues in hand therapy and having unmet expectations could cause patients to lose faith and trust in their therapist. These unforeseen circumstances were worsened by a lack of improvement in patient health issues despite access to traditional psychotherapy treatment. In all, this caused some therapists to be more apprehensive about raising the issue of psychosocial health in hand therapy.

There have also been patients that I've been treating who are receiving psychology but are not getting better. Moreover, I think I will keep treating them because they have started their psychology and I want to see after they have had some sessions of psychology, are they engaging more in therapy and things like that. And as I said, sometimes it is just not, you know, it is not going anywhere" (P012)

Increased knowledge is core to building the capacity to address psychosocial issues

Two organizing themes related to the therapist's knowledge about psychosocial issues were identified.

Professional background influences foundational knowledge

Some participants acknowledged that their entry-level education provided foundational knowledge in mental health. This proved very valuable at increasing their interest, confidence, and professional expectation to address psychosocial issues. Post-professional education in social work and clinic-based research in psychology also allowed therapists to close the gaps in their learning:

"We did a lot of mental health training, and it was well addressed as it applies to physical medicine" (P003)

"I took a diploma in social work, so my ability to deal with people that have depression and anxiety might be a bit more than the average clinician just because my background is in that" (P009)

Conversely, some therapists felt the lack of background education in mental health caused significant gaps in their knowledge of psychosocial issues. They also acknowledged that obtaining more education on psychosocial aspects of health influences physical health positively:

"So, I know about the things that I do not know, but I probably do not know everything that I do not know if that makes sense… Because I do not have that psychology background that my OT colleagues have" (P014)

"The mental health aspect is something I do not know about. I'm trying to understand more of this whole psychosocial stuff, and I cannot do much until I've dealt with the physical (P017)

Practice-based knowledge and active pursuit of lifelong learning

Other therapists reported that their knowledge of psychosocial issues was developed through work-based learning directly or indirectly during mentoring, observing, or interprofessional collaboration with psychologists or psychiatrists or attending educational sessions focused on psychosocial health. Participants also commented that clinical opinion leaders were instrumental in increasing their knowledge about psychosocial issues through scholarly writing, clinical research, and conference presentations. Some therapists reported capacity building through formal methods of instruction in psychosocial health through support groups at work and staff training:

"At our most recent hand conference, we had like an hour-long presentation basically on managing psychosocial issues using real-life case studies" (P004)

"I first got involved in psychosocial research for hand therapy at work when discussing the need to have a screening tool for hand therapists… we ended up developing the injured worker's survey" (P014)

"There was a hand injury support group, and it was led by one of the therapists and the social worker" (P001).

"I used to do a lot of staff training in lunch and learn or formal workshops on psychosocial education" (P008)

Some participants mentioned that years of observing and documenting clinical patterns created the confidence to build rapport, communicate effectively about psychosocial issues, and offer coping strategies:

"When you have been practicing for as long as I have, you accumulate a broad toolbox to individualize treatment based on the presenting psychosocial issues. I pull from particular skill sets to respond to the patient needs" (P003)

Some participants felt their knowledge and experience were validated by members of the healthcare team, which further increased their confidence to provide psychosocial support for patients. For example, some surgeons were only comfortable referring patients with psychosocial issues to clinicians they perceived to be skilled in providing psychosocial adjustment:

"The physicians are aware of therapist experience based on a working relationship…patient with known suicide attempts, underlying depression, psychosis or neurosis are referred to clinicians with a strong psychosocial education overlay" (P001)

Maximizing patient and therapist resources to manage psychosocial issues

Two organizing themes related to current practices/behavior of therapists concerning managing psychosocial issues were observed.

Available clinical support and systems

Many of the therapists interviewed were familiar with evidence-based cognitive-behavioral treatment techniques for fostering psychosocial adjustment techniques for patients with hand injuries and reported the use of various online tools to instruct patients on pain management, coping skills, and techniques to foster psychosocial adjustment. Participants also reported the use of coping skill strategies such as activity scheduling, cognitive behavior therapy, acceptance and commitment therapy, mindfulness, and motivational interviewing:

"I use internet education materials on problem-solving, relaxation, difficulties with thinking and wellness modules for patients with good internet access or from remote locations" (P011)

"Activity scheduling, helping people work to time limits rather than pain limits and helping to shift some of their cognitions in terms of harm versus hurt" (P009)

However, it was essential to ensure that the online information was confidential, interactive, credible, high-quality web design, inspirational, and easy to use. Some therapists were also willing to pay for the resources and suggested having hard copy materials may be a way to overcome confidentiality issues:

"There's so much out there that I think it is important to break it down it down for patients and to say this is something that I use and this is why I use it, and I would like you to look at it to see if it might be helpful" (P013)

"I made sure that if I am going online, it is going to be a credible website that I can get a patient to get the information from." (P017)

"As long as it is a quality product, I won't mind paying for it if I find it to be of value and worth my money" (P009)

"The challenge is confidentiality because most of the college guidelines say that anything online is not secure. It is always that storage is an issue. So, confidentiality or is also related to where do you store it? Right. So, right now most of the platform is a cloud platform, and it is very challenging to assume it is 100% secure" (P011)

Some participants reported sharing their caseloads with colleagues more skilled or experienced in fostering psychosocial adjustments and able to delineate whether patient symptoms are due to current or premorbid psychosocial issues:

"It is better to co-treat with therapists more skilled with managing mental health issues like PTSD, etc.…the hand issue may have resolved or improved significantly while the mental health issue persists." (P017)

Participants reported several sources for helping patients with psychosocial problems, which included accessing onsite mental health services or spiritual care, referral to family physicians, and community mental health services.

"Sometimes it would be a linkage to community services that comes from my long history of working in this area and understanding the other resources that perhaps would be useful because there was no social worker" (P016)

"I would refer out for that if I think somebody needs it. It is difficult because most of these services aren't covered by OHIP, and you are looking, you know, it's just an OHIP patient. All our patients are OHIP or WSIB. If it is a WSIB patient, then I can refer to the board and get a psychological evaluation for them" (P012)

"...a person that he connected with was someone from spiritual care. I could tell that his faith was quite important to him. So, I contacted them in spiritual Care and set up meetings so that the patient could be seen first before a session with me in the PT treatment room. We did it a few times, and it worked" (P001).

Establishing and advocating peer support

Some clinicians facilitated coping skills training by timing the clinical visits of patients with psychosocial health challenges with those that have successfully developed coping skills to provide opportunities for open discussion about psychosocial issues and first-hand sharing of personal experience about what works in reality:

"We do use that sort of peer mentorship element sometimes, and to the point wherein strategic cases we will get permission and set a time for people to meet informally as a peer mentor and give input around their own experience and looking for those teachable moments and opportunities to intervene" (P008)

Similarly, some therapists reported that manipulating the environment was another way to encourage patients to work through things together. For example, using the fish-bowl technique; a practice style that involves seating patients in a communal fashion around a treatment table to engage with each other. In certain instances, therapists designated discharged patients who volunteer their time to act as formal peer mentors in a more structured group program:

"We sometimes manipulate the environment so that we've booked patients that could use a little support with patients that we know naturally are altruistic and are reaching out and good at supporting others" (P009)

Maximizing facilitators and mitigating barriers are crucial to psychosocial adjustment

Six overarching themes of facilitating and limiting factors influencing the management of psychosocial issues in hand therapy were identified:

Developing therapeutic alliance

Most of the therapists acknowledged the importance of developing good relationships with patients to effectively manage psychosocial issues. This involved building rapport, affirming the patient's experiences and gain trust to get patient buy-in into managing psychosocial problems in routine hand therapy. Furthermore, showing empathy and developing interpersonal skills were keys to empowering patients and increase the acceptance of the role of hand therapists in addressing psychosocial issues:

"So, here's the thing. If you have that therapeutic rapport with the patient, they trust you, they share with you and you work through these issues, you will have better outcomes, they will do better" (P005)

"It's important to focus on understanding how the patient understands and learns things as a way to share power" (P013)

"It's really about validating and acknowledging what they've been through. Being a listening ear helps you understand what exactly happened and what you can expect." (P018)

Therapists also reported that rapport reduced the tendency to always handle patient encounters in a business-like manner, focus on physical impairments and stigmatize patients.

Overcoming the stigma of mental health

To most therapists, mental health remains a stigmatizing issue for patients and in society at large. This makes using language that normalizes psychosocial problems during clinical encounters even more critical. Therapists also reported that consistent messaging increases the acceptance of the role of hand therapists, especially for patients who feel stigmatized by going to see a licensed psychotherapist. Patients were sometimes more willing to receive care from a PT or OT versus a psychologist due to the stigma of seeing a designated mental health professional:

"I think absolutely that being consistent with messaging from the very beginning would make a difference." (P002)

"*Working with a therapist just normalizes it for the patient…Patients would refuse to see a psychologist or a psychiatrist but are willing to see a PT or OT to address the same thing." (P014)*

Therapists also highlighted the importance of acknowledging cultural differences and remain sensitive when communicating about psychosocial issues and affirm patient experiences or preferences to help them become more accepting of treatments for psychosocial issues:

"Eastern cultures do not even use the word mental health because it is just not okay. We should be cognizant of these things to be able to use the right kind of language and approach to make our work acceptable to patients" (P015)

"Because we might be too quick to stigmatize people as noncompliant and not patient enough to listen to them…forgetting how vulnerable, frightened and helpless they feel…we've seen it a thousand time" (P003)

Some therapists reported that the fear of been judged negatively based on outcome assessment scores sometimes made some patients wary of filling questionnaires. This attitude was often complicated by strained relationships with employers leading to fear of connivance between the healthcare team, insurance board, and employer. Furthermore, the stigma and cultural influences on gender roles may lead to apathy about psychosocial problems:

"I have tried using outcome measures but have not been all that successful. Sometimes patients read the title at the top, and they kind of do not want to do them because of the way things are described." (P011)

"Other barriers are stigma and fear of disclose. If it is cultural, the male role is supposed to be healthy and dominant and not vulnerable. It might even be a stigma within their sort of social community…that a depression is seen as a weakness, a spiritual problem, or whatever rather than it being an illness. (P013)

Managing emotional response to psychological illness and suffering

Participants reported experiencing several emotions such as anger, worry, frustration, helplessness, and exhaustion, sometimes when tackling psychosocial issues in hand therapy. Developing resiliency to overcome the emotional burden was necessary if therapists were to continue with this area of clinical practice.

"I find that working with patients, especially ones that have a lot of emotional baggage, takes a toll on you. I call them energy vampires because I feel like sometimes, they just suck the life out of you" (P003)

"Definitely frustration and anger too on behalf of the client too, because if you have a client that needs help, needs more therapy and you cannot get it, and they can afford to have it" (P017)

Participants observed that certain patients triggered past negative experiences based on their presentation and often fit into patterns of difficult cases previously encountered in clinical practice. This further increased apprehension to manage psychosocial issues. They also acknowledged the need to check their own bias to ensure all patients were treated fairly:

"You see them on your case, and you are like that person is going to wear me out. That is the tipping point for sure. It is just the natural frustration; those are the patients that wear me out for sure." (P011)

"I think I have been a therapist for 32 years. I trained myself able to separate my personal feeling at the same time, try not to be numb about what is going on. It is the only way to work without stereotyping patients" (P011)

Some therapists also acknowledged that dealing with their mental health further posed challenges to helping patients with psychological problems. In a rare instance, one therapist was known to have been overwhelmed with the weight of their mental health issues and decided to leave their practice completely to avoid triggers from patient encounters:

"I am susceptible to that because of personal experience that I had with my family" (P014)

"I mean, sometimes a therapist's mental health may be a factor…I worked with a therapist who had her mental health issues with severe depression, and she could not do it and left the profession. If you are not well yourself and you are trying to provide support in that area. There could be a cost to your own" (P001)

Accessible social and economic support

Participants reported that the cost associated with managing psychosocial issues was steep and posed a significant barrier due to fostering psychosocial adjustment. Therapists observed that patients with access to workers compensation and private insurance were able to access funding for psychosocial issues easily:

"Funding approval is a big challenge, so we use the psychosocial adjustment issue as one of the indicators for funding requests. If identified earlier, we advocate longer length of stay and alert the referral source that the client may need more resources for psychosocial service" (P011)

"It is difficult to access psychosocial care with OHIP coverage. If it is a WSIB patient, then we can refer to the workers' compensation for psychological evaluation and treatment. Otherwise, we refer to the family doctor (P010)

Therapists noted that family members also share the burden of psychosocial problems. It was important to consider providing extra support to struggling family members through education tools:

"Another factor I think is quite essential is the family. If we do have a way to educate family members to identify these issues and bring it up to the team…that may help the patient better than the 30min I spend with them" (P011)

"As simple as something like a family information pamphlet to let them know that in the recovery process there will be some time that their family member encounters some psychosocial, emotional changes" (P015)

The organizational system and environmental factors

Therapists identified several factors in the workplace, such as lack of privacy, cumbersome administrative processes, busy work environments, which often made it difficult or impossible to address psychosocial issues. Participants reported that they experience much pressure from managing multiple patients at the same time, and the reduced time for therapy made little or no time available to consider psychosocial factors in hand therapy:

"We only see the client for 30mins, and within that time it is hard to deal with the psycho-emotional adjustment and change the treatment program to suit the client's needs" (P004)

"It would not be unusual to have to have between 12 and 15 patients daily for each therapist in outpatients." (P005)

"Out of 250 referrals a month, only 18% are re-booked for another day, all those are seen on the same day" (P008)

"The cost is that you have to do a lot of extra paperwork to document everything you do" (P010)

The inadequacies around available time meant therapists felt obliged to focus on physical impairments for most patients who get a minimum number of visits due to the short length of stay or acuteness of their condition. Participants suggested that identifying at-risk patients early during pre-surgical consult would allow more time to make necessary referrals before discharge:

"The priority elements to deal with the time pressure includes protecting the person with the splint, providing pain management. It has been ingrained we need to protect the tendon that still is a priority issue" (P008)

Knowing that long wait times exist for many services and the associated stress and frustrations of patients made some therapists silent on the issue of psychosocial issues in their clinical practice:

"The most common challenge after opening up the can of worms is that the client will expect that you are going to help them. That expectation is tough to deal with, and often there is a long wait for services that frustrate and stress the client. So, I rather not talk to them about it" (P009).

Participants reiterated that using the built environment to create an atmosphere of warmth, openness, and calm and staffed by teams with a biopsychosocial approach to health increases the likelihood of helping patients cope with psychosocial problems:

"You need a calm environment. I bought the clinic with the hardwood ground; the walls are green and mimic trees to build a natural environment. It is a very calming environment to come into" (P012)

"There is no private treatment space in our clinic. However, we do have a separate room right now for splinting. I have been strategic to use that private time to address more personal issues and to bring maybe up some of the psychosocial pieces that people may have difficulty disclosing in an open environment" (P007)

The absence of support from social and professional influencers like managers and members of the health care team or even the health organization at large were also described as significant barriers:

"I do not think it is seen as my role with my employer at our current managed care environment…it's not seen as our role and it has to be an identified diagnosis and then maybe the person will be able to get more support" (P016)

"The last place I worked was terrible…basically, if you follow these four steps, and the patient does not get better, well, it is not your fault; it's the patient's fault. They have a problem, it is mental, and you cannot help them. They are a lost cause. No one else can help them. So, you did your best, and no one else can help them." (P018).

Therapists suggested that having a team-based approach was crucial to managing psychosocial issues effectively. Health organizations proactive in shaping a biopsychosocial approach to health foster interprofessional collaboration for improved patient outcomes:

"The piece with psychosocial issues is that if everybody addressed it, it would be far easier than one person on the team. Then it becomes a burden and has a toll on the staff because they keep wanting that one person or whatever" (P005).

Therapists reported that previous access to onsite psychologists or social workers was profoundly beneficial. Unfortunately, budget cuts, closure of several programs, and reduced staffing levels continued to make access care. Follow-up was also tricky for patients whose conditions were mostly acute or attending from distant locations and who typically receive only one treatment session:

"We should have a psychologist or social worker attached to every hand team to deal with these issues." (P006)

"We do not have the Psycho team anymore to help deal with some things that our patients are going through." (P009)

Some therapists also highlighted how the model of care could be a barrier to including psychosocial issues in hand therapy treatment plans. For example, the shared care model can lead to inconsistencies and gaps in communication due to multiple therapists managing the same patient. Having a focal point of contact is crucial to managing psychosocial issues. Furthermore, the lack of support from clinical managers or a negative work culture that assigns blame on patients or cumbersome administrative and referral processes also make managing psychosocial issues difficult:

"The other challenge is that we have a shared care model. It is not always a consistent therapist that sees the person, and that can be problematic. It may be better to have a primary therapist for at-risk patients" (P012)

Challenges with outcome assessments

Another issue raised by therapists was the reluctance of their clinical colleagues to adopt formal psychosocial assessment into clinical practice. This behavior limited opportunities to teach coping skills and measure changes in patient psychosocial symptoms:

"I feel a bit of a resistance to a, to a wider spread implementation. The use of comprehensive baseline assessments has been a battle that I have fought in our practice setting. There has been resistance in general to the systematic use of outcome measures. I have kind of repeatedly proposed tackling that from a few different angles and not ever been successful at changing the dynamic or the practice. I think that is probably part of my challenge" (P009)

Similarly, some therapists experienced challenges with routine use of outcome measures in clinical practice due to the lengthy measures and complicated scoring systems. Specific tools measured multiple constructs which were challenging to unpick and target appropriately in clinical practice which further limited their widespread use by clinicians:

"It would be helpful to have forms that do not take up much time because sometimes you have complex scoring systems and neither the patient nor I have time for that" (P010)

"Sometimes I have to sit down and read the entire form with them and then circle it with them because they just may be older and did not bring their glasses or something like that. However, it is also taking time out of my assessment or my treatment time. So I just think that they have to be worth my time." (P015)

Suggestions for freeing up time to create opportunities for managing psychosocial issues included asking patients to complete outcome measures or do exercises in the waiting area and using online tools to provide supplementary information on exercise or psychosocial issues. Recommendations for improving the use of outcome measures included the availability of tools that are easy to use in terms of scoring and completing, making multiple translations available and editing titles with a negative connotation:

If I can get the patient to go on a website and complete a questionnaire before they come in. Later, I can score and get an indication of what is going on before they get through the door. That is huge and will cut down much time" (P001)

"I think the most important is how easy the tool is because 30mins time is short. So, if we need tools that can be used within 10 mins to identify the key issues and advocate for the client's need at the right time" (P011).

DISCUSSION

The findings of this study have highlighted that a range of factors related to the clinician's knowledge, attitude, beliefs, and practice/behavior influence the management of psychosocial issues in hand therapy. Although hand therapists in this study held the belief that psychosocial problems negatively impact their perceived role, knowledge base influenced patient outcomes, their approach to dealing with patient complaints, and attitude towards psychosocial issues.

All participants acknowledged the detrimental effect of psychosocial issues on treatment outcomes after a HULI. In terms of awareness and familiarity, the knowledge of therapists in this study was quite mixed. This depended on education and the clinical environment. The findings from our study also showed that hand therapists with foundational knowledge in mental health expressed more confidence in helping patients develop resiliency and coping skills to deal with psychosocial issues. Exposure to work-based learning opportunities through mentoring from psychologists or clinical leaders and staff training also improved the therapist's capacity to manage psychosocial issues in hand therapy. Leadership was also associated with higher levels of knowledge about psychosocial issues, and inspiration from practice leaders and opinion leaders were associated with the desire to incorporate coping skills training into current hand therapy practice. Participants in this study identified transformational leaders, and they provided inspiration and vision for what therapists could achieve through personal effort. They also encouraged the development of personal and organizational missions that could promote the therapist's willingness to expend extra effort to learn about psychosocial issues and learn how to deliver coping skills in hand therapy [50].

The organizational climate that provided more educational support such as support for conferences, workshops, seminars, and journals were also associated with more positive attitudes [51] towards psychosocial issues. Providing therapists the opportunities to access these types of resources may increase their capacity to learn about psychosocial issues and other useful practices that may also allow therapists to more clearly understand how to incorporate coping skills into hand therapy practice. Therapists with higher knowledge about psychosocial issues tend to be associated with a supportive organization, which is consistent with literature suggesting proficient cultures as having up-to-date knowledge of current evidence for effective clinical practice [52]. Intuitively, it can be inferred that participants working in establishments resistant to incorporating psychosocial management practices into hand therapy may be less interested in new ways of working and may suppress efforts to change their current practice and less likely to seek and obtain new knowledge related to managing psychosocial issues [50]. For example, one of the participants described the difficulties with getting hand therapists to adopt outcome measures for assessing psychosocial problems in clinical practice despite seeking out a relevant and psychometrically sound measure with less time burden for completion. Some assurance that patient mental health expectations can be met, support from employers, and working with a highly knowledgeable and skilled team encourages a positive attitude to psychosocial issues.

Attitudes towards psychosocial problems were notably diverse and encompassed positions that could be related to being willing or reluctant to combine traditional hand therapy with coping skills training. Two fundamental beliefs; fiduciary duty and period of employment were facilitative to therapists having a positive attitude. Some therapists felt it was their legal and ethical responsibility to support their patients, especially when the trust was already established. Prolonged pain and disability from lack of access to traditional psychotherapy was enough motivation for these therapists to learn about managing psychosocial problems. A practice that includes psychosocial issues was also linked to experience such that therapists newer to the organization were keen on adopting new treatment strategies and policies to sometimes prove themselves compared to more experienced therapists.

Furthermore, the organizational climate also influenced the therapist's attitudes towards psychosocial issues. Climates that are engaging are typified by therapists' perceptions that they are personally able to complete worthwhile things, remain involved in their work, and maintain concern for their clients [53]. As reported by participants in this study, establishments, where most therapists are more engaged with psychosocial issues, provide a fertile ground for therapists to orient toward personal growth and to nurture more positive attitudes toward psychosocial issues. Organizational challenges such as high patient volumes were associated with lower interest in adding more treatment techniques to the therapist's tool kit. Stresses such as feeling exhausted, overworked, and the inability to get necessary tasks completed also reduce the prospect of learning about psychosocial issues and the appeal of implementing coping skills training in practice.

Therapist practices/behavior required leveraging on therapist and patient skills and resources through the use of different strategies such as behavior change techniques, peer and social support. A recent mapping of hand therapy practice in the past ten years concluded that more evidence is needed to support behavioral treatments for complex diagnosis [54]. Similar to our findings, Sposato et al. [55] also recommend facilitating peer support, emphasizing pain management, and focusing on client-centered goals and interventions to foster psychosocial adjustment in hand therapy. Regardless of therapist knowledge and experience, our study findings show that a team-based approach where therapists collaborate with mental health professionals was more suitable for managing psychosocial issues. This enhanced the development of an organizational culture that prioritizes psychosocial problems and interventions. Kress et al. [56] also opined that a holistic approach to managing psychosocial issues should involve all healthcare stakeholders.

Several enablers and barriers influencing clinical practice were reported in this study. This is consistent with recent research showing that orthopedic hand surgeons are aware of psychological illness, several barriers such as lack of time, social stigma, and confusion about referral processes affect the screening and referring patients for psychosocial issues [57]. Participants reiterated the vital role of building rapport with patients to effectively manage psychosocial issues in hand therapy. Patients continuously face barriers to communication in most healthcare systems, and attributes such as active discussion, explicit language, listening, and an empathic manner facilitates effective communication [58]. However, they respond better to empathic interactions, are willing to understand the influence of psychosocial issues on their response to injury, and appreciate the emotional toll of psychosocial issues on therapists. [59] Empathetic communication [60] ensures that the physical and emotional aspects of illness, such as orthopedic trauma-related stress and distress are expected and validated [57]. Excellent communication skills have been linked to improved understanding of cultural diversity [61] better-perceived support by patients [62], especially from ethnic minorities [63].

Time was described as a critical barrier due to the overwhelming nature of making referrals for psychotherapy treatment, high patient volumes, and the burden of outcome measurement.

Specifically, the use of several instruments increased the burden to both patients and therapists. Although, a single outcome measure may not capture the impact of psychosocial issues on HULI, outcome measures that best capture the outcome of relevance to the patient should be prioritized [64]. Fear of being stereotyped and deemed unfit for work was another reason why patients decline psychosocial assessment. A multidisciplinary team approach, educating patients and workplace representatives about assessment requirements and direct feedback to workers with HULI are ways to avoid misunderstanding and increase patient engagement [65]

Several psychological factors, including patients' beliefs, cognitions, and emotions, are shaped by a person's culture, which may alter the pain experience and impact on their outcomes. Hand therapists can provide culturally competent care by seeking to understand the values and beliefs of the patients to collaborate on interventions and care while being sensitive to their culture and its effect on the illness experience [66]. The non-adaptive pain thoughts of patients and words/concepts used by hand therapists are both critical in the recovery from HULI. [67] reported a correlation between disability and patient goals and interpretation of advice from hand therapists. It is vital to address non-adaptive interpretations of nociception and provide participants with words, concepts, and coaching that increase patient confidence with healthy, but uncomfortable exercises [67]

Strengths and Limitations

The strength of this study was first-hand knowledge, knowledge-gaps, and suggestions for improving the management of psychosocial factors in hand therapy by frontline allied health professionals. Purposive sampling [68] was also used to select a wide range of allied health professionals from several locations and areas of clinical practice. A limitation of this study was that all the study participants were aware that the interviewer was a Ph.D. student researching psychosocial factors in hand therapy, which could affect their answers, such as when they were asked their views on using technology for managing mental health issues. Another limitation was that the participants were from Ontario, Canada, and study findings may not apply to other regions or generalized to people with psychosocial problems broadly. However, qualitative studies are designed to generate a more in-depth understanding of issues rather than create a generalizable result.

CONCLUSION

This study evaluated the knowledge, attitudes, beliefs, and practices/behavior of occupational therapists and physiotherapists about addressing psychosocial issues in hand therapy. Participants acknowledged the considerable impact psychosocial issues on pain, disability, and outcomes in patients with HULI, but the knowledge in terms of awareness and familiarity was mixed. Educational background and work-based learning were the two principal routes to building capacity. Attitudes were also diverse and encompassed positions that varied between willingness and reluctance to act on psychosocial issues. Most hand therapists perceive they have a role in managing psychosocial factors and usually involved both patients and therapists in the management process. Study participants reported several facilitating and limiting factors that impact the ability of therapists to incorporate psychosocial care into traditional hand therapy. While psychosocial issues remain a significant reason for prolonged pain and disability, it should not be a significant source of anxiety for therapists. Clearer and evidence-based supplemental strategies focusing on building coping skills for managing moods and behavior, pain management, planning activities, problem-solving, and relaxation techniques might reduce the anxiety of therapists. Individuals seeking care in hand therapy stand to gain from these efforts with reduced suffering from the effects of prolonged pain and disability.

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Table 1: Description of interviewed participants (n=18)

Interview number	Sex	Highest Education	Profession	Clinical Experience (years)	Years in hand Therapy (years)	Clinical Setting
Poo1	F	Masters	OT	35	15	Private
Poo2	F	Masters	OT	17	10	Outpatient
Poo3	F	Masters	OT	21	12	Outpatient
Poo4	F	PhD	OT	35	25	Inpatient
P005	M	Bachelors	PT	36	15	Outpatient
P006	F	Masters	OT	15	10	Inpatient
P007	F	Bachelors	OT	18	12	Inpatient
P008	F	Masters	PT	22	10	Private
P009	M	Masters	OT	27	8	Private
P010	M	Masters	OT	36	18	Outpatient
P011	F	Masters	PT	12	5	Outpatient
P012	F	Masters	OT	17	5	Outpatient
P013	F	Masters	PT	26	10	Inpatient
P014	F	PhD	OT	43	30	Outpatient
P015	F	Masters	OT	19	6	Inpatient
P016	F	Masters	OT	18	10	Inpatient
P017	M	Bachelors	PT	22	12	Outpatient
P018	F	Masters	OT	40	28	Outpatient

Table 2: Topic guide for semi-structured interviews and the corresponding theoretical Domains Framework (TDF) domains

Domain	**Questions**
1. Knowledge	• Can you tell me what you know about psychological care in the management of psychosocial issues affecting hand and upper limb pain and disability? • How did you acquire this knowledge (prompt for entry level and post grad learning) • Are you aware of any guidelines on mental health or Psychotherapy guiding your professional practice? - If yes, what is your understanding of the recommendations? - If no [description of the guideline by the COPO and COTO provided to participants]
2. Skills	• How do you usually deliver psychological care to patients with psychosocial issues? - Can you give a specific example of what aspects you deliver? • What skill-based training have you received in psychological care?
3. Social/professional role & identify	• What do you think about the relevance of this guideline in the context of hand therapy practice? • Do you think it is an appropriate part of your role to be following these recommendations?
4. Beliefs about capabilities	• How difficult or easy is it for you to provide psychological care to patients with hand and upper limb conditions and psychosocial issues? • What problems have you encountered? - What would help you to overcome these problems?
5. Optimism	• How confident are you that you can deliver the psychological care recommendations despite the difficulties? • What do you think will happen if you do not routinely provide psychological care to patients in your practice?
6. Beliefs about consequences	• What do you feel are the consequences of offering psychological care to patients with psychosocial issues? - prompt for advantages such as return to work, adequate sleep and disadvantages such as strained therapeutic relationship, healthcare costs, healthcare shopping
7. Reinforcement	• How do incentives/rewards influence the delivery of psychological care to patients with hand and upper limb conditions in your practice? - What incentives would make it easy for you to deliver psychological care?
8. Intentions	• Do you currently or intend to deliver psychological care to patients with psychosocial issues? (prompt for further explanation) • Are there other things that interfere with your intentions to deliver psychological care recommendations to patients with psychosocial problems?
9. Goals	• How much do you want to deliver the psychological care treatment techniques to patients with psychosocial issues? - In what situations would you want to deliver the recommendations?
10. Memory, attention, decision processes	• Do you consider delivering psychological care to patients with psychosocial issues? • How much attention do you have to pay to deliver psychological care to patients in your practice? • What are your reasons for not offering psychological care to patients with hand and upper limb conditions? - prompt for attention, forgetting, lack of time, feeling uncomfortable, being unsure of what to do, fear of upsetting patients,
11. Environmental context & resources	• To what extent do physical or resource factors facilitate or hinder you in delivering the psychological care to patients with psychosocial issues? • Are there competing tasks and time constraints that impact the delivery of psychological care to patients in your clinical practice? • Do you have the necessary resources available to you to deliver psychological care to patients with hand and upper limb conditions?
12. Social influences	• To what extent do social influences such as colleagues, physicians, surgeons, professional bodies facilitate or hinder you in delivering psychological care to patients with hand and upper limb conditions? • Do you observe other peers and role models providing psychological care to patients with hand and upper limb conditions? • How do the expectations of your patients and their families influence your provision of psychological care?
13. Emotion	• How do emotional factors influence whether psychological care is delivered to patients with hand and upper limb conditions? • How would you describe your emotional response to delivering psychological care? • Does not providing psychological care in your practice evoke worry or concern in you?
14. Behavioral regulation	• Are there any procedures or ways of working that encourage or discourage providing psychological care to patients with hand and upper limb conditions? • What do you think is needed to ensure the consistent delivery of psychological care to patients with hand and upper limb conditions?

(Adapted from chapman et al, Barriers and enablers to the delivery of psychological care in the management of patients with type 2 diabetes mellitus in China: a qualitative study using the theoretical domains framework, 2016;16:106.)

FIGURES

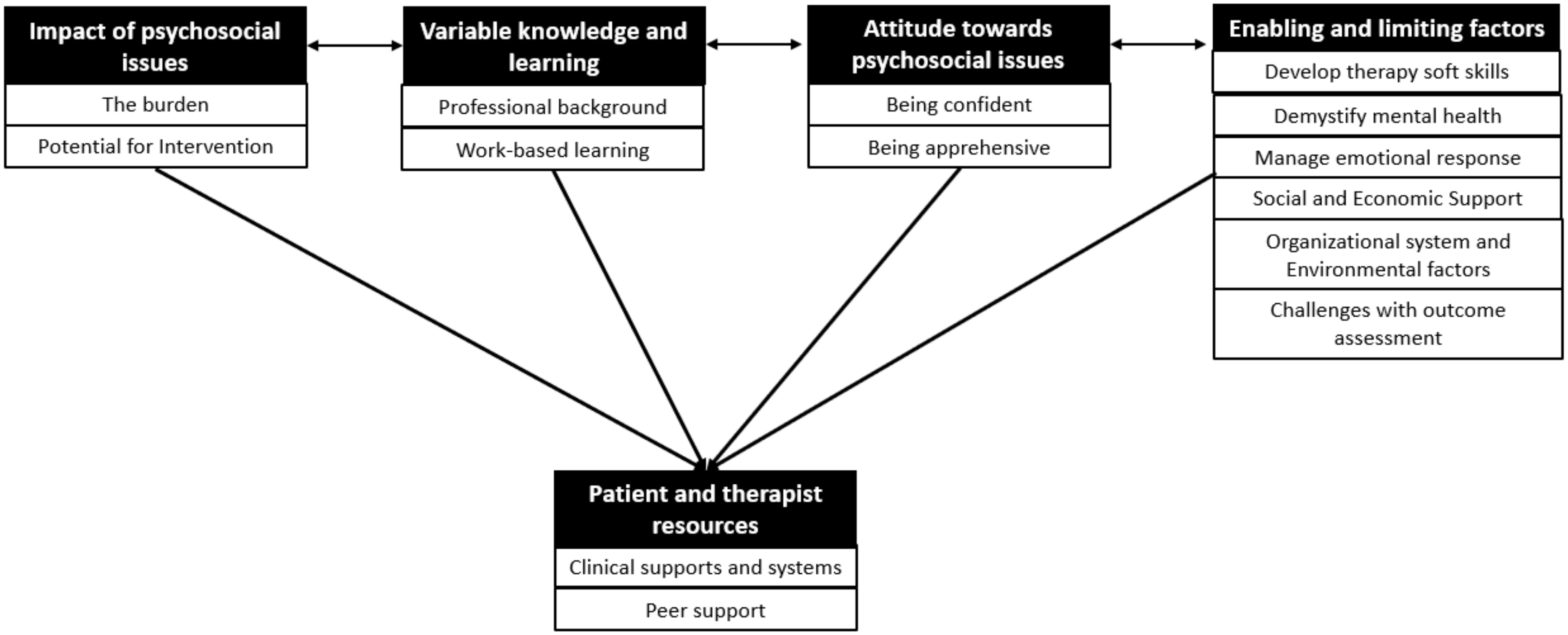

Figure 1: Visual representation of themes and subthemes

APPENDIX 1: Domains in the Theoretical Domains Framework

Domain/constructs	Definition
1. Knowledge – condition, scientific rationale, procedural, task environment	An awareness of the existence of something
2. Skills – development, competence, ability	An ability or proficiency acquired through practice
3. Social/professional role & identify	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting
4. Beliefs about capabilities – empowerment, competence, self-confidence	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use
5. Optimism – realistic, identify	The confidence that things will happen for the best or that desired goals will be attained
6. Beliefs about consequences – outcome expectancies, regrets	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation
7. Reinforcement – incentives, rewards, contingencies	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus
8. Intentions – motivation, commitment	A conscious decision to perform a behaviour or a resolve to act in a certain way
9. Goals – priority, plans, implementation	Mental representations of outcomes or end states that an individual wants to achieve
10. Memory, attention, decision processes – decision making	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives
11. Environmental context & resources - materials	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour
12. Social influences – norms, pressure, modelling	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours
13. Emotion – affect, anxiety, fear, stress, depression, burnout	A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event
14. Behavioral regulation – action planning	Anything aimed at managing or changing objectively observed or measured actions

Reference:
Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, Foy R, Duncan EM, Colquhoun H, Grimshaw JM, Lawton R, Michie S, A guide to the Theoretical Domains Framework of behaviour change to investigate implementation problems. Implementation Science, 2017;12:77.
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CHAPTER 5: DEVELOPMENT AND USABILITY TESTING OF A WEB-BASED HAND THERAPY COPING SKILLS PROGRAM FOR MANAGING PSYCHOSOCIAL PROBLEMS IN HAND AND UPPER EXTREMITY REHABILITATION: A MIXED METHODS STUDY

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TITLE:

DEVELOPMENT AND USABILITY TESTING OF A WEB-BASED HAND THERAPY COPING SKILLS PROGRAM FOR MANAGING PSYCHOSOCIAL PROBLEMS IN HAND AND UPPER EXTREMITY REHABILITATION.

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ABSTRACT

Background**:** Ineffective coping has been linked to prolonged pain, distress, anxiety and depression after a hand and upper limb injury. Evidence show that interventions based on cognitive and behavioral therapy may be effective to improve treatment outcomes, but traditional psychological interventions are resource-intensive and unrealistic in busy hand therapy practices. Developing evidence-based online psychological interventions specifically for hand therapy may be feasible in practice and at home with reduced training and travel costs.

Objective: The Hand therapy Online Coping Skills program (HOCOS) was developed to make cognitive and behavioral treatment strategies widely available to hand therapists. The aim of this study was to describe the development and assess the usability of HOCOS to aid hand therapists in the management of psychosocial problems.

Methods**:** We developed HOCOS using a three-step process using feedback from information and communication technology experts and clinician contributors. The development of HOCOS was informed by heuristic testing of HOCOS with 4 ICT experts using 2 sets of heuristics; Monkman heuristics and the Health Literacy Online (HLO) Checklist. User usability testing involved 12 hand therapists performing 10 tasks on the website while using the think aloud protocol, administration of the system Usability Scale (SUS) and a semi-structured interview in two iterative cycles. Descriptive statistics and simple content analyses were used to organize data.

Results: Heuristic evaluation revealed 15 of 35 violations on HLO checklist and 5 of 11 violations on the Monkman heuristics. The cognitive interview findings are organized into 6 themes: task performance, navigation, design aesthetics, content, functionality and features and desire for future use. Usability issued identified in cycle 1 were addressed prior to cycle 2. There was good agreement on all items of SUS. Overall, therapists found HOCOS was detailed and a helpful learning resource for therapists and patients.

***Conclusions*:** HOCOS is a new online psychosocial intervention for individuals with a hand and upper limb condition. We actively involved target users in the development and usability evaluation of the website. The tool was modified to meet participants needs and preferences.

Keywords: Usability Testing, Hand and Upper Limb, Psychosocial factors, Web-based resource

BACKGROUND

Hand and upper limb illness (HULI) are some of the most common injuries in orthopedic settings [1, 2], and approximately 11-20% of emergency department visits are due to HULI [3, 4]. In addition to pathophysiology, psychosocial factors can predict disability in individuals with HULI [5, 6]. HULI has been shown to impact employment, body image [7], relationships [8], and functional abilities [9, 10, 11] negatively.

Most of the studies conducted in HULI have focused on maximizing physical recovery and adjustments with regards to medical or occupational therapy procedures [12, 13, 14, 15]. Interventions such as joint protection [16], exercise therapy [17], mobilization [18], and modalities [19] in hand therapy have well-established benefits for pain and function. However, they do not directly target psychosocial factors that contribute to patient morbidity [20]. Several studies have established the mediating effect of psychological distress on HULI pain and disability [21, 22, 23, 24] based on the far-reaching impact of psychosocial problems on pain and disability and patient expectations after a HULI, a greater understanding how to facilitate psychosocial adjustments are warranted [25, 26]. Psychological interventions such as Cognitive and Behavioral Therapy (CBT) interventions have been shown to yield long-term [27] improvements in pain, daily function, quality of life and overall mental health compared to active treatments alone for MSK conditions [28, 29] such as knee pain [30], subacute low back pain [31, 32] and fibromyalgia [33] and preoperative spine [34] and knee surgery [35]. CBT is also cost-effective [36] (Smittenaar et al., 2017) and costs neutral when considering the overall health care sector and labor market perspective [34] with reduced healthcare utilization at 5-year follow-up [27]. CBT has also been shown to be effective in improving adherence to exercise

[37]. CBT techniques such as graded activity can be integrated into traditional physiotherapy [38, 39].

In hand therapy, CBT may be an efficient treatment to improve pain and distress by increasing adjustment to hand injury concerning illness perception and coping strategies [40, 41, 42, 25]. Unfortunately, traditional CBT is resource-intensive and not feasible to implement in busy hand therapy practices due to prolonged face-to-face encounters and associated cost implications [43]. Internet CBT is a potential tool emerging with modern interactive and communicative technologies for use in rural and urban areas, across languages and cultures, and on a global scale [44]. Internet CBT is useful for reducing catastrophization and improving the attitudes of the patient with MSK conditions to exercise therapy [45]. Current evidence supports the feasible and efficacious delivery of internet CBT using non-traditional health professionals like physiotherapists and occupational therapists [46], with reduced time commitment and treatment costs, and positive self-reported changes in physiotherapists' attitudes, confidence, and practice [47, 48, 49]. Therapist competence and the therapeutic alliance are crucial factors influencing CBT [50]. Therapist competence can be developed online [51], and the delivery of CBT online does not diminish the alliance [52].

Hagemen et al. [53] reported that almost 50% of outpatients presenting to hand clinics investigated their symptoms online, which increases the potential to deliver evidence-based pain management and coping skills for HULI online. Further studies on the use of psychosocial interventions in HULI have the potential to convince payers to fund psychotherapy treatments, generate enthusiasm to include psychosocial treatments in educational curriculums, and advance the incorporation of evidence-based psychosocial treatments in hand therapy recommendations for psychosocial problems [54]. Therefore, online evidence-based CBT is feasible to implement during wait times for hand therapy, easy to use in home-settings, and reduce costs associated with training providers and fewer hospital visits. To meet the need of patients with HULI at risk of prolonged pain and disability due to psychosocial treatments, we decided to develop an intervention which incorporates evidence from CBT in orthopedic practice.

The "Hand-therapy Online COping Skills" program (HOCOS)

HOCOS is an evidence-based and theory-based psychosocial coping skills program based on principles of cognitive and behavior therapy. HOCOS was developed by Folarin Babatunde during his doctoral studies at McMaster University with direction from a team of researchers, hand therapists, physiotherapists, occupational therapists, and a hand surgeon (Joy MacDermid Ph.D., Mike Szekeres Ph.D., Luciana Macedo Ph.D., and Ruby Grewal MD). HOCOS involved five hand therapist-directed modules multi-component, interactive online-based program consisting of hand and upper-limb specific information covering pain education and training in coping skills (activity-rest cycling, pleasant activity scheduling, problem-solving, identifying and challenging negative thoughts, relaxation response and their applications (Appendix 1) for adults with HULI and clinicians practicing hand therapy. The program was designed to supplement traditional hand therapy with therapist guided coping skills training. The development of HOCOS was guided by the five steps of the Needs Analysis/Assessment, Design, Development, Implementation, and Evaluation (ADDIE) model [55, 56].

Objectives

This paper aims to provide a brief overview of the internet-based system and to report on the usability from the perspectives of Information and Communication Technology (ICT) experts and clinicians practicing in the field of hand therapy. Usability testing is a critical step in the development of online interventions and involves obtaining feedback to understand what is positive or negative about a system and identify existing gaps in content or functionality using iterative cycles of prototype alteration [57].

METHODS

Design and Procedure

A mixed-method usability testing approach with semi-structured interviews, observations, and questionnaires was undertaken, with iterative cycles to determine the usability of the online intervention and to refine the prototype [58, 59] further. Participants were recruited using snowball sampling by asking key informants to suggest another participant they believe is suitable for study and introducing that person to the researcher [60]. This paper provides a report on step 3 of the ADDIE process (Figure 1). ADDIE is commonly used in instructional development as a systematic way to achieve desired results [61].

Participants

We recruited Information and Communication Technology (ICT) experts online through the Weebly™ "hire a professional" portal to participate as heuristic evaluators in Phase 1 of usability testing. In phase 2, Ontario-based physiotherapists (PT) and occupational therapists

(OT) practicing in the clinical area of hand therapy were invited to participate in enhancing the development of HOCOS. Clinicians were messaged directly using contact details available to the public on the Canadian Society of Hand Therapy (CSHT) website. Interested participants contacted the research team directly by telephone or email and were provided with a letter of information and signed consent forms prior to data collection.

Procedure

One of the researchers, FB, facilitated data collection by conducting the interviews, taking notes, and observing participants' behavior. Appointments were made to meet with participants at the study site or desired destination within 2 hours of the study site. A brief description of the study was provided to each participant. It was emphasized that the evaluation was about the content and functionality of the website. An explanation of cognitive interviews and information about the privacy and protection of data collected was also provided. Before the interviews, demographic data including age, gender, educational level, practice area, and use of technology was collected. All participants were identified by pseudonyms to ensure anonymity [62]. Current evidence shows that 80% of usability problems can be identified with 4 to 9 participants and 95% with 9 participants [63], and we proposed a convenience sample of 12 participants for usability testing. The usability testing protocol was approved by the Western University Health Sciences Research Ethics Board (REB #108064). Guided by steps 1 and 2 (Figure 1), we revised the prototype and developed a preliminary version of HOCOS that was tested by ICT experts and therapists (12).

Phase 1 – Heuristic testing

Heuristic testing is a usability inspection method completed by usability experts, and involves evaluating an application to find usability problems, assigning them to a specific category of heuristic and ascribing a severity rating [64]. ICT experts were given a brief introduction to the background and rationale of the web application under review and given instructions on how to conduct the heuristic testing. Between March and May 2018, the evaluators each separately conducted a heuristic evaluation of HOCOS through a page by page review of the website and noted "violations" where the interface did not conform to 2 sets of heuristics of predetermined criteria; the Health Literacy Online (HLO) Checklist (DHHS, 2015) and the Monkman Heuristics [65]. HLO was designed for the creation of valuable online health content and comprised 35 separate criteria, categorized into five domains; *Write Actionable Content, Display Content Clearly on the Page*, *Organize Content and Simplify Navigation, Engage Users and Testing site with Users with Limited Literacy Skills* [66]. The fifth domain was not factored in the study since this study was about system design and development rather than the implementation in practice. Monkman Heuristics [65] comprised of 11 checklist items and was designed for experienced heuristic evaluators by summarizing design guidelines from the HLO guide and incorporating research from e-health/health literacy and usability literature [67]. The evaluators conferred using Skype and aggregated their results only after completing individual reviews. This phase resulted in the construction of a list of usability violations that was used to inform design changes before user testing commenced.

Phase 2 – User testing

Each study visit included "thinking aloud" [68] while going through the website and feedback interviews during 1.5 to 2 hours of face-to-face interaction. This enabled the researcher to capture the ongoing thought processes of the participants while going over the program and any difficulties been encountered [69]. First, participants were required to log onto the website, read an introductory script and get familiar with the online learning environment using hyperlinks to move between pages. Next, the participants completed the following tasks: (1) logging in, (2) reading the introductory page, (3) completing of a set of psychosocial outcome measures, (4) listening to an audio recording, (5) reading a PowerPoint presentation, (6) downloading a pdf or Word document script, (7) completing one activity on the workbook, (8) set up an activity plan for homework, (9) find content by browsing, (10) find content by searching, (11) complete a feedback form and (12) contact the web manager. These tasks tested the user's ability to follow the session plan and the amount of assistance to use the online e-tools. The facilitator did not offer any help during the tasks unless explicitly requested by the participants [68, 70]. The facilitator encouraged the participants to talk about what they felt, saw or thought while browsing through the website during the cognitive interviews. Verbal probes were also used to clarify the participant's answers [70].

The facilitator also asked the participants to explain or demonstrate the information in the video related to the module that has been reviewed, such as metal practice and breathing exercises in Module 1 and Module 5, respectively. The participant's ability to follow the instructions correctly were observed, and any difficulties, doubts, and reports were documented using a 3-point scale (1 = correctly demonstrated, 2 = assistance required from an evaluator or replaying the video, 3 = difficulty demonstrating the activity correctly after being assisted) [56]. At the participant's request, whole or specific areas of content were re-visited. Based on the benchmark by Rubin and Chisnell [71], a task was classified as a usability problem requiring attention to remedy if more than 70% of participants were unable to complete the task. The System Usability Scale (SUS) questionnaire [72, 73] was used to evaluate satisfaction. SUS comprises ten open-ended polarity-balanced based questions with a 5-point Likert scale for responses. The average scores were categorized based on adjective ratings [74]. Finally, the facilitator interviewed each participant using a semi-structured interview (10-15 mins) guide (APPENDIX 3) to obtain feedback about navigation, content, and layout adopted from Stinson et al. [75] at the end of the second cycle of user testing.

Data Analysis

All interviews were audiotaped and transcribed verbatim. The usability testing and interview data were analyzed together using triangulation [76]. Simple content analysis [77] of transcripts from the think-aloud sessions, field notes, and the feedback interviews were coded using predetermined codes related to usability issues (navigation, content, layout, learnability, errors, satisfaction) after each iterative cycle. The interviews from the first cycle were analyzed and used to make minor modifications to the website before evaluation in the second cycle of testing. Very few modifications to the prototype were required after the second cycle of testing. In calculating the SUS score, the score contributions from each item are first summed. Each item's score contribution will range from 0 to 4. For items 1, 3, 5, 7, and 9, the score contribution is the scale position minus 1. For items 2, 4, 6, 8, and 10, the contribution is five minus the scale position. Quantitative data from SUS (10 questions, each scored from 0 to 4 points) were transformed by multiplying by 2.5 to convert scores to a 0 to 100 range and categorized using adjective ratings [74]. The descriptive analysis (means, standard deviations) of the quantitative data was conducted using Stata 13 software for Windows.

RESULTS

Participant characteristics

We enrolled 4 ICT experts as evaluators during the heuristic evaluation, which meets the optimal requirement for detecting all usability problems [78]. During user testing, 26 clinicians agreed to participate in this study, needs assessment (n=14), and usability testing (n=12). Eighteen participants (69%) were females (Table 1). Most participants (65%) had a background in occupational therapy, had at least 16 years' experience in hand therapy (38%), and practiced in outpatient rehabilitation (38%). Most participants were "very comfortable" using a computer/tablet and or internet, respectively. See Table 1 for participant characteristics.

Phase 1

The heuristic evaluation of HOCOS against the HLO checklist identified violations in 15 of 35 criteria with violations seen across all domains (Table 2). Domain 1 showed violations in 2 of the seven criteria. There were four violations in the 13 criteria for Domain 2. Most of the violations were represented in Domain 3, with six of 10 violations reported. Violations included: (1) the home page image not representing the context of the website, (2) lack of a search function, and (3) links are difficult to differentiate from surrounding text or other graphic elements. Corrections were made and included adding a welcome image on the home page, adding a search function, and creating a box around link icons. Domain 4 revealed three violations in the five criteria due to heavy reliance on text-based information, lack of quizzes or forms, and lack of social media sharing options. We included more pictures, and reducing the words per page, creating a separate link for the form. We decided against adding a social media link due to privacy concerns and the sensitive nature of psychosocial issues. Evaluation of HOCOS using Monkman heuristics identified violations in 5 of the 11 criteria (Table 3) including lack of options for tailoring information to the user, reduced use of plain language including medical jargon and Gunning Fog readability index [79, 80] higher than 8, information in multiple languages, few succinct summaries versus more detailed information, need for scrolling to find relevant information and poor communication of risks. The remaining violations were managed by adding activities that could be personalized, editing the content for therapists and patients using the Gunning Fog Index, creating a summary of key points in the slides, adding an icon to relevant information and adding a disclaimer to express inherent risks and benefits of the program.

Phase 2

This included findings from the user task performance and cognitive interviews (think aloud) components of usability testing of the HOCOS.

Task performance – We measured user performance based on ease of navigating through the site, assessing the ease of learning for a first-time user without familiarity with the interface and the frequency and importance of errors. Errors observed during usability testing were reported in 3 categories; completed with ease, completed with help, not completed [81]. Performance on the ten tasks is presented in Table 4. In summary, eight tasks were completed efficiently by participants: logging in, browsing, reading the introductory pages, listening to audio files, reading PowerPoint™ presentations, filling a homework plan, contacting the researchers, and downloading a document. The remaining four tasks revealed difficulties with usability. Navigation errors were defined as failures to locate functions, excessive keystrokes, or failures to follow recommended screen flow [81]. Five participants were not able to find the "assessment" page to fill outcome measures. The page was accessible through the "resources" page even though the opening comments on the page highlighted contents on the resource page. Six participants did not realize that the workbook contained both educational information and homework despite text alongside the introduction highlighting different module assignments.

Control usage errors were defined as improper toolbar or entry field usage [81]. Five participants were unable to identify the icons for submitting answers to some activities on the modules. This error was corrected by writing "click on the link to write your answers" on the link to provide answers. Providing feedback using the website form was the most difficult task for participants. Users did not click on the next page at the end of every module where the feedback form was placed. We included a text highlighting where to find the feedback form on the introductory module page and the final page of every module. Presentation errors were defined as failures to locate and appropriately act upon desired information or selection errors due to labeling obscurities [81]. Searching was a bit of a challenge for 5 participants because they did not know what to search for, unsure of search terms to use, or struggled to come up with a health topic in the context of the website. Participants were able to complete the 12 tasks in phase 2 at the end of the second cycle of testing.

Cognitive interviews – The key usability findings from the think-aloud interviews are organized into the following four themes (Table 5): design aesthetics, content, functionality and features, and desire for future use.

Design aesthetics

Overall design aesthetics were critical to enhancing engagement and motivation to use the website and relates to the layout, navigation, visual assets, and appeal. Participants liked the idea of different textures, colors, and cultures represented in the graphics. It was suggested that the font sizes should be set at size 14 to 16, and a large amount of information should be grouped and broken up with visual assets (graphics, illustrations). In response, we divided the PowerPoint slides into Parts A and B and C to reduce information overload and reduce the feeling of been overwhelmed. Part C was created as an addendum with the caption; "*Please, see part C for deeper learning on this topic."* Users also recommended that the most important message on each page should be at the top of the page. Since the modules were standalone content, the participants suggested that a decision tree or matrix would reduce the burden of prescribing the appropriate module to patients based on their presentation and treatment goals. In response we created a matrix with information on key learning points, indications and contraindications, for each module. For example, patients with paradoxical response to visualization avoid thinking about their hand injury and those focused on the loss may find mental imagery distressing. Changes were also suggested to some features to increase user interest and reduce negative response. For example, we changed the title "Mental practice" to "Picturing My Movement," "Thought Reprocessing," was changed to "Healthy Thinking," and "Board of Directors" was changed to "Thinking Traps."

Content

The program content was described in terms of completeness, understandability, quality, credibility, relevance, and interest. The comments on program content such as texts, images, and multimedia components were generally positive. The layout structure of presenting information in different formats and having a summary of key points after each lesson was valued. All participants judged that the site content was relevant and credible. Generally, participants were pleased with the completeness of the website, but additional content was suggested. Examples of additions made included creating reflective pieces to improve engagement with the slideshows and linking activities under "Mental practice" to portray the multisensory nature of hand movement. HOCOS was created with a focus on understandability, and all text developed to meet grade 6 to 7 reading level. Most of the participants valued this consideration and commented that the information, language level, medical term explanations helped further understanding of topics that were unclear or new to them. However, some of the languages used still had to be changed to conjure everyday talk and meet societal norms such as changing wife/husband to spousal partner and routine from day today. Several language changes were made to clarify the meaning, such as changing tissues to the body, thought record to thought journal, healthy to uninjured, and Food-For-Thought to Pause-Stop-think.

Functionality and features

These referred to the adaptive and interactive features on the website and included module 1 to 5 audio clips, printable pdf information forms for patient and clinician users, videos of simulated patients completing module activities. It was agreed that these features allowed for an increased level of personalization of HOCOS content to meet the individual needs of the users. To further enhance participant motivation and engagement, we added the following functions: interactive questions (quizzes after each PowerPoint presentation), an "Ask an Expert" link to allow users to send an email question to the web developers and a goal plan journal to keep track of goals and activities. Participants suggested having features that allows the program to support social interactions among participants such as a discussion board. However, due to budgetary and time constraints we were unable to include these functions in HOCOS. Other features that were introduced to help patients incorporate the new information to their daily routine was the "How to Make It Work Guide."

The desire for future use

Overall, participants received HOCOS very well and expressed a desire to use the program in the future. It was agreed that the website would be especially useful if available to patients from initial contact for the pre-surgical screen with surgeons or in immediately after surgery in acute care. The therapists commented that they valued the site content focused on supplementing current hand therapy practice for patients struggling with psychosocial issues. The accompanying navigation of workflow would make it easy to prioritize programs for their patients. Most participants suggested that collaboration with the CSHT and hand programs in Ontario would help facilitate increased uptake in the hand therapy community.

System Usability Scale (SUS) and User satisfaction

The SUS scores from both cycles of usability testing are listed in Table 6. Scores above 68 (12.5) indicate above-average usability (Brooke, 2013). The mean SUS score for this study was 84 (8.2), indicating that the average participants were highly satisfied (Excellent) with the usability of this online learning tool on all items of the SUS questionnaire, in terms of learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 1993). After addressing Cycle 2 usability issues, we made some revisions to the final version of HOCOS. Specifically, a "Do It Yourself" (DIY) Guide was created to support each module, and we added a "Go to homepage" tab was created to signpost to individual sessions after logging in a navigation tutorial video and informational videos on the clinical impact of psychosocial factors on HULI was created. Finally, we included patient-friendly resources on Chronic Pain, Problem-solving, Time Management, and A Sleep Guide. Overall, therapists found that HOCOS was a comprehensive and helpful learning resource for therapists and patients. Participants liked the Web layout, tabs for modules, and the resource page.

The final version of HOCOS

The final version of HOCOS was built on Weebly platform, customized and styles using platform add-ons and publicly available pictures on Creative Commons. The platform included a landing page, a resource library, tabs for each of the modules, feedback page, assessment page, goals page, and therapist or patient-specific resources (Figure 3). See Appendix 1 for a brief overview of the content of HOCOS. Sessions can be accessed by logging in and completed using a suggested timetable. See Figure 2 for a navigation pathway to complete the 5 Modules.

DISCUSSION

The overall objective of this paper was to provide an overview of HOCOS and report the findings from usability testing with ICT experts and clinicians practicing hand therapy. HOCOS is designed to help patients with a hand, and upper limb injury learns how to manage psychosocial issues better. The uniqueness of HOCOS is the design of an interface that offers learning opportunities to both clinicians and patients. Usability testing uncovered what therapists felt were positive features of the website: simple, user-friendly, engaging, browsing, function, design, and accessibility following usability testing. User performance errors and areas to enhance user satisfaction were also identified. Several changes were made to the online portal that corrected the errors uncovered and improved user satisfaction. Formal usability testing is a fundamental process required to ensure the relevance of content and make the website easy to use, learn, efficient, and acceptable to users [81].

Although HOCOS was initially designed for all modules to be completed together, feedback from clinicians showed the benefits of also having modules as standalone options. Hand therapists felt confident that patients could execute the activities in the workbook, especially with the DIY guide. Testing also demonstrated that the primary condition of the patients determined the modules that therapists choose to introduce and apply in clinical practice. This process was enhanced by providing a guide on how to use the features when to introduce the modules and how the website may fit within the broader tool kits used in hand therapy. Overall, therapists were pleased with the objective and content of HOCOS and found it a useful resource for meeting patient needs in hand therapy.

This study contributes to the dearth of literature on the usability testing of online applications developed for managing psychosocial factors in hand therapy. Chad-Friedman et al. [82] reported on the use of an online interface designed to deliver a 60-second mindfulness intervention for MSK pain with positive results. Similarly, Vranceanu et al. [83] described the "Toolkit for Optimal Recovery (TOR)"; a four-session, live video, manualized program informed by the fear-avoidance model to prevent chronic pain in at-risk adults with orthopedic injuries. TOR combines relaxation response with CBT, acceptance, and commitment therapy skills. HOCOS provides a more prominent platform offering multiple options to therapists and patients using concepts from therapeutic neuroscience education, relaxation response, and cognitive behavioral therapy principles. Based on post cognitive interview feedbacks, therapists involved in this study preferred an online program that teaches patients how to change maladaptive cognitions and not merely accept such thoughts. HOCOS was designed using CBT principles, and CBT aims to challenge automatic thoughts by holding them up to disproving evidence, and then change them into different thoughts [84, 85]. CBT begins with identifying a primary treatment goal and continuously striving to meet those goals [86].

Dissemination of evidence-based therapies remains poor in routine practice [87]. Although allied health care professionals are aware of the benefits of incorporating psychological interventions within their practice, they feel insufficiently trained to optimize their use of such interventions [88]. Barriers to practicing evidence include lack of access to evidence resources [89, 90] and limited usable formats of the evidence [91]. Training hand therapists to manage the physical and psychological sequela of hand and upper limb conditions using HOCOS would increase their knowledge of psychosocial interventions and build their capacity and confidence to deliver it in clinical practice.

Limitations

Our study should be viewed with consideration of certain limitations encountered. The study was conducted amongst hand therapists in Ontario, and most participants were comfortable with using the computer and the internet, which limits the generalizability of the study results.

This may not be representative of the end-users like patients seen in most hand therapy clinics. In recruiting participants for this study, we chose snowball sampling, a form of convenience sampling. This increases the risk of compiling a non-representative sample. We planned to create an online platform that is user-friendly for a significant portion of patients with hand and upper limb injuries who are mostly elderly [92], low-skilled [93] with less education [94]. These groups of individuals tend to be less computer literate, and to this end, we did our best to incorporate recommendations to ensure accessibility and ease of use in the web design (NIA/NLM, 2009) and simplifying the user experience [66]. This included a larger font size, white space around texts, and a simple color scheme to enhance readability.

The presence of one of the researchers (FB) during the usability testing sessions may have affected the behavior of end-users conducting the testing. The participants may have felt reluctant to be critical despite encouragement to highlight both the weak and robust features of the website. Furthermore, we were unable to test the HOCOS website in the context of the patient-user's experience to gain a comprehensive view of the system's functioning in a clinical setting due to financial and time constraints. Usability testing with patients, needs to be addressed in future research through examination of the effectiveness of HOCOS in a randomized controlled trial to determine whether the present system design can contribute to improved outcomes in practice. The next phase of the HOCOS project is to evaluate the impact of HOCOS training on the actual implementation of the program on patients. We plan to carry out further testing in a proof-of-concept study to establish if individuals with hand and upper limb conditions and psychosocial problems are willing and able to complete the HOCOS program, complete the activities correctly and adhere to the program principles.

CONCLUSION

This study provides initial support for the usability of HOCOS. Ensuring that therapists were involved in the design and development process of HOCOS enhanced the user-centeredness and user-friendliness of the website. Usability testing during the formative stage of e-health intervention development is necessary to ensure that online interventions are effective and acceptable to potential users. HOCOS has the potential to increase access and acceptability of coping skills training programs for many individuals with hand and upper limb injuries that are not able to receive hospital or clinic-based treatment psychotherapy treatment. We plan to conduct a pilot study to determine the feasibility of the website for adults with hand and upper limb injuries and further refine the tool for a fully powered randomized controlled trial. If effective in improving outcomes, this program could be used as a template to develop more interventions targeting the psychosocial challenges confronting individuals with hand and upper limb injuries.

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Table 1 Demographic and computer/internet use characteristics of therapists (n=26) participating in needs assessment/analysis and usability testing of the study.

Demographics	**Needs assessment (n=14)**	**Usability testing (n=12)**
Age group in years, n (%)		
- 21-30	3 (21)	2 (17)
- 30-40	5 (35)	2 (17)
- 40-50	2 (15)	3 (25)
- >50	4 (29)	5 (42)
Gender, n (%)		
- Male	6 (43)	2 (17)
- Female	8 (57)	10 (83)
- Prefer not to say	0	0
Profession, n (%)		
- Occupational therapists	10 (71)	7 (58)
- Physiotherapists	4 (29)	5 (42)
Education, n (%)		
- Entry level (Baccalaureate degree)	4 (29)	3 (25)
- Entry level (Master degree)	8 (57)	8 (67)
- PhD	2 (15)	1 (8)
Work experience, n (%)		
- < 5 years	2 (15)	0
- 10 to 15 years	4 (29)	3 (25)
- 16 to 20 years	6 (43)	4 (33)
- > 20 years	2 (15)	5 (42)
Practice setting, n (%)		
- Private practice	2 (15)	2 (17)
- Acute care	3 (21)	3 (25)
- Inpatient rehab	2 (15)	3 (25)
- Outpatient rehab	6 (43)	4 (33)
- Other (teaching)	1 (6)	0
Employment, n (%)		
- Full time	9 (64)	9 (75)
- Part time	3 (21)	3 (25)
- Casual	1 (6)	0
Information about computer use		
- **Computer/tablet use at home**		
Yes	12 (85)	12 (100)
No	2 (15)	0
- **Computer/tablet use at work**		
Yes	14 (100)	12 (100)
No	0	0
- **Hours spent on computer/tablet each week**		
≤ 5 hours	0	0
> 5 hours	14 (100)	12 (100)
- **Hours spent on internet each week**		
≤ 5 hours	5 (35)	4 (33)
> 5 hours	9 (65)	8 (67)
- **Comfort level on computer/tablet**		
Not at all comfortable	0	0
A little comfortable	0	0
Comfortable	4 (29)	4 (33)
Very comfortable	10 (71)	8 (67)
- **Comfort level on Internet**		
Not at all comfortable	0	0
A little comfortable	2 (14)	0
Comfortable	4 (29)	4 (33)
Very comfortable	8 (57)	8 (67)

Table 2 Heuristic Evaluation of HOCOS by ICT experts using general and readability guidelines of the Health Literacy Online (HLO) Checklist

Domain	Criteria	HOCOS
Domain 1. Writer actionable content	a. Identify user motivations and goals.	Yes
	b. Put the most important information first.	No – key information not consistent in the first paragraph
	c. Describe the health behavior - just the basics	Yes
	d. Stay positive. Include the benefits of taking action.	Yes
	e. Provide specific action steps.	Yes
	f. Write in plain language.	No – poor use of the active voice, use of jargon and long sentences.
	g. Check content for accuracy	Yes
Domain 2. Display Content Clearly on the Page	a. Limit paragraph size. Use bullets and short lists.	Yes
	b. Use meaningful headings.	Yes
	c. Use a readable font that’s at least 16 pixels.	No – inconsistent font sizes.
	d. Use white space and avoid clutter.	Yes
	e. Keep the most important content above the fold - even on mobile.	No – key information sometimes below the fold
	f. Use links effectively.	Yes
	g. Use color or underline to identify links.	Yes
	h. Use images that help people learn.	Yes
	i. Use appropriate contrast.	Yes
	j. Make web content printer friendly.	Yes
	k. Make your site accessible to people with disabilities.	No
	l. Make websites responsive.	Yes
	m. Design mobile content to meet mobile users’ needs.	No – mobile format needs a lot of editing.
Domain 3. Organize content and simplify navigation.	a. Create a simple and engaging homepage.	No – need to use links with clickable buttons. The image used does not directly reflect the planned end user.
	b. Label and organize content with your users in mind.	Yes
	c. Create linear information paths.	No – too much scrolling to get through materials.
	d. Give buttons meaningful labels.	Yes
	e. Make clickable elements recognizable.	No – users must skim across some headings before they become clickable.
	f. Make sure the browser “Back” button works.	No – inconsistent on the website
	g. Provide easy access to home and menu pages.	Yes
	h. Give users options to browse.	Yes
	i. Include a simple search function.	No – search function not available.
	j. Display search results clearly.	No – search function not available.
Domain 4. Engage Users	a. Share information through multimedia.	Yes – good use of multimedia.
	b. Design intuitive interactive graphics and tools.	No – missing interactive graphics and tools.
	c. Provide tailored information.	No – no means to tailor and guide information gathering.
	d. Create user-friendly forms and quizzes.	Yes
	e. Consider social media sharing options.	No – no social media sharing option.

Reference: US Department of Health and Human Services (DHHS), Office of Disease Prevention and Health Promotion. “Health Literacy Online: A Guide to Simplifying the User Experience.” 2nd ed. 2015. Available on https://health.gov/healthliteracyonline/checklist/

Table 3: Heuristic evaluation of HOCOS by ICT experts using health-specific usability guidelines based Monkman heuristics.

Heuristic	Description	HOCOS
Item 1. Immediately inform users of purpose and engage users; avoid registration.	Identify the purpose and audience on the home screen page. If unavoidable, make registration and logging in simple and obvious.	Criteria met
Item 2. Use complementary interaction methods.	Make use of alternative inputs (e.g., touch screen, barcode scanning, voice commands) and outputs (e.g., audio recordings, videos, text-to-speech engines).	Criteria met
Item 3. Leverage interactivity.	Offer interactive tools (e.g., quizzes, questionnaires, glossaries, tutorials) to engage with the information and provide performance feedback. Allow users to share information (e.g., print, e-mail) with others.	Criteria not met - the little interactivity on the website does not provide participant engagement.
Item 4. Provide accurate, colloquial, comprehensive, succinct content.	Written information should be brief, relevant, and in user's vernacular.	Criteria not met - poor use of plain language (grade 6 level)
Item 5. Provide tailored, flexible, layered content.	Prioritize information according to importance. If possible, personalize information. Provide succinct summaries but allow users to access more detailed information. Offer content in multiple languages.	Criteria not met - content not prioritized or personalized, use of English language alone.
Item 6. Use visuals to complement text but avoid tables.	Visuals (e.g., pictures, videos, animations) may enhance written information. If unavoidable, tables should be designed as independent, simplistic representations of information.	Criteria met
Item 7. Simplistic, consistent navigation.	Keep users oriented. Use linear navigation to facilitate forward and backward movement. Use large buttons, clearly label links, and provide a search engine.	Criteria met
Item 8. Simplistic, consistent displays.	Avoid on-screen complexity. Avoid the need for scrolling by limiting information on a page/screen.	Criteria not met - too much scrolling to access key information.
Item 9. Clear and comprehensive communication of risks.	Describe risk terminology in a way the users will understand. Use 100 as upper limit on bar graphs. Avoid logarithmic scales.	Criteria not met - risk such as privacy/confidentiality not clearly conveyed
Item 10. Clear depiction of monitoring data and/or test results.	Emphasize values outside acceptable ranges. Facilitate pattern recognition and rapid identification of influential factors.	Not applicable
Item 11. Considerations for mobile devices.	Allow users to adjust the display size using familiar input (e.g., pinch to zoom, turning to landscape orientation). Use appropriately sized interface elements. Limit the amount of information displayed.	Criteria met

Reference: Monkman, H., J. Griffith, and A. W. Kushniruk. "Evidence-based Heuristics for Evaluating Demands on eHealth Literacy and Usability in a Mobile Consumer Health Application." Studies in Health Technology and Informatics 2015;216:358–62.

Table 4: Task performance findings during usability testing (n=12)

Task Performance (Cycle 1)	**Completed** **With ease**	 **with help**	**Not completed**
	n (%)	**n (%)**	**n (%)**
Logging in to the website	8 (66)	3 (25)	1 (8)
Read information on home page and each module Introductory page	10 (83)	2 (17)	-
Complete a questionnaire from the list of outcome measures	4 (33)	3 (25)	5 (42)
Listen to an audio recording	8 (66)	4(33)	-
Read a PowerPoint™ slide	8 (66)	3 (25)	1 (8)
Download a pdf or Word document of a workbook or PowerPoint™ slide	10 (83)	2 (17)	-
Complete one activity in a workbook	4 (33)	2 (17)	6 (50)
Set up an activity plan for homework	7 (58)	3 (25)	2 (17)
Find content of interest by browsing	9 (42)	2 (25)	1 (8)
Find content of interest by searching	4 (33)	3 (25)	5 (42)
Complete a feedback form	2 (17)	3 (25)	7 (58)
Contact the website manager	8 (33)	4 (50)	-
Task performance (Cycle 2)			
Logging in to the website	12 (100)	-	-
Read information on home page and each module Introductory page	12 (100)	-	-
Complete a questionnaire from the list of outcome measures	10 (83)	2 (17)	-
Listen to an audio recording	8 (66)	4(33)	-
Read a PowerPoint™ slide	12 (100)	-	-
Download a pdf or Word document of a workbook or PowerPoint™ slide	12 (100)	-	-
Complete one activity in a workbook	8 (66)	4 (33)	-
Set up an activity plan for homework	10 (83)	2 (17)	-
Find content of interest by browsing	9 (75)	3 (25)	-
Find content of interest by searching	8 (66)	4 (33)	-
Complete a feedback form	9 (75)	3 (25)	-
Contact the website manager	12 (100)	-	-

Table 5: Sample comments for each of the themes derived from analysis of the cognitive interview and feedback interview transcripts

Theme and its definition	Example of negative comments	Changes made to HOCOS website
General comments: *Comments about the overall website.*	• “In my experience, most of the therapists are not likely to go to this level of detail and understanding about it. Go for a more basic route and give them some simple tools with good examples that they could try out without having to do as much learning as this might demand of them [CH, cycle 1]” • “It was feeding me information, but it did not ask me about myself. e.g. write down three key stressors in your life. Write down 5 items you can remember at 9.00 pm tonight” [AB, cycle 1] • “It did not feel as engaging as I would like it to be” [RC, cycle 1]	• We broke down the module content into sections and adding a link for additional learning if desired by therapists. • Included active learning in the “Stop-Pause-think” section by inviting learners to respond to questions in the PowerPoint slide. • Reflective pieces were created to support learning on the website. For example, think about it for 20 seconds”
Navigation: *Comments on the ability for participants to independently move around the website, review the content and use e-tools.*	• “I think therapists might benefit from having a bit of a decision matrix/tree or a matrix…what kind of people are more likely to use this module versus another one? What's the key thing about this technique? Who's gonna Respond? What are the contraindications” [CH, cycle 2]	• Added a decision matrix on the “Introductory” page.
Content: *Comments about the materials offered by the website including PowerPoint presentations, videos, didactic information, e-tools*	• “15 mins, probably too long for mental imagery. Maybe 5 mins…Five is a very long time if you’re asking people to just sit quietly and use their imagination for something. [CH, cycle 2, M1]” • “I would suggest doing them together instead of the good side first and then the bad side for more active engagement for the patients…for a lot of people, visualization is pretty difficult [CH, cycle 2, M1]” • “Thinking about doing an audio tape that that instead of reading alone, people can go through this in 15 min because they could just hit play on their device and actually be more present in doing activity” [TP, cycle 1, M1] • “Limit the information on correlation (research) to therapists alone and not the patients” [AB, cycle 1, M3] “Keep slide 34 only for the therapists” Give me a bit more scientific evidence for the sensitive brain like MRI” [AB, cycle 2, M1] • “So, the see module two a, there seems to be difficult for me to, to grab because I have to remember the entire module before I get to this point. And so, it's quite challenging” [TS, cycle 1, M4] • “This is a very condensed slide with a lot of information. Lot of wording to read. So I just find it too busy for my eyes” [TS, cycle 2, M5]	• Instruction on mental imagery was modified to include comments about focusing on completing the task sequence instead of focusing on how long it takes. • The guideline for mental imagery was edited to suggest practicing with both hands initially. • An audio recording was created to support all the activities on the website modules. • References to website materials were added directly to therapist information only. Patients could find more information on the “Resource” page. • We created a direct link to a section of the website that is referenced on another page of the website. • We tried to follow the PowerPoint Math: 1-6-6 rule as much as possible (Have only 1 idea per slide, Have at most six bullet points, Maximum 6 words per bullet point, this slide has 6 bullet points, Each bullet point has 6 words).
Layout: *Comments about the visual appearance of the website, including color, font size, images.*	• “I actually would like to see pain a number of times in different colors and different sizes because I think that would communicate the experience of pain is different for everybody because not everybody feels like pain as the dominant issue” [TP, cycle 2, M1] • “These pictures. I think we'll be fine for therapist again for patients they are extreme. That's just from the, from the CRPS world because when people have really changed their body map, this looks threatening to them” [IN, cycle 2, M1]	• We introduced the concept of coloring pain. • Modified the pictures on the website to ensure they are sensitive to the needs of potential users on the website.

	• "I would change running to walking. Because all these three are pretty high level. You know, you're probably talking to people who aren't at this level" [AB, cycle 2, M3] "Sorry, the exercise part, you may not want to have a jog or a walk or something. Something softer and gentler" [VF, cycle 2, M3] • "It looks like the picture is someone in white coats counseling someone in pink cloth. Um, so it doesn't reflect much about the musculoskeletal injury, distressing symptoms such as pain" [TS, cycle 1, M1] • "Looks like down time is all about sports in this slide, which is not necessarily so depending on who the person is. So pictures there could include reading a book or doing some gardening, that sort of thing. In any case, make sure it's not just sports that are included in this slide. Give people more ideas. [RC, cycle 2, M5]	• Reviewed the pictures used to reflect different activity suggested on the website. • Reviewed the pictures on each page to reflect the information on each slide. • We ensured a proper mix of IADLS, ADLS, Occupations and sporting activities on the website.
Design: *Comments on the functionality of the website, including graphic design and content production.*	• "Make sure that it's going to display well on other devices like the smart phone which many younger adults use for everything" [CH, cycle 2]. • "So, I think finding something that makes a lot of sense to them already that they don't need to do a lot of new learning in the intro piece to the module is important" [CH, cycle 1, M1] • "You need to have a measure on injustice because the fractured relationship is sometimes with the employer, or the co-workers or with WSIB" [CH, cycle 1, M1] • "Start with the thinking traps… Because that's really developing awareness is the first part of that. Right? Before you can do any solving of anything" [CH, cycle 2] • "So, in addition to teaching them what to do and how to do it, it's important to help them plan out how to be compliant. [CH, cycle 2]" • "I think sleep should be a stand-alone model because it's a problem that uh, sometimes it's related to pain or sometimes it's related to depression, sometimes related to anxiety, anxiety, stress can be many things and people" [CH, cycle 1] • "Consider doing PART A, B and C over 1-week period. So, then you could do a week because then someone can do 10 minutes and they're okay to and then the next day do 10 minutes." [PP, cycle 1, M3] • "Create a summary page for key concepts for take home messages" [JT, cycle 1, M4]	• Edited the content to fit the pages of hand-held devices. • Decided against make Mental Imagery the first activity in Module 1. • Introduced the Injustice Experience Questionnaire to assess perceived injustice. • In Module 2, we introduced the thinking traps before discussing the cognitive restructuring. • Incorporate a 'how to make this work' section. • Sleep education was included in the resource section. • We broke down the PowerPoint presentation into sections to reduce viewer fatigue. • We added a "summary page" at the end and beginning of every module"
Language: *Comments on the grammar, word choice, header titles and*	• "The sentences are too long, but it's still. That's a little bit text dense. I'm worn just from the first part. That first paragraph. So, I might, I might even break that into a second pair [PP, cycle 1] • "Just be careful. The no pain, no gain. I know it's a play on words here, but that's an old myth that drives people to overwork. So, knowing pain equals knowing gain, maybe" [AB, cycle 2, M1] • "Saying husband sounds too gendered. [JT, cycle 2, M4] • "I think I would use language that like if you were to maybe if you think about it in the sense of, you know, I'm talking to a sixth grader, how am I going to speak to them and then therefore how can it be worded because your content is good" [JT, cycle 1, M4]	• We made the sentences shorter with smaller paragraphs. • Edited the content to ensure slogans were not misleading. • Preferable to say spousal partner" • Ensured that the patient documents and materials were at Grade 6 level.

	• "Some terms are too big. Make the terms more related to day to day life here will be better. The materials are also trying to help clinicians talk to clients. So, being able to use simple words in the presentation is training the clinicians to come up with a grade five language to talk to clients" [TS, cycle 2, M5] • "Okay. I understand that you want to do metaphors. Metaphors need explanation" [VF, cycle 2, M5]	• Reviewed the words to find synonyms that would enhance lay man understanding. • More clarification was provided to support the metaphors used.

Table 6: System Usability Scale (SUS) (n=12)

	Questionnaire Items	**Cycle 1 mean (SD)[a]**	**Cycle 2 mean (SD)[a]**
1	I think that I would like to use this website frequently (+)	3 (0.8)	4 (0.5)
2	I found the website unnecessarily complex (-)	2 (0.7)	3 (0.9)
3	I thought the website was easy to use (+)	2 (0.6)	3 (0.0)
4	I think that I would need the support of a technical person to be able to use this website (-)	3 (1.08)	4 (0.5)
5	I found the various functions in the product were well integrated (+)	3 (0.5)	3 (0.5)
6	I thought there was too much inconsistency in this website (-)	3 (0.4)	4 (0.5)
7	I imagine that most people would learn to use this product very quickly (+)	2 (0.7)	3 (0.4)
8	I found the website very awkward to use (-)	3 (0.5)	4 (0.5)
9	I felt very confident using the website (+)	2 (0.4)	3 (0.4)
10	I needed to learn a lot of things before I could get going with this website (-)	2 (0.9)	3 (0.4)
Total score (+) items 1, 3, 5, 7, 9		2.4 (0.5)	3.2 (0.6)
Total score (-) items 2, 4, 6, 8, 10		2.6 (0.7)	3.6 (0.5)
Total score		25 (3.4)	34 (3.2)
SUS score[b]		62 (8.5)	84 (8.1)
SUS Adjective Rating[c]		Good (n=58%)	Excellent (75%)

[a] Rating scale, 1 = strongly disagree; 5 = strongly agree

[b] SUS score = Total score *2.5

[c] (Best Imaginable, Excellent, Good, OK, Poor, Awful, Worst Imaginable)

FIGURES

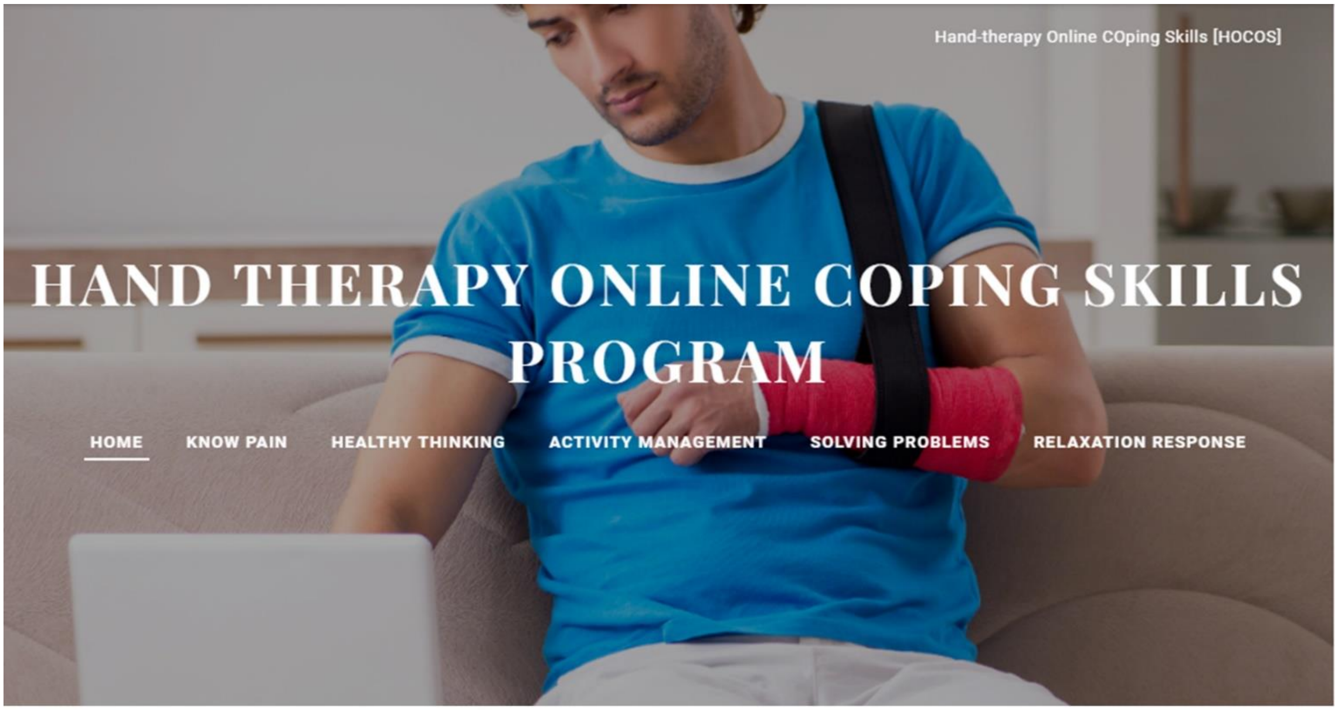

Figure 1: Feature Image for Manuscript homepage

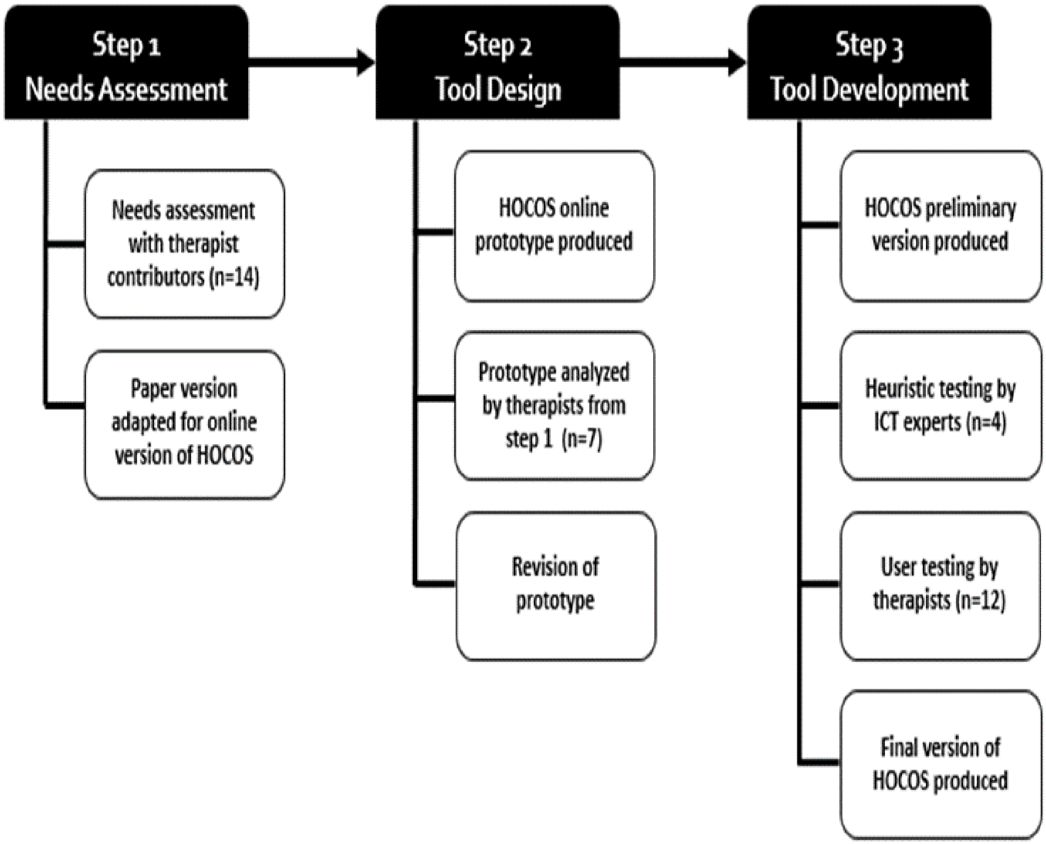

Figure 2: Diagram depicting of the flow of the study.

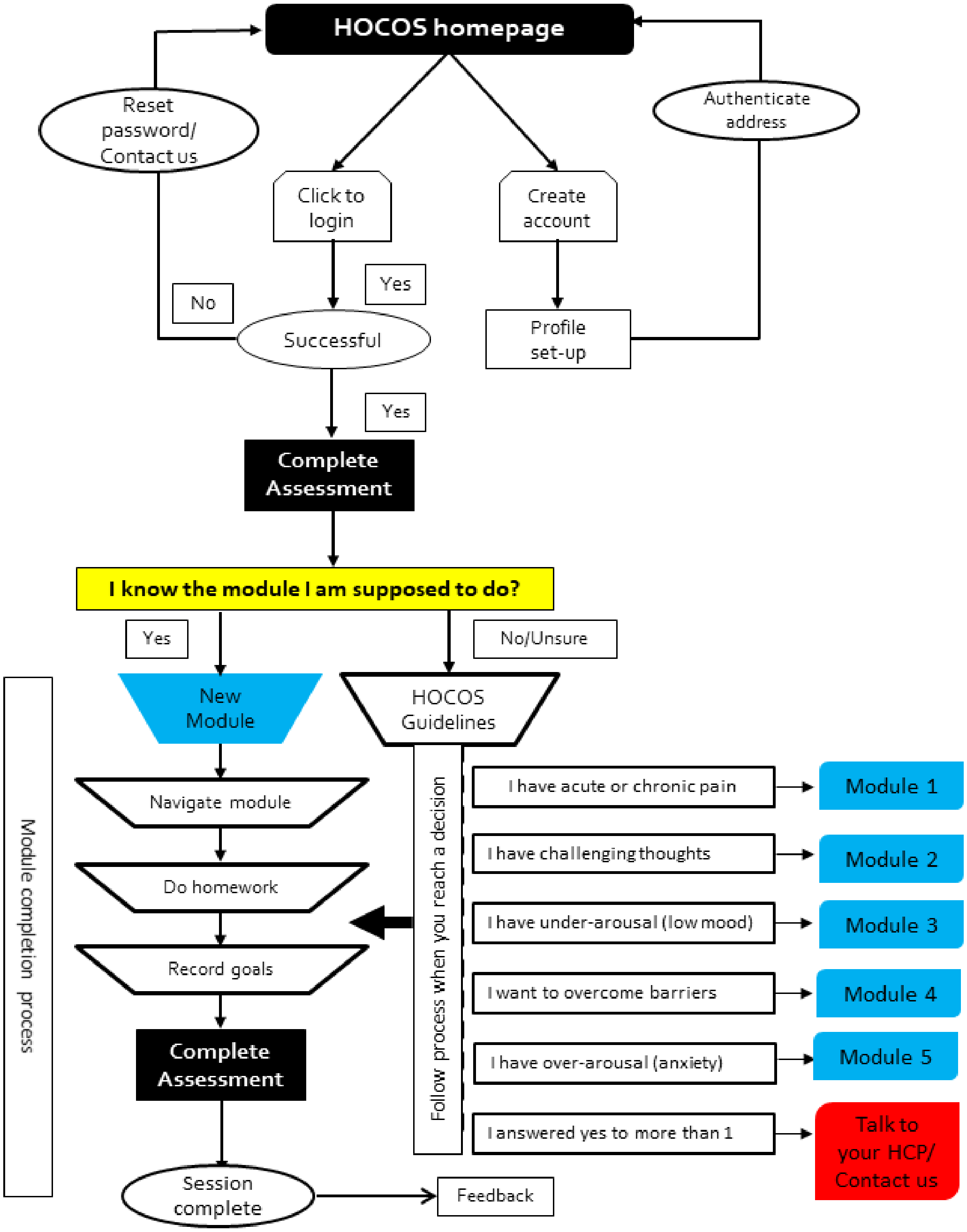

Figure 3: Navigation workflow of Hand Therapy coping Skills Training Program

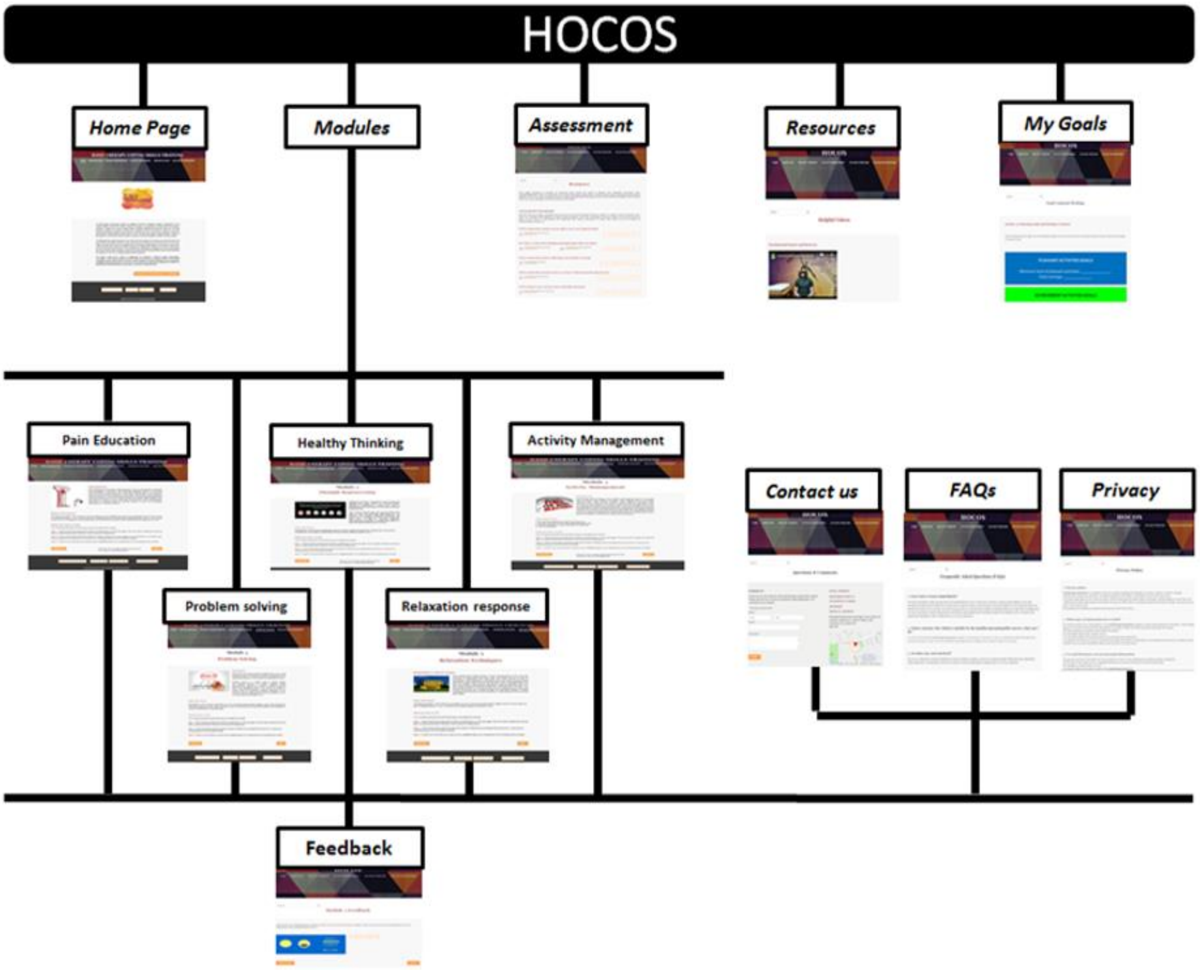

Figure 4: Screenshot of web pages showing the architecture of the website.

APPENDIX 1: Outline of HOCOS session contents

Session	**Projected duration**	**Outline of Content**
1	One week	▪ Logging in and account set up using provided password ▪ Completing battery of questionnaires (demographic information, self-report of hand pain and function, psychosocial factors, assessment) ▪ Information provided about the psychosocial aspects of prolonged pain ▪ Introduction to the Module contents ▪ Introduction to SMART goals and using the program calendar to plan activities. ▪ Providing information on contacts for technical difficulties.
2	Two weeks	▪ Module 1: Introduction pain (meaning, definition, impact on recovery) ▪ This module teaches concepts from therapeutic neuroscience education using stories and metaphors. ▪ Promote interest in exercise and physical activity.
3	Two to four weeks	▪ Module 2: Introduction to the cognitive model. ▪ Encourages users to identify and rate their moods ▪ Encourages users to reflect on their thinking style and identify patterns. ▪ Encourages users to follow the guidelines to completing a thought record
4	Two weeks	▪ Module 3: Introduction to activity management principles ▪ Encourages users to pace activities to avoid boom and bust situations ▪ Encourages users to review their day planner and spot patterns of overactivity and underactivity. ▪ Encourages users to focus on activities that have high mastery and pleasure value.
5	Two weeks	▪ Module 4: Introduction to problems limiting recovery and how to solve them. ▪ Encourages users to consider barriers to doping exercises and reflect on how to overcome those barriers. ▪ Discussion on challenges to exercise and physical activity adherence and steps to regain control.
6	Two weeks	▪ Module 5: Introduction to stress management, relaxation response and sleep training ▪ Encourages users to reflect on the cycle of stress, muscle tension and pain. ▪ Encourages users to practice and adopt one or two relaxation techniques to their day plan. ▪ Encourages users to include downtime in their daily plan
7	Post training (single or multiple modules)	▪ This session focuses on how to continue recommended activities after completing the program. ▪ Users are encouraged to continue to access the resources on the website if necessary ▪ Clinicians are provided with follow-up strategies to ensure patient success ▪ Users complete a feedback form on their experience and a battery of questionnaires to measure their progress.

APPENDIX 2: The behavioral Intervention Technology (BIT) Model mapped to the online version of the **H**and Therapy **O**nline **CO**ping **S**kill Training Program (HOCOS)

Conceptual/Technical components	**BIT Model Components**	**Examples (HOCOS)**
The "Why" describes the focus of the intervention (conceptual)	Product Aims	- To provide patients with psychosocial problems causing prolonged pain and delayed recovery with a supplement to regular hand therapy. - To promote adherence to recommended exercise programs - To increase hand therapists' capacity to screen, assess and manage psychosocial issues.
The "How" described the program characteristics in terms of active ingredients (conceptual)	Cognitive and behavioral change strategies	- Knowledge: why mental health is important to overall health? how the body uses pain as a protective measure - Cognitive: managing moods by working on persistent negative thoughts - Problem solving: Identifying and overcoming barriers to exercise adherence and take full advantage of facilitators. - Planning your day: Planning enjoyable activities and pacing to manage pain and energy levels, setting and modifying goals using SMART - Releasing stress: using relaxation the relaxation response to overcome fear and pain anxiety - Self-monitoring: monitoring's one's own mood and regular engagement in exercise and physical activity. - Reinforcement: Instruction and demonstration of mental practice, activity scheduling and relaxation activities.
The "What" defines the elements of the intervention (technical)	Elements	- PowerPoint slides, audio files, homework, reminder emails, activity calendars, summary reports, fillable forms, links to external resources.
The "How" describes the program characteristics in terms of medium (technical)	Product characteristics	- Medium: text, images, videos - Aesthetics: simple, less distractive, color themed - Complexity: Easy to complete tasks, forms, and activity calendars
The "When" describes the workflow of intervention delivery (technical)	Workflow	- Free flow based on clinician recommendation - Time-based delivery (successive HOCOS sessions scheduled based on previous session date of completion) - Continued access to HOCOS for 3 months.

APPENDIX 3: Semi-structured interview guide for conducting cognitive interviews during usability testing

Now that you have used the website, we are interested in learning about what you liked and disliked about the website.

Question:

1. What did you like best about the website?
   Probes: information, layout, animations, audio quality, PowerPoint presentations, graphics, video clips, workbook etc. Can you tell more about that?
2. What did you like the least or dislike about the website?
   Probes: information, layout, animations, audio quality, PowerPoint presentations, graphics, video clips, workbook etc. Can you tell more about that?
3. How easy was to find your way around the website?
   Probes: What were the challenges of navigating through the website? What would make it easier to navigate through the site?
4. What are your thoughts on the overall look of the website?
   Probes: For example, the design, colours, and images/backgrounds, feeling warm/friendly/cold/too technical? Do you think it is visually appealing or unappealing? What would make the website more appealing? What caught your attention the first time you went through the website?
5. Tell me what you think about the information provided on the website?
   Probes: Accuracy, trustworthiness, amount of information. What needs to be added? Was the information provided helpful, clearly presented, easy to read and understand? Potential to help patients and therapists learn how to cope with psychosocial problems like depression, pain anxiety?
6. Tell me whether or not you would use HOCOS to better manage psychosocial problems?
   Probes: What would motivate you to use this website?
7. Tell me whether or not you think other therapists would be interested in using HOCOS?
   Probes: Perceive interest, recommendation friend with psychosocial issues after a HULI.
8. If you could make any changes to the website, what changes would you make?
   Probes: In terms of content, overall look, graphics?
9. Is there anything else you would like to tell us the website?
   Probes: Can you tell me more about that?

CHAPTER 6: DISCUSSION

Musculoskeletal disorders (MSD) are pervasive in Canada, and the leading cause of disability (Kopec et al., 2019). MSD causes widespread pain and discomfort, leading to problems with function, disabilities, and massive cost to the Canadian health system (IMHA, 2017). The estimated annual burden (direct and indirect costs) of MSD is approaching $22B annually in Canada, with injuries costing an additional $15 billion annually (IMHA, 2014). The projected direct and indirect economic burden of MSD is the highest of any group of diseases according to a recent Public Health Agency of Canada report (PHAC, 2014). According to a recent study, MSD is responsible for an estimated 3,015 years lived with disability (YLD) per 100,000 population in 2017, ahead of mental disorders (1,938 YLD), neurological conditions (1,214 YLD), skin diseases (869 YLD) and unintentional injuries (802 YLD) (Kopec et al., 2019).

This thesis included four manuscripts that aimed to increase understanding of how to improve the management of MSD using TE broadly in orthopedic practice and specifically to hand therapy in terms of therapist practice patterns and the development of an online tool targeting psychosocial issues. A summary of the findings of each article, contributions of this body of work to the scientific literature, limitations in the research, and future directions are described throughout the chapter.

Summary of Findings from Each Chapter

Summary of Chapter 2 "Study Protocol of a Meta-ethnography of Barriers and Facilitators of Adherence to Therapeutic Exercise and Physical Activity in Individuals with Musculoskeletal Conditions."

The first manuscript in this thesis (Chapter 2) was a study protocol for a meta-ethnography on barriers and facilitators of adherence to therapeutic exercise in individuals with musculoskeletal conditions. We conducted a qualitative synthesis to achieve a more in-depth understanding of the subject of adherence than would have been possible through the interpretation of individual primary research alone. The primary purpose of the study protocol was to provide a step by step guide for locating, reviewing, and synthesizing the current state of the evidence following the eMERGe reporting guidelines (France et al., 2019). This study protocol followed a rigorous approach consistent with good practice recommendations and discussed some of the limitations of the design. The protocol described the seven stages of a meta-ethnography developed by Noblit and Hare (1988) and using the World Health Organization Multidimensional Adherence Model (WHO, 2003) as an overarching framework. The findings of this meta-synthesis are presented in Chapter 4. Preparing protocols a priori minimizes the potential for bias in the review process since judgments on the definition of the research question, study eligibility criteria, analysis methods, and synthesis methods should be made before the review is conducted (Allers et al., 2018). However, changes to the protocol may be required while conducting reviews and should be documented and justified when publishing the review findings (Moher et al., 2015). These efforts reduce bias and increase transparency (Silagy et al., 2002).

This qualitative synthesis commenced before the release of the eMERGe guidelines for meta-ethnography (France et al., 2019) and Enhancing transparency in reporting the synthesis of qualitative research (ENTREQ) guidelines (Tong et al., 2012) failed to address some of the complex synthesis processes used in meta-ethnography Although, mete-ethnography is the most reported synthesis method in qualitative health research, the poor quality of reporting often discourages trust in and use of its findings. The eMERGe guideline provided an improved understanding of the "how," "what," "when," and "why" of crucial steps in the original meta-ethnography strategy proposed by Noblit and Hare (1988). Furthermore, due to the multidimensional nature of exercise adherence, more than 200 barriers have been identified in the literature. We decided to build on the existing literature on exercise adherence by using a line of argument of the reciprocal translation based on the overarching World Health Organization (WHO) multidimensional adherence model to provide a new interpretation of the relationships among the five dimensions of adherence, namely: patient-related, condition-related, treatment-related, socioeconomic-related and health-system-related factors.

Summary of Chapter 3, "A Meta-ethnography of Barriers and Facilitators of Adherence to Therapeutic Exercise and Physical Activity in Individuals with Musculoskeletal Conditions."

The second paper (Chapter 3) was a qualitative synthesis designed to locate, appraise, and synthesize studies evaluating the barriers and facilitators of adherence to therapeutic exercise in individuals with MSK pain and disability. The findings revealed the interplay among the five dimensions of exercise adherence. Twenty- six concepts were identified from the original patient or HCP description of factors influencing adherence in the studies included in the synthesis. These were summarized into five themes using the WHO adherence model (WHO, 2003).

Motivation and self-discipline, being able to prioritize exercises into daily routine, having positive illness and health beliefs, and adaptable attributes and traits to overcome adversity were the patient personal and lifestyle characteristics identified. Properly planning exercise programs to increase engagement and promote fidelity, providing exercise instructions to build competence and confidence, and the perceived benefits of the treatment program were shown to be relevant to the nature and structure of exercise program — the physical and psychological sequelae of the health condition impact adherence. The level of social support and availability of financial incentives and favorable environmental conditions accounted for the social and economic determinants. Lastly, the findings showed that the HCP plays a crucial role in promoting adherence based on their personality and style, how their clinical skills and competencies are perceived, and how they provide individual and practical support.

The line of argument further showed that some factors could be conceptualized as being on a continuum representing degrees of positive (facilitator) or negative (barriers) effect on adherence. For example, while social support was often welcome by many patients in terms of family support to plan and exercise programs, other patients could also struggle with receiving such support if they perceive they have to return the favor in the future or feel pressured to meet goals set by others who 'care' about them. Also, sometimes perceived exercise benefits were described as a reason to stop exercises in the short term, especially when goals of pain relief are met. However, other patients described feeling obliged to keep exercising due to the positive impact of not feeling any more pain with exercise.

These findings have implications for understanding how patients with MSK conditions can be better supported to enhance facilitators of adherence and limit barriers impeding adherence. This is valuable information for all stakeholders to collaborate such that adherence and treatment plans can be better planned and completed for improved outcomes and goals. Furthermore, the findings of this review are unique to understanding adherence to MSK conditions compared to other reviews focused on adherence in adults from with various clinical populations including oncology and neurology (Davenport et al., 2019) or adults' adherence to recreational physical activities (Morgan et al., 2019; Ige-Elegbede et al., 2019). This study also explored the perspectives of both patients and HCPs. Thus, closing the gaps in adherence literature, which has mostly focused on patient and treatment factors.

Summary of Chapter 4 "Knowledge, Attitude, Beliefs, and Practice Behaviour of Therapists concerning Managing the Psychosocial Aspects of Pain and Disability for Patients with Hand Injuries: A Qualitative Study."

The purpose of the third study (Chapter 4) was to gain more understanding about the knowledge, attitudes, beliefs and practice behavior of PTs and OTs regarding psychosocial issues in hand therapy practice using qualitative description (Sandelowski et al., 2000) and Theoretical Domains Framework (Atkins et al., 2017). The study findings revealed five themes: concern about the detrimental impact of psychosocial issues (2 sub-themes), attitudes towards psychosocial issues influences clinical practice (2 sub-themes), increased knowledge is core to building the capacity to address psychosocial issues (2 sub-themes), leveraging patient and therapist resources is required to foster psychosocial adjustment (2 sub-themes), and understanding influencing factors is crucial to psychosocial adjustment (6 sub-themes).

The results of this study corroborate the evidence for incorporating the management of psychosocial issues into routine hand therapy practice. Clinicians and trainees in hand therapy need more opportunities in practice to develop the required capacity to effectively screen, assess, and manage psychosocial issues. Similarly, physiotherapy and occupational therapy educational curriculum should be expanded to provide more learning opportunities about psychosocial issues. More formal routes of developing the required knowledge and skills would increase the confidence of therapists to address psychosocial issues. Moreover, opportunities exist to collaborate with other HCPs and patients through peer support programs, and health organizations must be more proactive in creating structures and systems that facilitate these alliances. Lastly, the identified barriers and facilitators can be further developed to guide clinical practice and mitigate patient suffering due to psychosocial issues.

The research implications are that more research is required to understand the perspective of clinicians outside Ontario since care packages and funding schemes differ from one province to the other. The perspective of top management would also be beneficial to understand some of the system related challenges highlighted by participants.

Summary of Chapter 5 "Design, Development and Usability Testing of the Hand Therapy Online Coping Skills Program (HOCOS) for Managing Psychosocial Problems in Hand and Upper Extremity Rehabilitation."

The purpose of the fourth study (Chapter 5) was to highlight the process in the design, development, and usability testing of the HOCOS program for improving the management of hand injuries in routine hand therapy using heuristic testing with ICT experts and usability testing with clinicians. HOCOS contained five online-delivered and therapist-directed modules offering *Pain Education, Cognitive Restructuring, Activity Management, Problem Solving, and Relaxation Response*. Several violations were identified and corrected during the iterative cycles of testing. Seven tasks out of 10 were completed efficiently during task performance. The findings of the cognitive interviews conducted on clinicians were organized into four themes, namely: design aesthetics, content, functionality and features, and desire for future use. Fundamental changes made to HOCOS based on the feedback included the addition of a decision matrix to increase module prescription, language, and grammar changes to clarify meaning and including a "How to make it work guide" for a step-by-step guide on following the program.

The study findings have important implications for clinical practice and research. In terms of clinical practice, HOCOS provides a portal to deliver educational information and coping skills strategies for improved management of psychosocial issues in hand therapy. For research, the findings of this study require further usability testing and refinement with patients diagnosed with hand and upper limb injuries and pilot testing of HOCOS to determine its acceptability, feasibility, and effectiveness.

OVERALL FINDINGS AND LIMITATIONS

This body of work contributes to the evidence of using exercise therapy and psychosocial interventions in MSK rehabilitation.

Chapter 2 was designed to itemize every step of the process that would be used to locate and synthesize the evidence on barriers and facilitators of adherence to TE in chapter three. The syntheses of several qualitative studies allow for the concise collation and summary of data across various contexts, generate new theoretical or conceptual models, identify research gaps, and provide further evidence for the development, implementation, and evaluation of health processes, services, and interventions (Tong et al., 2012). Review articles are crucial to the development of clinical practice guidelines and inform clinical decision-making (Moher et al., 2015). In developing the qualitative meta-synthesis on barriers and facilitators of adherence to

TE, we consulted the ENTREQ guidelines (Tong et al., 2012). The ENTREQ statement enumerates the steps for transparent reporting of the process of searching and selecting qualitative data, appraising study quality, and synthesis of qualitative findings. Furthermore, we drew upon the guidelines for PRISMA-P guidelines (Shamseer et al., 2015) recommendations for including a flow diagram that clearly described the search strategy for selecting studies for a review.

The synthesis of qualitative studies methods continues to undergo refinement due to their recent addition to evidence appraisal and synthesis. There are several qualitative synthesis methods including meta-ethnography (Noblit and Hare, 1988), grounded theory (Eaves, 2001), thematic synthesis (Thomas and Harden, 2008), textual narrative synthesis (Lucas et al., 2007), meta-study (Paterson et al., 2001), meta-narrative (Greenhalgh et al., 2005), critical interpretive synthesis (Dixon-Woods et al., 2006), ecological triangulation (Banning, 2003), and framework synthesis (Oliver et al., 2008). While these approaches can be applied to any phenomenon on interest, the methods for conducting them remain poorly operationalized, there is a lack of clarity about matching appropriate review methods to research questions and how to analyze and present results for informed decision making (Kastner et al., 2012). We chose meta-ethnography because it is widely recommended for evidence synthesis in health and social care research (Dixon-Woods et al., 2007; Ring et al., 2011; Hannes et al., 2012), increasingly used by academic disciplines (Uny et al., 2017) and other forms the foundational basis for other qualitative synthesis methods (Dixon-Woods et al., 2006; Paterson, 2011). Furthermore, the eMERGe reporting guidance, the first reported guideline for reporting complex synthesis processes (France et al., 2019), was used to improve the reporting quality of the findings of our synthesis findings in Chapter 3. In line with the ENTREQ guidelines, we will use a computerized software (EPPI Reviewer) to create an audit trail.

Quality appraisal of eligible studies was completed in two stages to improve the internal validity of this review. Initially, a preliminary appraisal of every article meeting two of the four quality reporting criteria by Campbell et al. (2011) was completed. Subsequently, the CASP checklist (CASP, 2018) for appraising qualitative studies was used to provide a transparent assessment of study quality rather than for exclusionary reasons. Excluding studies comes with a potential risk of losing valuable insights (Hannes 2011). Low-quality studies based on methodological flaws or lack of reporting may yield new insights, grounded in the data, while high-quality studies may show a poor interpretation of data, leading to deficient insight into the phenomenon of interest (Dixon-Woods, 2007).

Chapter 3 enumerates the findings from the meta-synthesis described in chapter two. Increased adherence to TE is crucial to obtaining physical and functional outcomes. The new understanding from this study contributes to designing more acceptable and effective exercise programs that meet the needs and preferences of individuals with MSD. This study also provides HCP with a way to operationalize the factors influencing adherence to exercise proffered by the WHO (WHO, 2003). Although, several robust systematic quantitative reviews (Jack et al., 2010; Jordan et al., 2010; Marks, 2012; Beinart et al., 2013; Picorelli et al., 2014; Ezzat et al., 2015; Dobson et al., 2016; Room et al., 2017; Essery et al., 2017; Meade et al., 2019) have explored adherence to exercise. The existing qualitative synthesis have limited scope focusing on physical activity (Morgan et al., 2019; Koshoedo et al., 2015; Smith et al., 2015), blacks and minorities (Ige-Elegbede et al., 2019), older adults (Morgan et al., 2019) and mental health conditions (Quirk et al., 2017; Soundy et al., 2014). The findings from these qualitative may not be generalizable to individuals with MSD and prescribed therapeutic exercise. Qualitative research can be defined as an iterative process for generating and analyzing empirical material so that improved understanding is achieved by making new significant distinctions resulting from getting closer to the phenomenon studied" (Aspers and Corte, 2019). Meta-ethnography is a method of synthesizing qualitative data. It involves reconceptualization of original studies by considering the set of papers as a whole, more than the sum of their parts (Noblit and Hare, 1988) by comparing study concepts to identify new overarching concepts and new interpretations in a systematic way (Britten et al., 2002). This study summarized the evidence from 38 articles to create a line of argument about adherence to TE.

Our study findings may have excluded essential studies, which means other important constructs were omitted in our conceptualization. Excluding studies not published in English, and lack of data from low-income countries limits the generalization of the review findings to all populations. The strength of this study includes the comprehensive literature search, inclusion and exclusion criteria, quality appraisal, and the presence of both patients and healthcare professionals (HCP) perspectives. The flow diagram and table on study characteristics provide readers with material to understand the search process, quality, and applicability of results. Contribution from both patients and HCP and a detailed description of the analysis process are highlighted in tables and provide an audit trail for readers. The diverse study backgrounds, methods, and participant perspectives make the result both transferable but, at the same time, challenging to synthesize.

The third-order construct (our interpretation) in this review was likely influenced by the background of team members, even though the extent to which this context influences the findings is difficult to ascertain (Atkins et al., 2008). The aim of meta-ethnography is conceptual insight rather than summarizing and aggregating data (Noblit and Hare, 1988). However, our line of argument may have removed the original findings so far from the unique experience and original context of reviewed studies (Sandelowski and Barroso, 2007). Another criticism of meta-synthesis is providing technically well-implemented but simple and exaggerated descriptions (Thorne, 2017). Therefore, the validity of our findings depends on the interpretive logic of the meta-synthesis as we reframed the findings from original studies to create the line of argument description (Strandas and Bondas, 2017). We also ensured a unique focus to this synthesis such that the core themes and metaphor offer a higher level of understanding of the barriers and facilitators of adherence to TE compared to the original description in the multidimensional adherence model (WHO, 2003).

In chapter 4, we focused on gaining insight into how PT and OT screen, assess, and manage psychosocial issues for individuals with MSD. Qualitative research is a diverse group of descriptive and interpretive methods designed to explore, understand, and explain experiences using non-numerical data (Denzin and Lincoln, 2017). The use of qualitative research is well established for generating data within healthcare and social research with a significant increase in the citation in the last decade (Hadi and Jose Closs, 2016). Qualitative research often involves the use of several methods (Anderson, 2010) but mostly interviews and focus groups (Gill et al., 2008). Such studies are designed to obtain information from the individuals who are focal to the phenomenon of interest and generate data about what was said or done in the form of texts which are then analyzed, often by the interviewer or observer, leading to a greater tendency for subjectivity and bias (Hadi and Jose Closs, 2016). This approach lends credence to the criticism of qualitative research as lacking rigor, transparency with a weak justification of data collection and analysis methods, and integrity of findings (Anderson, 2010).

Nonetheless, strengths of qualitative research include the ability to examine issues in-depth and in detail, exploring the direct human experience, transferability of findings to another setting, opportunities to discover the subtilties and complexities about subjects and quick revision of research framework and direction as new information emerges (Anderson, 2010). In this study, we took a "realist approach" to bias as opposed to "positivism" and "interpretivism" (Cohen and Crabtree, 2008) because we believe researcher bias affects the trustworthiness, truthfulness, and validity of the study (Eakin and Mykhalovsky, 2003). Furthermore, using rigorous data collection procedures influences the quality and trustworthiness of qualitative research (Kitto et al., 2008) and critically influences the study results (Gibbs et al., 2007). We developed the interview guide for this study using the Theoretical Domains Framework (TDF) (Michie et al., 2005). Developing interview guides based on the TDF is recommended for qualitative studies with objectives including intervention development, clarifying the roles and responsibilities of healthcare professionals and determining factors that potentially influence clinical behavior (McSherry et al., 2012; Gray et al., 2017; Mekonnen et al., 2018; Cheung et al., 2019; Munday et al., 2019). Using established frameworks for designing interview guides increases the credibility, confirmability, and dependability of the study (Kallio et al., 2016).

Our findings of a lack of adequate knowledge, clinical know-how, and clear organizational pathway for addressing psychosocial factors echoes recent findings in MSK literature. Singla et al. (2015) observed that PTs demonstrated and acknowledged a poor understanding of what constitutes "psychosocial," defaulted to assessing psychosocial issues based on their gut feelings, demonstrated limited training and education, and indicated a need for formal training and additional needs. Although participants in our study acknowledged the biopsychosocial model and the importance of psychosocial issues, the current clinical practice for most PTs and OTs did not reflect this overall. Some of the participants had a dualistic conceptualization of psychosocial as the presence or absence of negative factors affecting patient recovery. This may depict an understanding of the biopsychosocial model as containing two separate entities; biological and psychosocial. This dualization may arise due to the continued influence of having a more biomedically oriented approach or thinking to MSK rehabilitation. Furthermore, participants acknowledged the lack of knowledge and skills to apply the biopsychosocial model in their practice. More efforts must be taken to address the applied knowledge gap through improved entry-level education curriculum regarding psychosocial assessment and treatment and further education for practicing clinicians.

Our findings also showed that participants might also avoid assessing psychosocial factors due to limited understanding or depend on their gut feelings instead of formal techniques. |Despite good intentions, improvised or intuition led assessment has the potential to result in incomplete or ineffective attempts to recognize psychosocial issues. Several barriers were cited by participants in this study, including the stigma surrounding psychosocial factors, time constraints, social support, and the health organization's approach to psychosocial factors. Most participants recommended that building a clinician's capacity to assess and manage psychosocial issues should be addressed at entry-level to the profession and the creation of structures in place at all levels, from formal education to professional practice. This approach may encourage clinicians in hand therapy to view psychosocial assessment as an integral component of overall hand therapy practice.

This study used qualitative description (QD) (Sandelowski, 2000; 2010; Neergaard et al., 2009) to explore the phenomena of interest and especially relevant in mixed-method research, questionnaire development, to gain firsthand knowledge of patients', relatives' or professionals' experiences with a particular topic and suitable if time or resources are limited (Kim et al. (2017). QD has been criticized as being too simple or lacking rigor (Milne and Oberle, 2005). Thus, this study was designed by following principles of authenticity, credibility, criticality, and integrity for enhancing rigor in QD (Milne et al., 2005). Authenticity was achieved using purposive, flexible sampling, participant-driven data collection, accurate transcription, data-driven coding, and categorizing using a framework. Credibility involved capturing and portraying the perspective of clinicians treating patients with hand injuries. We showed criticality by using a journal to document reflections made on the way each decision was made. Acknowledging potential bias of primary author having multiple roles as a clinician, researcher, and interviewer and using peer review for knowledge sharing fulfilled integrity expectations.

Finally, chapter 5 focused on the design, development, and usability testing of HOCOS. HOCOS was designed to make coping skill training more accessible to in hand therapy through web-based platforms. It is not intended to replace the expertise and care of HCP. HOCOS was promoted to HCP as a complement to professionally delivered coping skill training when feasible in hand therapy. Using HOCOS has the potential to help patients better understand the relationship between psychosocial factors, pain, and disability in hand therapy so they can better communicate their needs to HCPs in their cycle of care. In this mixed-methods study, participants (clinicians in hand therapy) in the study identified several usability violations that were corrected during iterative cycles of testing and reported satisfaction with the final prototype.

There are a few limitations that are limiting the generalizability of our findings. The rigor of the current study was enhanced by using method triangulation, including the use of interviews, observations and field notes for data analysis (Carter et al., 2014; Noble and Heale, 2019). The use of observational analysis of video recordings in the think-aloud procedure to observe user interactions with HOCOS would have provided more abundant information on non-verbal elements of usability testing. We recruited a few participants for this study, mostly from urban centers in Ontario, Canada. However, usability testing involving as few as five participants per cycle may be adequate to identify most usability problems and issues (Stinson et al., 2010). A single initial cycle of usability testing could lead to a 10-fold reduction in usability violations (Gustafson and Wyatt, 2004).

Further research may be needed to confirm the usability of the website in community-based centers. User testing of an online intervention should include the ultimate end users including patients to allow for the examination of factors related to participants (age, gender, education), disease (severity, duration of symptoms) and experience (access ad comfort with using the internet and computers) (Stinson et al., 2010). Based on ergonomic quality and safety principles, it has been recommended that prototypes of eHealth interventions should be thoroughly inspected and walked through by HCPs before exposure to potentially vulnerable user groups such as individuals with significant psychosocial problems after a hand injury (Harte et al., 2017). Financial and time constraints were a significant barrier to testing HOCOS on patients with hand injuries. The next phase of this research before implementing HOCOS is to determine how these characteristics would impact the usability of HOCOS in hand therapy and outcome assessment for individuals with hand injuries.

CONCLUSION

MSD is very common in Canada and is the leading cause of disability. The prevalence of MSD has increased rustically in the last three decades due to both the aging population and the age-standardized prevalence rates for some conditions. These trends have significant implications for orthopedic practice and the overall Canadian health policy. Therapeutic exercise remains the most cost-effective approach to the treatment and prevention of the debilitating effects of MSD. Our study enumerates the relationship among the five main factors known to influence adherence to exercise based on the WHO recommendation. Due to the multidimensional nature of adherence, patients and HCP have to collaborate to mitigate barriers and maximize facilitators of adherence effectively. While therapeutic exercise is vital to MSK health, a few patients continue to experience prolonged pain and disability eve when adherence to exercise is at a high level. Therefore, psychosocial interventions have been proposed as a supplement to traditional exercise therapy. In exploring the perspectives of PT and OT practicing in the clinical practice area of hand therapy, our findings showed therapist intention and practice behavior is affected by variations in education and training, having an attitude driven by confidence or apprehension and existential barriers and facilitators. In our final study, clinicians were satisfied with the design of an online intervention for teaching coping skill sin hand therapy to facilitate psychosocial adjustment in their patients after usability testing. Together, these studies provide opportunities for optimizing the musculoskeletal health of Canadians using therapeutic exercise and psychosocial interventions.

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ETHICS MATERIALS FORM (LETTER OF INFORMATION, APRROVAL, AMMENDMENT)

Letter of Information and Consent

Project Title:

DESIGN, DEVELOPMENT AND USABILITY TESTING OF THE HAND THERAPY ONLINE COPING SKILLS PROGRAM (HOCOS) FOR MANAGING PSYCHOSOCIAL PROBLEMS IN HAND AND UPPER EXTREMITY REHABILITATION.

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What is the purpose?

At The Hand and Upper Limb Centre (HULC) we routinely assess and treat patients with injuries that affect the ability to use their hands. You are being invited to enroll in a research study because you a health care professional assessing and managing patients/clients with a hand and/or upper limb injury affecting their activities of daily living and ability work. Any individual with a caseload that includes individuals with traumatic injuries or non-traumatic upper limb conditions would be eligible to participate in this study. The main purpose of the research study is twofold:

1. To assess to assess clinicians (registered Ontario Physiotherapists and Occupational Therapists) awareness of psychosocial factors affecting recovery after a hand and upper limb condition and to identify barriers and facilitators to the screening and management of psychosocial factors for patients with a hand and upper limb condition. We would also like to understand more about the effects of targeting psychosocial factors in patients with hand and upper limb conditions, so that we can provide more information as well as better care to future patients who suffer from such conditions. Psychosocial factors are issues that affect an individual’s response to daily activity and work conditions and potentially causing psychological health problems.
2. To test the usability of an online coping skills intervention for addressing issues such as fear of movement, low mood, and anxiety after a hand and upper limb injury. We also want to understand the challenges to know the amount of change in pain and function that would result from this treatment.

What is involved?

We are looking for clinicians who are currently managing patients with a diagnosis of a hand and/or upper limb injury or condition. This study will include two phases. In phase 1, we will ask you to take part in a face-to-face interview to answer questions about knowledge of psychosocial factors after a hand and upper limb condition, competence to screen for and manage psychosocial factors, skills you need to improve your capacity to manage psychosocial factors, perceived social/professional role to mage psychosocial factors, environmental context and resources facilitating or hindering the ability to assess and manage psychosocial factors. In phase 2, you would be asked to review a website designed for screening and managing psychosocial factors after a hand and upper limb injury. If you agree to participate in this study, you will be required to meet with an investigator for an interview session. Also, you would be assigned by chance to review two of five online coping skills modules on a laptop:

- Module 1 (Pain Education),
- Module 2 (Healthy Thinking),
- Module 3 (Activity Management),
- Module 4 (Problem Solving)
- Module 5 (Relaxation Response).

The modules teach participants about pain and coping strategies for dealing with your low mood, pain anxiety, pain catastrophizing and fear of movement designed to be delivered over a 5-week period. Coping programs are designed to provide participants with skills to overcome psychosocial factors that may otherwise hinder their recovery after an injury or health condition and potential to reduce participation in daily physical activity and return to work. Each module involves listening to an audio podcast, watching a PowerPoint presentation and completing the accompanying homework.

We will also collect information about your general demographics (sex, age, years in practice, education, employment). A Research Assistant will be available to answer some of your questions before asking you to perform either of the interviews. The primary location for these interviews would be at the Hand and Upper Limb Centre (HULC) at St. Joseph's hospital or the MacHAND lab in McMaster University. We would also be willing to conduct the interviews at secondary locations of your choosing such as a public library, personal office or home. One of the co-investigators can also plan to meet with you to conduct the interview over the telephone for the phase 2 part of this study. This interview would be tape-recorded. We will use information collected from this study to further the development of the online coping skills program before testing it on real life patients. We anticipate that each phase of this project would take between 60 and 90 minutes each.

How many people will be in this study?

We are looking for at least 40 participants to volunteer in this study out of which at potentially 20 participants would follow through with both phases of this study.

What are the benefits of participating in this study?

Your participation will allow HULC and those who manage hand and upper limb conditions to better understand how to address psychosocial problems causing prolonged pain and disability and affecting recovery to return to daily physical activity and work. We would be able to understand the benefits and the challenges inherent in introducing internet-based interventions to this patient population either on self-management basis or with supervision from a clinician. Also, there may be no benefit to participants in this study. However, the gathered information can be used to improve treatment planning for managing psychosocial issues affecting recovery after a hand and upper limb injury. HULC is committed to improving the quality of care and participates in these processes on a regular basis.

Is there any compensation?

There is no payment for participating in this study and enrolment is completely voluntary. You may refuse to participate, refuse to answer any questions, or withdraw from the study at **any** point in time with **no** effect on your future healthcare. We will provide parking passes on the days that you choose to do the interviews at MacHAND lab in McMaster or the Hand and Upper Limb Centre in London, Ontario. We would also cover parking costs if you decide to complete the interviews at a location of your choosing and when free parking is not available.

Are there any risks of discomfort associated with this study?

We do not anticipate that there will be any significant risks associated with participating in this study. No additional testing for research purposes other than that stated above will be performed. Some participants may experience minor discomfort because of the unfamiliarity with the study. Also, some of the questionnaires may be upsetting to the participant as they deal with topics of a sensitive nature. If new information becomes available that would affect your participation, you will be informed by our Research Team. Our research team seeks to minimize stress by answering any questions that you may have prior to the beginning the study.

Will your results be kept confidential?

The overall results of the study will be available to you upon request. Your individual results will be held in strict confidence. No person, other than the investigators in this study will have access to your recorded conversation with the research team without your permission. Your data that is sent into the study database for analysis will have your personal identifying information (name, gender, address, telephone, personal identification numbers) coded so that the study database will be anonymous. All audio recordings would be deleted from the recorder and the transcript of recordings would be saved in anonymized data files in our database. Information collected during the study may be presented to other healthcare professionals including physicians, physiotherapists, occupational therapists and hospital administrators in a presentation or paper. Your results would be part of a group of anonymous data, and would not identify you in any way. Representatives of The University of Western Ontario Health Sciences Research Ethics Board and representatives of Lawson Quality Assurance (QA) Education Program may look at study data for quality assurance purposes and to monitor the conduct of the research. We will maintain the study records for 15 years.

Alternatives to Study Participation:

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your future care. You will receive a copy of the letter of information and consent form for your records. You do not waive any of your legal rights by signing the consent form.

Whom may you contact to find out more about this study?

You will be given a copy of this letter and the signed consent form. If you have questions about taking part in this study, you can directly contact:

Dr. Joy MacDermid, BScPT, MSc, PhD - at 519-646-6081, at the Hand and Upper Limb Centre, St. Joseph's Health Centre, Suite D0-209, 268 Grosvenor Street, London, Ontario, N6A 4L6.

Folarin Babatunde, BScPT, MScPT, PhD Candidate, School of Rehabilitation Science, McMaster University at 289-700-8543.

Katrina Munro – at 519-646-6100 ext. 64875 Research Assistant, The Hand and Upper Limb Clinical Research Lab St. Joseph’s Health Centre.

If you have questions about your rights as a research participant or about the conduct of the study you may contact Dr. David Hill at the Lawson Research Institute at 646-6100 ext. 64672.

CONSENT FORM

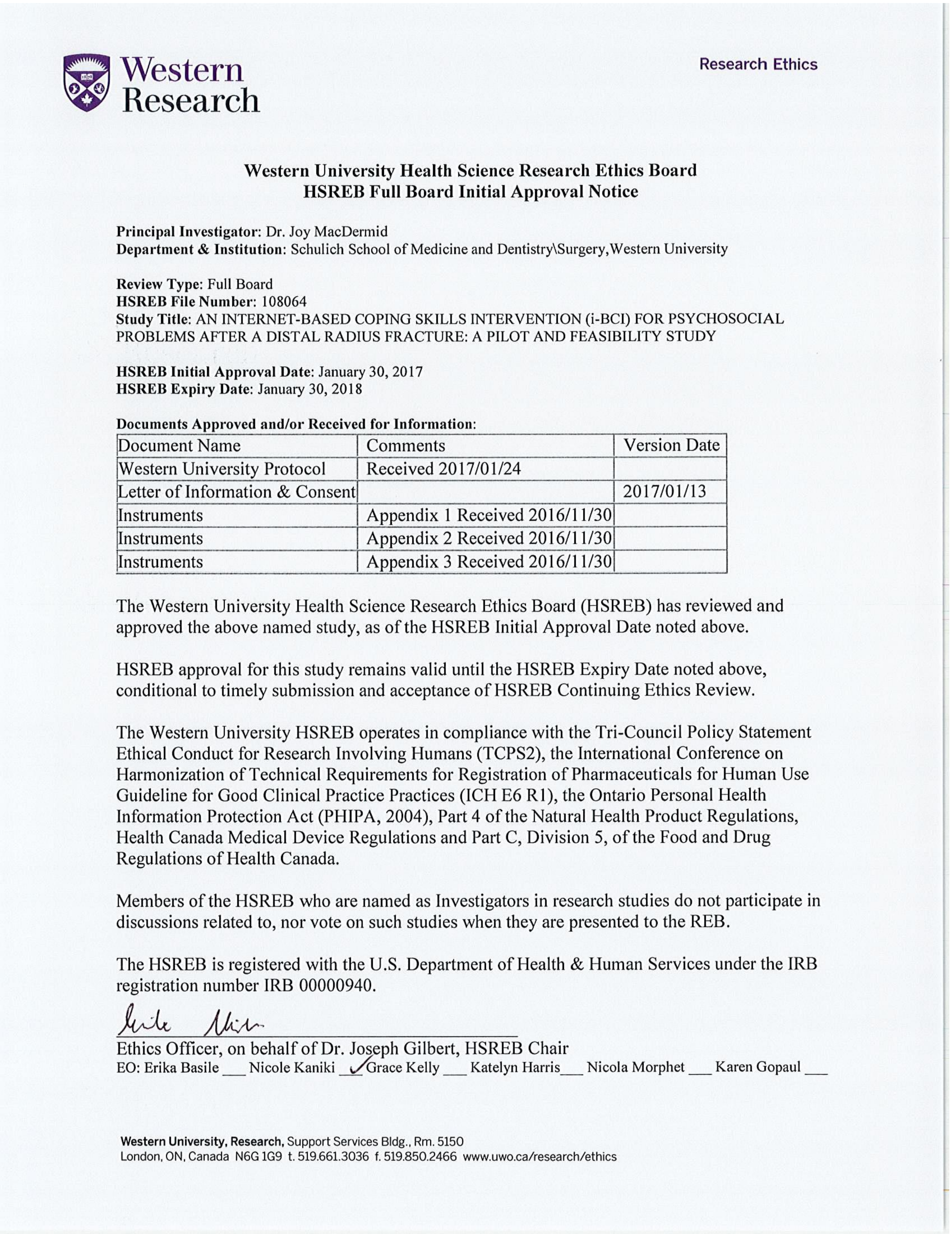
Consent to Participate In Study Titled:

DESIGN, DEVELOPMENT AND USABILITY TESTING OF THE HAND THERAPY ONLINE COPING SKILLS PROGRAM (HOCOS) FOR MANAGING PSYCHOSOCIAL PROBLEMS IN HAND AND UPPER EXTREMITY REHABILITATION.

I have read the letter of information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction

______________________________	______________________________	______________
Signature of Participant	Print Name	Date
______________________________	______________________________	______________
Signature of person obtaining consent	Print Name of person obtaining consent	Date

ETHICS FORMS (APPROVAL)



Western Research

Research Ethics

Western University Health Science Research Ethics Board
HSREB Full Board Initial Approval Notice

Principal Investigator: Dr. Joy MacDermid
Department & Institution: Schulich School of Medicine and Dentistry\Surgery,Western University

Review Type: Full Board
HSREB File Number: 108064
Study Title: AN INTERNET-BASED COPING SKILLS INTERVENTION (i-BCI) FOR PSYCHOSOCIAL PROBLEMS AFTER A DISTAL RADIUS FRACTURE: A PILOT AND FEASIBILITY STUDY

HSREB Initial Approval Date: January 30, 2017
HSREB Expiry Date: January 30, 2018

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Western University Protocol	Received 2017/01/24	
Letter of Information & Consent		2017/01/13
Instruments	Appendix 1 Received 2016/11/30	
Instruments	Appendix 2 Received 2016/11/30	
Instruments	Appendix 3 Received 2016/11/30	

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

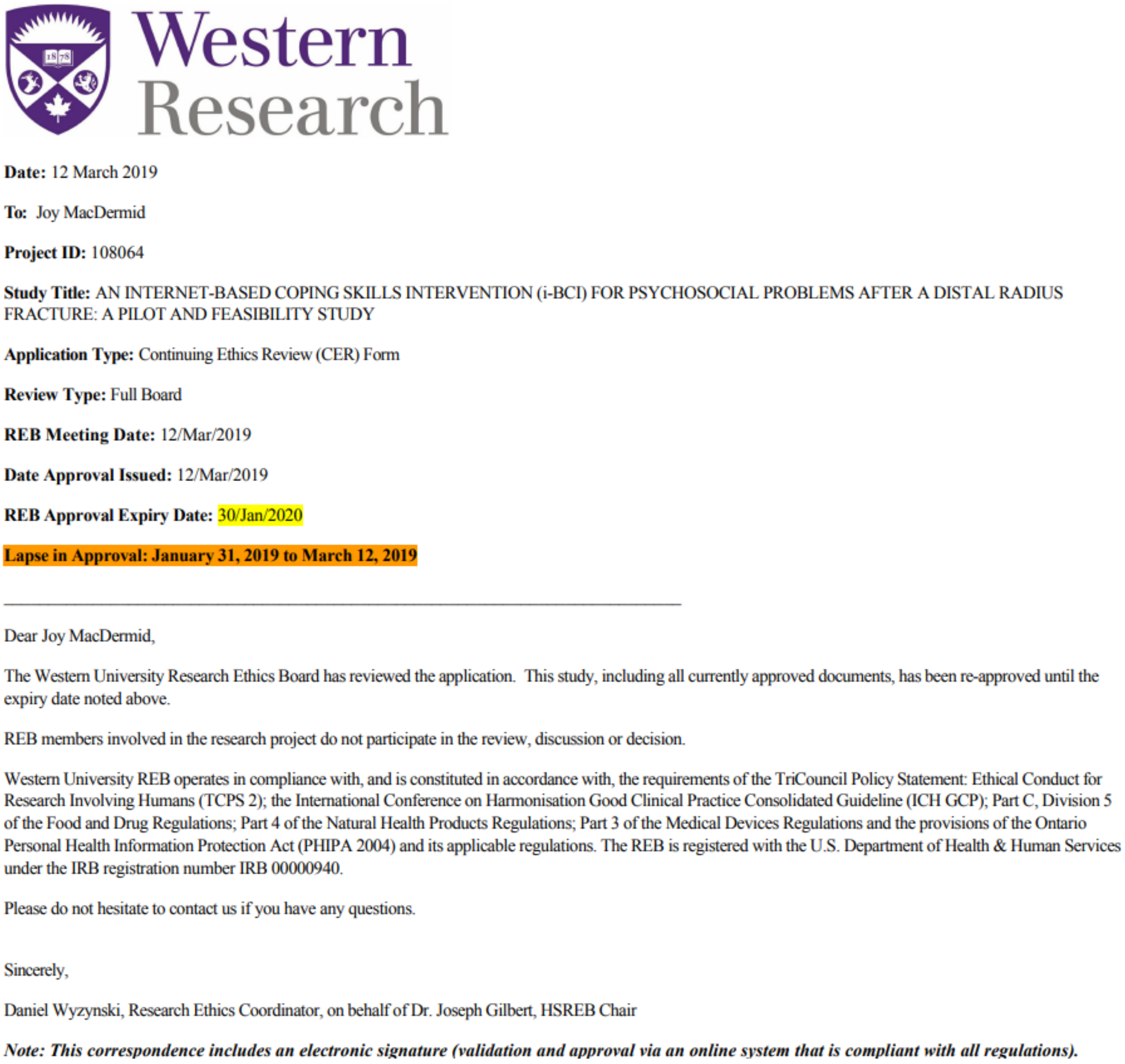
Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer, on behalf of Dr. Joseph Gilbert, HSREB Chair
EO: Erika Basile ___ Nicole Kaniki _✓_ Grace Kelly ___ Katelyn Harris___ Nicola Morphet ___ Karen Gopaul ___

Western University, Research, Support Services Bldg., Rm. 5150
London, ON, Canada N6G 1G9 t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/ethics

ETHICS APPROVAL (AMENDMENTS/EXTRNSION LETTER)



Western Research

Date: 12 March 2019

To: Joy MacDermid

Project ID: 108064

Study Title: AN INTERNET-BASED COPING SKILLS INTERVENTION (i-BCI) FOR PSYCHOSOCIAL PROBLEMS AFTER A DISTAL RADIUS FRACTURE: A PILOT AND FEASIBILITY STUDY

Application Type: Continuing Ethics Review (CER) Form

Review Type: Full Board

REB Meeting Date: 12/Mar/2019

Date Approval Issued: 12/Mar/2019

REB Approval Expiry Date: 30/Jan/2020

Lapse in Approval: January 31, 2019 to March 12, 2019

Dear Joy MacDermid,

The Western University Research Ethics Board has reviewed the application. This study, including all currently approved documents, has been re-approved until the expiry date noted above.

REB members involved in the research project do not participate in the review, discussion or decision.

Western University REB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The REB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Daniel Wyzynski, Research Ethics Coordinator, on behalf of Dr. Joseph Gilbert, HSREB Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).