Perceived injustice and recovery outcomes following surgery for osteoarthritis of the knee

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ABSTRACT

Previous research has shown that perceptions of injustice might interfere with recovery following musculoskeletal injury. This program of research addressed the role of perceived injustice in the prediction of post-surgical outcomes in individuals treated for severe osteoarthritis (OA) of the knee. Demonstrating that a psychological variable increases the risk of problematic post-surgical outcomes may provide an empirical basis for the development of interventions aimed at promoting a more positive recovery following joint replacement surgery. In addition, demonstrating that perceptions of injustice can arise in the absence of an eliciting event (i.e., injury) and a salient source for blame, may contribute to the development of a theoretical framework addressing how injustice appraisals impact on health and mental health outcomes in individuals with OA.

Study 1 validated an adapted version of the Injustice Experiences Questionnaire (IEQ) in individuals with OA of the knee. The study sample consisted of 110 individuals with severe OA of the knee who completed the adapted IEQ (IEQ-chr), along with measures of pain severity, physical disability, pain catastrophizing, fear of movement, and depressive symptomatology. The findings supported the construct validity of the IEQ-chr (chr; Chronic). Specifically, the results revealed that IEQ-chr replicated the two-component solution of the original IEQ, had high internal consistency, and was significantly associated with all study variables in zero-order correlation analyses. The results of hierarchical regression analyses revealed that perceived injustice contributed significant unique variance to pain severity and physical disability, above and beyond the variance accounted for by measures of pain catastrophizing and fear of movement. The relevance of perceived injustice in an OA context is addressed.

Study 2 examined the role of pre-surgical perceptions of injustice in predicting pain outcomes one year after Total Knee Arthroplasty (TKA). The study sample consisted of 116 individuals with OA of the knee who completed measures of perceived injustice, pain catastrophizing, fear of movement, pain severity, and physical disability before surgery, and one year after surgery. The results of prospective multivariate analyses revealed that perceived injustice contributed significant unique variance to the prediction of post-surgical pain severity, beyond the variance accounted for by demographic variables, comorbid health conditions, pre-surgical pain severity, and pain-related psychological variables. Receiver Operating Characteristic curve analyses were used to identify optimal cut off scores on the IEQ-chr in relation to patients' pain and disability scores one year after surgery. The results inform about the importance of assessing perceptions of injustice before surgery, and developing psychosocial interventions that target perceptions of injustice in individuals at risk.

Study 3 examined the relative contributions of post-surgical reductions in pain severity, depressive symptoms, and disability to the prediction of reductions in perceptions of injustice. The study sample consisted of 110 individuals with OA of the knee who completed measures of perceived injustice, pain severity, disability, and depressive symptomatology before surgery and one year after surgery. The results of prospective multivariate analyses revealed that reductions in disability and reductions in depressive symptomatology contributed significant unique variance to the prediction of post-surgical reductions in perceived injustice. The results inform about the determinants of perceived injustice in the context of OA. The findings serve to guide the development of clinical interventions that aim to reduce perceptions of injustice.

The studies of this thesis extend previous research by demonstrating the relevance of assessing perceived injustice in the context of OA of the knee. The prognostic value of perceived

injustice in predicting post-surgical pain, and the identification of determinants of perceived injustice may provide an empirical basis for the development of psychosocial interventions aimed at reducing perceived injustice. The General Discussion examines prominent theoretical frameworks of justice-appraisals. It proceeds with a discussion of theoretical and clinical implications of perceived injustice in the context of OA. It concludes with addressing current limitations, and the necessary components required for the development of a comprehensive model of perceived injustice in the context of pain.

RÉSUMÉ

Des études antérieures ont démontré qu'un sentiment d'injustice pouvait nuire au rétablissement après une blessure musculosquelettique. Le présent programme de recherche portait sur le rôle du sentiment d'injustice dans la prévision des résultats post-opératoires chez les personnes traitées pour gonarthrose (GA) sévère. La démonstration qu'une variable psychologique augmente le risque de résultats post-opératoires problématiques peut servir de base empirique à l'élaboration d'interventions visant à promouvoir un rétablissement plus satisfaisant après une chirurgie. En outre, la démonstration qu'un sentiment d'injustice peut survenir en l'absence d'un événement déclencheur (p. ex. une blessure) et d'une source de blâme conséquente peut contribuer à l'élaboration d'un cadre théorique axé sur l'impact du sentiment d'injustice sur les résultats pour la santé physique et mentale chez les personnes atteintes de GA.

L'étude 1 visait à valider une version adaptée de l'Injustice Experiences Questionnaire (IEQ) chez les individus atteints de GA. L'échantillon à l'étude était constitué de 110 personnes atteintes de GA sévère invitées à répondre à l'IEQ adapté (IEQ-chr) et soumises à des mesures d'intensité de la douleur, d'incapacité physique, de pensée catastrophique, de peur du mouvement et de symptômes dépressifs. Les résultats ont confirmé la validité conceptuelle de l'IEQ-chr. Plus précisément, les résultats ont révélé que IEQ-chr reproduisait la structure factorielle de l'IEQ original et présentait une cohérence interne élevée de même qu'un lien significatif avec toutes les variables à l'étude lors d'analyses de corrélation d'ordre zéro. Les résultats d'analyses de régression hiérarchique ont révélé que le sentiment d'injustice était source d'une importante variance unique en ce qui a trait à l'intensité de la douleur et à l'incapacité physique, au-delà de la variance issue des mesures de pensée catastrophique et de peur du mouvement. La pertinence du sentiment d'injustice dans un contexte de GA est abordée.

L’étude 2 portait sur le rôle des sentiments d'injustice préopératoires dans la prévision des résultats en matière de douleur un an après une arthroplastie totale du genou (ATG). L'échantillon à l’étude était constitué de 116 personnes atteintes de GA soumises à des mesures de sentiment d'injustice, de pensée catastrophique, de peur du mouvement, d’intensité de la douleur et d'incapacité physique avant la chirurgie et un an après la chirurgie. Les résultats d’analyses prospectives multivariées ont révélé que le sentiment d'injustice était source d’une importante variance unique en ce qui a trait aux prévisions relatives à l’intensité de la douleur postopératoire, au-delà de la variance attribuable aux variables démographiques, aux affections concomitantes, à l’intensité de la douleur préopératoire et aux variables psychologiques liées à la douleur. Des analyses de courbe d’efficacité du récepteur ont été effectuées pour déterminer le score seuil optimal à l'IEQ-chr par rapport aux scores de douleur et d’incapacité du patient un an après la chirurgie. L'importance d'évaluer le sentiment d'injustice avant la chirurgie et d’élaborer des interventions psychosociales axées sur le sentiment d'injustice est abordée.

L’étude 3 portait sur la contribution relative d’une réduction postopératoire de l’intensité de la douleur, des symptômes dépressifs et de l'incapacité physique à la prévision d’une réduction du sentiment d'injustice. L'échantillon à l’étude était constitué de 110 personnes atteintes de GA soumises à des mesures de sentiment d'injustice, d’intensité de la douleur, d’incapacité physique et de symptômes dépressifs avant la chirurgie et un an après la chirurgie. Les résultats d’analyses prospectives multivariées ont révélé qu’une réduction de l'incapacité physique et des symptômes dépressifs suscitait une importante variance unique en ce qui a trait à la prévision d’une réduction postopératoire du sentiment d'injustice. Les déterminants du sentiment d'injustice dans le contexte de la douleur chronique et la pertinence des résultats de

l'étude concernant l'élaboration d'interventions cliniques visant à réduire le sentiment d'injustice sont abordés.

Les études de cette thèse prolongent les recherches antérieures en démontrant la pertinence de l'évaluation du sentiment d'injustice dans le contexte de la GA. La valeur pronostique du sentiment d'injustice quant aux prévisions relatives à la douleur postopératoire et l'identification des déterminants du sentiment d'injustice fournissent une base empirique à l'élaboration d'interventions psychosociales visant à réduire le sentiment d'injustice. La discussion générale porte sur des principaux cadres théoriques en matière de perception d'injustice. On y aborde ensuite les des implications théoriques et cliniques du sentiment d'injustice dans le contexte de la GA. On y traite enfin des limites actuelles et les éléments de modèle requis qui nécessitent des recherches ultérieures pour développement d'un modèle compréhensif du sentiment d'injustice dans le contexte de la douleur chronique.

PREFACE AND CONTRIBUTION OF AUTHORS

This thesis consists of three multi-authored manuscripts. The author of this thesis, Ms. Esther Yakobov was the lead author on each of these manuscripts. Study 1 was co-authored with Dr. Whitney Scott, Dr. Michael Tanzer, Dr. William Stanish, Dr. Michael Dunbar, Dr. Glen Richardson and Dr. Michael Sullivan. Study 2 was co-authored with Dr. Whitney Scott, Dr. William Stanish, Dr. Michael Dunbar, Dr. Glen Richardson and Dr. Michael Sullivan. Study 3 was co-authored with Dr. Whitney Scott, Dr. William Stanish, Dr. Michael Tanzer, Dr. Michael Dunbar, Dr. Glen Richardson and Dr. Michael Sullivan. As lead author of all three studies, Ms.Yakobov formulated study questions, planned and performed all data analyses, and wrote the manuscripts as well as the response letters to reviewers following submission of the manuscripts. Dr. Michael Sullivan provided guidance and support for all studies with respect to study design, data analyses, manuscript preparation and revision. Dr. Whitney Scott assisted with feedback and revisions for all three studies. Dr. Michael Tanzer, Dr. William Stanish, Dr. Michael Dunbar, and Dr. Glen Richardson assisted with data collection, and participated in reading and editing the manuscripts for all three studies. The studies presented in this thesis represent original scholarship and distinct contributions to knowledge.

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CHAPTER 1: GENERAL INTRODUCTION

It is more important to know what sort of person has the disease than what kind of disease the person has. Hippocrates

Pain is defined by the International Association for the Study of Pain, as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP, 2017). A distinction has been drawn between acute and chronic pain. Acute pain is characterized by its sudden onset, discernable cause, and limited duration (Ferrell, 2003). Chronic pain is defined as persistent or recurrent pain lasting longer than 3 months (Treede et al., 2019). While acute pain signals injury or disease onset, chronic pain, in many cases no longer functions as a sign of disease process (Flor, Birbaumer, & Turk, 1990).

In Canada, chronic pain affects approximately 20% of the adult population, and data indicate that individuals of 50 years of age and older are twice as likely to develop it (Gatchel, 2005; Schopflocher, Taenzer, & Jovey, 2011). Osteoarthritis (OA) is the leading cause for chronic pain and disability in Canada (Schopflocher et al., 2011). OA is characterized by progressive deterioration of joint tissues; main symptoms involve joint pain, stiffness, swelling, and decreased range of motion. The risk of developing the disease increases with age (Centers for Disease Control and Prevention [CDC], 2010).

In Canada, the estimated direct costs of OA surpassed 10 billion dollars in 2010 (Arthritis Alliance of Canada [AAC], 2011). Associated costs include visits to health professionals, medical tests, hospitalizations, medication, and community services. The estimated indirect economical cost measured by productivity loss surpassed 17 billion dollars in 2010 (AAC, 2011). Current population trends in terms of aging, and growing life expectancy suggest that the

direct and indirect costs associated with OA will rise substantially in the next 20 years (AAC, 2011).

In addition to the economic and societal costs associated with OA, a significant burden is imposed on individuals living with the condition. In the advanced stages of the disease, they may experience significant pain and mobility restrictions that impact negatively on the quality of life (Snider, MacDonald, & Pototschnik, 2005). Advanced OA symptoms can interfere with participation in valued life activities including employment, social interactions, leisure and more. Research indicates that 15% of individuals with OA who were scheduled for joint replacement surgery, scored in the 'near-death equivalent' to 'death-equivalent' range on a measure of quality of life (Ackerman, Graves, Wicks, & Osborne, 2005).

Total knee arthroplasty (TKA) is a surgical intervention often considered for individuals with advanced OA of the knee. TKA involves the replacement of diseased tissue and bone with a prosthetic joint. Research indicates that the majority of individuals who undergo TKA report significant gains in terms of reduction in pain and disability (Juni, Reichenbach, & Dieppe, 2006). However, research also indicates that 15%- 20% of patients continue to experience severe pain, mobility restriction, and reduced quality of life long after surgery despite successful objective surgical outcomes (Baker, van der Meulen, Lewsey, & Gregg, 2007; Bourne, Chesworth, Davis, Mahomed, & Charron, 2010). A growing body of literature indicates that symptoms of pain and disability following TKA cannot be fully accounted for by medical status variables alone (Sullivan, 2014).

Biopsychological conceptualizations of chronic pain have emerged as the dominant frameworks to account for the range of manifestations of pain and disability associated with OA (Keefe et al., 2002). Current biopsychosocial conceptualizations of OA-pain propose that the

experience of pain is influenced jointly and reciprocally by psychological, biological, and social variables (Hunt, Birmingham, Skarakis-Doyle, & Vandervoort, 2008; Keefe et al., 2002). Numerous investigations have pointed to the important role of psychological factors as determinants of health and mental health outcomes following TKA (Dunbar, 2001; Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008; Riddle, Wade, Jiranek, & Kong, 2010).

Recent research has drawn attention to perceived injustice as a psychological factor that contributes to problematic outcomes in individuals who sustained debilitating injuries (Sullivan, Yakobov, Scott, & Tait, 2014). Perceived injustice has been conceptualized as an appraisal process characterized by a tendency to construe one's losses as severe and irreparable, and to attribute blame for one's suffering to others (Sullivan et al., 2008). Numerous cross-sectional and prospective studies have shown that high scores on a measure of perceived injustice are associated with more severe symptoms of pain, prolonged disability, and the persistence of symptoms of depression and PTSD (Scott, Trost, Milioto, & Sullivan, 2013; Sullivan et al., 2008; Sullivan, Davidson, Garfinkiel, Siriapaipant, & Scott, 2009; Sullivan, Thibault, et al., 2009).

To date, research on perceived injustice has focused primarily on individuals with musculoskeletal pain following an injury. Research has proceeded under the assumption that perceptions of injustice arise consequent to an eliciting event that is appraised as a violation of justice principles (Colquitt, 2001; Sullivan et al., 2008). There are grounds, however, for considering that an eliciting event may not be a necessary condition for the emergence of perceived injustice. According to Darley and Pitman (2003), perceptions of injustice are likely to emerge from an attributional search aimed at identifying causes of experiences characterized by suffering and loss. While suffering and loss are likely consequences of a debilitating injury,

themes of suffering and loss are not unique to individuals who sustained a traumatic injury. A wide range of debilitating health and mental health conditions of insidious onset have been shown to be associated with significant suffering and loss (Lyons & Sullivan, 1998; Roy, 2004).

Narratives of individuals with advanced OA are replete with themes of physical and emotional suffering, and losses associated with OA-related disability (Demierre, Castelao, & Piot-Ziegler, 2011; Fujita, Makimoto, & Hotokebuchi, 2006). Thus, even in the absence of an eliciting event (i.e., injury), or a source for blame, the severity of suffering and the multitude of losses that accompany OA might set the stage for the emergence of injustice appraisals, which in turn might compromise recovery after TKA.

The current thesis aimed to examine the role of perceived injustice in pain and disability outcomes in individuals with severe OA of the knee. From a clinical perspective, this program of research aims to identify psychological risk factors for problematic post-TKA outcomes. Increased knowledge about psychological risk factors for problematic recovery outcomes might contribute to the empirical foundation for the development of new avenues for interventions aimed at promoting successful recovery after TKA. From a theoretical perspective, this program of research aims to bring greater specificity to the identification of maladaptive cognitive processes that can impede recovery following surgical interventions. At present, biopsychosocial conceptualizations of pain have been silent on the role of perceived injustice in health and mental health outcomes.

The thesis is comprised of three empirical studies. The goal of the first study was to validate the Injustice Experience Questionnaire adapted for use in individuals with OA. The goal of the second study was to examine the role of perceived injustice as a predictor of pain-related

outcomes after TKA. The goal of the last study was to identify the determinants of changes in perceived injustice.

The General Introduction provides a framework within which the three thesis studies are situated, a brief history of pain theories and the role of cognitions in pain outcomes. It then addresses recent research on perceived injustice and health and mental health outcomes in chronic pain context, followed by theoretical perspectives in this area of inquiry. The final section discusses the clinical and theoretical implications of research on perceptions of injustice and pain outcomes in individuals with OA of the knee.

The evolution of theories of pain

René Descartes, a 17th century French philosopher and mathematician, is credited with having put forward the first comprehensive model of pain transmission. Descartes held a dualistic perspective on human nature; he proposed that the mind (psyche) and the body (soma) represented distinct and independent spheres of experience (Descartes, 1662). Descartes distinguished between the sensory transduction and the perceptual experience of pain. He described nerves as hollow tubules that convey both sensory and motor information. In his model, a sensory event in the periphery (i.e., injury) opened pores that control the tubules initiating movement of *animal spirits* through nerve tubes until they exerted pressure on the pineal gland, which in turn produced the perception of pain. For Descartes, pain was entirely a bodily phenomenon, and was directly proportional to the severity of the physical damage (Descartes, 1662).

Descartes' model of pain transmission served as a foundation for the development of the *specificity theory* of pain. Initially articulated by Muller (1835), and further developed by Von Frey (1895), the specificity theory suggested that the body contains specific pain receptors in the

periphery (Frey, 1895; Muller, 1835). According to the specificity theory, when activated by external stimuli, the dedicated pain nerve fibers transmit information from pain receptors in the site of injury to brain areas that give rise to the perception of pain (Frey, 1895, 1896). Conversely, the *pattern theory* suggested that there was no separate system for pain perception. Initially articulated by Nafe (1929), and further developed by Sinclair (1955) and Weddell (1955), the pattern theory proposed that the receptors for pain are shared with other senses such as touch, and temperature (Nafe, 1929; Sinclair, 1955; Weddell, Palmer, & Pallie, 1955). According to the pattern theory, overstimulation of peripheral sensory receptors leads to patterns of neural activity that result in the perception of pain.

Early theories based on Descartes' model assumed that the experience of pain was the result of a bottom-up process with pain severity proportional to the magnitude of tissue damage. These early theories had a number of shortcomings. For example, they could not account for individual differences in pain experience, they failed to explain the persistence of chronic pain after the injury had healed, and could not account for phantom limb pain after amputation.

Henry Beecher was the first to draw attention to the role of psychological and contextual factors in the experience of pain. His observational research revealed that during World War II wounded American soldiers in Italy demanded significantly fewer analgesics than civilians treated at the same hospital, even though the injuries of the soldiers were more severe. Beecher suggested that for many soldiers, their wounds may have represented their 'ticket to safety' and their pain experience may have been lessened by this positive reinterpretation (Beecher, 1946). In sum, there was a need for a more comprehensive model of pain that could account for a wider range of factors that influenced the experience of pain.

The Gate Control Theory (GTC) advanced by Ronald Melzack and Patrick Wall (1965), has successfully unified the bottom-up physiological aspects of pain, with top-down mechanisms mediated by cognition, affect and contextual factors. Melzack and Wall proposed that the perception of pain was a complex interplay between the ascending and descending projections that control a "gate" found in the substantia gelatinosa in the dorsal horn of the spinal cord. According to the GTC, the stimulation of peripheral nociceptors can initiate the transmission of pain along different afferent fibers that enter the dorsal horn of the spinal cord. The descending fibers from supraspinal regions can also project to the dorsal horn and modulate the "opening" or "closing" of pain gate. Extensive research has focused on understanding of the facilitatory and inhibitory mechanisms involved in pain experience (Basbaum & Fields, 1984; Gatchel, Peng, Peters, & Fuchs, 2007; Julien, Goffaux, Arsenault, & Marchand, 2005; Julien & Marchand, 2006).This conceptualization of pain has dramatically changed the field, and facilitated the development of modern biopsychosocial models of pain that integrate the biological, social, affective, and cognitive factors involved in the experience of pain (Gatchel, 2004).

Towards the biopsychosocial models of chronic pain

George Engel is recognized for his pioneering efforts in the elaboration of the first biopsychosocial conceptualizations of health. Engel critiqued the prevailing biomedical model of the time for its dualistic nature, reductionism, and narrow focus on organic pathology (Engel, 1980). One of Engel's most important contributions to subsequent biopsychosocial pain models was the distinction between disease and illness (Gatchel et al., 2007). Engel defined disease as an objective biological event underlying an organic pathology. Illness, on the other hand, was defined as a subjective experience of the patient that may be influenced by the immediate social context and response to disability. Engel called for a focus on both, disease and illness. He also

advanced the notion that a patient's health condition had to be considered in the context of psychological and social factors (Engel, 1980).

This distinction between disease and illness proposed by Engels is analogous to the distinction between nociception and pain (Gatchel et al., 2007). Whereas nociception refers to the stimulation of nerves that transmit signals about tissue damage, pain is a subjective perception that is the result of the transduction, transmission, and modulation of the sensory input. Pain may be influenced by learning history, psychological factors, and social and cultural contexts. Some of these ideas were reflected in the conceptual model of pain proposed by Loeser (Loeser, 1982). Loeser delineated four dimensions of the experience associated with pain: *nociception*, *pain*, *suffering* (i.e., emotional responses triggered by pain such as fear or depression), and *pain behavior* (i.e., communications of pain, avoidance of activities) (see Gatchel et al., 2007 for review; Loeser, 1982).

In 1987, Gordon Waddell introduced a biopsychosocial model in the context of non-specific low back pain (Waddell, 1987). The original biopsychosocial model of health and illness was neither based on underlying theory and was not tested empirically (Van Oudenhove & Cuyper, 2014). Waddell's model provided a shift from simple description to empirical testing of interrelations between model components (Shakespeare, Watson, & Alghaib, 2017). Waddell's model has extended Engel's model of illness, and Loeser's model of pain to include disability and the cognitive dimension of chronic pain as essential model components.

Waddell remarked that in many individuals with chronic low back pain, the relationship between tissue damage, chronic pain, and chronic disability was not always evident (Waddell, 1987). He emphasized that pain (subjective symptom) and disability (restriction of function) are conceptually and clinically distinct (Waddell, Newton, Henderson, Somerville, & Main, 1993).

Waddell suggested that chronic pain and chronic disability become significantly dissociated from the original physical event as the period of chronicity extends over time. Chronic pain and disability instead become increasingly associated with emotional distress, depression and adoption of sick role behaviours (Waddell, 1987). Waddell suggested that disability was influenced by physical, psychological, and behavioral factors, and can be viewed as an illness in its own right, rather than being a consequence of physical pathology. This approach shifted attention from pain management to restoration of function as viable treatment goal for individuals with persistent pain conditions.

Waddell also pointed out that disability could not be fully evaluated without understanding the psychological status of the individual (Waddell, 1987). Waddell and colleagues suggested that anxiety, and fear avoidance beliefs about physical activity and work, play an important contributing and maintaining role in low back pain and disability (Waddell, 1987; Waddell, Main, Morris, Di Paola, & Gray, 1984; Waddell, et al., 1993). An important clinical implication of this conceptualization was the need to address fear avoidance beliefs and affective responses in the assessment of individuals with persistent pain and disability.

Waddell's biopsychosocial model of chronic low back pain prompted a wealth of research examining psychological contributions to low back pain (Linton, 2000; Pincus, Burton, Vogel, & Field, 2002). The broader implication of Waddell's model was the recognition that medical interventions alone were not sufficient to treat chronic pain and disability. Over the next three decades, research has accumulated to show that psychological variables such as self-efficacy, pain catastrophizing, and beliefs about pain played a significant role in pain severity, disability and mental health outcomes in individuals with chronic low back pain (George & Beneciuk, 2015; Kovacs et al., 2008; Simmonds, Kumar, & Lechelt, 1996). Research has also

shown that psychological variables contribute to chronic low back pain and disability independently of objective markers of organic pathology (Crombez, Van Damme, & Eccleston, 2005; Crombez, Vervaet, Baeyens, Lysens, & Eelen, 1996; Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006).

A biopsychosocial model of pain relevant to OA was put forward by Keefe and colleagues (Fig 1) (Keefe & Bonk, 1999; Keefe et al., 2002). Keefe's biopsychosocial model of arthritis asserts that pain and disability associated with OA are affected by biological, psychological and social variables. Relations between model components can be joint, sequential, and reciprocal. Biological variables, whether precipitated by trauma, or influenced by genetic or metabolic factors, can result in damage to cartilage and changes to the bone. The consequences of this pathology comprise joint pain, tenderness, limitation of movement, and various degrees of inflammation and swelling. In response to pain and reduced range of motion, many individuals may become deconditioned which in turn can amplify pain, contribute to muscle weakness, and reduce tolerance for physical activity.

According to Keefe and colleagues, the most relevant psychological factors in the biopsychosocial model of arthritis include self-efficacy, helplessness, depression, stress, and coping strategies (Keefe et al., 2002). Research has also accumulated to show that pre-surgical pain-related psychological variables are important determinants of pain and disability after TKA Sullivan, Tanzer, et al., 2009; Zhaoyang, Martire, & Sliwinski, 2017). For example, pain catastrophizing was found to predict pain intensity 6 months after surgery above and beyond the severity of pre-surgical pain (Sullivan, Tanzer, et al., 2009). In another study, higher pre-surgical scores on pain catastrophizing predicted lower quality of life one year after surgery, despite significant reductions in pain and improvement in function (Yakobov et al., 2018). Social

support, socioeconomic status, and caregiver responses have also been discussed as important social factors that can exacerbate or attenuate OA symptoms (Keefe et al., 2002). According to Keefe and colleagues, a comprehensive assessment of OA must include a thorough evaluation of psychological variables, and the social context of the patient (Keefe et al., 2002).

The overarching goal of the biopsychosocial model of OA is to improve the understanding of OA-pain and disability, and to guide assessment and interventions. Traditional approaches to treatment for OA have been largely symptomatic with a focus on pain management and physical therapy (Keefe et al., 2002). Research highlighting the incremental value of psychological variables in the prediction of post-surgical outcomes drew attention to the need for psychosocial treatments in this population. Research exists to show that cognitive-behavioural interventions contribute to an improved ability to cope with pain, decreased pain severity and disability, and improved well-being in individuals with OA (Hausmann et al., 2017; Keefe, Porter, Somers, Shelby, & Wren, 2013).

Perceived injustice and health outcomes in the context of chronic pain

Over the past decade, numerous investigations have examined the role of perceived injustice in health and mental health outcomes associated with pain (Sullivan et al., 2008; Sullivan et al., 2014). Empirical research on perceived injustice and the processes by which it impacts on pain-related outcomes is in its infancy, and to date, this construct has been primarily studied in individuals who have sustained debilitating injuries. Systematic research on injustice appraisals was made possible following the development of the Injustice Experience Questionnaire (IEQ) (Fig 2) (Sullivan et al., 2008). The development of the IEQ was guided by clinical observations of the commonality of injustice-related narratives in patients with post-injury pain. The items of the IEQ were generated by 44 psychologists who specialized in treating

patients with chronic pain. Based on group consensus, 12 items reflecting various injustice-related appraisals relevant to the experience of injury were retained on the final IEQ.

Sullivan and colleagues conceptualized perceived injustice as a cognitive appraisal comprising elements of the severity of loss ("Most people don't understand how severe my condition is"), the irreparability of loss ("My life will never be the same") and blame ("I am suffering because of someone else's negligence"). The instructional set of the IEQ prompts respondents to indicate the frequency with which they experience each injustice-related thought on a five-point scale with the endpoints 0 (never) and 4 (all the time). The original IEQ was validated in a sample of patients with persistent musculoskeletal post-injury pain and showed high internal consistency (alpha=.92), and high test-retest reliability (r = .90) (Sullivan et al., 2008). Principal component analyses revealed that the IEQ had a two-component structure; "blame/unfairness" and severity/irreparability of loss". Further research confirmed the validity of the scale and suggested that a cut-score of 19 on the IEQ differentiates between individuals who recover from a musculoskeletal injury and those whose course of recovery will be characterized by persistent pain and disability (Scott, Trost, Milioto, et al., 2013).

Since the development and validation of the IEQ, research has accumulated to demonstrate that perceived injustice is associated with adverse pain-related outcomes, and opioid use in individuals with whiplash injuries, low back pain and work-related injuries, and spinal cord injuries (Scott, Trost, Milioto, et al., 2013; Sullivan et al., 2008; Sullivan, Davidson, et al., 2009; Sullivan, Thibault, et al., 2009; Trost, Monden, Buelow, Boals, & Scott, 2016; Trost et al., 2017). In a cross-sectional study of patients with chronic musculoskeletal pain treated in a tertiary care pain clinic, perceived injustice was associated with pain severity and disability (Scott, Trost, Bernier, & Sullivan, 2013). In a prospective study of individuals with

musculoskeletal injuries, high scores on perceived injustice predicted work disability at 1-year follow-up, even when accounting for initial ratings of pain severity, pain catastrophizing, and pain-related fear of movement (Sullivan et al., 2008).

Cross-sectional and prospective associations between perceived injustice and mental health outcomes have also been well documented in individuals with various pain-related conditions. Several cross-sectional and longitudinal studies demonstrated that in individuals with musculoskeletal injuries to the neck or back, perceived injustice was associated with depressive symptoms (Scott & Sullivan, 2012; Sullivan et al., 2008; Trost et al., 2016; Trost et al., 2017). In one study with patients with chronic musculoskeletal pain, pain severity was associated with heightened symptoms of depression only in those who also endorsed high scores on perceived injustice (Scott & Sullivan, 2012). Prospective studies have shown that perceived injustice impedes recovery from depressive and post-traumatic symptoms in individuals with whiplash injuries (Scott, Trost, Milioto, & Sullivan, 2015; Sullivan, Davidson, et al., 2009).

Mounting evidence linking perceived injustice to adverse health and mental health outcomes, calls for the development of interventions for treatment and management of perceived injustice in patients with pain. Present multidisciplinary rehabilitation programs for patients with chronic pain incorporate components of cognitive-behaviour therapy. These interventions, however, focus on problematic cognitions such as pain catastrophizing, fear of movement and beliefs about pain controllability and self-efficacy (McCracken & Turk, 2002; Turk, Swanson, & Tunks, 2008). Treatments that focus on injustice appraisals have not been systematically investigated in patients with chronic pain conditions.

Theoretical perspectives on perceived injustice and pain

Research on the relationship between perceived injustice and pain has proceeded in relative absence of a guiding theoretical framework. However, several theorists have presented conceptual models that could be relevant to understanding how perceived injustice might be impacting on recovery outcomes. Adams (1965) published the first paper on the psychological underpinnings of perceived injustice. Adams' primary focus was on processes related to distributive justice. Distributive justice is concerned with equity and proceeds with expectation that resources and benefits will be distributed equitably among members of a society. Adams defined perceived injustice as a dissatisfied state of mind "*a felt discrepancy between what is perceived to be and what is perceived should be*" (Adams 1965, p. 272). This definition emphasized the subjective nature of injustice appraisals by allowing a wide range of individual differences in the construal of "what is" and for "what should be" (Sullivan et al., 2014).

Darley and Pitman addressed appraisals of retributive and compensatory justice that may arise following injury (Darley & Pittman, 2003). According to Darley and Pittman, suffering and loss will trigger attributional processes aimed at identifying the cause of injuries or losses sustained. Depending on the severity, and the circumstances under which the harm was done, and the loss was sustained, the victim may demand retribution in a form of punishment, or compensation for suffering and losses incurred. Implicit in this model is that experiences or situations appraised as violations of these justice principles give rise to perceptions of injustice.

Mikula discussed attributions of blame and responsibility as important contributors to perceptions of injustice (Mikula, 2003). In his model of attribution-of-blame of judgments of injustice, Mikula suggested that when individuals perceive that their entitlements have been violated, they make attributions of responsibility that in turn contribute to perceptions of

injustice. Attributions of responsibility in this model are composed of attributions of causality (i.e., an action or omission of an actor who had control over his or her behaviour), intentionality, and lack of sufficient justification for violation. The model stresses the notion that perception of a violation of an entitlement will not lead to appraisals of injustice under certain circumstances. Some of these circumstances include perceived lack of responsibility for harmful action, or sufficient justification for the violation of entitlement.

Appraisals of events as unjust might also arise consequent to events that challenge an individual's 'belief in a just-world'. Belief in a just world has been defined as the need for individuals to believe that they live in a world where people generally get what they deserve (Lerner, 1980). According to Lerner, the belief in an orderly and predictable world serves as a buffer against life stressors, including injustice. He further suggested that the experience of an *event* that challenges a belief in a just world will invoke the necessary perceptual (e.g., denial) or cognitive (e.g., rationalization) strategies required to maintain the belief.

Jackson and colleagues theorized that the deleterious influence of injustice appraisals on health outcomes occurs via the impact of perceived unfairness on the physiological stress response (Jackson, Kubzansky, & Wright, 2006). They also suggested that social location variables (identity relevance and helplessness) may act as potential moderators in the relationship between perceived unfairness, stress and physical health. Empirical research on the moderating role of social location variables in the relation between perceived unfairness and stress response is currently lacking.

Violations of distributive, compensatory and retributive justice principles, challenges to a belief in a just world, and attributions of blame are evident in numerous attestations of chronic pain patients who sustained an injury. "What did I do to deserve this?", "I wish he could see

what he has done to my life", "It all seems so unfair", or "Nothing will ever make up for what I have gone through", "I am suffering because of someone's else negligence" are few among the numerous accounts that evidence at once elements of suffering, loss, and violations of justice principles (Sullivan et al., 2008).

On pain, suffering, and injustice from antiquity to the present time

Although research on the relation between pain and perceptions of injustice is relatively new, it has been a point of reflection since antiquity. Many ancient cultures regarded pain, suffering, and disease as divine punishment for human misdeeds (Visser & Davis, 2009). The origin of the English word "pain" has been traced to the Latin word *poena,* which pertains to a form of penalty or suffering inflicted as a punishment for an offense (Visser & Davis, 2009). The Latin word *poena* derives its roots from *Poine*, a Greek goddess of retribution, vengeance, and punishment. Indeed, the early Greeks regarded pain as a means by which gods punished the mortals for their wrong-doing. In his poems, Homer alluded to pain as divine punishment that manifested itself as a state of mind, a physical symptom, and emotional suffering (Fradelos, Fradelou, & Kasidi, 2014). Another epic poet, Hesiod, referred to pain as a brother of mythical creatures called starvation, lawlessness, and other possible sources of physical or emotional suffering (Fradelos et al., 2014). In sum, the semantic representation of the word *pain* pertains at least partly to the negative physical and emotional experience that is associated with punishment.

The Bible is replete with themes of pain, suffering, and losses as a means for the delivery of punishment and restoration of justice. The first mention of suffering and pain in the Bible appears in the book of Genesis and relates to the expulsion of Adam and Eve from the Garden of Eden. As a punishment for their transgression of eating a fruit from the forbidden tree, the decree on men was to suffer by toiling the earth, the decree on women was to give birth in pain, and the

decree on humankind as a whole was mortality. Early Judaic writings including the Torah and the Talmud contain numerous references to various forms of suffering, pain, and losses as part of complex mechanisms by which punishment could be delivered, repentance accomplished, and a divine order restored.

Thinkers of the ancient world compiled Talmudic writings outlining an intricate system of laws on restoration of damages that result from a bodily injury. The Talmudic Order of Damages discusses the assessment of damages for personal injuries (Epstein, 1947). It contains several subsections that describe a situation where a person who willfully, or by gross negligence inflicts bodily harm on another. In this case, the perpetrator is obligated to pay compensation to the latter, not only for the damages but also for four additional aspects of harm. These include pain and suffering, medical expenses, loss of earnings, and humiliation (Albeck, 1965; Epstein, 1947; Weiss, 1966). Compensatory justice and retributive justice represent two dimensions of justice appraisals that are reflected in early Judaic writings and continue to be central in contemporary frameworks of justice principles (Auerbach, 1951)

Perceived injustice and osteoarthritis

The focus of systematic research conducted to date proceeded from the assumption that perceptions of injustice arise following an incident or an event appraised as unjust. Events (i.e., injury) causing unexpected harm or losses (Montada, 1991), suffering and disability (Sullivan et al., 2008), and limited access to resources or opportunities (Adams, 1965) can give rise to perceived injustice. Attributions of responsibility and blame have also been discussed as important components of perceived injustice (Darley & Pittman, 2003; Montada, 1992). Themes of suffering, loss, and unfairness are reflected in narratives of individuals who suffer from OA of the knee, a condition of insidious onset characterized by deterioration of the knee joint and

tissue. For example, while some individuals speak of their inability to participate in valued life activities, others speak of physical and emotional suffering that they have endured, or functional or monetary losses they incurred as a result of their medical condition (Demierre et al., 2011; Fujita et al., 2006; Toye, Barlow, Wright, & Lamb, 2006). It is thus plausible that OA related experiences can also be construed as violations of justice principles. Accounts of unfair punishment can be construed as a violation of retributive justice. Functional losses and impaired ability to participate in life activities when compared to healthy peers can be construed as a violation of distributive justice. Failure of loved ones to tend to patient's needs or lack of treatment options available can be construed as a violation of compensatory justice.

The role of perceived injustice as a predictor of health and mental health outcomes in individuals with OA has yet to be addressed. One of the obstacles that impeded research in this area is the absence of a measure that can assess perceptions of injustice relevant to the context of OA. Research findings on the role of perceived injustice in health and mental health outcomes in individuals with OA will have important clinical and theoretical implications. From the clinical perspective, findings might contribute to the empirical foundation for developing new interventions to promote successful recovery after TKA. From the theoretical perspective, findings can provide information relevant for refining the biopsychosocial model of chronic pain.

OA might serve as an ideal context for research on perceived injustice in the absence of an eliciting event, or a salient source for blame. This research is needed to identify whether injustice appraisals are associated with pain severity, depressive symptoms, and disability in this population. Research on determinants of injustice in this population is needed to guide the development of clinical interventions that target injustice appraisals in individuals with health conditions that lack an eliciting event, and external attribution of blame.

Objectives of the present thesis

To address current knowledge gaps on perceived injustice in individuals with severe OA of the knee, the present thesis had three main goals: 1) to develop and validate the Injustice Experience Questionnaire adapted for use in individuals with OA; 2) to examine the role of perceived injustice in pain-related outcomes after TKA; 3) to identify the determinants of perceived injustice in the context of OA. To this end, three empirical studies were conducted. The first cross-sectional study examined the construct validity of IEQ-chr (chr; Chronic) in individuals with severe OA of the knee. The second longitudinal study examined the role of pre-surgical perceived injustice in pain and physical disability one year after TKA. The final prospective study identified the determinants of perceived injustice by examining associations between reductions in pain severity, depressive symptoms, disability, and reductions in perceptions of injustice after joint replacement surgery. Implications of the results of each study are discussed in each of the three individual manuscripts. The sample for the papers included in this thesis was drawn from a multisite cohort study involving the Montreal General Hospital, the Hôpital Maisonneuve-Rosemont, and the Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia.

FIGURES

Figure 1. Biopsychosocial Model of Arthritis Pain and Disability (Keefe et al., 2002)

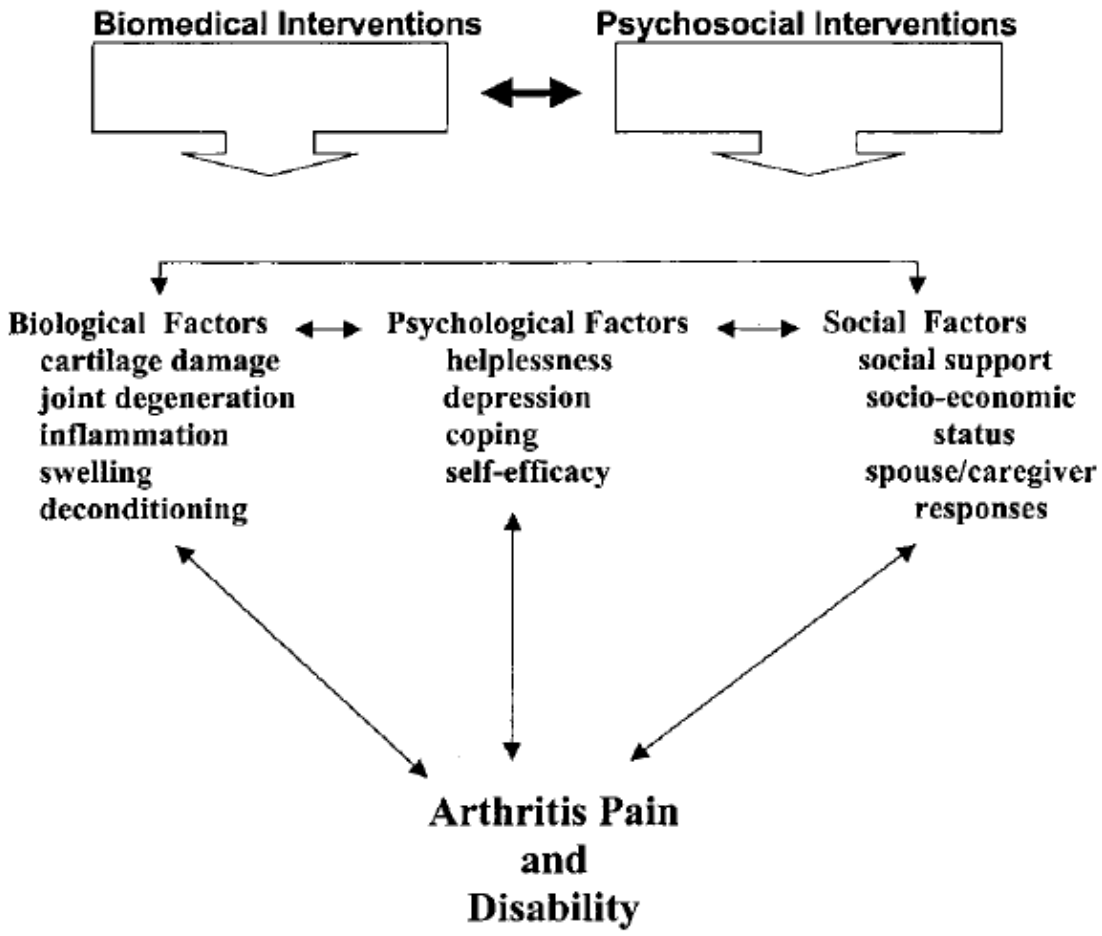
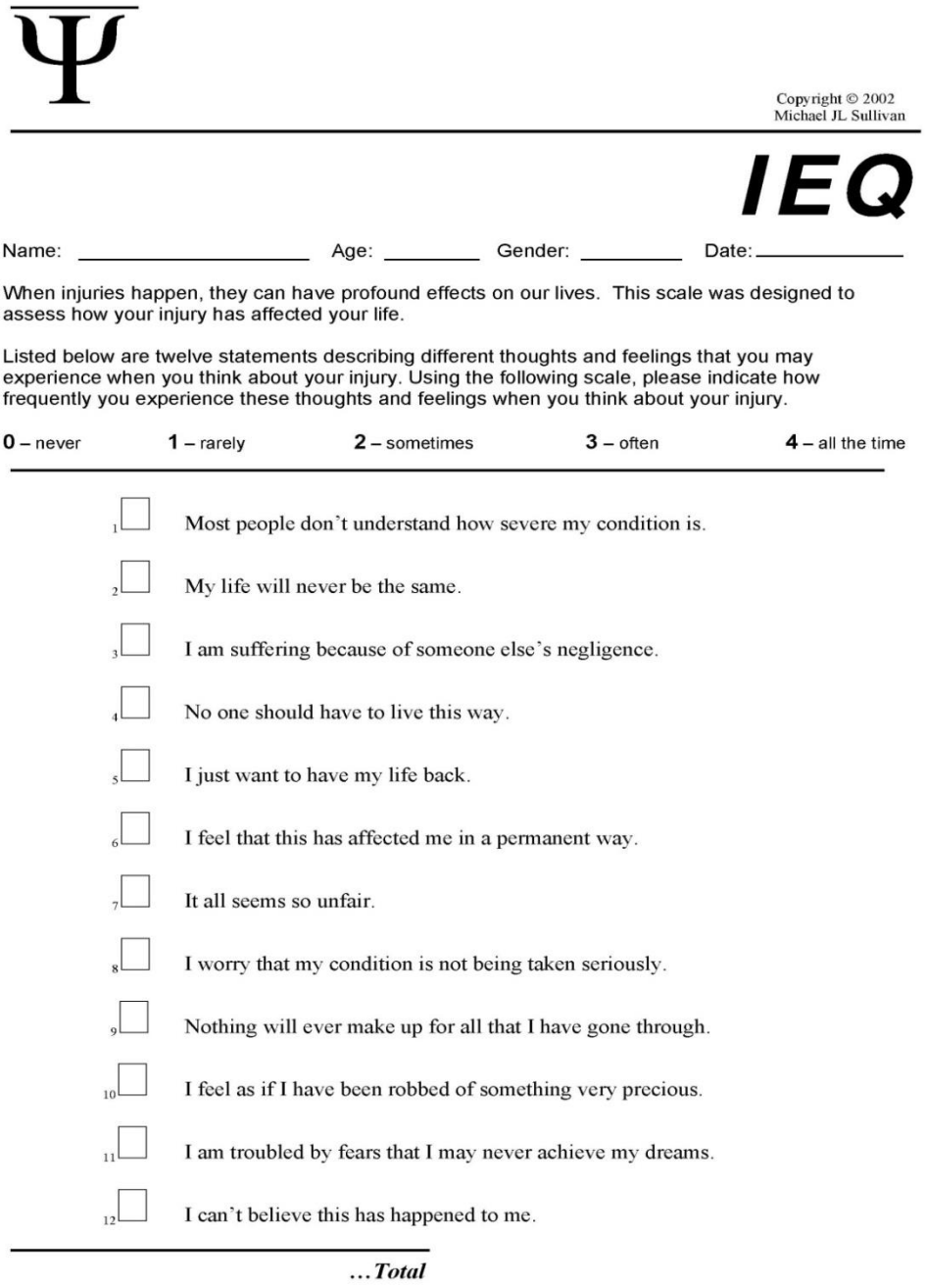


Figure 2. The Injustice Experiences Questionnaire (Sullivan, Adams, Horan , et al., 2008)



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Michael JL Sullivan

IEQ

Name: _____ Age: _____ Gender: _____ Date: _____

When injuries happen, they can have profound effects on our lives. This scale was designed to assess how your injury has affected your life.

Listed below are twelve statements describing different thoughts and feelings that you may experience when you think about your injury. Using the following scale, please indicate how frequently you experience these thoughts and feelings when you think about your injury.

0 – never **1** – rarely **2** – sometimes **3** – often **4** – all the time

1. ☐ Most people don't understand how severe my condition is.
2. ☐ My life will never be the same.
3. ☐ I am suffering because of someone else's negligence.
4. ☐ No one should have to live this way.
5. ☐ I just want to have my life back.
6. ☐ I feel that this has affected me in a permanent way.
7. ☐ It all seems so unfair.
8. ☐ I worry that my condition is not being taken seriously.
9. ☐ Nothing will ever make up for all that I have gone through.
10. ☐ I feel as if I have been robbed of something very precious.
11. ☐ I am troubled by fears that I may never achieve my dreams.
12. ☐ I can't believe this has happened to me.

…*Total*

CHAPTER 2: Validation of the Injustice Experiences Questionnaire adapted for use with patients with severe osteoarthritis of the knee

Yakobov E, Scott W, Tanzer M, Stanish W, Dunbar M, Richardson G, Sullivan MJL. *J Arthritis* 2014; 3:130-136.

ABSTRACT

OBJECTIVE: Recent research has linked perceptions of injustice to problematic recovery outcomes for individuals with musculoskeletal injuries. However, the measure currently used to assess perceived injustice is not readily applicable to individuals who have a pain condition, such as osteoarthritis (OA), where pain onset is insidious as opposed to traumatic. The purpose of this study was to validate a modified version of the Injustice Experiences Questionnaire (IEQ-chr) for patients with OA of the knee.

METHODS: The IEQ-chr was administered along with measures of pain catastrophizing, fear of movement, depressive symptoms, pain severity and physical function to 110 individuals with severe OA of the knee.

RESULTS: Principal component analyses yielded a factor structure similar to that in the original validation study. The IEQ-chr had high internal consistency (Chronbach alpha = 0.88), and was significantly correlated with pain catastrophizing, fear of movement, depressive symptoms, pain severity and physical function. Regression analyses revealed that the IEQ-chr contributed significant unique variance to prediction of pain severity and physical function, beyond the variance accounted for by measures of pain catastrophizing and fear of movement.

CONCLUSIONS: The findings of the present study support the construct validity of the IEQ-chr in the context of osteoarthritis, and suggest that this measure may be useful in psychosocial assessment of individuals at risk for adverse pain outcomes. The discussion addresses theoretical and clinical implications of these findings.

Key Words: osteoarthritis, perceived injustice, pain, disability, depressive symptoms

INTRODUCTION

Considerable evidence indicates that psychological variables play a significant role in the experience of pain and disability. Pain catastrophizing and fear of movement are examples of psychological variables that have been associated with heightened levels of pain severity, physical disability, and depressive symptoms in a number of clinical pain populations (Archer, Seebach, Mathis, Riley, & Wegener, 2013; Campbell et al., 2010; Edwards, Cahalan, Mensing, Smith, & Haythornthwaite, 2011; Goodin et al., 2009; Lee et al., 2009; Linton, 2002; Sullivan, Tanzer, et al., 2009; Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995). Recent investigations suggest that perceptions of injustice associated with debilitating pain conditions are also implicated in problematic recovery following musculoskeletal injury (Scott, Trost, Milioto, et al., 2013; Scott & Sullivan, 2012; Sullivan et al., 2008; Sullivan, Scott, & Trost, 2012; Sullivan, Davidson, Garfinkel, Siriapaipant, & Scott, 2009).

Perceived injustice has been defined as a multidimensional construct comprising negative appraisals of the severity and irreparability of pain-related loss, attributions of blame, and a sense of unfairness (Sullivan et al., 2008). There are indications that appraisals of injustice may trigger psychological and physiological changes that increase the intensity of pain and complicate recovery (Scott, Trost, Bernier, et al., 2013; Sullivan, Scott, et al., 2012; Trost, Vangronsveld, Linton, Quartana, & Sullivan, 2012). For individuals who have sustained musculoskeletal injuries, perceived injustice has been shown to prospectively predict the persistence of pain symptoms, more pronounced and prolonged disability, as well as the persistence of post-traumatic stress symptoms (Sullivan et al., 2008; Sullivan, Adams, Martel, Scott, & Wideman, 2011; Sullivan, Thibault, et al., 2009; Sullivan et al., 2009). To date, research on the health and mental health consequences of perceived injustice has been conducted almost exclusively with

patients with persistent pain following musculoskeletal injury. The role of perceived injustice as a determinant of adverse health and mental health outcomes associated with OA has not been investigated.

There is a basis for suggesting that perceptions of injustice may be relevant to the experience of severe OA. The majority of patients with severe OA are near retirement age (Arthritis Alliance of Canada [AAC], 2011; Neustadt, 2006). A time of life that, for many, was intended to bring freedom from employment and realization of one's dreams is now replaced by pain, restricted mobility, and decreased quality of life. Narratives reflecting a sense of injustice are not uncommon in patients with severe OA (Demierre et al., 2011; Toye et al., 2006). The experiences of loss and unnecessary suffering consequent to OA may give rise to perceptions of injustice which in turn, might augment the experience of pain, distress and disability.

The aim of this study was to validate a version of the Injustice Experiences Questionnaire (IEQ) adapted for use with patients with OA. The instructional set of the original IEQ was modified to make it more suitable to the context of OA pain where pain onset is insidious as opposed to traumatic. The psychometric properties of the modified IEQ were examined in a sample of patients with severe OA of the knee. The pattern of findings was compared to previous research using the original version of the scale.

METHODS

Participants The sample consisted of 110 (67 women and 43 men) patients with severe OA of the knee. The mean age of the participants was 66.9 years, ranging from 50 to 80 years. The majority of the sample was married (85%) and had completed at least 12 years of education (90%).

Measures

Perceived Injustice

The modified Injustice Experiences Questionnaire (IEQ-chr) is a 12-item measure used to assess pain-related injustice perceptions (Sullivan et al., 2008). The only difference between IEQ-chr and the original IEQ is the instructional set. Whereas the original scale asks individuals to respond to items in terms of how their injury affected their life, the IEQ-chr asks individuals to respond in terms of how their 'health condition' has affected their life. The suffix 'chr' was added to the scale acronym to distinguish it from the original measure. The IEQ measures cognitions associated with unfairness ("I can't believe this has happened to me"), perceived severity and irreparability of loss ("Nothing will ever make up for what I have gone through"), blame ("I am suffering because of someone else negligence"). The IEQ uses a 5-point Likert-type scale with responses ranging from 0= "never" to 4= "all the time".

Catastrophizing

The Pain Catastrophizing Scale (PCS) was used to measure pain catastrophizing (M. J. L. Sullivan, Bishop, & Pivik, 1995). The PCS is a 13-item measure that assesses various thoughts and feelings related to the experience of pain. The PCS uses 4-point Likert-type scale with responses ranging from 0="not at all" to 4= "all the time." Item responses are summed to yield a total score. The scale and its subscales have been shown to have high internal consistency (Cronbach's (Cronbach, 1951) alpha s: total= .87; rumination=.87, magnification=.66, helplessness=.78) and to be associated with measures of pain intensity and disability (Sullivan et al., 1995; Sullivan & Neish, 1998; Sullivan, Stanish, Sullivan, & Tripp, 2002; Sullivan & Stanish, 2003).

Depressive symptoms

The Patient Health Questionnaire-9 (PHQ-9) is a 9-item instrument used to assess the severity of depressive symptoms (Spitzer, Williams, Kroenke, & al., 1999). Respondents are asked to indicate the frequency with which they experience each of nine symptoms that are considered in the diagnostic criteria for major depressive symptoms (Spitzer et al., 1999). Ratings are made on a 4-point frequency scale with the endpoints 0 "not at all" and 3 "everyday". The scores range from 0 to 27 with higher scores representing worse symptoms of depressive symptoms. A clinical cut score of 15 has been suggested to identify individuals with clinically significant depressive symptoms. Reliability and validity of the PHQ-9 has been demonstrated in various clinical populations (Gilbody, Richards, Brealey, & Hewitt, 2007; Huang, Chung, Kroenke, Delucchi, & Spitzer, 2006; Li, Friedman, Conwell, & Fiscella, 2007).

Fear of Movement/Re-Injury

The Tampa Scale for Kinesiophobia -13 (TSK-13) is a 13-item measure used to assess fear of movement and contains 13 items from the original TSK-17 (Clark, Kori, & Brockel, 1996; Kori, Miller, & Todd, 1990). The TSK-13 uses a 4-point Likert-type scale with responses ranging from 1="strongly disagree" to 4 ="strongly agree". High scores represent more intense fear of movement. Elevated scores on the original and shortened versions of TSK have been associated with a wide range of manifestations of behavioural avoidance and physical disability in patients with various conditions including OA (Crombez et al., 1999; Geisser, Haig, & Theisen, 2000; Goubert, Crombez, & Van Damme, 2004; Picavet, Vlaeyen, & Schouten, 2002; Roelofs, Goubert, Peters, Vlaeyen, & Crombez, 2004; Sullivan, Tanzer, et al., 2009). The validity and internal reliability of the shortened TSK have been confirmed (Cronbach's alpha= .86) (Clark et al., 1996; Geisser et al., 2000).

Pain and Function

The Western Ontario and McMaster University Osteoarthritis Index (WOMAC) is a self-administrated questionnaire used to evaluate pain, stiffness and physical function in individuals with osteoarthritis of the hip or knee (Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988). The WOMAC uses a 5-point Likert scale with responses ranging from "none" to "extreme". For the purposes of the current study, only the subscale scores for pain and function are reported. Higher scores represent worse pain and higher disability. The scores of WOMAC Pain and WOMAC Function were converted to 0-100 ranges to allow for cross-scale and cross-study comparison (Bischoff-Ferrari et al., 2004; Bullens, van Loon, de Waal Malefijt, Laan, & Veth, 2001). The WOMAC has been shown to be a valid and reliable measure for assessing pain and disability in the context of OA (Bellamy, 1989; Bellamy et al., 1988; Bellamy, Kean, Buchanan, Gerecz-Simon, & Campbell, 1992).

Procedure

Patients with severe OA of the knee were invited to participate in the current study at one of three collaborating hospitals. For the purposes of the present study, severe OA of the knee was operationalized as a diagnosis of primary OA of the knee for which the patients were scheduled to undergo total knee arthroplasty within the next 4 weeks. Patients were informed that the research was concerned with the physical, psychological and social aspects of pain associated with OA. All patients signed a consent form and received $25 as compensation for completing the questionnaires. The research was approved by the Research Ethics Boards of the McGill University Health Centre, the Hôpital Maisonneuve-Rosemont, and the Capital Health Authority of Nova Scotia.

Data Analysis

All measures used in psychometric analyses showed a normal distribution with values of skewness below 3 and values of kurtosis below 10. Descriptive statistics were computed on sample characteristics and independent sample t-tests were computed to investigate sex differences on all measures. A principal component analysis (PCA) with oblique rotation was performed to assess the structure of the IEQ-chr. Based on previous research examining the psychometric properties of the original IEQ, it was expected that the PCA would yield a two-component solution (blame/unfairness and severity/irreparability). Construct validity was assessed by examining correlations between the IEQ-chr and measures of pain catastrophizing, fear of movement, depressive symptoms, pain and physical function.

Hierarchical regression analyses were used to assess whether the IEQ-chr contributed significantly to the prediction of pain, physical function, and depressive symptoms beyond the variance accounted for by pain catastrophizing, and fear of movement. All tolerance coefficients in the regression results were greater than .49 indicating no problems of multicollinearity.

RESULTS

Sample Characteristics

Demographic information and means and standard deviations on assessment measures are summarized in Table 1. Men and women did not differ significantly on any of the study variables. The distribution of age, body mass index (BMI), and WOMAC pain and function scores were comparable (less than one standard deviation from the mean) to those reported in previous studies with patients with OA of the knee (Nunez et al., 2007; Papakostidou et al., 2012; Sullivan et al., 2011). The scores on the PHQ-9, and PCS were also comparable to those reported research on patients with OA of the knee (Sullivan et al., 2011; Sullivan, Tanzer, et al., 2009). The majority of patients scored below the cut off for clinically significant depressive

symptoms. Scores on the IEQ-chr were lower (greater than one standard deviation) than the IEQ scores reported on patients with musculoskeletal injuries (Scott, Trost, Milioto, et al., 2013; Sullivan et al., 2008).

Structure and internal consistency of the IEQ-chr

Principal component analysis with oblique rotation yielded a two-component solution with eigenvalues greater than 1. The loadings of the pattern matrix were similar to those found in the original validation study (Table 2). The first component labelled blame/unfairness accounted for 46% of the total variance. The second component labelled severity/irreparability accounted for 11% of the variance. The correlation between the two components was .42. The coefficient alpha was .88 and item total correlation coefficients ranged between .38 and .72, indicating good internal consistency.

Construct Validity

As presented in Table 3, the construct validity of the IEQ-chr was supported by significant correlations with pain severity (r = .41, p <.001), physical function (r = .44, p <.001), depressive symptoms (r = .48, p <.001), fear of movement (r = .47, p <.001), and pain catastrophizing (r = .67, p <.001). Age was inversely correlated with pain intensity (r = -.28, p <.05), physical function (r = -.20, p <.05) and BMI (r =-.36, p <.001). BMI was also correlated with pain intensity (r = .24, p < .05).

Contributions of Perceived Injustice to the Prediction of Pain, Function and Depression

Three separate hierarchical regression analyses were conducted to examine the unique contribution of the IEQ-chr to the prediction of pain severity, physical function, and depressive symptoms after controlling for pain catastrophizing and fear of movement. In each regression,

age, sex, and BMI were entered in the first step. In the second step pain catastrophizing and fear of movement were entered, followed by perceived injustice in the third step.

Table 4 shows the results of the regression analyses for the prediction of WOMAC pain. The demographic variables entered in the first step contributed significant variance to the prediction of pain severity. Pain catastrophizing and fear of movement were entered in the second step and contributed significant variance to the prediction of pain severity. Perceived injustice was entered in the third step and also contributed significantly to the prediction of pain severity, and accounted for 6% additional variance in WOMAC pain scores. Examination of the standardized beta weights from the final regression equation indicated that of the three psychological variables, only the IEQ-chr (β=.35, $p < .05$) contributed significant unique variance to the prediction of pain severity.

Table 5 shows the results of the regression analyses for the prediction of WOMAC function. Demographic variables were entered in the first step but did not contribute significant variance to the prediction of physical function. Pain catastrophizing and fear of movement were entered in the second step and contributed significant variance to the prediction of WOMAC function. Perceived injustice was entered in the third step and also contributed significantly to the prediction of physical function, accounting for 6% additional variance in WOMAC function scores. Examination of the standardized beta weights from the final regression equation indicated that of the three psychological variables, only the IEQ-chr (β=.34, $p <.05$) contributed significant unique variance to the prediction of WOMAC function scores.

Table 6 shows the results of the regression analyses for the prediction of depressive symptoms. Demographic variables were entered in the first step but did not contribute significant variance to the prediction of depressive symptoms. Pain catastrophizing and fear of movement

were entered in the second step and contributed significant variance to the prediction of symptoms of depression. Perceived injustice was entered in the last step but did not contribute significantly to the prediction of depressive symptoms. Examination of the standardized beta weights from the final regression equation revealed that fear of movement (β=.22, p <.05) and pain catastrophizing (β=.24, p <.05) contributed significant unique variance to the prediction of symptoms of depression while the predictive value of the IEQ-chr was only marginally significant (β=.21, p =.06).

DISCUSSION

The aim of the current study was to evaluate the psychometric properties of the IEQ-chr in the context of OA of the knee. The original measure of perceived injustice (IEQ) was developed for use in individuals with musculoskeletal injuries. In the current version, the instructional set was modified to make it suitable to the context of pain and suffering associated with OA, which is characterized by insidious onset as opposed to traumatic onset.

Consistent with the original IEQ validation study conducted with individuals with various musculoskeletal injuries (Sullivan et al., 2008), the principal component analysis of the IEQ-chr yielded a two-component solution (blame/unfairness and severity/irreparability of loss). The scale had high internal consistency (alpha = .88). Replicating research conducted with the original IEQ, the construct validity of IEQ-chr was supported by significant correlations with measures of pain catastrophizing, fear of movement, depression, pain intensity and physical function (Rodero et al., 2012; Scott, Trost, Milioto, et al., 2013; Scott & Sullivan, 2012; Sullivan et al., 2008; Sullivan et al., 2011; Sullivan, Scott, et al., 2012).

Consistent with previous findings, in the current study perceived injustice showed a strong correlation with pain catastrophizing (r = .67) (Sullivan et al., 2008). One explanation that has been proposed for the strong correlation between these variables is the conceptual overlap between subcomponents of perceived injustice and pain catastrophizing. It has been suggested that the "severity and irreparability" component of the IEQ overlaps with the "magnification" component of the PCS. However, blame and unfairness dimensions of IEQ are not reflected in the item content of the PCS, suggesting that these constructs are at least partially distinct. (Sullivan et al., 2008; Sullivan, Scott, et al., 2012; Sullivan et al., 2001).

Zero-order correlations revealed that the IEQ accounted for 17%, 19% and 23% of the variance in pain severity, physical function and depression, respectively. Regression analyses revealed that perceived injustice contributed significant unique variance to the prediction of pain intensity, and physical function beyond the variance accounted for by pain catastrophizing and fear of movement. Pain catastrophizing and fear of movement contributed unique variance to the prediction of depressive symptoms while perceived injustice, was marginally significant (p = .06). In previous research, pain catastrophizing and fear of movement have been identified as two of the most robust predictors of problematic health and mental health outcomes associated with OA (Heuts et al., 2004; Keefe et al., 2000; Somers et al., 2009; Sullivan, Tanzer, et al., 2009). The present findings suggest that perceptions of injustice are as important, if not more important, than previously identified psychosocial risk factors in the prediction of problematic health and mental health outcomes associated with OA.

The total IEQ-chr score in the current sample of patients with OA was substantially lower than that previously reported in samples of individuals who had sustained musculoskeletal injuries. Sullivan and colleagues reported a mean IEQ score of 25.1 (SD =11.8) in individuals

with whiplash injuries, and a mean IEQ score of 17.3 (*SD* = 12.2) in individuals who have sustained work-related musculoskeletal injuries (Sullivan et al., 2008). In the present study, the mean IEQ-chr score was 8.7 (*SD* = 8.3). There could be several explanations to this finding.

Firstly, when examining the phenomenology of perceived injustice in injury and non-injury populations the main distinction arising between the individuals in these two samples is the salience of targets to blame for their health condition. Osteoarthritis patients, given the insidious nature of their condition, may not have one such identifiable source for the onset of their pain. Indeed, 99 out of 110 individuals in the current sample reported a score of "0" on question assessing attributions of blame ("I am suffering because of someone else's negligence"). The mean score for this particular question in the present sample was .18 (*SD* = .64), lowest of all items on the IEQ-chr. The mean score for this item in whiplash-injured patients was 10 times higher (*M* = 1.85; *SD* =1.60) (Scott, Trost, Milioto, et al., 2013).

Other factors that may account for lower perceptions of injustice in individuals with OA include age, the nature of symptom onset, and treatment context. The majority of patients with musculoskeletal injuries are significantly younger than patients with OA (AAC, 2011; Neustadt, 2006; Scott, Trost, Milioto, et al., 2013). Post-injury life for patients with musculoskeletal injuries is often associated with loss of employment, loss of independence, possible financial losses, and chronic pain (Lyons & Sullivan, 1998; Montada, 1992). It has been suggested that health related losses are perceived to be less severe for an older person than for a younger person as older individuals have a larger portion of life of enjoyment and accomplishment behind them (Shaw, 1994). Thus, having to live with a debilitating condition at a young age might be perceived more unjust than developing painful and debilitating condition at a later stage in life. Due to the insidious nature of OA, patients with OA might also have more

time to adjust to their medical status, compared to younger individuals with a sudden onset of painful condition.

Another difference between patients with OA and patients with musculoskeletal injuries is the treatment context. Injury, as a result of a work injury or a motor vehicle accident, is managed within an insurance context where relations between clients and insurer representatives can become adversarial fueling the injured person's perceptions of injustice (Sullivan, Scott, et al., 2012). Moreover, legal representatives have a vested interest in maintaining their client's perceptions of injustice (Sullivan, Scott, et al., 2012). The process of litigation for compensation has been consistently associated with pain severity and prolonged disability (Blyth, March, Nicholas, & Cousins, 2003; Turk & Okifuji, 1996).

Therefore the salience of target for blame, age, the onset of pain, and treatment context may partially explain why perceived injustice in the current OA sample was lower compared to injury samples. However, in spite of the lower IEQ-chr scores in the current sample, perceived injustice still emerged as a significant predictor of pain severity and disability after controlling for measures of pain, catastrophizing, and fear of movement.

Research is beginning to elucidate the processes by which perceptions of injustice might impact on recovery outcomes. For example, research emerging from social psychology indicates that perceptions of injustice give rise to anger responses (Mikula, Scherer, & Athenstaedt, 1998; Miller, 2001). There is also research to show that anger contributes to the experience of greater pain intensity through disruption of endogenous opioid mechanisms (Bruehl, Chung, & Burns, 2006a; Bruehl, Chung, Burns, & Diedrich, 2007). Increased muscle reactivity resulting from anger is also thought to be implicated in heightened experience of pain (Burns, 1997). Several investigations reported associations between anger, pain, disability, and poor self-efficacy in

patients with chronic pain conditions including arthritis (Burns et al., 2008; Greenwood, Thurston, Rumble, Waters, & Keefe, 2003; Scott, Trost, Bernier, et al., 2013; Treharne, Lyons, Booth, Mason, & Kitas, 2004; Trost et al., 2012). Thus, anger arising from perceptions of injustice may be one vehicle through which perceived injustice impacts on pain in individuals with OA. Emotional distress, attentional focus on themes related to injustice and maladaptive coping have also been proposed as possible mechanisms by which perceived injustice might impact on pain outcomes (Sullivan, Scott, et al., 2012).

The results of this study add to the mounting evidence highlighting the significance of perceived injustice in the context of pain and physical disability. The present results also suggest that assessment of perceived injustice in patients with OA of the knee might permit identification of individuals at-risk for problematic health and mental health outcomes. Based on previous research with individuals with chronic pain, cognitive behavioural approaches to anger management and acceptance-based interventions may be beneficial in reducing perceptions of injustice in individuals with OA (Eifert, McKay, & Forsyth, 2006; Graham, Lobel, Glass, & Lokshina, 2008; McCracken & Eccleston, 2003).

The current study has several limitations. The correlational design of the study precludes strong statements about the direction of causality. For example, while perceptions of injustice may augment pain intensity, it is possible that the experience of severe pain may increase patients' of perceptions of injustice. In addition, the size of the study sample was modest, thus inviting caution in generalizing the findings to the wider OA population. Despite these limitations, this study is the first to provide support for the validity of a measure of perceived injustice in patients with OA. Results indicated that the IEQ-chr was associated with increased pain and disability, even when controlling for pain catastrophizing and fear of movement. Future

research is needed to investigate whether the IEQ-chr scale can be used as a screening measure to identify individuals with OA who might be at risk for problematic health or mental health outcomes.

Tables

Table 1: Sample Characteristics

Pre surgical variables	Women N=67	Men N= 43	*P*	Total
Age	67.0 (8.6)	66.7 (7.8)	ns	66.8 (8.3)
BMI	31.2 (5.9)	30.6 (4.0)	ns	31.0 (5.3)
Pain	54.0 (16.3)	50.6 (18.7)	ns	52.7 (17.2)
Function	55.7 (16.8)	55.3 (19.3)	ns	55.6 (17.7)
PHQ-9	6.7 (6.6)	6.3 (7.7)	ns	6.6 (7.0)
PCS	12.9 (11.4)	11.2 (9.2)	ns	12.2 (10.6)
TSK-13	27.9 (8.5)	28.6 (8.3)	ns	28.1 (8.4)
IEQ-chr	9.3 (9.0)	7.7 (7.1)	ns	8.7 (8.3)

Note: *N*= 110. BMI=body mass index; Pain = WOMAC Pain Score; Function = WOMAC Physical Function Score; PHQ-9 = Patient Health Questionnaire; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire-chr

Table 2. IEQ Rotated factor Loadings (pattern matrix)

Item#		F1	F2	Item total r
IEQ9	Nothing will ever make up for what I have gone through	**.83**		.66
IEQ8	I worry that my condition will not be taken seriously	**.82**		.66
IEQ1	Most people don't understand how severe my condition is	**.71**		.56
IEQ3	I am suffering because of someone else negligence	**.71**		.38
IEQ12	I can't believe this has happened to me	**.65**		.57
IEQ11	I am troubled by fears that I may never achieve my dreams	**.60**		.59
IEQ7	It all seems so unfair	**.54**	.38	.72
IEQ10	I feel as if I have been robbed of something precious	**.51**	.38	.69
IEQ4	No one should have to live this way	.44	**.**49	.71
IEQ2	My life will never been the same		**.68**	.65
IEQ5	I just want my life back		**.75**	.44
IEQ6	I feel that this has affected me in permanent way		**.85**	.52

Values in bold are factor loadings greater than .50

Table 3. Correlations among pre-surgery pain-related psychological measures

	1	2	3	4	5
IEQ-chr					
PCS	.67**				
TSK-13	.47**	.51**			
Pain	.41**	.32 **	.20*		
Function	.44**	.36**	.33**	.72**	
PHQ-9	.48**	.50**	.44**	.28*	.36**

Note: N = 110; Pain WOMAC Pain Score; Function = WOMAC Physical Function Score; PCS = Pain Catastrophizing Scale; PHQ-9 = Patient Health Questionnaire; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire-chr
*p <.05, **$p \leq .001$

Table 4.

Regression analyses examining the role of perceived injustice in the prediction of pain severity

	Beta	R^2change	F change
Dependent = Pain Intensity			
Step 1			
Age	-.19*		
Sex	-.06		
BMI	.15	.11	4.37(3,106)*
Step 2			
PCS	.02		
TSK-13	.04	.08	4.86(2,104)*
Step 3			
IEQ-chr	.35*	.06	8.07(1,103)*

Note. N=110. Pain Intensity = WOMAC Score; BMI=body mass index; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire-chr. Standardized Beta weights are from the final regression equation.

*$p < .05$; **$p < .001$

Table 5.
Regression analyses examining the role of perceived injustice in the prediction of physical function

	Beta	R^2change	F change
Dependent = Function			
Step 1			
Age	-.11		
Sex	.02		
BMI	.14	.06	2.09(3,106)
Step 2			
PCS	.02		
TSK-13	.17	.14	9.32 (2,104)**
Step 3			
IEQ-chr	.34*	.06	8.41(1,103)*

Note. N=110. Function = WOMAC Physical Function Score, BMI=body mass index; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire-chr. Standardized Beta weights are from the final regression equation.
*$p < .05$; **$p < .001$

Table 6.
Regression analyses examining the role of perceived injustice in the prediction of depressive symptoms

	Beta	R^2change	F change
Dependent = Depressive symptoms			
Step 1			
Age	-.09		
Sex	-.01		
BMI	-.04	.02	.74(3,106)
Step 2			
PCS	.24*		
TSK-13	.22*	.28	21.14 (2,104)**
Step 3			
IEQ-chr	.21†	.02	3.68(1,103)

Note. N=110. PCS = Pain Catastrophizing Scale; BMI=body mass index; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire-chr. Standardized Beta weights are from the final regression equation.
†p =.06; *p < .05; **p <.001

PREFACE TO CHAPTER 3

Study 1 was the first cross-sectional empirical investigation that validated the Injustice Experience Questionnaire in individuals with severe OA of the knee. The results of the study demonstrated that perceived injustice is associated with pain severity, physical disability and depressive symptoms in univariate analyses. The results of the study also demonstrated that perceived injustice contributed unique variance to physical disability, and pain intensity independently of demographic variables and other pain-related psychological variables. These results indicate that perceived injustice is associated with pain-related variables in individuals with insidious onset of pain and disability, and without a discernable external cause for their suffering.

To date research on the predictive role of perceived injustice and pain-related outcomes following rehabilitation treatment has focused primarily on patients with traumatic onset of symptoms. Longitudinal research with patient with musculoskeletal injuries indicates that high pre-rehabilitation scores on perceived injustice predict pain intensity, prolonged disability, poor occupational outcomes, and worse mental health symptoms following rehabilitation treatment (Scott, Trost, Milioto, et al., 2013; Scott et al., 2015; Sullivan et al., 2008; Sullivan, Thibault, et al., 2009).

No study examined whether high scores on pre-surgical perceived injustice might predict pain and disability after total knee replacement surgery. The purpose of the second study was to investigate the predictive role of pre-surgical perceived injustice in pain severity and disability one year following TKA.

CHAPTER 3: The role of perceived injustice in the prediction of pain and function following total knee arthroplasty

Yakobov E, Scott W, Stanish W, Dunbar M, Richardson G, Sullivan MJL. *Pain* 2014;155:2040-2046.

ABSTRACT

Emerging evidence suggests that the appraisal of pain and disability in terms of justice-related themes contributes to adverse pain outcomes. To date, however, research on the relation between perceived injustice and pain outcomes has focused primarily on individuals with musculoskeletal injuries. The primary aim of this study was to investigate the role of perceived injustice in the prediction of pain and disability after total knee arthroplasty (TKA). The study sample consisted of 116 individuals (71 women, 45 men) with osteoarthritis of the knee scheduled for TKA. Participants completed measures of pain severity, physical disability, perceptions of injustice, pain catastrophizing, and fear of movement before surgery, and measures of pain and disability 1 year after surgery. Prospective multivariate analyses revealed that perceived injustice contributed modest but significant unique variance to the prediction of postsurgical pain severity, beyond the variance accounted for by demographic variables, comorbid health conditions, pre-surgical pain severity, pain catastrophizing, and fear of movement. Pain catastrophizing contributed significant unique variance to the prediction of postsurgical disability. The current findings add to a growing body of evidence supporting the prognostic value of perceived injustice in the prediction of adverse pain outcomes. The results suggest that psychosocial interventions designed to target perceptions of injustice and pain catastrophizing before surgery might contribute to more positive recovery trajectories after TKA.

Key words: Arthritis, TKA, Perceived Injustice, Pain Catastrophizing, Pain, Disability

INTRODUCTION

Arthritis is the leading cause of disability in North America. Osteoarthritis (OA) is the most common form of arthritis, affecting approximately 27 million people in the United States and 4 million people in Canada (Arthritis Alliance of Canada [AAC]; The Centers for Disease Control and Prevention [CDC], 2010; Kopec et al., 2007). In advanced stages of the disease, joint deterioration can lead to significant pain and limitations of function (Felson, 2004). Patients with severe symptomatic OA of the knee may be considered candidates for knee replacement surgery (Total Knee Arthroplasty; TKA). Although TKA yields significant benefit, research suggests that 20% of patients will follow a problematic course of recovery characterized by prolonged and intense pain, mobility restriction, and reduced quality of life (Baker et al., 2007; Bourne et al., 2010; Kennedy, Hanna, Stratford, Wessel, & Gollish, 2006).

Research indicates that psychological factors are significant determinants of surgical outcomes following TKA. For example, pre-surgical scores on measures of pain catastrophizing have been shown to predict the severity of pain and disability following TKA (Edwards, Haythornthwaite, Smith, Klick, & Katz, 2009; Forsythe et al., 2008; Riddle et al., 2010; Sullivan, Tanzer, et al., 2009). High scores on pre-surgical measures of fear of movement and depression have also been shown to predict problematic recovery following TKA (Brander, Gondek, Martin, & Stulberg, 2007; Brull, McCartney, & Chan, 2002; Sullivan, Tanzer, et al., 2009).

Recent research has drawn attention to another psychological predictor of problematic recovery outcomes. Individuals who interpret their health challenges in relation to themes of 'injustice' appear to be particularly susceptible to prolonged and complicated trajectories of recovery (Sullivan et al., 2008). In the context of debilitating injury and chronic pain, perceived injustice has been conceptualized as an appraisal process characterized by a tendency to construe

one's losses as severe and irreparable, and to attribute blame to others for one' suffering (Sullivan et al., 2008). Several investigations have shown that perceptions of injustice are associated with poor physical recovery and prolonged work disability in individuals who have sustained musculoskeletal injuries (Scott, Trost, Milioto, et al., 2013; Sullivan et al., 2008; Sullivan, Thibault, et al., 2009).

There is a basis for proposing that perceptions of injustice might also play a role in recovery from TKA. For many individuals, the severity of OA symptoms will peak as they approach their retirement years (AAC, 2011; Neustadt, 2006). Thus, a time that was intended to allow for the realization of many life dreams becomes characterized by suffering and disability. Themes of loss and injustice are reflected in the accounts and narratives of individuals with OA (Demierre et al., 2011; Fujita et al., 2006; Toye et al., 2006). The severity of suffering and the multitude of losses that accompany OA might set the stage for the emergence of injustice appraisals. In turn, injustice appraisals might trigger a cascade of psychological and physiological changes that ultimately compromise an individual's recovery potential (Scott, Trost, Bernier, et al., 2013; Sullivan, Scott, et al., 2012). To date, the relation between perceived injustice and post-surgical outcomes has not been systematically examined in individuals undergoing TKA.

The purpose of the present study was to determine the prognostic value of perceived injustice in predicting pain and disability outcomes following TKA. The identification of psychological risk factors for problematic TKA outcomes might contribute to the empirical foundation for the development of new avenues of interventions aimed at promoting successful recovery following TKA.

METHODS

Participants

The study sample consisted of 116 (71 women and 45 men) individuals who were scheduled for TKA at 1 of 3 hospitals in eastern Canada. The mean age of the sample was 67 years, with a range of 50 to 85 years. Sixty-four patients had TKA of the right knee, and 52 had TKA of the left knee. The mean pre-surgical body mass index (BMI) was 30.9, with a range of 20 to 45.2. The average duration of illness was 7.6 years. The majority of participants were married (85%) and had completed at least 12 years of education (90%).

Measures

Perceived Injustice

The Injustice Experiences Questionnaire (IEQ-chr) was used to assess illness-related perceptions on injustice. The IEQ-chr is a 12-item measure assessing individuals' appraisals of their illness in terms of the severity and irreparability of losses ("My life will never be the same"), unfairness ("It all seems so unfair"), and blame ("I am suffering because of someone else's negligence"). The IEQ-chr uses a 5-point Likert-type scale with responses ranging from 0 = never to 4 = all the time. To be appropriate for use with TKA patients, the instructional set of the original IEQ (Sullivan et al., 2008) was reworded to ask patients to assess the effects of their chronic condition on their life, as opposed to the effects of their injury. The suffix "chr" (for chronic) was added to the scale name to distinguish it from the original version. The psychometric properties of the IEQ-chr are similar to those that have been reported with the original version of the IEQ (Sullivan et al., 2008; Yakobov, Scott, Stanish, Tanzer, et al., 2014). The IEQ yields two correlated factors, severity/irreparability and blame/unfairness (Rodero et al.,

2012; Sullivan et al., 2008; Yakobov, Scott, Stanish, Tanzer, et al., 2014). In the current sample, the coefficient alpha for the IEQ-chr was .89.

Pain catastrophizing

The Pain Catastrophizing Scale (PCS) is a 13 item measure that assesses thoughts and feelings related to the experience of pain (Sullivan et al., 1995). The PCS is composed of three subscales: rumination, magnification and helplessness. Participants respond to items using a 5-point Likert-type scale with response options ranging from 0= not at all to 4= all the time. The scale has been shown to have high internal consistency (Cronbach's (Cronbach, 1951) alpha s: total= .87; rumination=.87, magnification=.66, helplessness=.78) and to be associated with heightened pain and disability in patients with various health conditions including osteoarthritis (Edwards et al., 2009; Riddle et al., 2010; Somers et al., 2009; Sullivan et al., 1995; Sullivan, Tanzer, et al., 2009).

Fear of Movement/Re-Injury

The Tampa Scale for Kinesiophobia -13 (TSK-13) is a 13-item measure used to assess pain-related fear of movement or re-injury (Clark et al., 1996). The TSK-13 contains 13 items from the original TSK-17 (Kori et al., 1990) and uses a 4-point Likert-type scale with response options ranging from 1=strongly disagree to 4 = strongly agree. High scores on TSK-13 and TSK-17 have been associated with physical disability and pain in patients with various conditions including OA (Geisser et al., 2000; Goubert et al., 2004; Picavet et al., 2002; Roelofs et al., 2004; Sullivan & Stanish, 2003). The TSK-13 has been shown to have high internal reliability (Cronbach's alpha= .86) (Clark et al., 1996).

Co-morbidities

Hypertension, osteoarthritis of other joints, diabetes mellitus, and chronic obstructive pulmonary disease (COPD) are among the common co-morbid conditions that can affect TKA outcomes. Co-morbidity was assessed with the Charlson Co-morbidity Index (CCI) (Charlson, Pompei, Ales, & MacKenzie, 1987). Respondents were asked to indicate the presence and severity of 13 different health conditions. A total score is calculated by summing the presence of different conditions indicated by the respondent (Charlson et al., 1987).

Pain and Function

The Western Ontario and McMaster University Osteoarthritis Index (WOMAC) was used to evaluate pain and physical function (Bellamy et al., 1988). The WOMAC is a self-administered questionnaire composed of three subscales: Pain, Stiffness, and Function. The WOMAC is a self-administered questionnaire composed of 3 subscales: Pain, Stiffness, and Function. The WOMAC uses a 5-point Likert scale with responses ranging from 0 = none to 4 = extreme. In the current study, only the subscale scores for pain and function were utilized. Higher scores represent worse pain (ranging from 0 to 20) and function (ranging from 0 to 68). To allow for cross-study comparison, the scores of WOPAIN and WOFUNC were converted to 0–100 range (Bischoff-Ferrari et al., 2004; Bullens et al., 2001). The WOMAC has been shown to be a valid and a reliable instrument for assessing health functioning in OA patients, and has been shown to be sensitive to changes in health functioning in patients who underwent TKA (Bellamy, 1989; Bellamy et al., 1988; Bellamy et al., 1992).

Procedure

Patients in the current study were recruited at 1 of 3 hospitals where they were scheduled for TKA. They were invited to participate in the research and were informed that the study was concerned with the physical, psychological, and social determinants of recovery after surgery.

All patients provided written informed consent as a condition of participation and received $25 as compensation for completing the questionnaires. The research was approved by the Research Ethics Boards of the McGill University Health Centre, the Hôpital Maisonneuve-Rosemont, and the Capital Health Authority of Nova Scotia. Participants completed questionnaires at the time of their pre-surgical evaluation (within 4 weeks of surgery) and at their 1-year postsurgical follow-up. Surgeries were performed by 11 surgeons from 3 different hospitals. By clinical standards, all patients in the study sample were considered surgical successes. Findings from cross-sectional analyses on a subsample of these data assessed before surgery have been reported in a previous article (Yakobov, Scott, Stanish, Tanzer, et al., 2014).

Data Analysis

All variables used in hypothesis testing were normally distributed. Descriptive statistics were computed for all pre- and post-surgical measures. Independent sample *t*-tests were computed on all measures to assess sex differences. Pearson correlations were used to examine the concurrent relations between pre-surgical measures of pain, function, and psychological variables. Partial correlations controlling for pre-surgical measures of pain and function were computed between pre-surgical variables and postsurgical measures of pain and function. Hierarchical regression analyses were used to assess the utility of pre-surgical pain-related measures for predicting pain and physical functioning 1 year after surgery. All tolerance coefficients in the regression results were greater than .45, indicating no issues of multicollinearity.

A nonparametric receiver operating characteristic (ROC) curve analysis (Zweig & Campbell, 1993) was used to identify the pretreatment score on the modified IEQ that distinguished between individuals reporting a WOMAC summary above a cut-off point that

denotes severe symptoms of arthritis (Hawker et al., 2000). For the present analyses, optimal cut-off scores on the IEQ-chr were chosen at the point where sensitivity and specificity were closest to being equal. This methodology has previously been used to identify clinically meaningful cut-off scores in the context of chronic pain (Farrar, Young, LaMoreaux, Werth, & Poole, 2001).

RESULTS

Sample characteristics

Demographic information as well as means and standard deviations of study measures are summarized in Table 1. The distribution of age, BMI, and scores on measures of pain, disability, pain catastrophizing are comparable to (within one standard deviation from the mean) those reported in previous studies with TKA patients (Nunez et al., 2007; Sullivan, Tanzer, et al., 2009). The scores for perceived injustice were one SD lower than those reported in studies with patients with musculoskeletal injuries (Scott, Trost, Bernier, et al., 2013; Sullivan et al., 2008). Men and women did not differ significantly on any demographic or study variable. As expected, there was a significant decrease in pain (-36), t (115) = 18.9, $p < .001$, and functional difficulties (-35.4), t (115) = 18.83, $p < .001$ from the pre-surgical to post-surgical evaluation.

Concurrent relations among study variables assessed pre-surgery

Age was inversely correlated with pain intensity (r = -.28, p <.05), WOMAC function (r = -.20, p <.05), and BMI (r = -.36, p <.001). BMI was positively correlated with WOMAC function (r =.21, p <.05). Co-morbid health conditions correlated with WOMAC function (r =.20, p <.05), pain catastrophizing (r =.19, p <.05), and age (r =.27, p <.05).

As presented in Table 2, the IEQ-chr was significantly correlated with duration of illness, pain severity, physical functioning, and scores on the TSK-13 and PCS. The magnitude

of the correlation between the IEQ-chr and pain severity is comparable to that which has been reported in previous research (Sullivan et al., 2008). The subscale scores of the IEQ, "blame/unfairness" and "severity/irreparability of loss" were each significantly correlated with the total IEQ, pain catastrophizing, fear of movement, and all of the pain outcome variables.

Prospective relations between pre-surgical psychological variables and post-surgical outcomes

Table 3 presents partial correlations between pre-surgical psychological measures and measures of pain and function reported 1 year after surgery. In these analyses, pre-surgical pain and function were co-varied, respectively. Pre-surgical scores on the PCS and IEQ-chr were significantly correlated with long-term postsurgical WOMAC pain and function while controlling for pre-surgical WOMAC pain and function, respectively.

Predicting post-surgical pain and function

Two hierarchical regression analyses were computed to assess the role of pre-surgical measures of perceived injustice in the prediction of postsurgical pain and function 1 year after surgery. In each regression, age, sex, BMI, and illness duration were entered in the first step. Pre-surgical scores on the dependent variable were entered in the second step. Comorbid health conditions were entered in the third step, pain catastrophizing and fear of movement were entered in the fourth step, and perceived injustice was entered in the last step.

As shown in Table 4, in the prediction of postsurgical pain the demographic variables entered in the first step failed to reach statistical significance. Pre-surgical pain entered in the second step accounted for 10% of the variance in postsurgical pain. Comorbid health conditions entered in the third step failed to reach statistical significance. Pain catastrophizing and fear of movement accounted for an additional 9% of the variance, and perceived injustice entered in the

last step contributed another 4% to the variance to post-surgical pain. Examination of the standardized beta weights from the final regression equation indicated that only the IEQ-chr (β = .29, p < .05) contributed significant unique variance to the prediction of postsurgical pain.

A regression analysis was conducted to examine the independent contributions of the ‘‘severity/irreparability of loss’’ and ‘‘blame/unfairness’’ subscales of the IEQ-chr to post - surgical pain. Neither of the subscales contributed significant unique variance to the prediction of post-surgical WOMAC pain scores.

In the prediction of postsurgical function, the demographic variables entered in the first step failed to reach statistical significance. Pre-surgical WOMAC function scores entered in the second step accounted for 13% of the variance in physical function 1 year after TKA. Comorbid health conditions entered in the third step did not contribute significantly to the model. Catastrophizing and fear of movement entered in the fourth step accounted for an additional 11% of the variance in post-surgical WOMAC function scores. Perceived injustice entered in the last step failed to attain statistical significance. Examination of the beta weights from the final regression equation indicated that only pain catastrophizing (β =.26, p <.05) contributed significant unique variance to the prediction of post-surgical WOMAC function scores.

ROC curve analysis using perceived injustice to identify high scores for pain severity and disability one year after TKA

IEQ-chr score that was best associated with follow-up pain severity and disability 1 year after surgery. Although there are no formal criteria for the classification of WOMAC scores, a cut-off summary score of 39 (ranging from the score of 0 denoting no pain or disability to 100 denoting the most severe pain and disability) and above has been used to identify severe symptomatology of arthritis (Hawker et al., 2000). The area under the curve was significant, and

its value indicated that 78% of the time, individuals who had high scores on WOMAC pain and function combined at the follow-up also reported higher pre-treatment scores on the IEQ-chr than individuals who had low combined WOMAC scores. Examination of IEQ-chr scores revealed that a pre-surgical score of 12 optimally discriminated between individuals with high and low follow-up pain severity and disability ratings (Table 5). Individuals whose scores on pre-surgical IEQ-chr were below 12 reported a 74% decrease in post-surgical WOMAC pain and 67% in postsurgical WOMAC function. Individuals who obtained a pre-surgery IEQ-chr score of 12 or above reported only a 58% decrease in postsurgical WOMAC pain and a 56% decrease in postsurgical WOMAC function.

DISCUSSION

The aim of the current study was to examine the prognostic value of perceived injustice in predicting long-term pain and physical function outcomes after TKA. Consistent with previous studies, higher scores on measures of pre-surgical pain and function were associated with more severe postsurgical pain and functional difficulties (Fortin et al., 1999; Sullivan et al., 2011). The findings also were consistent with previous research on musculoskeletal injuries showing that perceived injustice was correlated with measures of pain catastrophizing, fear of movement, pain intensity, and physical disability (Scott, Trost, Milioto, et al., 2013; Scott & Sullivan, 2012; Sullivan et al., 2008; Sullivan, Scott, et al., 2012). The results of the present study extend previous research in showing that high scores on a measure of pre-surgical perceived injustice predict the long-term persistence of pain after TKA.

In recent years, there has been increasing interest in examining psychological contributions to surgical recovery trajectories. Research suggests that psychological factors such as pain catastrophizing and fear of movement increase the risk for problematic recovery after

TKA (Somers et al., 2009; Sullivan et al., 2011). Of interest in the present study was whether perceived injustice contributed to the prediction of follow-up pain severity and disability beyond the variance accounted for by these variables. Analyses revealed that perceived injustice accounted for an additional 4% of variance in the prediction of pain 1 year after TKA, even after controlling for the contributions of pain catastrophizing and fear of movement.

Although the independent contribution of perceived injustice to post-surgical pain was modest, it is important to note that the analytic approach taken in this study was very conservative. The order of entry of variables in the regression analyses proceeded from the assumption that variables such as pain catastrophizing and fear of movement had theoretical primacy and as such were entered in an earlier step of the analyses. If no assumptions were made about theoretical primacy and variables were allowed to compete for entry, only the IEQ-chr would have emerged as a significant psychological predictor of pain severity. In univariate analyses, the results of prospective partial correlations showed that the IEQ-chr accounted for more variance (13%) in follow-up pain severity than pain catastrophizing (8%), fear of movement (3%), or pre-surgical pain severity (10%).

Numerous investigations have shown that TKA is an effective intervention for severe pain and disability associated with osteoarthritis of the knee (Jones, Voaklander, Johnston, & Suarez-Almazor, 2000; Robertsson, Dunbar, Pehrsson, Knutson, & Lidgren, 2000). Several studies have reported pain reduction following TKA in the range of 53% – 76% and improvement in function in the range of 36% – 67% (Bachmeier et al., 2001; Bourne et al., 2010; Nunez et al., 2007; Sullivan et al., 2011). The findings of the present study suggest that perceptions of injustice attenuate the pain-reducing properties of TKA. Participants with an IEQ-chr score below 12 showed 74% reduction in pain and 67% reduction in disability from pre-

surgery to 1-year follow-up; participants with an IEQ-chr score of 12 or above showed only a 58% reduction in pain and a 56% reduction in disability.

A subscale analysis was conducted to further address the unique role of blame/unfairness and loss-related components of the IEQ-chr in pain outcomes. When entered separately in regression analyses, the blame/unfairness and severity/irreparability components of the IEQ-chr failed to contribute significant unique variance in the prediction of postsurgical pain. The results suggest that in the context of OA, the experience of pain is affected by the shared and not by a unique variance of these 2 subcomponents of perceived injustice.

In the present study, scores on the IEQ-chr were lower (M = 9.0, SD = 8.7) than those that have been reported in samples of individuals with musculoskeletal pain resulting from work accidents (M = 17.3, SD =12.2), from motor vehicle accidents (M = 25.1, SD =11.8), and chronic musculoskeletal pain (28.9, SD = 11.1) (Scott, Trost, Bernier, et al., 2013; Sullivan et al., 2008). There are several possible explanations for this finding. Because of the insidious onset of their symptoms, it is possible that patients with OA may lack a salient source for blame for their losses and suffering. Indeed, inspection of individual items of the IEQ-chr indicated that item 3 (I am suffering because of someone else's negligence) had the lowest mean of all IEQ-chr items. Age-related factors might also be implicated in the degree to which pain and suffering are construed as unjust (Shaw, 1994). Greater injustice may be perceived in relation to sudden-onset pain and disability in younger individuals, forecasting a life of suffering, limitations, and restricted opportunities (Lyons & Sullivan, 1998; Montada, 1992). The same pain and suffering having its onset only in one's later years might not be appraised with the same degree of injustice. It is also possible that the adversarial climate of claim adjudication and injury compensation might augment perceptions of injustice consequent to injury (Sullivan, Scott, et al.,

2012). Taken together, these factors offer at least a partial explanation of higher scores on the IEQ in the context of injury. Despite the lower scores, the current study showed that perceptions of injustice play a significant predictive role in pain outcomes after TKA, even after controlling for other pain-related measures.

At the present time, little is known about the factors that give rise to perceptions of injustice. Conceptual models of justice related appraisals have addressed the potential role of blame, loss, and suffering in the experience of subjective injustice (Sullivan et al., 2008; Sullivan, Scott, et al., 2012). It has been proposed that perceptions of injustice can ensue from acts or conditions that might cause someone to suffer hardship or loss undeservedly (Hamilton & Hagiwara, 1992; Lind & Tyler, 1988). It also has been suggested that perceptions of injustice are likely to emerge in situations that are characterized by a violation of basic human rights, transgression of status or rank, challenge to equity norms and just world beliefs, and the experience of unnecessary suffering as a result of another's actions (Fetchenhauer & Huang, 2004; Hafer & Begue, 2005; McParland, Eccleston, Osborn, & Hezseltine, 2011; Miller, 2001; Mohiyeddini & Schmitt, 1997).

In response to an adverse event such as disability-related loss and suffering, individuals respond by initiating an attributional search to identify the causes of the adverse event. Blame can be construed as the cognitive product of identifying an external cause for an adverse event. Blame attributions, however, are not considered essential to the experience of injustice. Theoretical perspectives on distributive justice suggest that perceived inequities in the distribution of resources or losses are sufficient to give rise to a sense of injustice (Lucas, Alexander, Firestone, & Lebreton, 2008; Montada, 1992; Tyler & Smit, 1998). In other words, violations of equity norms can give rise to perceived injustice even when the adverse event or

situation seems to be random. Thus, in the context of OA, perceptions of injustice may arise as a result of restricted mobility, loss of independence, uncertainty about the prognosis, and prolonged pain, even in the absence of blame.

The study of perceived injustice in individuals with OA might provide a unique opportunity to address questions concerning the origins and impact of perceptions of injustice in a context in which individuals may not be able to readily attribute blame for their losses and suffering. For example, OA differs from musculoskeletal injury in relation to the onset of loss and suffering as well as the course of symptoms. In the case of musculoskeletal injury, pain and disability have a sudden onset and then improve over time. In OA, pain and disability have an insidious onset, and deteriorate over time. For individuals with severe OA who are considered candidates for surgery, TKA often will be performed only after a prolonged period of progressive pain and disability. In the context of OA, incremental losses consequent to disease progression might augment perceptions of injustice. Consistent with this perspective, in the current sample, scores on perceived injustice increased as a function of the duration of illness.

Recent investigations have addressed the pathways by which perceptions of injustice might impact on pain. One study conducted with patients with chronic musculoskeletal pain demonstrated that state anger mediated the relation between perceptions of injustice and pain severity, suggesting that anger may be one vehicle by which perceived injustice augments pain (Scott, Trost, Bernier, et al., 2013). Consistent with previous research, the present study showed that measures of perceived injustice and pain catastrophizing were significantly correlated (Sullivan, Scott, et al., 2012). It has been proposed that the mechanisms by which pain catastrophizing impacts on adverse pain outcomes might also contribute to the detrimental effects of perceived injustice on pain symptoms (Sullivan et al., 2011). Rumination, negative

outcome expectancies, magnification of the perceived threat value of pain symptoms, and difficulties disengaging attention from pain-related stimuli have been identified as possible vehicles by which catastrophizing might impact on adverse pain outcomes (Sullivan et al., 2011).

The results of the present study suggest that including measures of perceived injustice in the pre-surgical screening of individuals scheduled for TKA might permit identification of individuals at risk for problematic surgical outcomes. Psychosocial interventions targeting problematic cognitions, including perceived injustice, have been shown to be effective in promoting faster resumption of occupational activities in individuals with various musculoskeletal injuries (Sullivan & Adams, 2010; Sullivan, Adams, & Ellis, 2012; Sullivan, Adams, Rhodenizer, & Stanish, 2006). Given the success of these treatments in the context of injury, adapting these interventions to individuals with OA holds promise.

The findings in the present study must be interpreted with caution. The study sample size was modest, and replication is needed to bolster confidence in the reliability and generalizability of the present findings. The absence of process measures limits the ability to make confident statements about the specific pathways linking perceptions of injustice to problematic pain outcomes. Despite these limitations, this was the first study to show that perceived injustice plays an important role in determining problematic pain outcomes after TKA. Future research is needed to determine whether screening and intervention for perceived injustice and catastrophizing may prevent prolonged pain and disability after TKA.

Acknowledgements

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Tables

Table 1: Sample Characteristics

Variables	Women (*n* =71)	Men (*n* = 45)	*P*	Total Sample
Age	67.4 (8.6)	66.6 (7.7)	ns	67.0 (8.2)
BMI	31.0 (5.8)	30.8 (4)	ns	30.1 (5.2)
Pain pre	54.0 (17.1)	51.4 (18.7)	ns	53.0 (17.7)
Pain post	18.1 (17.9)	15.2 (16.1)	ns	17.0(17.2)
Function pre	55.5 (17.7)	56.3(19.5)	ns	56.1(18.4)
Function post	22.0(17.5)	18.6(15.5)	ns	20.7(16.8)
Comorbid	3.0 (1.6)	2.7 (1.3)	ns	2.9 (1.4)
PCS	13.5 (12.1)	11.2 (9)	ns	12.6 (11.0)
TSK-13	27.8 (8.4)	28.9 (8.4)	ns	28.3 (8.4)
IEQ-chr	9.5 (9.6)	8.1 (7.3)	ns	9.0 (8.7)

Note: *N*= 116. BMI=body mass index; Pain Pre = WOMAC Pain Score, pre-surgery; Function Pre = WOMAC Physical Function Score, pre-surgery; Pain Post = WOMAC Pain Score, post-surgery; Function Post = WOMAC Physical Function Score, post-surgery; Comorbid = number of comorbid health conditions; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire–chr.

Table 2. Correlations among pre-surgery pain-related psychological measures

	1	2	3	4	5	6	7
IEQ-chr							
IEQ - blame	.94**						
IEQ - loss	.87**	.65**					
PCS	.69**	.67**	.56**				
TSK-13	.48**	.39**	.50**	.51**			
Pain pre	.46**	.41**	.44**	.36 **	.23*		
Function pre	.50**	.46**	.46**	.38**	.36**	.74**	
Illness duration	.23*	.21*	.22*	.28*	.18	.06	.08

Note: N = 116; Pain Pre = WOMAC Pain Score, pre-surgery; Function Pre = WOMAC Physical Function Score, pre-surgery; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire–chr; IEQ-blame = blame/unfairness subscale of the IEQ-chr; IEQ-loss = severity/irreparability subscale of the IEQ. *p <.05, **p < .001

Table 3. Prospective partial correlations between pre-surgical and post- surgical variables

	Pain post	Function post
Pain Pre†	.31**	.30**
Function Pre†	.31**	.35**
Comorbid	.07	.09
PCS	.29*	.38**
TSK-13	.18	.18*
IEQ-chr	.36**	.37**
IEQ-blame	.36**	.33**
IEQ-loss	.26*	.32**
BMI	-.16	-.14

Note: *N*=116. BMI=body mass index; Comorbid = number of comorbid health conditions; Pain Pre = WOMAC Pain Score, pre-surgery; Function Pre = WOMAC Physical Function Score, pre-surgery; Pain Post = WOMAC Pain Score, post-surgery; Function Post = WOMAC Physical Function Score, post-surgery; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire–chr; IEQ-blame = blame/unfairness subscale of the IEQ-chr; IEQ-loss = severity/irreparability subscale of the IEQ

*$p < .05$, **$p < .001$

† Zero order correlations

Table 4. Regression analyses predicting post-surgical pain severity and physical function

	Beta	R^2change	F change
Dependent = Pain at 1 year follow-up			
Step 1			
Age	-.10		
Sex	-.04		
BMI	-.18		
Illness Duration	-.11	.03	.96(4,110)
Step 2			
Pain pre-surgery	.14	.10	12.90(1,109)**
Step 3			
Comorbid	.04	.01	.98(1,108)
Step 4			
PCS	.15		
TSK-13	.01	.09	5.88(2,106)*
Step 5			
IEQ-chr	.29*	.04	5.52(1,105)*
Dependent = Function at 1 year follow-up			
Step 1			
Age	-.05		
Sex	-.05		
BMI	-.15		
Illness Duration	-.01	.04	1.10 (4,110)
Step 2			
Function pre-surgery	.17	.13	17.23(1,109)**
Step 3			
Comorbid	.06	.01	1.17(1,108)
Step 4			
PCS	.26*		
TSK-13	.00	.11	8.19 (2,106)**
Step 5			
IEQ-chr	.20	.02	2.67(1,105)

Note. N=116. BMI = body mass index; Wait time= Time on the waiting list before surgery; Pain Pre = WOMAC Pain Score, pre-surgery; Function Pre = WOMAC Physical Function Score, pre-surgery; Pain Post = WOMAC Pain Score, post-surgery; Function Post = WOMAC Physical Function Score, post-surgery; Comorbid = number of comorbid health conditions; PCS = Pain Catastrophizing Scale; TSK-13 = Tampa Scale for Kinesiophobia; IEQ-chr = Injustice Experiences Questionnaire–chr. Standardized Betas are reported.

*$p < .05$; **$p \leq .001$

Table 5. ROC curve statistics for IEQ-chr total score

WOMAC Score	AUC	95% CI	P	IEQ-chr	Sensitivity (%)	Specificity (%)
≥39	.78	0.65-0.90	<.001	11.5	.71	.75

Note. N=116. AUC = Area under the curve. WOMAC score = Combined WOMAC Pain and WOMAC Function scores.

PREFACE TO CHAPTER 4

Study 2 provided the first empirical support for the predictive role of perceived injustice in pain outcomes one year after TKA. Specifically, it was demonstrated that higher scores on perceived injustice before surgery predicted pain severity one year after surgery independently of demographic variables, co-morbid health conditions, baseline levels of pain, pain catastrophizing and fear of movement. Additionally, ROC curve analysis identified a clinically meaningful cut-off score of pre-surgical IEQ that is associated with poor outcomes after the TKA.

Together, the results of Study 1 and Study 2 demonstrate that perceptions of injustice can arise in the absence of an eliciting event. Moreover, the results revealed that perceived injustice contributes significant unique variance to the prediction of pain-related outcomes before and after TKA. These results suggest that perceived injustice is a cognitive risk factor for adverse post-TKA outcomes, and may be a candidate for psychological interventions that target problematic cognitions in individuals at risk.

However, little is currently known about the factors that contribute to the development and maintenance of perceptions of injustice. Information about determinants of injustice will have important clinical and theoretical implications. First, information about determinants of perceived injustice might contribute to the development of effective interventions aimed at reducing perceptions of injustice. Identification of determinants of perceived injustice might contribute to the development of conceptual models of perceived injustice in the context of pain.

Physical and emotional suffering, and a multitude of losses associated with disability have been discussed as determinants of perceived injustice in individuals with injury (Montada, 1994; Sullivan et al., 2008). Empirical research on determinants of perceived injustice, however, is lacking. One approach to examining the relations between perceptions of injustice, and OA-

related suffering and losses associated with disability is to examine the outcome of interventions designed to reduce symptom severity (i.e., pain severity and depressive symptoms) and disability. If symptom severity and disability are important contributors to perceptions of injustice, it follows that interventions that yield reductions in symptom severity and disability should result in reductions in perceptions of injustice. The goal of study 3 was to examine the relative contribution of reductions in symptom severity and disability to reductions in perceived injustice following TKA.

CHAPTER 4: Reductions in perceived injustice are associated with reductions in disability and depressive symptoms after total knee arthroplasty

Yakobov E, Scott W, Stanish W, Tanzer M, Dunbar M, Richardson G, Sullivan MJL. *Clin J Pain* 2018;415-420.

ABSTRACT

Introduction: Perceptions of injustice have been associated with problematic recovery outcomes in individuals with a wide range of debilitating pain conditions. It has been suggested that, in patients with chronic pain, perceptions of injustice might arise in response to experiences characterized by illness-related pain severity, depressive symptoms, and disability. If symptoms severity and disability are important contributors to perceived injustice, it follows that interventions that yield reductions in symptom severity and disability should also contribute to reductions in perceptions of injustice. The present study examined the relative contributions of post-surgical reductions in pain severity, depressive symptoms, and disability to the prediction of reductions in perceptions of injustice.

Methods: The study sample consisted of 110 individuals (69 women and 41 men) with osteoarthritis of the knee scheduled for total knee arthroplasty (TKA). Patients completed measures of perceived injustice, depressive symptoms, pain, and disability at their pre-surgical evaluation, and at 1-year follow-up.

Results: The results revealed that reductions in depressive symptoms and disability, but not pain severity, were correlated with reductions in perceived injustice. Regression analyses revealed that reductions in disability and reductions in depressive symptoms contributed modest but significant unique variance to the prediction of postsurgical reductions in perceived injustice.

***Discussion*:** The present findings are consistent with current conceptualizations of injustice appraisals that propose a central role for symptom severity and disability as determinants of perceptions of injustice in patients with persistent pain. The results suggest that the inclusion of psychosocial interventions that target depressive symptoms and perceived injustice might

augment the impact of rehabilitation programs made available for individuals recovering from TKA.

Key words: Perceived injustice, disability, pain, depressive symptoms

INTRODUCTION

Several research studies have highlighted the deleterious physical and mental health consequences of perceived injustice (Scott, Trost, Milioto, et al., 2013; Scott & Sullivan, 2012; Sullivan et al., 2008; Sullivan, Davidson, et al., 2009; Sullivan, Thibault, et al., 2009). Perceived injustice has been defined as an appraisal process characterized by attribution of blame, a sense of unfairness and a tendency to construe one's losses as severe and irreparable (Sullivan et al., 2008). Perceptions of injustice have been prospectively associated with poor recovery outcomes in patients with musculoskeletal injuries (Scott, Trost, Milioto, et al., 2013; Sullivan et al., 2008). Elevated pre-surgical scores on a measure of perceived injustice have been shown to be prospectively associated with persistent pain one year following knee replacement surgery (Yakobov, Scott, Stanish, Dunbar, Richardosn et al., 2014). In addition, in several studies with individuals with whiplash, perceived injustice predicted the persistence of posttraumatic and depressive symptoms following rehabilitation treatment (Scott et al., 2015; Sullivan, Thibault, et al., 2009).

Although research has been consistent in showing a relation between perceived injustice and problematic recovery outcomes, little is currently known about the factors that contribute to the development and maintenance of perceptions of injustice. The lack of information about the factors that contribute to the emergence of perceptions of injustice will necessarily impede efforts to develop effective interventions aimed at reducing perceptions of injustice.

It has been suggested that perceptions of injustice are likely to arise in response to experiences characterized by suffering and loss (Darley & Pittman, 2003; Lind & Tyler, 1988; Montada, 1991; Montada, 1994). The experience of debilitating health conditions can be construed in terms of suffering and loss (McParland & Eccleston, 2013; Montada, 1991). The

suffering associated with pain-related conditions might include symptoms of pain and emotional distress (Berglund, Bodin, Jensen, Wiklund, & Alfredsson, 2006; Nederhand, Hermens, Ijzerman, Turk, & Zilvold, 2003). Pain symptoms can also interfere with physical functioning, and lead to the experience of losses in multiple life domains. The losses associated with pain-related disability might include loss of independence, employment, financial security, and the loss of identity (Lyons & Sullivan, 1998; Walker, Sofaer, & Holloway, 2006). The magnitude of losses associated with debilitating health conditions has been previously discussed as a possible contributor to perceived injustice (Lind & Tyler, 1988; Montada, 1992, 1994; Sullivan et al., 2008).

Osteoarthritis is a debilitating health condition that affects up to 40% of the population by the age of 65 years (Salaffi, Carotti, & Grassi, 2005). In advanced stages of the disease, joint deterioration can lead to significant pain and limitations of function (Felson, 2004; Martel-Pelletier, Boileau, Pelletier, & Roughley, 2008). Progressive increase in pain and impairment in function often lead to loss in one's ability to participate in many activities of daily life (Farr Ii, Miller, & Block, 2013). Total knee arthroplasty (TKA) is a surgical procedure that involves the replacement of diseased tissue and bone with a prosthetic joint. TKA has been shown to be highly successful in reducing pain and disability in majority of cases (Robertsson, Dunbar, Pehrsson, Knutson, & Lidgren., 2000). If symptom severity and disability are important contributors to perceived injustice, it follows that interventions that yield reductions in symptom severity and disability should also contribute to reductions in perceptions of injustice. No research to date has investigated the relative contributions of reductions in symptom severity and disability to reductions in perceived injustice following a surgical intervention.

The primary objective of the present study was to examine whether reductions in symptom severity (i.e., pain and depressive symptoms) and disability following TKA contributed to reductions in perceptions of injustice. Participants completed measures of perceived injustice, depressive symptom severity, pain severity, and disability before surgery and at 1-year follow-up. Regression analyses were used to examine whether postsurgical reductions in symptom severity and disability were associated with reductions in perceptions of injustice. It was hypothesized that perceived injustice would decrease as a function of post-TKA reductions in symptom severity and disability.

The identification of determinants of change in perceptions of injustice after TKA might contribute to a better understanding of the factors that influence injustice appraisals in patients with OA. Increasing our understanding of the determinants of change of perceived injustice in this population might contribute to the empirical foundation for the development of novel interventions aimed at promoting successful recovery after TKA.

METHODS

Participants

The study sample consisted of 110 individuals (69 women and 41 men) with severe OA of the knee scheduled for TKA. The age range of the study sample was from 50 to 85 years (mean = 66.9; SD = 8.3). The pre-surgical body mass index (BMI) ranged from 20.52 to 45.2 (mean =31.00; SD= 5.0). Sixty-one individuals had TKA of the right knee and 49 had TKA of the left knee. More than 80% of the participants were married and completed at least 12 years of education. The data reported in this paper were drawn from a larger study examining predictors

of recovery trajectories following TKA (Yakobov, Scott, Stansh, Dunbar et al., 2014; Yakobov, Scott, Stanish, Tanzer, et al., 2014)

Measures

Perceived injustice

Perceived injustice was assessed with the Injustice Experiences Questionnaire adapted for use in patients with chronic conditions (IEQ-chr). The original IEQ asks patients to assess the effect of their injury on their life. The instructional set of the original IEQ (Sullivan et al., 2008) was modified to ask respondents to assess the effects of their chronic condition on their life, and the suffix "chr" (for chronic) was added to the scale name to distinguish it from the original version. The IEQ-chr contains 12 items that assess respondents' appraisals of their illness in terms of unfairness (It all seems so unfair), the severity and irreparability of losses (My life will never be the same), and attributions of blame (I am suffering because of someone else's negligence). Respondents are asked to rate the frequency with which they experience the thoughts described in the item-content of the IEQ-chr on a 5-point Likert-type scale with the endpoints (0)= never and (4) =all the time. Previous research has supported the reliability and validity of the IEQ-chr as a measure of health-related perceptions of injustice (Yakobov, Scott, Stanish, Tanzer, et al., 2014).

Pain severity and disability

Pain severity and disability were assessed with The Western Ontario and McMaster University Osteoarthritis Index (WOMAC) (Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988). The WOMAC is a 24-item measure that yields a total score and subscale scores for 1) Pain, 2) Stiffness, and 3) Physical Function. For the purposes of the present study, only the subscale scores for pain and physical function are reported. For each item of the WOMAC,

respondents are asked to rate the severity of their OA-related symptoms and limitations on a 5-point Likert scale with the endpoints (0) = *none* to (4) = *extreme*. The scores range from 0 to 20 for pain subscale and 0 to 68 for physical function subscale. The reliability and validity of the WOMAC have been demonstrated in patients in several studies (Bellamy, 1989; Bellamy et al., 1988; Bellamy et al., 1992).

Depressive symptomatology

Depressive symptoms were assessed with the Patient Health Questionnaire-9 (PHQ-9) (Spitzer et al., 1999). Respondents are asked to rate the frequency with which they experience nine symptoms that are considered in the diagnostic criteria for major depressive disorder. For each item of the PHQ-9, respondents make their ratings on a 4-point frequency scale with the endpoints (0) = *not at all* to (3) = *nearly every day*. The PHQ-9 has been shown to be reliable and valid measure of depressive symptom severity in individuals with various health conditions (Gilbody et al., 2007; Huang et al., 2006; Li et al., 2007).

Procedure

Participants in the current study were recruited from 3 hospitals located in Eastern Canada. Criteria for inclusion in the present study included a diagnosis of primary OA of the knee, age between 50 and 85 years and scheduled for TKA at one of the 3 collaborating sites. Exclusion criteria included; (1) diagnosis of rheumatoid arthritis, (2) previous arthroplasty of the knee, (3) previous patellectomy, (4) major bone loss requiring structural bone graft, and (5) requiring bilateral TKA within 1 year of the index procedure.

Participants were informed that the study was concerned with the physical and psychological determinants of recovery after surgery. Patients interested in study participation provided written informed consent and received $25 as compensation for completing the

questionnaires. The research was approved by the Research Ethics Boards of the McGill University Health Centre, the Hôpital Maisonneuve- Rosemont, and the Capital Health Authority of

Nova Scotia. Participants were asked to complete the questionnaires at the time of their pre-surgical evaluation (within 4 weeks of surgery) and at their 1-year postsurgical follow-up. Outcomes of all surgical procedures in the present sample were considered as clinically successful. Findings from cross-sectional and prospective analyses on a portion of these data have been reported in 2 previous papers (Yakobov, Scott, Stanish, Dunbar, et al., 2014; Yakobov, Scott, Stanish, Tanzer, et al., 2014)

Data Analysis

Out of 116 participants at pre-surgical evaluation, 110 completed the follow-up questionnaires and were retained in study analyses. All data analyses were conducted with SPSS version 20 (IBM Corp, 2011). Independent sample t tests were used to assess sex differences on all study measures. Paired sample t tests were computed to assess the differences between pre-surgical and postsurgical scores on measures of pain severity, disability, depressive symptoms, and perceptions of injustice. Change scores were computed for pain severity, disability, depressive symptoms, and perceived injustice. Zero-order Pearson correlations were used to examine the associations between changes in pain, disability, depressive symptoms, and perceived injustice. A hierarchical regression equation was conducted to examine the unique contribution of changes in symptom severity and disability to the prediction of changes in scores on perceptions of injustice.

RESULTS

Sample characteristics

Men and women did not differ significantly on any demographic or study variable except for post-TKA depressive symptoms where women reported higher scores (M = 4.3; SD = 6.1) than men (M = 2.2; SD = 2.9) t (108) = 2.5, $p < .05$. There was a significant decrease in pain severity t (109) = 19.13, $p < .001$, d = 1.82, disability t (109) = 18.80, $p < .001$, d = 1.79, depressive symptoms t (109) = 5.69, $p = .001$, d = 0.54 and perceived injustice t (109) = 4.16, $p < .001$, d = 0.40 from the pre to postsurgical evaluation (Table 1).

Correlations among study variables

Zero-order correlations revealed that, before surgery, perceived injustice was associated with depressive symptoms (r = .52, $p < .001$), pain severity (r = .50, $p < .001$), and disability (r = .53, $p <.001$). Pain intensity was associated with age (r = -.26, $p <.05$) and BMI (r = .24, p <.05). (Table 2).

Pearson correlations were computed between change scores of pain, disability, depressive symptoms, and perceived injustice (Table 3). Zero-order correlations revealed that postsurgical reductions in depressive symptom severity were associated with reductions in perceived injustice (r = 0.24; $p < 0.05$), and reductions in disability (r = 0.20; $p < 0.05$). Postsurgical reductions in pain severity were associated with reductions in disability (r =0.71; $p < 0.001$) but were not significantly correlated with reductions in perceived injustice (r = 0.10; $p = 0.29$). Postsurgical reductions in disability were associated with reductions in perceived injustice (r = 0.20; $p < 0.05$). Pre-surgical BMI was associated with reductions in pain (r = 0.26; $p <0.05$) and disability (r = 0.25; $p <0.05$).

Determinants of changes in perceived injustice

A hierarchical regression was computed to assess the contribution of changes in depressive symptoms, and disability to changes in perception of injustice from pre-surgery to post-surgery. Because reduction in pain severity was not correlated with reductions in perceived, changes in pain severity were not included in regression analyses. The overall model was significant, F (5, 104) =3.38; $p < 0.05$ and accounted for 14% of the variance (10% adjusted) (Table 4). Demographic variables were entered in the first step of the analysis but did not make a significant contribution to the prediction of reductions in perceived injustice. Changes in depressive symptom severity were entered in the second step of the analysis and accounted for 6% of the variance in changes in perceived injustice. Changes in disability were entered in the last step and accounted for additional 7% of the variance in changes in perceived injustice. Examination of the standardized beta weights from the final regression equation indicated that only reductions in depressive symptom severity (β =0.19; $p < 0.05$), and reductions in disability (β = 0.27; $p < 0.05$) contributed significant unique variance to the prediction of reductions in perceptions of injustice. A hierarchical regression analysis using residualized change scores was also conducted yielding a comparable pattern of findings.

DISCUSSION

The goal of the present study was to examine whether reductions in pain severity, depressive symptoms, and disability following TKA would be associated with reductions in perceptions of injustice. The results of the present investigation were consistent with previous research showing significant cross-sectional relations between perceptions of injustice, pain severity, depressive symptom severity, and disability. The findings of the present study extend previous research in showing that reductions in depressive symptom severity and reductions in disability contributed uniquely to reduction in perceptions of injustice.

Numerous research investigations have reported significant associations between perceptions of injustice, symptom severity and disability. Sullivan and colleagues (Sullivan et al., 2008) reported that in a sample of individuals with musculoskeletal injuries perceived injustice was associated with pain severity, disability, and depressive symptoms. Similar findings were reported across several patient samples including whiplash, spinal cord injury, fibromyalgia, rheumatoid arthritis, and osteoarthritis of the knee (Ferrari & Russell, 2014; Rodero et al., 2012; Scott, Trost, Milioto, et al., 2013; Sullivan, Davidson, et al., 2009; Trost et al., 2015; Yakobov, Scott, Stanish, Tanzer, et al., 2014).

Little is currently know about the determinants of perceived injustice. It has been suggested that life events including illness or injury that lead to suffering, deprivation of resources, and losses might give rise to perceived injustice (Darley & Pittman, 2003; McParland & Eccleston, 2013; McParland et al., 2011; Montada, 1991). Contributions of loss and suffering to perceived injustice can be conceptualized within the theories of distributive justice and equity norms (Adams, 1965; Montada, 1991). At the core of the principles of distributive justice and equity norms is the assumption that all individuals are "entitled" to the same benefits or resources as others. The losses or suffering associated with debilitating illness or injury can be appraised as a violation of equity norms, leading to perceptions of injustice. Darley and Pittman (2003) go further to suggest that individuals also expect to be compensated for suffering and losses when they believe that harm was not done unintentionally (i.e., poor medical care, health care professional's neglect). The absence of compensation for suffering and losses associated with chronic illness may also contribute to the experience of perceived injustice. To date, empirical research on dimensions and determinants on injustice in pain context is lacking and conceptual models of perceived injustice in this area have yet to be put forward.

The mechanisms by which perceived injustice compromises recovery outcomes are not well understood. There is a paucity of research on the specific challenges that individuals with high scores on perceived injustice may face in rehabilitation context. In one study, perceived injustice was associated with poor therapeutic alliance and poor rehabilitation outcomes in patients with musculoskeletal pain following injuries (Scott, Milioto, Trost, & Sullivan, 2016). In another study of patients with musculoskeletal pain, anger mediated the relations between perceived injustice pain severity, and depressive symptoms (Scott, Trost, Bernier, et al., 2013). The associations between perceived injustice, anger and therapeutic alliance have not been investigated in patients with OA.

Consistent with recent investigations on perceived injustice and pain outcomes, in the current study, the relation between perceptions of injustice and disability was stronger than the relation between perceived injustice and pain severity. (Sullivan et al., 2008; Sullivan, Davidson, et al., 2009; Yakobov, Scott, Thibault, & Sullivan, 2016). In the present study, reduction in disability, but not reduction in pain was associated with reduction in perceived injustice. At present, there is no conceptual framework that predicts that disability is weighted more heavily in perceived injustice than pain severity. It is possible that availability of medication that can reduce the intensity of pain may reduce the degree to which pain severity is construed a violation of justice principles. In addition, it has been suggested that injustice appraisals are influenced by comparisons that individuals make to others in their reference group (Montada, 1991). For many individuals with OA the severity of symptoms peaks towards retirement years (Neustadt, 2006). Although pain in old age might be perceived as a relatively normal phenomenon, this may not be the case for disability. For many individuals the retirement years are intended for realization of life dreams and aspirations. For individuals with severe OA perceptions of injustice may arise

not only because of losses associated with functional limitations, but also because of the inability to fulfill retirement dreams. Surgical intervention aimed at reducing or minimizing disability might recover some of these losses restoring breaches in justice violation and reducing perceived injustice.

In the present study, reductions in depressive symptoms were associated with reductions in perceived injustice even when controlling for reductions in disability. These findings indicate that depressive symptoms impact on perceived injustice through mechanisms that are at least partly independent of the experience of disability. Several empirical investigations highlighted strong associations between perceived injustice and depressive symptoms (Rodero et al., 2012; Scott et al., 2015; Sullivan et al., 2008). Clinical psychology literature suggests that part of the phenomenology of depression entails a sense of being unfairly punished (Freud, Strachey, Freud, Strachey, & Tyson, 1917). The relation between perceived injustice and depressive symptoms is reflected in the content of an item "I feel I am being punished" of the BDI-II, an instrument that is widely used to assess depression (Beck, Steer, & Brown, 1996). In addition, punitive and invalidating responses of others to one's suffering have been discussed as important contributors to psychological distress (Dickerson, Gruenewald, & Kemeny, 2004; Ghavidel-Parsa et al., 2015; Gilbert, 2000; Sullivan et al., 2014), and have been identified as important contributors to perceived injustice in individuals with chronic pain (Scott et al., 2016). The results of the present study suggest that reductions in depressive symptoms after TKA might trigger a reappraisal of injustice cognitions. Future research is needed to explore the processes by which reductions in depressive symptomatology lead to reductions in perceived injustice.

The results of hierarchical regression analyses revealed that pre-surgical BMI and demographic variables, and reductions in depressive symptoms and disability accounted for

approximately 10% of the variance in the prediction of reduction in perceived injustice, leaving 90% of the variance not accounted for. In one study Scott and colleagues (2016) interviewed individuals with whiplash injuries about sources of injustice. They found that participants identified their employers, insurers, family members, health care providers, and other individuals from their social circle as sources of injustice. Reasons for identifying the sources included inadequate assessment and treatment by health professionals, invalidation, and lack of social support (Scott et al., 2016). It is possible that similar factors might contribute to perceived injustice in patients with severe OA of the knee.

In the present study the scores on perceived injustice (M = 8.9, SD = 8.4) were similar to those reported in another study with OA patients (SD = 12.0, SD = 1.7) but lower than scores reported in individuals with musculoskeletal pain following work injuries (M = 17.3, SD = 12.2), spinal cord injury (M = 16.7, SD = 12.4), motor vehicle accidents (M = 25.1, SD = 11.8), and traumatic injuries (M = 17.1, SD = 14.5) (Ferrari, 2015; Scott, Trost, Bernier, et al., 2013; Sullivan et al., 2008; Trost et al., 2015; Trost et al., 2016). It is possible that these variations in IEQ scores might reflect condition-relevant differences in the phenomenology of injustice. First, when compared to individuals who have sustained injuries, individuals with conditions that have an insidious onset often do not have an identifiable source for pain onset. As such, attributions of blame for illness-related suffering and disability in individuals with OA are expected to be lower than in populations with traumatic onset of symptoms caused by someone else's mistake or negligence (ie, other driver, coworker). In line with this perspective, inspection of individual items of the IEQ-chr in the present study confirmed that the item that reflects attributions of blame had the lowest mean of all IEQ-chr items. It is also possible that age might influence appraisals of injustice (Shaw, 1994). Most individual with OA experience pain and disability as

they approach their retirement years. Young individuals who experience a sudden onset of symptoms forecasting a life of suffering and limited opportunities might appraise their situation with greater injustice than individuals whose symptoms only became prominent later in life.

There are significant clinical implications to current findings. The findings suggest that interventions designed to reduce disability might have a greater impact on reducing perceptions of injustice than interventions designed to reduce pain severity. The findings also suggest that interventions designed to reduce depressive symptoms might also be important in reducing perceptions of injustice. Even though depression has been identified as a prognostic indicator for poor recovery outcomes following TKA, there have been few reports addressing the management of depressive symptoms in this population. Future studies need to investigate whether the outcomes of TKA might be enhanced by the provision of interventions designed to target depressive symptoms and perceptions of injustice.

The findings of the present study must be interpreted in light of several limitations. The sample size was modest, and replication is needed to support the reliability of the findings. Assumptions were made about the specific principles of justice that were violated by the experience of symptom severity and disability associated with OA. The tenability of assumptions has to be taken in consideration, and in the absence of empirical verification of these assumptions, confidence in the conclusions drawn must await replication. In addition, participants in this study received medical services under publicly funded health care system. Publicly funded health care systems are known to have longer wait times for knee replacement surgery than privately funded health care systems. Longer wait time may have played a role in a pattern of findings relevant to perceptions of injustice.

Although the discussion has proceeded from the perspective that reductions in depressive symptoms and disability might lead to reductions in perceived injustice, it is very likely that this association is bidirectional. In other words, although reductions in disability and depressive symptoms might contribute to reductions in perceived injustice, reductions in perceived injustice might also contribute to reductions in depressive symptoms and increases in function. Although surgery would not be considered an intervention designed to reduce perceptions of injustice, being the recipient of a surgical intervention might have been experienced as a form of compensation, leading to reductions in perceived injustice, and in turn, yielding reductions in depressive symptoms.

Despite the limitations, this was the first study that to demonstrate that changes in depressive symptoms and severity of disability are significant correlates of changes in perceived injustice following TKA. The present findings call for the inclusion of interventions designed to reduce perceptions of injustice and depressive symptoms in the rehabilitation programs made available to individuals recovering from TKA. Future research is needed to determine whether psychosocial interventions that target depressive symptoms and perceptions of injustice might promote more successful recovery following TKA.

Tables

Table 1: Means and Standard Deviations of Pre and Post treatment variables

Variables	Pre-treatment	Post-treatment	*P*	Cohen's d
Pain intensity	10.6 (3.3)	3.4 (3.4)	.000	1.82
Disability	37.8 (11.8)	14.4 (11.5)	.000	1.79
Depressive symptoms	6.8 (7.0)	3.5 (5.2)	.000	0.54
IEQ-chr	8.9 (8.4)	6.3 (8.4)	.000	0.40

Note: *N*= 110. IEQ-chr = Injustice Experiences Questionnaire

Table 2. Correlations among variables before surgery

	1	2	3	4	5	6
1. Age						
2. BMI	-.38*					
3. Sex	-.06	-.03				
4. IEQ-chr	-.08	-.02	-.05			
5. Depressive symptoms	-.09	-.04	-.01	.52**		
6. Pain intensity	-.26*	.24*	-.07	.50**	.31*	
7. Disability	-.18	.17	.01	.53**	.39**	.71**

Note: N = 110; IEQ-chr =Injustice Experiences Questionnaire
*p <.05, **p < .001

Table 3. Correlations among change scores pre and post treatment

	1	2	3
1. Δ IEQ-chr			
2. Δ Depressive symptoms	.24*		
3. Δ Pain intensity	.10	.07	
4. Δ Disability	.29*	.20*	.71**

Note: N = 110; Δ IEQ-chr = Changes in Injustice Experiences Questionnaire; Δ Depressive symptoms = Changes in Depressive Symptoms; Δ Pain intensity = Changes in Pain intensity; Δ Disability = Changes in disability.
*p <.05, **p < .001

Table 4. Regression analyses predicting post-treatment changes in perceived injustice

	Beta	R^2change	F change
Dependent = Change in scores of IEQ			
Step 1			
Age	-.08		
BMI	-.09		
Sex	-.09	.02	.68 (3, 106)
Step 3			
Δ Depressive symptoms	.19*	.06	6.18 (1, 105)*
Step 4			
Δ Disability	.27*	.07	8.00 (1,104)*

Note: N = 110; BMI = Body Mass Index; Δ Depressive symptoms = Changes in Depressive Symptoms; Δ Pain intensity = Changes in Pain intensity; Δ Disability = Changes in disability. Standardized Betas are reported for the final step.
*p <.05

CHAPTER 5: GENERAL DISCUSSION

Over the past decade, perceived injustice has emerged as a robust predictor of poor recovery outcomes in patients with musculoskeletal injuries (Sullivan et al., 2008; Sullivan et al., 2014). To date, research on the relationship between perceived injustice and pain-related outcomes has proceeded from the assumption that injustice appraisals arise consequent to an eliciting event (Colquitt, 2001; Sullivan et al., 2008).

The present thesis examined the role of perceived injustice in pain and disability outcomes in individuals with severe OA, a chronic pain condition with insidious onset. The objective of Study 1 was to validate the adapted Injustice Experiences Questionnaire for use in individuals with OA. The objective of Study 2 was to examine the role of pre-surgical perceived injustice in pain and disability outcomes one year after TKA. The objective of Study 3 was to identify the determinants of change in post-surgical reductions in perceived injustice.

The following sections provide a summary of results of the three studies. Contributions to the existing literature, as well as the theoretical and clinical implications of these findings are discussed. The discussion concludes with avenues for future research and final remarks.

Theoretical implications

The pattern of findings of studies presented in this thesis is largely consistent with the perspective on perceived injustice described within the framework of distributive justice theory. According to this theory, perceptions of injustice might arise following comparative appraisals that result in perceptions of inequity (Adams, 1965). More specifically, this theory contends that appraisals of fairness depend on the normative expectation that inputs (i.e., age, experience, education level) translate into anticipated outcomes (i.e., salary, social status, and other rewards). Inequity exists when a person perceives that the ratio of his or her *outcomes* to *inputs* is not equal

to the ratio of others. This may occur when both parties engage in direct exchange, or when a person compares himself or herself to others in the same reference group. Previous qualitative research that explored the personal meaning of pain-related experience in individual with OA evidenced narratives consistent with violation of distributive justice principles. For example, some individuals reported they could no longer engage in life activities peers their age are able to enjoy; others reflected on many losses and grief of their pain-related disability (Demierre et al., 2011; Toye et al., 2006).

There is recognition that appraisals of justice violations can occur along multiple dimensions. Writers have discussed the wide range of dimensions of justice appraisals that include distributive, compensatory, and retributive justice principles. However, there have been no efforts to date to organize these into a comprehensive model of justice appraisals. It remains unclear whether these dimensions are organized in a hierarchical manner or whether some dimensions have primacy over others. It has been suggested that distributive justice might represent the most fundamental and intuitive-based judgment system encompassing other dimensions of justice (Carlsmith & Darley, 2008). It is also possible that these dimensions are completely determined by context (i.e., presence or absence of an eliciting event) and culture (i.e., rule systems). Research programs on different dimensions of justice have proceeded independently, and no efforts have been made to integrate various justice dimensions into a more comprehensive model.

It is important to note that the construction of the Injustice Experiences Questionnaire was guided by an empirical rather than dimensional approach (Sullivan et al., 2008). The objective was to capture critical elements underlying justice appraisals in patients with chronic pain. Authors selected items from a pool of patients' verbalizations reflecting attributions of

blame, the magnitude of suffering, and irreparability of losses sustained following an injury. Even though the IEQ is grounded in the theoretical principles of justice, it does not provide enough information about the exact theoretical dimensions of justice that have been violated. Some items appear to map onto one or several principles of justice. For example, the item "I am suffering because of someone's negligence" reflects at once elements of suffering, attribution of blame, and desire for retribution. The item "I feel as if I have been robbed of something very special" reflects at once elements of inequity, the magnitude of loss, and inadequacy of compensation. In sum, IEQ items are modeled after phrases used by patients as opposed to being derived from specific dimensions of justice. As such, the IEQ is best construed as a measure of a phenomenology of injustice, as opposed to a measure reflecting dimensional analyses of which principles of justice are violated. Underlying this approach of scale development is an assumption that abstract and complex constructs like perceived injustice, may be difficult to translate into items that individuals can relate to their experiences. One limitation of this approach is that by assessing the implied consequence of justice violations, the link between items and the underlying construct remains untested. However, the internal consistency of the IEQ is sufficiently high (alpha >.90), and it would be difficult to argue that all items do not assess the same underlying construct.

In sum, although the theoretical perspectives on perceptions of injustice have been addressed from a dimensional approach, it would be significantly challenging to develop a measure reflecting different injustice dimensions applicable to a wide range of injuries and illnesses. For example, while an incident event may not be necessary for appraisal of violation of distributive justice, an incident event is likely to be required for appraisals of violation of compensatory or retributive justice (Adams, 1965; Darley & Pittman, 2003). Attributions of

blame may be central to retributive justice appraisals, but not necessary for violation of distributive justice principles. These challenges partly explain why bodies of literature addressing violations of distributive, compensatory, and retributive justice principles have proceeded mostly independently.

The differences in scores between the IEQ-chr and IEQ

The IEQ-chr scores in individuals with OA were lower than the IEQ scores in individuals with chronic musculoskeletal pain following an incident event such as motor vehicle accident, whiplash injury (Scott & Sullivan, 2012), and occupational accident (Sullivan et al., 2008). There may be several explanations for this finding. First, having no source for blame renders the item assessing attribution of blame to be virtually unendorsed. For this reason alone, scores on IEQ-chr are expected to be lower by nearly 4 points than IEQ scores of individuals with injuries caused by negligence or external sources. Other factors that may augment perceptions of injustice in individuals with injuries include the nature of symptom onset and treatment context.

Individuals who experience a sudden onset of pain and disability face many challenges of adapting to their painful condition. They tend to report higher levels of emotional distress than individuals with health conditions with a gradual onset of symptoms (Bennet, 2002). Greater emotional distress and sudden onset of disability are likely to result in greater perceived injustice (Sullivan et al., 2008). According to Adams (1965), when individuals face injustice, they tend to engage in justice restoration actions that reduce the discrepancy between what is perceived to be and what is perceived should be. When they cannot change the situation, they may cognitively distort their appraisals, or change the object of their comparison. It is possible that individuals with gradual onset of symptoms have more time to re-appraise their sense of unfairness or shift focus to a different reference group for comparison.

Finally, the treatment context of OA patients may differ substantially from that of patients with injuries. For the latter, perceptions of injustice might be implicit in litigations systems where victims pursue compensation for suffering, and losses incurred. When an injury is caused by unsafe working conditions, compensations systems are often involved to settle disability claims or compensation packages. Research has pointed to a significant association between involvement in a compensation system and negative pain-related outcomes (Hestbaek, Rasmussen, & Leboeuf-Yde, 2009; Teasell, 2001). Research suggests that the relationship between claimants, insurer representatives, and other parties like "company doctors", can become adversarial and possibly augment perceptions of injustice (Chibnall & Tait, 2009; Rudolph, Dervin, Cheadle, Maizlish, & Wickizer, 2002). Indeed, in a recent study with individuals with spinal cord injuries, perceived injustice was associated with intention to engage in litigation process (Trost et al., 2016). When an injury is caused by a motor vehicle collision, outcomes depend on insurance policy. Research demonstrated that compared to the no-fault system, in the tort system, claims for whiplash injury were 28 percent greater, and the time to claim closure was over 200 days longer (Cassidy et al., 2000).

Scores on perceived injustice in the current sample were lower than in studies with younger participants. The mean age in our studies was over 66, whereas previous studies using the IEQ reported mean ages of 35 – 49 (Scott, Trost, Bernier, et al., 2013; Scott & Sullivan, 2012; Sullivan et al., 2008). It is possible that prospecting a future with pain and restrictions might be perceived with more injustice by young individuals since in their group, the onset of pain and disability is not age normative (Montada, 1992). According to Montada, individuals are more likely to appraise their living conditions with a sense of injustice if others in their reference group have more advantages (i.e, better health, more resources) (Montada, 1994). Greater

perceived discrepancy between the sufferer and others in the reference group might bring a greater sense of injustice (Adams, 1965; Montada, 1994). A 66-year-old individual with OA may not always perceive his or her health condition as unjust, as many individuals over 65 years are likely to experience pain, or limitation of function. On the other hand, debilitating pain and mobility restrictions are not typical in individuals under 40, which may result in a greater sense of injustice in young sufferers.

Processes linking perceived injustice to adverse pain outcomes

Construct validation of a measure is strengthened significantly if it has incremental predictive value (Bandura, 2006). In our second study, we demonstrated that pre-surgical perceived injustice contributed unique significant variance to the prediction of post-surgical pain severity above and beyond demographic variables, pre-surgical pain severity, and other pain-related psychological variables. The results suggest that perceived injustice presents a psychological risk factor that complicates the trajectory of recovery after TKA. Pathways by which perceived injustice augments pain, however, remain largely unknown. Greater understanding of processes by which perceived injustice impacts on post-surgical recovery outcomes might contribute to the development of a theoretical model of perceived injustice in chronic pain. It may also facilitate the implementation of interventions aimed at mitigating the effects of perceived injustice on recovery outcomes. While process research has only begun to gain momentum, several empirical investigations suggest that affective, cognitive, and behavioural variables might mediate that the relation between perceived injustice and adverse outcomes.

Social psychology literature contends that anger is the predominant emotional response to perceived injustice (Mikula, 2003; Miller, 2001). Experimental research exists to show that

injustice appraisals are likely to trigger anger responses (Darley & Pittman, 2003; Trost et al., 2014). Anger, in turn, has been shown to exacerbate pain by interfering with endogenous opioid analgesia (Bruehl, Chung, & Burns, 2006b, 2008). Anger has also been shown to augment muscle tension and systolic blood pressure, possibly increasing sensitivity to pain (Burns et al., 2008).

Research exists to suggest that anger serves as a pathway by which perceived injustice augments pain in individuals with chronic musculoskeletal pain (Scott, Trost, Bernier, et al., 2013). In one cross-sectional study of patients with chronic musculoskeletal pain, Scott and colleagues demonstrated that state anger mediated the relation between perceived injustice and pain severity (Scott, Trost, Bernier, et al., 2013). Another cross-sectional study of inpatients with spinal cord injuries demonstrated that trait anger and anger expression mediated the relation between perceived injustice and post-traumatic symptoms (Trost et al., 2017). Anger has also been shown to mediate the relation between perceived injustice and therapeutic working alliance, undermining recovery outcomes in patients with persistent musculoskeletal pain attending a rehabilitation clinic (Scott et al., 2016). In sum, cross-sectional research has evidenced the potent role of anger as a vehicle by which injustice contributes to adverse outcomes in patients with pain. Research on the effectiveness of interventions that target anger in individuals with chronic pain is lacking.

Attentional bias, rumination, and negative outcomes expectancies have also been discussed as potential cognitive pathways by which injustice appraisals may contribute to adverse pain outcomes (Sullivan et al., 2011). Studies have shown robust associations between perceived injustice and pain catastrophizing (Scott & Sullivan, 2012; Sullivan et al., 2008; Sullivan, Tanzer, et al., 2009). One pathway by which pain catastrophizing augments pain

outcomes is rumination and excessive focus on pain-related sensations (Sullivan et al., 2001). Injustice perceptions might also lead to rumination and excessive focus on suffering and losses. Recent research partially supported this hypothesis by demonstrating that attentional bias towards pain was associated with higher perceived injustice in patients with chronic low back pain (Trost, Van Ryckeghem, Scott, Guck, & Vervoort, 2016). A recent prospective study demonstrated that in individuals with whiplash injuries, negative expectancies mediated the relation between perceived injustice and return to work (Carriere et al., 2017). It is possible that negative expectancies about recovery might act as a vehicle by which perceived injustice contributes to adverse pain-related outcomes.

Another possible vehicle through which perceived injustice might exert a negative influence on pain-related outcomes is pain behaviour. (i.e., grimacing, holding, rubbing, and vocalizing). In one study, heightened pain behaviour was associated with higher scores on perceived injustice in individuals with whiplash injuries (Sullivan, Davidson, et al., 2009). The authors suggested that pain behaviour might serve as a vehicle by which the sufferer communicates the magnitude of injury-related losses or suffering to the observer. Expression of pain might also be used as a strategy to elicit validation of injury-related loss or suffering. However, research also exists to show that pain behaviour is a significant predictor of prolonged work absence following musculoskeletal injury (Prkachin, Schultz, & Hughes, 2007). Pain behaviour might contribute to prolonged disability directly by compromising task performance and, indirectly by influencing the judgment of others about sufferer's ability to perform certain tasks (i.e., physicians who may recommend extended period for sick leave) (Sullivan et al., 2014). A recent cross-sectional investigation supported this hypothesis by demonstrating that

pain behaviour mediated the relation between perceived injustice and opioid medication prescription for chronic pain patients (Carriere, Martel, Kao, Sullivan, & Darnall, 2017).

The results of Studies 1 and 2 extend the existing literature in this area of inquiry by demonstrating that perceived injustice presents as a cognitive risk factor for complicated trajectory of recovery following TKA. Moreover the findings of the present thesis indicate that perceptions of injustice can arise in individuals with OA, a condition characterized by insidious versus traumatic onset. The findings of the present thesis contribute to the existing knowledge base and may lay a foundation to guide the development of a more comprehensive theoretical model of perceived injustice in chronic pain. However, the development of such model will necessitate additional research about the phenomenology of perceived injustice in OA, the relevant justice principles, and the processes by which perceived injustice augments OA-pain and disability.

Clinical implications

Over the past decade, there has been a growing emphasis on the clinical assessment of psychological factors in patients with chronic pain. Pain catastrophizing and pain-related fear, are examples of psychological measures that are routinely included in assessment protocols of pain clinics and rehabilitation centers (Sullivan, 2013; Wideman et al., 2012). Growing research highlights the adverse impact of perceived injustice on recovery outcomes, and the need for interventions that target perceived injustice is gaining ground (Sullivan et al., 2014). However, lack of information about the determinants of perceptions of injustice will necessarily impede efforts to develop effective interventions aimed at reducing perceptions of injustice.

Study 2 provided an empirical basis to identify patients with clinically meaningful levels of perceived injustice on the IEQ-chr who are at risk for adverse post-surgical outcomes.

Screening for psychological risk factors, however, is most useful if interventions are implemented to target those risk factors (Sullivan, 2013). The results of our final study demonstrated that post-surgical reductions in depressive symptoms and reductions in disability were associated with reductions in perceptions of injustice. Our findings suggest that in individuals who score high on a measure of perceived injustice, reducing depressive symptomatology and disability could be important elements of interventions designed to target perceived injustice.

Total knee arthroplasty has been shown to be very effective for relieving pain, stiffness, and mobility restrictions in individuals with end-stage OA of the knee (Rasanen et al., 2007). However, TKA may only be available after a significant period of time marked by pain, and physical disability. Current management for OA symptoms largely focus on pain relief. The results of Study 3 indicate that interventions designed to reduce disability may have a greater impact on reducing perceptions of injustice than interventions designed to reduce pain severity. Rehabilitation-centered approaches including strength training, Tai Chi, as well as aquatic and aerobic exercises, have been shown to improve physical function in individuals with OA (Bhatia, Bejarano, & Novo, 2013). Restoration of function and resumption of daily life activities might reduce the extent of losses associated with disability that in turn may reduce perceived injustice.

The results of regression analyses revealed that after controlling for pre-surgical BMI, and demographic variables, reductions in depressive symptoms and disability accounted for approximately 10 % of the variance in the prediction of reductions in perceived injustice. Approximately 90 % of the variance unaccounted for by reductions in depressive symptoms and disability might be attributed to situational and contextual variables, as well as individual level factors that can contribute to perceived injustice.

Situational elements that are necessary to invoke injustice appraisals and contextual factors that may influence justice-appraisals are yet to be fully understood. Laboratory justice violations have typically been manipulated by the experimenter. In one study, manipulation consisted of exposing the participant to the experience of pain stimulus ostensibly as a result of someone's negligence (Trost et al., 2014). Other studies utilized various paradigms that assigned the participants to groups characterized by "advantageous inequity" (i.e., participant had more money than others), "disadvantageous inequity" (i.e., participant had less money than others), and "equity (i.e., all participants received equal shares of money) to study the impact of unfair outcomes on emotional responses, behavioural outcomes and neuronal activity (Singer & Steinbeis, 2009; Tanaka, Yamamoto, & Haruno, 2017). The degree to which these experimental justice violations simulate the situational factors that contribute to perceived injustice outside of laboratory is highly speculative.

Fairness of procedures and interpersonal justice, have also been discussed as important context specific contributors to perceived injustice. Procedural justice is concerned with fairness of processes that determine outcomes (Lind & Tyler, 1988). Procedures related to medical treatment decisions, wait time for surgery, the adjudication of compensation claims, and occupational re-integration might be appraised as unfair among individuals with chronic pain (McParland, Eccleston, Osborn, & Hezseltine, 2011). Violations of procedural justice might be fueled by lack of transparency in the decision making process (McParland et al., 2011). Interpersonal justice is concerned with perceived quality of one's interpersonal treatment (Lind & Tyler, 1988). Disrespect, invalidation, and punitive responses from others have been discussed as violations of interpersonal justice (Miller, 2001; Sullivan et al., 2014). Qualitative research conducted by Scott and colleagues demonstrated that social invalidation of pain, lack of social

support, and failure to receive proper assessment and treatment were among the most endorsed sources of injustice among individuals with chronic pain (Scott et al., 2016).

To date, there have been no clinical trials of interventions designed specifically to reduce perceptions of injustice. Research in the area of pain has shown that multidisciplinary approaches in rehabilitation programs are not effective in reducing significantly the levels of perceived injustice (Sullivan et al., 2008). One reason might be the lack of techniques necessary to change perceived injustice in standard protocols of multidisciplinary programs. It is possible that even though perceived injustice has been construed as an 'appraisal process', perceived injustice can also be construed as a trait-like variable. For example, repeated exposure to adverse life events might predispose an individual to develop enduring beliefs about unfairness. Research shows that individuals tend to preferentially process information consistent with their beliefs, and discount information inconsistent with their beliefs (Burns & Beck, 1978; Edwards & Smith, 1996). Just world belief, defined as a need for individuals to trust that they live in a world where people generally get what they deserve, might also be relevant to perceived injustice (Lerner, 1980). In one experimental pain induction study, individuals who scored high on a measure of just world belief, exhibited more adverse response to injustice manipulation than individuals with low scores (Trost et al., 2014). Trait-like variables might require interventions that are very different than the brief types of interventions used to address maladaptive appraisals in cognitive behavioural therapy approaches.

Injustice related issues have been addressed in clinical literature on sexual assault (McGlynn & Westmarland), and victims of criminal trauma, or physical abuse (Bicknell-Hentges & Lynch, 2009). However, most research on injustice has focused on systemic, rather than individual approaches. A large body of literature addressed policies that remediate social

injustices and inequities for disadvantaged groups. Social policies that aim to reduce social, economic, income and health inequalities through anti-poverty programs and community initiatives have been discussed and implemented by governments and other organizations with various degree of success (Myers, McCollam, & Whitehouse, 2006; Organisation for Economic Co-operation and Development [OECD], 2012). The Truth and Reconciliation Commission is an example of a multi-layered policy that aims to develop a respectful and just relationship with First Nations in Canada through restoration of lands, provision of economic self-sufficiency, and political jurisdiction (Henderson & Wakeham, 2009). While success in changing system-levels of injustice has been variable, and more work is required to remediate inequities for disadvantaged groups worldwide (Institute for Policy Studies, 2018), little is known about changing perceived injustice on an individual level. Perceived injustice might entail individually defined perceptual elements as well as a reaction to objectively defined social injustices. This combination of individual-level and system-level injustice may make perceived injustice a very challenging risk factor to modify for therapeutic benefit.

Research on the efficacy of interventions the target perceived injustice at individual level remains scarce. Cognitive reframing techniques have been discussed as a useful for reframing cognitive distortions, including perceived unfairness (Deffenbacher, 2011). At the core of these interventions is the identification of unhelpful thoughts and generation of more adaptive thoughts (Beck, Rush, Shaw, & Emery, 1978). Within this approach, perceived injustice can be conceptualized as an unhelpful thinking style associated with negative affective (i.e., anger, depression) and behavioural (i.e., withdrawal, non-adherence to treatment) outcomes. Recent research suggests that behavioural approaches couched within acceptance and commitment therapy framework might also help target perceived injustice in individuals with chronic pain

(Scott, McCracken, & Trost, 2014). These interventions focus on cessation of efforts to control or avoid pain-related thoughts, and emotions so that important life activities may be pursued with the challenges of living with chronic pain (Scott et al., 2014). On the basis of present findings, targeting depressive symptoms, and incorporating functional restoration techniques might improve treatment protocols that address perceived injustice in individuals with chronic pain.

Future directions

Research on perceived injustice and chronic pain outcomes has proceeded in the absence of an overarching conceptual framework. An important next step necessary for the development of a theoretical model must address the ontology of perceived injustice, the developmental and contextual factors that contribute to perceived injustice, and the multiple dimensions of justice related appraisals. Developing a more coherent theoretical framework of justice appraisals in the context of chronic pain and disability is crucial for guiding research, generating meaningful study hypotheses, and developing interventions that reduce perceptions of injustice.

As noted earlier, there are currently no intervention programs that have been developed specifically to modify perceptions of injustice in individuals with debilitating health and mental health conditions. Furthermore, little is currently known about the determinants of perceived injustice in individuals with OA, or determinants of changes in perceived injustice in general. These knowledge gaps will necessarily impede efforts to develop evidence-informed approaches to modifying perceptions of injustice in individuals with chronic pain. Important questions needed to be addressed in future research pertain to: 1) The conditions that initiate information processing leading to appraisal of negative events or adverse health outcome as a violation of justice principles; 2) The contribution of individual differences to the degree with which events are perceived as unjust; 3) The maintaining contextual factors that perpetuate injustice

appraisals. Answers to these questions hold promise of laying the conceptual and empirical foundation for the development of interventions aimed at targeting and modifying perceptions of injustice in individuals with chronic pain, including OA.

However, the objective in this area of inquiry is not aimed at elimination of injustice related appraisals. Negative emotional and behavioural reactions to injustice appraisals are likely instrumental under certain conditions in bringing an end to injustice eliciting situations. The adaptive function of injustice appraisals has been discussed by researchers and theorists across a wide range of disciplines (Barash & Lipton, 2011; Beugré, 2009; Darley & Pittman, 2003). Disrespect, or transgressions threatening one's social standing, or recognition of merit, tend to give rise to perceived injustice and trigger anger responses (Aquino, Tripp, & Bies, 2006; Baumeister, Bushman, & Campbell, 2000; Fessler, 2010; Miller, 2001). It appears that injustice mobilizes the individual to retaliate against the transgressor thus re-establishing one's social standing, ensuring access to resources, and reducing the probability of future transgressions (Buss & Duntley, 2006; Fessler, 2010). Given the adaptive function of perceived injustice, the key challenge in the development of clinical interventions will be to distinguish between the potential adaptive value of injustice appraisals from their detrimental influence on health and mental health outcomes.

Concluding Remarks

This thesis shows that perceived injustice is an important cognitive factor to consider in the context of OA of the knee. The studies presented in this thesis provide evidence that perceived injustice is associated with pain-related outcomes, and predicts poor post-surgical outcomes in those who score high on a measure of IEQ-chr before surgery. The findings of this thesis also show that reductions in depressive symptoms and physical disability after surgery are

associated with reductions in perceived injustice. Together, these studies extend existing literature on perceived injustice and chronic pain with traumatic onset. Specifically, the present thesis adds to the existing literature by showing that perceived injustice is associated with poor recovery outcomes in individuals with OA, a condition characterized by insidious onset of symptoms. The findings of this thesis may help guide the development of a more comprehensive theoretical model of chronic pain. Finally, the findings of this thesis provide empirical evidence that might inform the implementation of interventions to mitigate the negative impact of perceived injustice on post-surgical recovery, and improve the lives of individuals suffering from OA-related pain and disability.

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