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EXAMINING THE ROLE OF INJUSTICE PERCEPTION IN A MULTIETHNIC SAMPLE OF INDIVIDUALS WITH CHRONIC LOW BACK PAIN

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EXAMINING THE ROLE OF INJUSTICE PERCEPTION IN A MULTIETHNIC SAMPLE OF INDIVIDUALS WITH CHRONIC LOW BACK PAIN

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ABSTRACT

Chronic low back pain (CLBP) is among the most disabling, costly, and painful conditions worldwide. In the United States, there is consistent evidence that the burden of chronic pain and associated disability disproportionately affect non-Hispanic Blacks ("Blacks") compared to non-Hispanic Whites ("Whites"), with Blacks reporting greater pain frequency, severity, and disability. Moreover, emerging evidence suggests that perceptions of injustice related to personal pain or injury is a crucial risk factor for poor outcomes in chronic pain, including persistent musculoskeletal pain disorders. Although racial differences have been reported for multiple chronic pain conditions, relatively minimal attention has been given to potential racial differences in CLBP or pain-related injustice perception. The current study addressed the possible interplay between race, CLBP, and pain-related perceived injustice by examining potential differences in pain-related outcomes – specifically, pain severity, disability, and depression – as well as pain-related injustice perception among community-dwelling individuals with CLBP who identified as either Black or White. In addition, given the role of injustice-related factors in racial health disparities, the study further examined whether pain-related perceived injustice mediates any observed racial disparities in CLBP outcomes. Results indicated that Blacks reported significantly greater pain severity, depressive symptoms, and level of disability than White counterparts. When adjusting for relevant demographic, psychosocial, and pain variables, perceived injustice did not mediate the relationship between race and pain intensity. However, in a regression-based model adjusted for relevant variables, perceived injustice mediated the relationship between race and disability. Analyses further suggested potential mediation pathways for the relationship between race and depression. Findings from this study reinforce the importance of further examining injustice appraisals as a target for CLBP intervention.

Keywords: chronic pain, low back pain, CLBP, disability, racial disparities, perceived injustice

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Chronic low back pain (CLBP) is among the most painful and disabling conditions worldwide, with substantial direct and indirect economic costs (Deyo et al., 2014; Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education, 2011; Murray et al., 2013). Within the United States, low back pain is also the second leading cause of seeing a physician, accounting for 3.7 million medical visits annually (Andersson & American Academy of Orthopaedic Surgeons, 2008; Centers For Disease Control and Prevention (CDC), 2009). Over the last several decades, research has identified a number of cognitive-behavioral risk factors for negative outcomes following acute back injury and in the context of CLBP (Moore, 2010). This research has largely focused on pain catastrophizing and pain-related fear (Swinkels-Meewisse, Roelofs, Oostendorp, Verbeek, & Vlaeyen, 2006). In recent literature, perceptions of injustice related to personal pain or injury represent another crucial risk factor for poor outcomes in chronic pain, including persistent musculoskeletal pain disorders (Scott, Trost, Bernier, & Sullivan, 2013). Perceived injustice has been described as an appraisal reflecting the severity and irreparability of pain-related unfairness, blame, and loss (Sullivan et al., 2008).

While pain affects all segments of the population, there is consistent evidence that the burden of chronic pain and associated disability disproportionately affects non-Hispanic Blacks (“Blacks”) compared to non-Hispanic Whites (“Whites”), with Blacks reporting greater pain frequency, severity, and disability (Green et al., 2003; Hoy et al., 2012). However, although racial differences have been reported for multiple chronic pain conditions (Green et al., 2003), relatively minimal attention has been given to potential racial differences in CLBP. This is surprising given the noted magnitude of back-related issues, in addition to the rise of racial diversity in the United States. Similar to this dearth of research on racial disparities in CLBP outcomes, to date only one study has examined racial differences in perceived injustice related to pain (Trost et al., 2015). In a sample of individuals discharged from a Level I trauma center, Trost and colleagues found that individuals who identified as Black reported higher perceived injustice than individuals who identified as White.

Given the lack of research on the potential interplay between race, CLBP, and pain-related perceived injustice, the proposed study examined potential differences in pain-related outcomes – specifically, pain severity, disability, and depression – as well as pain-related injustice perception, among community-dwelling individuals with CLBP who identified as either Black or White. The study further examined whether pain-related perceptions of injustice mediate any observed racial disparities in CLBP outcomes. Findings from this study aim to address important gaps in current understanding of the relative impact of CLBP across racial groups, as well as the role of a previously unexamined psychological appraisal process (Monden, Trost, Scott, Bogart, & Driver, 2016). Given that current psychological interventions for chronic pain do not target perceptions of injustice, the findings may likewise inform clinical interventions tailored to the needs of specific populations.

Chronic Low Back Pain

Chronic low back pain (CLBP) is traditionally defined as pain in the lower back that has persisted for at least 3 months and has resulted in pain for a minimum of half the days in the past 6 months (Deyo et al., 2014). The “low back” typically includes the space between the lower posterior margin of the rib cage and the horizontal gluteal fold (Deyo et al., 2014). According to the National Institutes of Health (NIH), CLBP is among the most common and costly public health conditions affecting the United States today (Deyo et al., 2014). Specifically, CLBP is the most prevalent type of musculoskeletal chronic pain (Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education, 2011), accounting for the largest number of years lived with disability (Murray et al., 2013). Additionally, low back pain is the second leading cause of seeking medical care in the US, accounting for 3.7 million physician visits annually (Andersson & American Academy of Orthopaedic Surgeons, 2008; Centers For Disease Control and Prevention (CDC), 2009). Health expenditures for adults with CLBP are estimated at approximately $6,000 per person (Martin et al., 2008), and total costs associated with low back pain are estimated to exceed $100 billion per year (Katz, 2006). More recently, a 2016 study observed that individuals with CLBP are more likely to be covered by government-subsidized health insurance (e.g., Medicaid, Medicare, etc.) than individuals without CLBP, further contributing to larger societal costs associated with this condition (Shmagel, Foley, & Ibrahim, 2016).

In terms of physiological etiology, the three most common causes of CLBP include discogenic lower back pain (Schwarzer, Aprill, Derby, et al., 1995), facet joint pain (Schwarzer, Wang, Bogduk, McNaught, & Laurent, 1995), and sacroiliac (SI) joint damage (Maigne, Aivaliklis, & Pfefer, 1996; Schwarzer, Aprill, & Bogduk, 1995). Discogenic lower back pain occurs when a tear from the nucleus pulposus extends towards the outer third of the annulus fibrosus (Bogduk, 1991), causing inflammatory proteins to escape into the nerve fibers that can produce irritation and pain (Cooper, 2015). Facet joint pain occurs when the capsule of the joint is torn due to injury, which can cause the cartilage to degenerate and potentially lead to inflammation within the joint that produces pain (Cooper, 2015). Damage to the SI joint due to trauma, degeneration of joints, or altered biomechanics can likewise lead to painful inflammation (Cooper, 2015). Finally, spondylolisthesis – a condition in which one vertebra (i.e., one of the 33 bones of the spinal column) has slipped in relation to another (Cooper, 2015) – can also lead to irritation and inflammation that may produce low back pain (Grobler, Robertson, Novotny, & Pope, 1993).

However, the traditional biomedical (physiological) approach to back pain has been shown to be largely inadequate (Moore, 2010). This is because only a minority of back pain cases stem from specific physiological causes (Ehrlich, 2003). In fact, specific physical causes account for less than 20% of back pain cases, with only a 0.2% probability that a particular case has a specific determined etiology (Ehrlich, 2003). Additionally, back pain disability has continued to increase despite advances in medical technology (Fordyce & International Association for the Study of Pain, 1995), and many biomedical treatments in common use today are not supported by evidence of improved outcomes (Chou et al., American Pain Society Low Back Pain Guideline Panel, 2009; Deyo, Mirza, Turner, & Martin, 2009). The failure of a strictly biomedical model to produce adequate treatment for CLBP has contributed to the general adoption of the biopsychosocial conceptualization of CLBP, which recognizes that cognitive, behavioral, and social/environmental factors – in addition to biomedical factors – influence low back pain outcomes (Engel, 1977; Fava & Sonino, 2017; Papadimitriou, 2017). Contemporary research regarding CLBP suggest that psychological factors are at least as important as biomedical factors in predicting and influencing the course of pain (Boos et al., 2000; Carragee, Alamin, Miller, & Carragee, 2005; Chou et al., 2017).

Psychological Factors in Chronic Low Back Pain

Over the last several decades, a great deal of literature has demonstrated that psychological factors contribute to CLBP outcomes. This research has largely focused on two types of cognitive appraisal processes, pain catastrophizing and pain-related fear (Swinkels-Meewisse et al., 2006). In this context, an 'appraisal' is best described as a cognitive-evaluative process by which events are judged regarding their relevance to an individual's environmental, physical, and psychological goals (Folkman, Lazarus, Gruen, & DeLongis, 1986; Lazarus & Folkman, 1984).

Pain catastrophizing refers to an exaggerated negative orientation towards noxious stimuli comprising of rumination about pain, magnification of the threat value of pain, and helplessness to cope with the pain (Sullivan, Bishop, & Pivik, 1995). The reliability and validity of the Pain Catastrophizing Scale (PCS), a self-report instrument measuring an individual's catastrophizing level, has been supported by many independent studies across a range of patient populations (Osman et al., 2000; Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove, 2002). Catastrophizing has been shown to predict up to 31% of the variance in pain severity and is one of the strongest predictors of disability and depression associated with pain (Sullivan et al., 2001). Likewise, research implicates catastrophizing in the transition from acute to chronic pain following injury and surgery (Katz & Seltzer, 2009; Sullivan, Adams, Martel, Scott, & Wideman, 2011). In the context of CLBP, catastrophizing has been associated with pain and disability at follow-up, with significantly worse outcomes for high catastrophizers compared to low catastrophizers (for review, see Wertli, Burgstaller, et al., 2014).

Pain-related fear also plays a role in the transition from acute to chronic pain, as posited by the Fear-Avoidance Model of chronic back pain (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995). The model proposes that functioning following a pain episode is influenced by how the individual interprets the pain (Crombez, Eccleston, Van Damme, Vlaeyen, & Karoly, 2012). For example, if an individual interprets the pain stimuli as non-threatening, the individual will typically resume physical activities of daily living and keep pain expectations in line with their actual experiences (Crombez et al., 2002; Trost, France, & Thomas, 2008). However, if an individual erroneously interprets the pain stimuli as a sign of serious injury, such catastrophic misinterpretation typically contributes to excessive fear of pain and injury that can gradually extend to a fear of (re)injury and movement (i.e., kinesiophobia) (Crombez et al., 2012). Consequently, people will avoid activities that are presumed to worsen their pain condition. Because avoidance limits an individual's opportunity to test and correct their pain expectations, the individual will tend to overestimate their future pain and its possible negative outcomes (Crombez et al., 2012). As these individuals become less inclined to be physically active or pursue daily activities, they become more at risk to a variety of negative outcomes such as physical deconditioning and depression, which may further maintain and exacerbate pain and disability (Crombez et al., 2012). A large body of research supports the Fear-Avoidance model (e.g., Gheldof et al., 2010; Jensen, Karpatschof, Labriola, & Albertsen, 2010; Panhale, Gurav, & Nahar, 2016), collectively underscoring the importance of pain-related fear in the development of negative outcomes within CLBP and other conditions (Wertli, Rasmussen-Barr, et al., 2014).

Although beyond the scope of this review, additional psychological risk factors implicated in poor CLBP outcomes also include depression, anxiety, and anger (Boersma & Linton, 2006; Linton, 2000; Picavet, Vlaeyen, & Schouten, 2002; Pincus, Vogel, Burton, Santos, & Field, 2006). As with the psychological-behavioral factors discussed above, outcomes associated with these psychological variables include greater pain severity (Geisser, Roth, Theisen, Robinson, & Riley, 2000), increased disability (Nisenzon et al., 2014), and higher health care utilization (Linton, 2000; Von Korff et al., 2005).

Perceived Injustice

Theoretical Background

In addition to established risk-factors like catastrophizing and pain-related fear, recent research has highlighted perceived injustice as another potentially important cognitive appraisal that influences pain outcomes. Social psychological research has long suggested that humans have an underlying aversion towards injustice; rather, humans tend to embrace the *justice motive*, described as “the need to strive for justice and fairness in life” (McParland & Knussen, 2016). According to Lerner’s *just-world theory*, people have an inherent need to believe they live in a just world in which we get what we deserve and deserve what we get in life (Lerner, 1980); this positive illusion serves as an adaptive mechanism that helps make the world seem more orderly and stable (Furnham, 2003, p. 200). Lerner (1998) theorized that such justice beliefs are shaped during childhood under societal and parental influences, which can fluctuate in strength with cognitive maturity and possibly as a function of demographic variables and/or personality (Furnham, Swami, Voracek, & Stieger, 2009; Nudelman, 2013). Further, correlational research finds that individuals who reject the belief that the world is an unjust place and maintain their just world beliefs in the face of hardship report greater adverse physical and psychological outcomes (McParland, Hezseltine, Serpell, Eccleston, & Stenner, 2011). *Perceptions of injustice* are likely to arise when such beliefs are violated by underserved suffering and loss that may interfere with valued goals, as may be the case in chronic pain conditions (McParland, Eccleston, Osborn, & Hezseltine, 2011; Sullivan et al., 2008; Sullivan, Yakobov, Scott, & Tait, 2014).

The role of perceived injustice has long been studied in organizational justice research regarding how individuals perceive the fairness of outcomes (i.e., distributive justice) and the fairness of the procedures used to determine those outcomes (i.e., procedural justice) in the workplace (Colquitt, Conlon, Wesson, Porter, & Ng, 2001). More recently, empirical efforts have begun to address the impact of perceived injustice on physical health outcomes. Jackson, Kubzansky, and Wright (2006) proposed an early conceptualization of the relationship between injustice and physical health outcomes in the context of racial and socioeconomic disparities. The authors highlight the disproportionate rates of major diseases in the U.S. (e.g., heart disease, cancer, stroke) among Blacks relative to other racial groups. “Weathering,” or “the cumulative impact of repeated experience with social, economic, or political exclusion" (Geronimus, 2001, p. 133), has been proposed as one explanation for this disparity and has been linked to early health decline (Jackson et al., 2006). To this end, the authors introduce the Perceived Unfairness Model, which proposes that experiencing prejudice or discrimination oneself can trigger a cascade of maladaptive psychological and physiological processes. Over time, the recurrence of such processes may eventually initiate the development of disease.

The model does not address antecedents of perceived unfairness; rather, it focuses on the point at which the perception occurs. Further, Jackson et al. (2006) propose that perceiving unfairness is not inevitably harmful. Whether perceiving unfairness leads to a potential (toxic) stress response or a benign response depends upon identity relevance and perceptions of helplessness to redress the unfairness (Jackson et al., 2006). If a stress response does occur, it can contribute to maladaptive biological, behavioral, and social mechanisms that increase physical wear and tear, leading to poorer health outcomes over time (Jackson et al., 2006). A number of studies have supported this link between injustice perceptions and outcomes related to physical and psychological functioning (e.g., Bosma, Gerritsma, Klabbers, & van den Akker, 2012; Chandola, Ferrie, Sacker, & Marmot, 2007; De Vogli, Ferrie, Chandola, Kivimäki, & Marmot, 2007; Kivimäki et al., 2005). For example, one study showed that Black and Latino participants who reported greater sensitivity to race-based rejection also reported more stress-related symptoms such as sleep issues and low energy (Page-Gould, Mendoza-Denton, & Mendes, 2014).

Perceived Injustice in Response to Pain

Although the Perceived Unfairness Model provides an initial conceptualization of the mechanisms by which perceptions of unfairness may affect physical health, the model does not address injustice appraisals with respect to a given physical health condition. Emerging research has begun to examine the impact of individuals' injustice appraisals regarding their own physical health, with a particular focus on musculoskeletal injury and associated pain-related outcomes. This line of research suggests that individuals who have sustained injury-related pain may perceive a sense of injustice related to potential losses (e.g., independence, established identity, employment, financial stability) resulting from their health status (Sullivan, Sullivan, & Adams, 2002). In response to such significant loss, one may understandably feel a sense of unfairness, especially if the health condition or injury resulted from another person's actions or negligence (Sullivan et al., 2008). Accordingly, contemporary research has conceptualized perceived injustice in the context of health as a cognitive appraisal reflecting a sense of unfairness, attributions of blame, and the severity and irreparability of loss consequent to injury or pain (Rodero et al., 2012; Sullivan et al., 2008).

Research on the role of perceived injustice in health outcomes among individuals with chronic pain has been facilitated by the development of the *Injustice Experiences Questionnaire* (IEQ) (Scott, Trost, Milioto, & Sullivan, 2013; Sullivan et al., 2008). The IEQ contains 12 items reflecting a variety of justice-related appraisals relevant to the experience of injury and pain (Sullivan, Yakobov, Scott, & Tait, 2014). Individuals are asked to report the frequency with which they experience each thought (e.g., "Nothing will ever make up for all that I have gone through") on a five-point scale ranging from (0) *never* to (4) *all the time* (Sullivan et al., 2014). The measure was originally normed on a sample of 226 work-disabled individuals receiving rehabilitation for various musculoskeletal conditions caused by motor vehicle or occupational accidents (Sullivan et al., 2008). Research shows that the IEQ has high test-retest reliability (r = .90) and high internal consistency (Cronbach's α = .92). Furthermore, the IEQ has demonstrated construct validity through high correlations with constructs previously linked to pain and injury including depression, disability, pain intensity, and catastrophizing (Sullivan et al., 2008).

A growing number of studies utilizing the IEQ have demonstrated that higher perceived injustice contributes to worse psychological and functional outcomes in the context of chronic pain, including across various musculoskeletal conditions (see Appendix A for summary of pain-related perceived injustice studies). In addition, a number of prospective studies suggest that individuals with higher levels of perceived injustice show less improvement across a number of domains (e.g., psychological distress, disability, pain severity) following treatment (e.g., multi-disciplinary rehabilitation) compared to individuals with lower levels perceived injustice.

The relationship between pain-related perceived injustice and worse pain outcomes have been observed in the following samples: *whiplash injury* (Ferrari & Russell, 2014; Scott, Trost, Milioto, et al., 2013; Scott, Trost, Milioto, & Sullivan, 2015; Sullivan, Thibault, et al., 2009; Sullivan, Davidson, Garfinkel, Siriapaipant, & Scott, 2009; Yakobov, Scott, Thibault, & Sullivan, 2016), *fibromyalgia* (Ferrari & Russell, 2014; Rodero et al., 2012), *rheumatoid arthritis* (Ferrari & Russell, 2014), *patients undergoing total knee replacement surgery* (Yakobov et al., 2014), *orthopedic trauma* *patients* (van Leeuwen et al., 2016), and *women with genito-pelvic pain* (i.e., PVD) (Pâquet et al., 2016). Similar findings have been observed in *mixed samples* (i.e., comprising of various types of pain conditions) *of chronic musculoskeletal pain* (Scott, Trost, Bernier, et al., 2013; Sullivan, Scott, & Trost, 2012), *pediatric chronic pain patients* (Miller, Scott, Trost, & Hirsh, 2016), and *mixed samples of trauma patients* (Trost et al., 2015).

Among individuals with whiplash injury, perceived injustice was positively associated with post-traumatic stress (Sullivan, Thibault, et al., 2009) and significantly predicted self-reported disability (Sullivan, Davidson, et al., 2009), return to work (Scott, Trost, Milioto, et al., 2013), and change in depression (Scott et al., 2015) when controlling for relevant pain outcomes. Among mixed samples of trauma patients, perceived injustice was positively associated with pain-related fear, pain catastrophizing, pain severity, depression, and post-traumatic stress (Agtarap, Scott, Warren, & Trost, 2016), was negatively associated with resilience and quality of life (Agtarap et al., 2016), significantly predicted pain severity, depression, emotional quality of life, and post-traumatic stress (Trost et al., 2015), and mediated the relationship between injury compensation and return to work (Giummarra et al., 2017). Among mixed samples of individuals with chronic pain, perceived injustice was associated with greater pain catastrophizing (Sullivan et al., 2011), more severe pain (Yakobov et al., 2014), poorer psychological functioning (Scott & Sullivan, 2012; Scott, Trost, Bernier, et al., 2013; Sullivan, Thibault, et al., 2009), greater disability (Sullivan, Davidson, et al., 2009), failure to return to work (Scott, Trost, Milioto, et al., 2013), and increased likelihood of engaging in litigation (Scott, Trost, Milioto, et al., 2013; Trost, Monden, Buelow, Boals,

& Scott, 2016). Among individuals with fibromyalgia, perceived injustice significantly predicted fibromyalgia-related health status, health-related depression, and health-related anxiety when controlling for pain intensity (Rodero et al., 2012). And, among individuals with chronic musculoskeletal pain, perceived injustice was positively associated with pain severity, depression, disability, and attentional bias to painful stimuli (Sullivan, Adams, Yakobov, Ellis, & Thibault, 2016; Trost, Ryckeghem, Scott, Guck, & Vervoort, 2016), was negatively associated with working alliance with health care providers (Scott, Milioto, Trost, & Sullivan, 2016), accounted for significant variance in depression and disability (Scott, Trost, Bernier, et al., 2013), and moderated the relationship between pain severity and depression (Sullivan et al., 2012).

In sum, a growing number of studies demonstrate that perceived injustice contributes to worse outcomes across a variety of chronic pain conditions and patient populations. However, existing studies are characterized by a number of limitations. First, review of the literature suggests that almost all studies to date have been conducted with relatively homogeneous and often Caucasian samples. In fact, only one study to date has examined potential racial differences in perceived injustice (Trost et al., 2015). Trost and colleagues found that individuals who identified as Black reported greater perceptions of injustice than individuals who identified as White. Given that race represents a major source of inequity in health outcomes and access to care (see below), this issue suggests that it is important to address the potential role of race in the relationship between perceived injustice and pain-related outcomes.

Racial Disparities in Pain Experience

Research consistently supports racial disparities in health outcomes across a variety of health conditions. Definitions for health disparities vary (Carter-Pokras & Baquet, 2002), however, all essentially address differences in one specific population compared to a more advantaged group (American Psychological Association, n.d.). The NIH, for example, broadly defines health disparities as “differences in the incidence, prevalence, mortality, and burden of diseases and other adverse health conditions that exist among specific populations” (Committee on the Review and Assessment of the NIH’s Strategic Research Plan and Budget to Reduce and Ultimately Eliminate Health Disparities, 2006). By comparison, the World Health Organization (WHO) defines health disparities in the context of social justice and equity as “health inequalities that are considered unnecessary, avoidable, and unfair/unjust” (Commission on Social Determinants of Health, 2008).

A growing literature documents evidence for racial and ethnic disparities in how individuals experience pain across the lifespan (e.g., experimental pain, acute postoperative pain, cancer pain, chronic non-malignant pain) (Anderson, Green, & Payne, 2009; Green et al., 2003). For example, a 2007 study examining a nationally representative sample of American adults over the age of 51 found that non-Hispanic Blacks and Hispanics were at higher risk for severe pain compared to non-Hispanic Whites (Reyes-Gibby, Aday, Todd, Cleeland, & Anderson, 2007). Among those with pain in the sample, Blacks and Hispanics reported more severe pain compared to non-Hispanic Whites. Factors such as psychological distress, Medicaid insurance, and lower education level helped to explain the racial and ethnic differences in pain severity and were significant predictors for severe pain. In another study, African American adults reported greater pain-related interference with daily living, lower levels of perceived control over pain, and greater difficulties in coping with pain compared to White adults among a national community sample of adults with chronic pain (Ruehlman, Karoly, & Newton, 2005).

Other studies evaluating individuals with chronic pain have further revealed increased pain severity for Blacks compared to Whites across the lifespan, regardless of gender (Green, Baker, Sato, Washington, & Smith, 2003; McCracken, Matthews, Tang, & Cuba, 2001). Among Blacks and Whites with chronic pain, Blacks report significantly more disability, more suffering, and less perceived control over pain than Whites across the lifespan, regardless of gender (Green et al., 2003; Green, Baker, Sato, et al., 2003; Green, Baker, Smith, & Sato, 2003). However, despite the accumulated evidence of racial and ethnic disparities in multiple chronic pain conditions (Green et al., 2003), there is a significant gap in the literature examining potential racial and ethnic disparities in the context of CLBP.

The Current Study: Perceived Injustice in a Multiethnic CLBP Sample

Despite accumulating evidence that perceptions of injustice contribute to maladaptive outcomes across a variety of pain conditions (e.g., whiplash injury, rheumatoid arthritis, fibromyalgia, orthopedic trauma), there is a notable lack of research examining the potential association between racial disparities, CLBP, and perceived injustice. Therefore, the current study examined potential differences in pain-related outcomes (i.e., pain severity, disability, depression) in addition to pain-related perceived injustice among community-dwelling individuals with CLBP who identified as either Black or White. Moreover, the Perceived Unfairness Model by Jackson et al. (2006) posits that racial minorities are more likely to be exposed to elements of discrimination, which can lead to negative health outcomes over time through the process of weathering. To this end, the study also examined whether perceived injustice mediates any observed racial disparities in CLBP outcomes. This study is the first to examine the role of perceived injustice in a multiethnic sample of individuals with CLBP.

For *Hypothesis 1*, we predicted that individuals who identified as Black would report greater pain severity, greater disability, and greater severity of depressive symptoms compared to individuals who identified as White. Similarly, for *Hypothesis 2,* we predicted that individuals who identified as Black would report greater pain-related perceived injustice compared to individuals who identified as White. Finally, for *Hypothesis 3,* we predicted that the observed impact of race/ethnicity on pain severity, disability, and depression would be mediated by perceived injustice.

METHODS

Participants

Participants were recruited from the greater Denton, Texas, and Dallas, Texas, communities through advertisements in newspapers, local community settings, and online classifieds. Individuals were screened over phone to determine study eligibility. Participants were included in the study if they endorsed the presence of low back pain that persisted for at least 6 months (i.e., chronic low back pain), reported that pain significantly interfered with daily activities, and were between 18 and 70 years of age. Individuals were excluded from the study if they reported comorbid health conditions that affected mobility and/or if they were currently pregnant.

Procedure

The present study was approved by the University of North Texas (UNT) Institutional Review Board and carried out in accordance with guidelines for the ethical conduct of research. As part of a larger study, participants completed an assessment battery that included demographic variables, CLBP history, and self-report questionnaires assessing disability, injustice perception, pain severity, and depressive symptoms. Participants were compensated $60.00 for completion of the full study protocol, which also included appraisals of physical activities completed at home and in the lab and a dot-probe task measuring attention to pain stimuli.

Measures

Demographics and Injury-Related Variables

Demographic and injury-related variables relevant to the current study were collected through basic interviews and self-report questionnaires. This information included the following: (1) Participant age, (2) Participant race/ethnicity, (3) Participant gender, (4) Level of income, (5) Level of education, (6) Participant marital status, and (7) Duration of pain.

Income was measured at the ordinal level, with the following levels: (1) “Less than $10,000,” (2) “$10,000 to $19,000,” (3) “20,000 to 29,999,” (4) “30,000 to 39,000,” (5) “40,000 to $49,000,” (6) “50,000 to 59,999,” (7) “60,000 to 69,999,” (8) “70,000 to $79,999,” (9) “80,000 to 89,999,” (10) “$90,000 to $99,999,” (11) “100,000 to $149,999,” and (12) “150,000 or more.” Likewise, education was measured at the ordinal level, with the following levels: (0) “N/A,” (1) “No Schooling Completed,” (2) “Nursery School to 8th Grade,” (3) “9th, 10th, or 11th grade,” (4) “12th grade, no diploma,” (5) “High School Graduate – High School Diploma or Equivalent (e.g., GED),” (6) “Some College Credit, but Less Than One Year,” (7) “One or More Years of College, No Degree,” (8) “Associate’s Degree,” (9) “Bachelor’s Degree,” (10) “Master’s Degree,” (11) “Professional Degree (e.g., MD),” and (12) “Doctorate Degree (e.g., PhD).”

Perceived Injustice

The Injustice Experiences Questionnaire (IEQ) was used to assess pain-related perceived injustice. Individuals rated the frequency with which they experienced each of 12 pain-related thoughts on a five-point scale ranging from (0) *never* to (4) *all the time*

(Sullivan et al., 2014). Previous research suggests that the IEQ yields 2 correlated factors – severity/irreparability of loss (e.g., “Most people don’t understand how severe my condition is.”) and blame/unfairness (e.g., “It all seems so unfair.”) (Trost, Ryckeghem, et al., 2016). Research shows that the IEQ has high test-retest reliability (r = .90) and high internal consistency (Chronbach’s α = .92) (Sullivan et al., 2008, 2016). The IEQ also demonstrates good construct validity through high correlations with constructs previously linked to pain and injury including depression, disability, pain intensity, and pain catastrophizing (Sullivan et al., 2008). For the current study, Cronbach’s alpha for the IEQ was .93, indicating high internal consistency.

Pain Severity

The McGill Pain Questionnaire – Short Form Pain Rating Index (SF-MPQ-PRI) (Melzack, 1987) was used to assess current level of pain severity. The SF-MPQ-PRI is a widely used measure of pain in both research and clinical settings (Strand, Ljunggren, Bogen, Ask, & Johnsen, 2008). The Pain Rating Index (PRI) consists of 15 descriptors of pain that individuals endorse on a four-point intensity scale ranging from (0) *none* to (3) *severe.* The PRI yields a weighed sum of all pain descriptors endorsed and reflects the individual’s sensory and affective dimensions of pain. The SF-MPQ-PRI demonstrates high validity, reliability, and sensitivity to change across a variety of pain and illness conditions (Burckhardt & Jones, 2003). For the current study, Cronbach’s alpha for the SF-MPQ-PRI was .91, indicating high internal consistency.

Disability

The Pain Disability Index (PDI) (Pollard, 1984) was used to assess the degree to which chronic pain interferes with seven areas of daily living (i.e., home, self-care, social, occupational, recreational, sexual, life support). Each question consists of perceived disability ratings on an 11-point scale ranging from (0) *no disability* to (10) *total disability*. The PDI has been shown to be internally reliable and valid for use with medical and chronic pain populations (Sullivan et al., 2008; Tait, Chibnall, & Krause, 1990). For the current study, Cronbach's alpha for the PDI was .95, indicating high internal consistency.

While the PDI was used to measure general perceived disability, the Roland Morris Disability Questionnaire (RMDQ) (Roland & Morris, 1983) was used to assess specific functional limitations due to low back pain. The questionnaire consists of 24 statements relating to an individual's perceptions of their back pain and associated disability, including items on pain frequency, psychosocial status, physical ability/activity, sleep/rest, household management, and eating (Stevens, Lin, & Maher, 2016). Total score can range from 0 (no disability) to 24 (maximal disability). The RMDQ demonstrates high validity, reliability, and internal consistency for individuals with low back pain (Stevens et al., 2016). For the current study, Cronbach's alpha for the RMDQ was .93, indicating high internal consistency.

Depression

The Patient Health Questionnaire – 9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001) was used to assess current level of depressive symptoms. The PHQ-9 scores each of the 9 DSM-IV depression diagnostic criteria on a 4-point rating scale ranging from (0) *not at all* to (3) *nearly every day*. The PHQ-9 score can range from 0 to 27, with higher scores indicating greater severity of depressive symptoms (i.e., mild, moderate, moderately severe, and severe depression). Research supports the PHQ-9 as a reliable and valid measure of depression (Kroenke et al., 2001). For the current study, Cronbach's alpha for the PHQ-9 was .89, indicating good internal consistency.

Statistical Analysis

The recommended sample size for the current study was determined to provide sufficient power for the detection of statistical significance. Recommended sample size was determined using G*Power, version 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009). Conservative parameter specifications were used, including a power of 0.80, an alpha level of 0.05, and a medium effect size of d = 0.50. According to these parameters set as two-tailed, a total sample size of 128 individuals was required for these analyses, with each group (i.e., Blacks and Whites) containing 64 participants.

All data was analyzed using SPSS (Statistical Package for the Social Sciences) at a statistical significance level of $p < 0.05$. Data was inspected for normality and outliers. In accordance with Tabachnick and Fidell (2013), 5 to 10% of cases with missing data is considered acceptable for maintaining external validity; missingness of all study variables were within range of this guideline. Among participants included in data analysis, all provided complete demographic data (e.g., age, race, gender). Spearman rank-order correlation coefficients were examined to determine the relationship between study variables.

To test *Hypothesis 1*, an independent samples t-test was used to compare mean levels of pain severity, self-report disability, and depressive symptoms between Black and White individuals with CLBP. Similarly, for *Hypothesis 2*, an independent samples t-test was used to compare mean levels of perceived injustice between Black and White individuals with CLBP.

For *Hypothesis 3*, mediation analyses of perceived injustice based on 10,000 bootstrapped samples using bias-corrected and accelerated 95% confidence intervals were tested using PROCESS version 2.13. developed by Andrew F. Hayes (2018). PROCESS is a computational tool used for path analysis-based mediation and moderation analyses, in addition to their integration in the form of a conditional process model. PROCESS estimates unstandardized model coefficients, standard errors, *t* and *p*-values, and confidence intervals using maximum likelihood logistic regression (for dichotomous outcomes) or OLS regression (for continuous outcomes). For simple mediation analysis, PROCESS estimates the total and direct effect of the independent variable (e.g., race) on the dependent variable (e.g., pain severity), as well as the indirect effect of the independent variable on the dependent variable through a mediator variable (e.g., perceived injustice). Further, PROCESS generates a bias-corrected 95% bootstrap confidence interval for the indirect effect using 10,000 bootstrap samples. Finally, PROCESS produces point estimates and bias-corrected 95% bootstrap confidence interval estimates of various indices of effect size for the indirect effect.

RESULTS

Participant Characteristics

Participant demographic characteristics are summarized in Table 1. Of the 94 participants who completed self-report measures, 52 were male and 42 were female; 45.7% identified as Black (n = 43), and 54.3% identified as White (n = 51). Participants ranged from 19 to 70 years of age (*M* = 42.10, *SD* = 12.2). Average pain duration among the sample was 8.52 (*SD* = 7.6) years. Median income was $10,000 to $19,000; 78.7% of the sample reported earning less than $40,000 per year.

Female participants reported greater pain-related perceived injustice (*M* = 6.90, *SE* = 2.58, *t* (90) = 2.68, *p* = .01) and depressive symptoms (*M* = 2.96, *SE* = 1.39, *t* (92) = 2.13, *p* = .04) than male counterparts. No other significant gender differences were observed.

Bivariate Correlations

Table 2 shows bivariate correlations among self-report, psychosocial, and demographic study variables. Age was significantly positively associated with pain-related variables (pain duration, self-reported pain intensity), perceived injustice, and both general and functional disability (PDI and RMDQ, respectively). Of the sociodemographic variables, income was significantly negatively associated with perceived injustice, pain intensity, general and functional disability, and depression. Level of education was significantly positively associated with participant self-reported income. In addition, education was significantly negatively associated with perceived injustice, pain intensity, perceived disability (PDI and RMDQ), and depression.

Perceived injustice displayed moderate to strong positive correlations with all self-report study variables including disability measures (r_s = .75 and r_s = .72 for PDI and RMDQ, respectively), pain intensity (r_s = .68), and depression (r_s = .66). Pain intensity, general and functional disability, and depression were significantly positively associated with each other.

Racial Differences in Perceived Injustice and Self-Reported Pain Outcomes

A series of independent samples t-tests was conducted to examine potential racial differences in pain-related perceived injustice and self-reported pain outcomes. No significant racial differences were observed in terms of participant age or pain duration.

A Mann-Whitney U test was run to determine if there were differences in participant income and education level, ordinal variables in this dataset, between Black and White individuals. Distributions of income for Blacks and Whites were similar, as assessed by visual inspection. Distributions of education level for Blacks and Whites were also similar, by visual inspection. Income was significantly higher in Whites (*Mdn* = 4.00) than in Blacks (*Mdn* = 2.00), U = 1470.00, z = 2.92, p = 0.004. As well, level of education was significantly higher in Whites (*Mdn* = 7.00) than in Blacks (*Mdn* = 6.00), U = 1317.00, z = 2.31, p = 0.021.

Notable racial differences were observed across self-reported pain outcomes and are summarized in Table 3. In particular, relative to White participants, individuals who identified as Black reported greater pain intensity (M_{diff} = 6.58, SE_{diff} = 2.13, t (91) = 3.08,

p = .003), general disability (M_{diff} = 13.98, SE_{diff} = 3.68, t (89) = 3.80, p < .001), functional disability (M_{diff} = 5.85, SE_{diff} = 1.26, t (92) = 4.65, p < .001), depressive symptoms (M_{diff} = 3.28, SE_{diff} = 1.38, t (92) = 2.38, p < .05), and perceptions of injustice related to pain (M_{diff} = 11.81, SE_{diff} = 2.36, t (90) = 5.01, p < .001).

Mediation Analyses between Race, Perceived Injustice, and CLBP Outcomes

To determine whether perceived injustice mediated racial differences in CLBP outcomes, a series of simple mediation analyses was conducted using ordinary least squares path analysis. Mediation was tested for the following CLBP outcomes.

Depression

Participant demographic, psychosocial, and pain variables that showed bivariate association with depression (i.e., gender, education, income, pain severity, general/functional disability) were included in the model as covariates. Separate analyses were conducted with the inclusion of general disability (PDI) or functional disability (RMDQ) as the additional covariate. Results of these analyses with relevant standardized regression coefficients are reported in Figure 1 for the inclusion of general disability in the model and in Figure 2 for functional disability as the alternative covariate, with additional corresponding results in Table 4 and Table 5.

When including general disability in the model, the standardized regression coefficient between race and depression, without perceived injustice entered as a potential mediator, was not statistically significant (c = 0.40, p = 0.54). However, the standardized regression coefficient between race and perceived injustice was statistically significant (*a* = -2.25, *p* = 0.02), as well as the standardized regression coefficient between perceived injustice and depression (*b* = 0.18, *p* = 0.03). A bias-corrected bootstrap confidence interval for the indirect effect (*ab* = -0.40) based on 10,000 bootstrap samples ranged from -1.14 to -0.02. Thus, the indirect effect was statistically significant. There was no evidence that racial differences influenced depressive symptoms independent of its effect on perceived injustice (*c'* = 0.80, *p* = 0.23). When controlling for functional disability, analyses reported similar results.

Pain Severity

Participant demographic, psychosocial, and pain variables that showed bivariate association with pain severity (i.e., age, education, income, depressive symptoms, general/functional disability) were included in the model as covariates. Separate analyses were conducted with the inclusion of general disability (PDI) or functional disability (RMDQ) as the additional covariate. Results of these analyses with relevant standardized regression coefficients are reported in Figure 3 for the inclusion of general disability in the model and in Figure 4 for functional disability as the alternative covariate, with additional corresponding results in Table 6 and Table 7.

When including general disability in the model, the standardized regression coefficient between race and pain severity, without perceived injustice entered as a potential mediator, was not statistically significant (*c* = 0.22, *p* = 0.81). The standardized regression coefficient between race and perceived injustice was statistically significant (*a* = -2.46, *p* = 0.01); however, the standardized regression coefficient between perceived injustice and pain severity was not significant (*b* = 0.16, *p* = 0.13). A bias-corrected bootstrap confidence interval for the indirect effect (*ab* = -0.39) based on 10,000 bootstrap samples ranged from -1.24 to 0.09. Thus, the indirect effect was non-significant. There was no evidence that racial differences influenced pain severity independent of its effect on perceived injustice (*c'* = 0.60, *p* = 0.51). When controlling for functional disability, analyses reported similar results.

General Disability (PDI)

Results of the following analyses with relevant standardized regression coefficients are reported in Figure 5, with additional results in Table 8. When adjusting for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity, depressive symptoms), the standardized regression coefficient between race and general disability, without perceived injustice entered as a potential mediator, was statistically significant (*c* = -3.56, *p* = 0.01). The standardized regression coefficient between race and perceived injustice was statistically significant (*a* = -3.61, *p* < 0.001), as well as the standardized regression coefficient between perceived injustice and general disability (*b* = 0.61, *p* < 0.001). A bias-corrected bootstrap confidence interval for the indirect effect (*ab* = -2.20) based on 10,000 bootstrap samples ranged from -4.18 to -0.91. Thus, the indirect effect was statistically significant. There was no evidence that racial differences influenced general disability independent of its effect on perceived injustice (*c'* = -1.37, *p* = 0.32).

Functional Disability (RMDQ)

Results of the following analyses with relevant standardized regression coefficients are reported in Figure 6, with additional results in Table 9. When adjusting for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity, depressive symptoms), the standardized regression coefficient between race and functional disability, without perceived injustice entered as a potential mediator, was statistically significant ($c = -1.52$, $p = 0.003$). The standardized regression coefficient between race and perceived injustice was statistically significant ($a = -3.42$, $p < 0.001$), as well as the standardized regression coefficient between perceived injustice and functional disability ($b = 0.16$, $p = 0.004$). A bias-corrected bootstrap confidence interval for the indirect effect ($ab = -0.55$) based on 10,000 bootstrap samples ranged from -1.11 to -0.16. Thus, the indirect effect was statistically significant. There was no evidence that racial differences influenced functional disability independent of its effect on perceived injustice ($c' = -0.99$, $p = 0.06$).

DISCUSSION

The goal of the present study was to assess potential racial differences in pain-related perceptions of injustice and pain-related outcomes (i.e., pain severity, disability, depression) among individuals with CLBP who identified as either Black or White. In light of observed racial disparities in CLBP outcomes, the present study further examined whether pain-related injustice perception mediated the relationship between race and CLBP outcomes. The current study was motivated in part by a relative lack of literature examining racial differences in the context of CLBP and the aforementioned impact of race/culture on pain outcomes. Further, given the suggested relevance of discrimination to negative health outcomes among racial minorities (Jackson et al., 2006), it was hypothesized that pain-related perceived injustice may help explain observed racial differences in CLBP.

The first aim of the present study was to examine potential racial differences in self-reported pain outcomes. Consistent with predictions, Blacks reported greater pain severity, general disability, functional disability, and depressive symptoms than their White counterparts. The second aim was to examine possible racial differences in pain-related perceived injustice. Likewise, in line with predictions, Blacks reported greater perceptions of injustice compared to White individuals. Finally, the third aim examined whether pain-related injustice perception mediated observed racial differences in CLBP outcomes. While mediation was not observed for pain severity as an outcome, mediation was indicated for both general and functional disability. Mediation analyses further suggested potential mediation pathways for the relationship between race and depression.

In relation to the first aim, current results are consistent with prior research documenting higher reports of pain severity (e.g., Green et al., 2003; Green & Hart-Johnson, 2012; McCracken et al., 2001), disability (e.g., Meghani & Houldin, 2007; Parmelee, Harralson, McPherron, DeCoster, & Schumacher, 2012), and depression (e.g., Baker, Buchanan, & Corson, 2008; Ndao-Brumblay & Green, 2005; Portenoy, Ugarte, Fuller, & Haas, 2004) among Black individuals with chronic pain conditions in comparison to White counterparts. Previous studies have also reported similar results for nonchronic and malignant pain samples (Anderson et al., 2009; Green et al., 2003). In this sense, the findings from this study are in line with evidence suggesting that race is a major indicator of increased inequity in health outcomes across a variety of health conditions (Anderson et al., 2009; Green et al., 2003), possibly due to reasons such as discrimination or lack of equitable access to resources or opportunities.

In the context of racial differences across health conditions, the current work represents one of the few studies to date that have examined Black and White differences in low back pain (LBP). As a notable exception, Chibnall and Tait have previously reported that Blacks with occupational LBP generally experience worse outcomes across a variety of domains relevant to back injury, including pain intensity, disability, psychological distress (e.g., depression and anxiety), and financial struggle when compared to Whites (Chibnall & Tait, 2005, 2009; Chibnall, Tait, Andresen, & Hadler, 2005; Tait & Chibnall, 2016a). However, while this line of research by Chibnall and Tait focused exclusively on workers' compensation (WC) claimants with work-related LBP, the present study assessed community-dwelling individuals with CLBP outside the context of the litigation process. Although our findings are in line with studies conducted by Chibnall and Tait, the WC population is different from a community-based sample due to unique factors that may influence pain-related outcomes; such factors include monetary incentive in the litigation process.

Finally, with respect to observed racial differences in various types of pain (e.g., experimental pain versus clinical pain – such as CLBP), it may also be valuable to examine whether pain type influences the magnitude of these differences. As previously discussed, CLBP represents one of the most pervasive and costly pain conditions in the United States and around the world (Deyo et al., 2014; Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education, 2011). However, while several studies have examined racial differences in the context of experimental pain, relatively little is known about racial differences in the context of CLBP, which is a very practical type of pain.

For the second aim, we found that Blacks reported greater injustice perception when compared to their White counterparts. As highlighted earlier, recent literature has identified pain-related perceived injustice as a significant risk factor for poor outcomes in chronic pain, including persistent musculoskeletal pain conditions (Scott, McEvoy, et al., 2016; Scott, Milioto, et al., 2016; Scott & Sullivan, 2012; Scott, Trost, Bernier, et al., 2013; Sullivan et al., 2008, 2012; Sullivan, Davidson, et al., 2009). However, existing studies in this line of research consist of relatively homogenous samples, with little data reported on racial minorities. Moreover, this literature has primarily focused on populations outside the United States – including Canada (e.g., Ferrari & Russell, 2014;

Scott & Sullivan, 2012; Scott, Trost, Bernier, et al., 2013; Scott, Trost, Milioto, et al., 2013; Sullivan et al., 2008; Sullivan, Davidson, et al., 2009; Sullivan, Thibault, et al., 2009), Spain (Rodero et al., 2012), Australia (Giummarra et al., 2017; Kennedy & Dunstan, 2014), the Netherlands (Mohammadi, de Boer, Sanderman, & Hagedoorn, 2017), Japan (Yamada et al., 2016), and Ireland (Margiotta, Hannigan, Imran, & Harmon, 2017). These studies were all conducted within distinctly different health care systems and potentially dissimilar cultural attitudes towards race that may differentially impact the salience of race for health outcomes or injustice perception.

While Chibnall and Tait have suggested that perceived injustice may impact LBP outcomes in their aforesaid studies, they also acknowledge that their studies do not explicitly measure perceived injustice in order to empirically test this hypothesis (Tait & Chibnall, 2016b, 2016a). As such, the present study represents the first effort to examine racial differences in injustice perception among individuals with a chronic musculoskeletal pain condition. Results from the present study also support previous findings by Trost and colleagues (2015) in which Blacks reported greater perceptions of injustice compared to their White counterparts within a sample of individuals with acute traumatic injury. Although findings by Trost et al. are in line with our study, the acute traumatic injury population assessed by Trost et al. is different from a chronic musculoskeletal pain population due to unique factors that may influence pain-related outcomes such as duration of symptoms, severity of injury, as well as sudden (i.e., traumatic) versus gradual development of the condition.

As a construct, perceived injustice is an appraisal concerning one’s own health condition as it relates to pain or injury. In regards to the current findings, there are a number of possibilities why Black individuals may appraise their CLBP condition as more unfair. For one, exposure to injustice from outside the health domain may affect perceptions of injustice within the health domain. Blacks, in particular, have been historically vulnerable to social injustices such as racial discrimination. In a recent survey conducted by the Pew Research Center (2016), a majority of Blacks (71%) reported that they had previously experienced unfair treatment due to racial discrimination. In the same study, Blacks were also more likely than Whites to report unfair treatment when interacting with police and in workplace practices such as job promotions, wages, the hiring process. Despite the impact of the Civil Rights Movement and related social reform in the United States, racism remains a major concern for many Americans (Neal, 2017).

Secondly, previous findings suggest the existence of racial injustice within the domain of pain management and health care. Systematic literature reviews suggest that Blacks are at greater risk for under-treatment of pain compared to Whites (Cintron & Morrison, 2006; Ezenwa, Ameringer, Ward, & Serlin, 2006; Meghani, Byun, & Gallagher, 2012). For example, the under-prescription of pain medication for Black patients has been well-documented within the empirical literature (Anderson et al., 2009; Cleeland, Gonin, Baez, Loehrer, & Pandya, 1997), which may partially be attributed to providers underestimating pain in Black patients compared to other patients (Staton et al., 2007). In one review, researchers found that Blacks relative to Whites were 34 percent less likely to be prescribed opioids for back pain, abdominal pain, and migraines, and 14 percent less likely to be prescribed opioids for pain related to surgery or traumatic injury (Meghani et al., 2012). Similarly, another study found that Black children with appendicitis were less likely to receive any analgesia in an emergency department compared to their White counterparts (Goyal, Kuppermann, Cleary, Teach, & Chamberlain, 2015). Data also suggests that less resources are allocated to Blacks seeking pain-related treatment. In one study, Tait and colleagues (2004) found that workers' compensation programs spent less to treat Blacks with low back injuries compared to Whites, with shorter treatment periods for Blacks regardless of income level. Altogether, racial disparities in both health care and disability compensation may contribute to feelings of invalidation among Black individuals seeking pain care. Themes of invalidation and disbelief are also reflected in certain items on the IEQ, such as "I worry that my condition is not being taken seriously" and "Most people don't understand how severe my condition is" (Sullivan et al., 2008).

Another possibility explaining why Blacks might appraise their CLBP condition as more unfair is the socioeconomic (SES) differences between Black and White individuals. In particular, Blacks are the poorest racial group in the United States, with the lowest U.S. median household income for the past 50 years (Noonan, Velasco-Mondragon, & Wagner, 2016; Renwick, 2015). As of June 2018, unemployment rates were nearly twice as high for Blacks (6.5%) compared to Whites (3.5%) (U.S. Bureau of Labor Statistics, 2018). Moreover, an educational gap exists between Blacks and Whites. In the United States, fewer Blacks earn a high school degree or a bachelor's degree compared to their White counterparts (Institute of Education & National Center for Education Statistics, 2015). In general, poverty is highly associated with poor health outcomes, as well as increased morbidity and mortality (Noonan et al., 2016). For example, in a recent longitudinal study, Grol-Prokopczyk (2017) found that people with lower levels of education and wealth are more likely to develop chronic pain, experience greater pain severity, and experience greater pain-related disability compared to individuals with higher levels of education and wealth. Other conditions prevalent among poor individuals also include heart disease, obesity, diabetes, elevated blood lead levels, and low birth weight (Noonan et al., 2016). Demographic analyses from the current study reflect this trend; as noted above, level of income and education were both significantly higher among Whites than Blacks in our study sample.

Recent research has suggested a mechanism by which health-related injustice perception may be reinforced in vulnerable subpopulations. In particular, Blacks may have greater *justice sensitivity* (JS) relative to Whites due to frequent activation of injustice-related concepts stemming from experiences with race-related injustice. Recent literature has identified JS as a trait reflecting an individual’s concern for injustice (Yoder & Decety, 2014). JS has been shown to be an important predictor of emotional reactions towards injustice and justice-related behavior (Baumert & Schmitt, 2016). To date, little is known about the processes contributing to development of JS (Baumert & Schmitt, 2016). However, Baumert and Schmitt (2011) hypothesize that frequent confrontation with instances of injustice may increase activation potential of injustice-related concepts, which may contribute to greater JS over time. This view is consistent with social psychology research finding that prior experiences can influence what information individuals attend to and process (Greenberg & Cropanzano, 2001). However, JS has yet to be examined in a health-related context, such as appraising one’s health condition.

In partial support of the JS construct, research suggests that exposure to injustice may promote health-related hypervigilance, thus further reinforcing health-related injustice appraisal. Hypervigilance has been described as an enhanced state of sensory sensitivity accompanied by exaggerated behaviors (e.g., scan and search) meant to detect threats (Crombez, Van Damme, & Eccleston, 2005; Rollman, 2009). Studies examining reactions to racial discrimination have found that racial minority adults who reported direct experiences with racism also endorsed higher levels of hypervigilance compared to individuals who did not (Carter & Forsyth, 2010). Other experimental pain studies have also found that Blacks reported higher attention to painful stimuli compared to Whites (Campbell, Edwards, & Fillingim, 2005; Herbert et al., 2014). Goodin and colleagues (2013) suggest that frequent experiences of discrimination may explain the heightened hypervigilance and perceptual amplification among Blacks in response to experimental pain stimulation.

Considering the strong possibility that race and pain-related perceived injustice are related, it is surprising that almost no research to date has examined racial differences in pain-related injustice appraisal. To this end, future studies may wish to address the potential role played by other factors, such as age as it relates to the historical experience of discrimination and identification with ethnicity, in the relationship between race and pain-related injustice perception. Further, future research may wish to address the potential role played by past experience of social injustice and discrimination on pain-related injustice perception. Moreover, it may be worthwhile to examine how individuals' experiences with pain care relate to pain-related injustice appraisals.

In regards to the third aim, pain-related injustice perception mediated observed racial differences for both general (PDI) and functional (RMDQ) disability outcomes. In general, both forms of disability reflect an individual's appraisal of the magnitude of disruption caused by their pain condition. As such, this can be viewed as an extension of the injustice appraisal process as captured by the IEQ, such as reflecting the severity and irreparability of loss in various aspects of life consequent to one's pain or injury (e.g., "My life will never be the same," "I am troubled by fears that I may never achieve my dreams"). Moreover, Blacks with CLBP face greater challenges in pain recovery/rehabilitation than their White counterparts, such as lower income, greater unemployment rates at baseline, and greater risk to be under-treated for pain by doctors. These challenges may also serve as explanations for why Black individuals may appraise their CLBP condition as more unfair. Given these barriers that may discourage Blacks with CLBP from engaging in new actions to improve function (Meints, Miller, & Hirsh, 2016), future studies may wish to examine the role of other possibly related factors, such as pain behavior and helplessness, in the relationship between race and disability.

While mediation was indicated for disability as an outcome, mediation was not observed for pain severity. Although pain is influenced by race as discussed above, the relationship between race and pain severity may not be explained by loss- or emotion-oriented appraisals targeted by the IEQ. However, future studies may wish to examine whether pain-related injustice perception moderates the relationship between race and pain, such that greater injustice perception may strengthen the relationship between these factors. Future research may also wish to explore other potential mediators that might better explain the relationship between race and pain severity. For example, Drwecki (2018) suggested that racial social exclusion may help explain racial differences observed in pain severity. Drwecki argues that social rejection and exclusion "literally hurt," as evidenced by a number of brain imaging studies that found that many of the same neurobiological structures activated during the experience of social exclusion (e.g., anterior cingulate cortex, prefrontal cortex) are also activated during the experience of physical pain (e.g., Bantick et al., 2002; Brooks, Nurmikko, Bimson, Singh, & Roberts, 2002; Eisenberger, Lieberman, & Williams, 2003; Kross, Berman, Mischel, Smith, & Wager, 2011; Rainville, Duncan, Price, Carrier, & Bushnell, 1997). Drwecki (2018) also suggested that cultural differences in pain coping strategies might help explain the relationship between race and pain. For instance, Blacks are more likely than Whites to engage in catastrophizing (Forsythe, Thorn, Day, & Shelby, 2011; Meints & Hirsh, 2015; Meints, Stout, Abplanalp, & Hirsh, 2017) and utilize prayer (Cano, Mayo, & Ventimiglia, 2006; Edwards, Moric, Husfeldt, Buvanendran, & Ivankovich, 2005; Meints & Hirsh, 2015; Meints et al., 2017) in response to experimental pain and clinical pain. Indeed, some experimental pain studies have found that racial differences in coping strategies partially mediate racial differences in experimental pain sensitivity (Forsythe et al., 2011; Meints & Hirsh, 2015; Meints et al., 2017).

For the remaining significant associations observed, analyses suggested that perceived injustice has a role in the relationship between race and depression. In this case, the IEQ may reflect elements of loss (e.g., “I just want my life back”) that are also captured by the PHQ-9. In contrast to the findings described above, mediation results for depression as the outcome were not as clearly (non)significant. Specifically, racial status did not predict depressive symptoms when controlling for relevant demographic, psychosocial, and pain variables. However, the presence of significant a and b paths, as well as a significant indirect effect of race on depression served to suggest mediation effects.

There are a number of possibilities why the relationship between race, perceived injustice, and depression is less clear. For one, although the IEQ captures the emotional experience of how pain or injury affects one’s life, it may not as closely reflect elements of depression in the PHQ-9 which is based upon criteria for DSM-IV depressive disorders (Kroenke et al., 2001). Arguably, DSM-IV depressive symptoms as expressed by the PHQ-9 are more behavior-focused (e.g., “sleeping too much,” “overeating”) and internally-oriented (e.g., “You are a failure…”) compared to the IEQ which is more emotion-focused and externally-oriented (e.g., “I am suffering because of someone else’s negligence”). Rather, the IEQ may more closely reflect elements of anger. Researchers suggest that anger, rather than depression or post-traumatic stress, is the negative emotion that demonstrates the most robust theoretical and empirical relationship with perceived injustice (Sturgeon et al., 2016; Trost, Vangronsveld, Linton, Quartana, & Sullivan, 2012). For example, Scott and colleagues (2013) found that perceived injustice influenced both depression and pain severity through increased feelings of anger. The complexity of these findings illustrates how these constructs – particularly pain-related injustice perception – may be captured imperfectly with current standardized instruments. For instance, while the PHQ-9 screener for depressive severity has been validated across a wide range of populations and medical conditions (Kroenke, Spitzer, Williams, & Löwe, 2010), the IEQ for perceived injustice in the context of health/pain is still a fairly new instrument, developed in the last decade, that might need further refinement through more validation studies.

Limitations

The current study includes some limitations. First, the study sample did not include individuals who identified as other racial groups, such as Hispanic/Latino and Asian or Pacific Islander (API). Hispanic Americans (HA) represent 16% of the American population and are one of the fastest growing U.S. demographic groups (Ennis, Rios-Vargas, & Albert, 2011). Despite this, relatively little is known about pain experience and disability for HA individuals (Hollingshead, Ashburn-Nardo, Stewart, & Hirsh, 2016). Similarly, Asian Americans also represent one of the fastest growing ethnic groups in the United States (Hoeffel, Rastogi, Kim, & Shahid, 2012); however, little is also known about Asian Americans' pain experiences (Ahn, Weaver, Lyon, Choi, & Fillingim, 2017). To this end, future research may wish to examine and compare pain-related injustice experience of other underrepresented racial groups. Secondly, mediation effects were conducted using cross-sectional data rather than longitudinal data, which precludes causal inferences and limits the ability to infer directionality between variables. As a result, mediation analyses from this study must be interpreted with caution. It should also be noted that power analyses indicate that the current study is underpowered, which may explain some of the non-significant relationships. Conservative parameter specifications (i.e., power of 0.80, alpha level of 0.05, medium effect size of d = 0.50) set at two-tailed recommend a total sample size of 128 individuals; however, only 94 individuals were included in the current study.

Future Directions

In spite of these limitations, the current study yields promising results that warrant follow-up for a number of issues described above. For one, future studies may wish to address the gap in literature on racial differences in pain-related perceived injustice, such as examining the potential role played by other factors (e.g., age, identification with ethnicity, pain treatment experience from providers) on the relationship between race and pain-related injustice perception. Relatedly, given that Black individuals indicated higher pain-related injustice perception than Whites in our study, it may be prudent to examine the potential role played by individuals' past experience of social injustice and discrimination on pain-related injustice perception.

Mediation analyses also revealed a number of different issues for potential follow-up. For one, given that perceived injustice mediated observed racial differences for disability in our study, it may be worthwhile to also examine the role of other factors possibly related to injustice perception (e.g., pain behavior, helplessness) in the relationship between race and disability. Secondly, while perceived injustice did not mediate the relationship between race and pain severity in our study, future research may wish to examine the possible moderating role of perceived injustice on race and pain. Recent research suggests that injustice-relevant constructs, such as racial discrimination and workplace bullying, are associated with bodily pain (Burgess et al., 2009; Saastamoinen, Laaksonen, Leino-Arjas, & Lahelma, 2009). On a related note, it may also be worthwhile to explore other potential mediators that may better explain the relationship between race and pain, such as social exclusion and pain coping strategies.

Conclusion

This study lends support to evidence of pain disproportionately affecting Blacks compared to Whites, with Blacks generally reporting worse outcomes (e.g., greater pain frequency, severity, and disability) compared to White counterparts across multiple pain conditions. Our study adds to the existing literature by highlighting racial differences in CLBP, which is a significant and prevalent pain condition that has been little studied in the context of pain disparities. Similar to previous studies examining racial differences among other pain conditions, our findings suggest that Blacks with CLBP experience greater pain severity, greater disability, and greater depressive symptoms compared to White counterparts.

In addition, our study contributes to a growing literature examining pain-related perceived injustice as a risk factor for poor outcomes in chronic pain. In particular, our study is the first to provide evidence of racial disparities in pain-related perceived injustice between Black and White individuals in the context of a chronic pain condition (i.e., CLBP). Critically, our study found that perceived injustice appears to help explain the relationship between race and pain outcomes. In our study, analyses revealed that perceived injustice mediated the relationship between race and disability, but not pain severity. Further, significant associations suggest that perceived injustice may play a role in the relationship between race and depressive symptoms. These findings elucidate the potential mechanisms by which racial differences influence pain outcomes.

Based on these findings, it would be prudent to recognize and empirically validate objective social inequities for individuals of color, particularly as it relates to barriers to effective chronic pain management. Further, our findings reinforce the importance of further examining injustice appraisals as a target for intervention. For instance, it may be salient to target perceived injustice as intervention for Black patients struggling with functional limitations related to pain. Intervention for perceived injustice may take the form of cognitive behavioral therapy (CBT) techniques, such as helping patients recognize cognitive distortions (e.g., magnification) from negative, automatic thoughts related to the perceived irreparability of their pain condition. If perceptions of injustice are left unaddressed in the context of pain, the current research suggests that affected individuals may continue to be at risk for poor psychosocial and physical outcomes, particularly those from disadvantaged/minority backgrounds.

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Table 1. Sample Characteristics: Demographic Variables

		N (%) or *Mean* (*SD*)
Gender	Female	42 (44.7%)
	Male	52 (55.3%)
Age (yrs.)		42.1 (12.2)
Pain Duration (yrs.)		8.52 (7.6)
Race	Black or African American	43 (45.7%)
	White	51 (54.3%)
Marital Status	Married	22 (23.4%)
	Separated	9 (9.6%)
	Widowed	2 (2.1%)
	Divorced	10 (10.6%)
	Single	51 (54.3%)
Education Level	Less than HS	16 (17%)
	HS Diploma	16 (17%)
	Some College (non-degree)	36 (38.3%)
	Associate's	7 (7.4%)
	Bachelor's	10 (10.6%)
	Graduate/Professional	6 (6.4%)
Income	< 10K	32 (34%)
	10-19K	22 (23.4%)
	20-29K	5 (5.3%)
	30-39K	15 (16%)
	40-49K	8 (8.5%)
	50+K	12 (12.8%)
Employment Status	Employed for Wages	27 (28.7%)
	Self-Employed	10 (10.6%)
	Out of Work & Looking for Work	15 (16%)
	Out of Work, but Not Currently Looking for Work	2 (2.1%)
	Homemaker	5 (5.3%)
	Student	5 (5.3%)
	Retired	4 (4.3%)
	Unable to Work	25 (26.6%)

Table 2. Associations between Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. Age	-								
2. Education	-.12	-							
3. Income	-.14	.54**	-						
4. Pain Duration (months)	.33**	.02	-.08	-					
5. Perceived Injustice (IEQ)	.28**	-.28**	-.25*	.16	-				
6. Pain Intensity (MPQ-SF-PRI)	.34**	-.37**	-.27**	.14	.68**	-			
7. Disability-General (PDI)	.39**	-.31**	-.29**	.03	.75**	.70**	-		
8. Disability-Functional (RMDQ)	.30**	-.31**	-.34**	.05	.72**	.70**	.79**	-	
9. Depression (PHQ-9)	.08	-.27*	-.27**	.09	.66**	.62**	.60**	.69**	-

Note: Spearman correlation matrix. *p < .05, **p < .01; IEQ = Injustice Experiences Questionnaire; MPQ-SF-PRI = The McGill Pain Questionnaire-Short Form-Pain Rating Index; PDI = Pain Disability Index; RMDQ = Roland Morris Disability Questionnaire; PHQ-9 = Patient Health Questionnaire-9

Table 3. Descriptive Statistics for Pain, Disability, and Psychosocial Outcomes

Mean (SD)	Total Sample (N = 94)	Black Participants (n = 43)	White Participants (n = 51)
Pain Intensity (MPQ-SF-PRI)	21.72 (10.73)	25.25 (11.00)[b]	18.68 (9.59)
Disability - General (PDI)	36.89 (18.69)	44.73 (17.24)[a]	30.75 (17.59)
Disability - Functional (RMDQ)	13.97 (6.71)	17.14 (6.10)[a]	11.29 (6.04)
Depression (PHQ-9)	11.15 (6.84)	12.93 (6.76)[b]	9.65 (6.59)
Perceived Injustice (IEQ)	11.15 (6.84)	32.67 (10.88)[a]	20.86 (11.58)

Note: [a] Score is significantly greater than White participants at $p < .001$; [b] Score is significantly greater than White participants at $p < .05$; MPQ-SF-PRI = The McGill Pain Questionnaire – Short Form Pain Rating Index; PDI = Pain Disability Index; RMDQ = Roland Morris Disability Questionnaire; PHQ-9 = Patient Health Questionnaire-9; IEQ = Injustice Experiences Questionnaire

Table 4. Model Coefficients for the Relationship between Race and Depressive Symptoms through Perceived Injustice Controlling for General Disability

		M (PERCEIVED INJUSTICE)				*Y* (DEPRESSION)				*Y* (DEPRESSION)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-2.25	0.91	0.02	*c'*	0.80	0.66	0.23	*c*	0.40	0.65	0.54
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.18	0.08	0.03		—	—	—
Constant	i_1	13.99	6.28	0.03	i_2	-3.22	4.50	0.48	i_3	-0.76	4.47	0.87
		$R^2 = 0.68$				$R^2 = 0.47$				$R^2 = 0.43$		
		$F(6,80) = 27.97$ $p < 0.001$				$F(7, 79) = 9.86$ $p < 0.001$				$F(6, 80) = 10.12$ $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., gender, education, income, pain severity, and general disability).

Table 5. Model Coefficients for the Relationship between Race and Depressive Symptoms through Perceived Injustice Controlling for Functional Disability

		M (PERCEIVED INJUSTICE)				*Y* (DEPRESSION)				*Y* (DEPRESSION)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-1.99	0.97	0.04	*c'*	0.93	0.62	0.14	*c*	0.70	0.61	0.26
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.12	0.07	0.09		—	—	—
Constant	i_1	12.70	6.81	0.07	i_2	-5.58	4.34	0.20	i_3	-4.10	4.30	0.34
		$R^2 = 0.63$ $F(6,82) = 23.62$, $p < 0.001$				$R^2 = 0.52$ $F(7, 81) = 12.65$, $p < 0.001$				$R^2 = 0.51$ $F(6, 82) = 13.97$, $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., gender, education, income, pain severity, and functional disability).

Table 6. Model Coefficients for the Relationship between Race and Pain Severity through Perceived Injustice Controlling for General Disability

		M (PERCEIVED INJUSTICE)				*Y* (PAIN SEVERITY)				*Y* (PAIN SEVERITY)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-2.46	0.95	0.01	*c'*	0.60	0.90	0.51	*c*	0.22	0.88	0.81
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.16	0.10	0.13		—	—	—
Constant	i_1	16.91	6.63	0.01	i_2	1.35	6.32	0.83	i_3	4.02	6.12	0.51
		$R^2 = 0.67$ $F(6,78) = 25.84$ $p < 0.001$				$R^2 = 0.58$ $F(7, 77) = 15.30$ $p < 0.001$				$R^2 = 0.57$ $F(6, 78) = 17.17$ $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, depression, and general disability).

Table 7. Model Coefficients for the Relationship between Race and Pain Severity through Perceived Injustice Controlling for Functional Disability

		M (PERCEIVED INJUSTICE)				*Y* (PAIN SEVERITY)				*Y* (PAIN SEVERITY)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-2.45	1.02	0.02	*c'*	0.52	0.93	0.58	*c*	0.08	0.91	0.93
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.18	0.10	0.07		—	—	—
Constant	i_1	15.25	7.30	0.04	i_2	0.20	6.58	0.98	i_3	2.93	6.50	0.65
		$R^2 = 0.78$				$R^2 = 0.58$				$R^2 = 0.56$		
		$F(6,80) = 20.83$, $p < 0.001$				$F(7, 79) = 15.51$, $p < 0.001$				$F(6, 80) = 17.06$, $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, depression and functional disability).

Table 8. Model Coefficients for the Relationship between Race and General Disability through Perceived Injustice

		M (PERCEIVED INJUSTICE)				*Y* (GENERAL DISABILITY)				*Y* (GENERAL DISABILITY)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-3.61	0.99	< .001	*c'*	-1.37	1.37	0.32	*c*	-3.56	1.40	0.01
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.61	0.14	< .001		—	—	—
Constant	i_1	22.16	7.11	0.002	i_2	5.71	9.57	0.55	i_3	19.26	9.97	0.05
		$R^2 = 0.60$ $F(6,78) = 19.40$, $p < 0.001$				$R^2 = 0.70$ $F(7, 77) = 25.73$, $p < 0.001$				$R^2 = 0.63$ $F(6, 78) = 22.15$, $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity and depression).

Table 9. Model Coefficients for the Relationship between Race and Functional Disability through Perceived Injustice

		M (PERCEIVED INJUSTICE)				*Y* (FUNCTIONAL DISABILITY)				*Y* (FUNCTIONAL DISABILITY)		
		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*		Coeff.	*SE*	*p*
X (RACE)	*a*	-3.42	0.99	< .001	*c'*	-0.99	0.51	0.06	*c*	-1.52	0.50	0.003
M (PERCEIVED INJUSTICE)		—	—	—	*b*	0.16	0.05	0.004		—	—	—
Constant	i_1	21.46	7.13	0.003	i_2	7.63	3.59	0.04	i_3	10.97	3.55	0.002
		$R^2 = 0.59$ $F(6,80) = 18.79$, $p < 0.001$				$R^2 = 0.67$ $F(7, 79) = 23.34$, $p < 0.001$				$R^2 = 0.64$ $F(6, 80) = 23.59$, $p < 0.001$		

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity and depression)

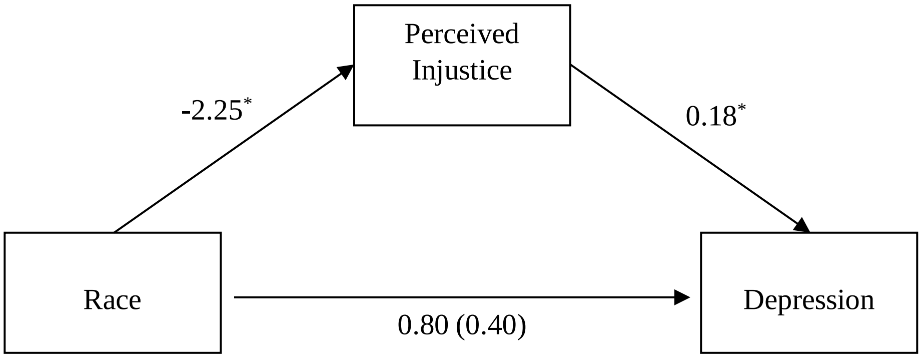

Figure 1. Standardized Regression Coefficients for the Relationship between Race and Depressive Symptoms (PHQ-9) through Perceived Injustice (IEQ) Controlling for General Disability

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Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., gender, education, income, pain severity, and general disability). The standardized regression coefficient between race and depression, without perceived injustice entered as a potential mediator, is in parentheses.
$* p < .05$ $** p < .01$, $*** p < .001$

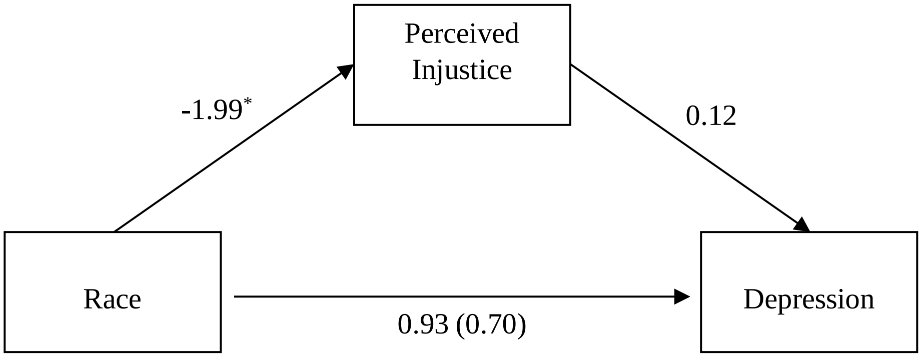

Figure 2. Standardized Regression Coefficients for the Relationship between Race and Depressive Symptoms (PHQ-9) through Perceived Injustice (IEQ) Controlling for Functional Disability

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., gender, education, income, pain severity, and functional disability). The standardized regression coefficient between race and depression, without perceived injustice entered as a potential mediator, is in parentheses.
* $p < .05$ ** $p < .01$, *** $p < .001$

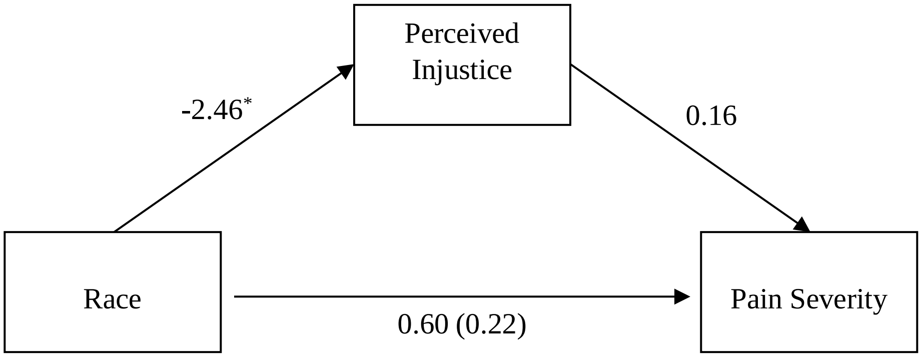

Figure 3. Standardized Regression Coefficients for the Relationship between Race and Pain Severity (SF-MPQ-PRI) through Perceived Injustice (IEQ) Controlling for General Disability

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Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, depression, and general disability). The standardized regression coefficient between race and pain severity, without perceived injustice entered as a potential mediator, is in parentheses.
* $p < .05$ ** $p < .01$, *** $p < .001$

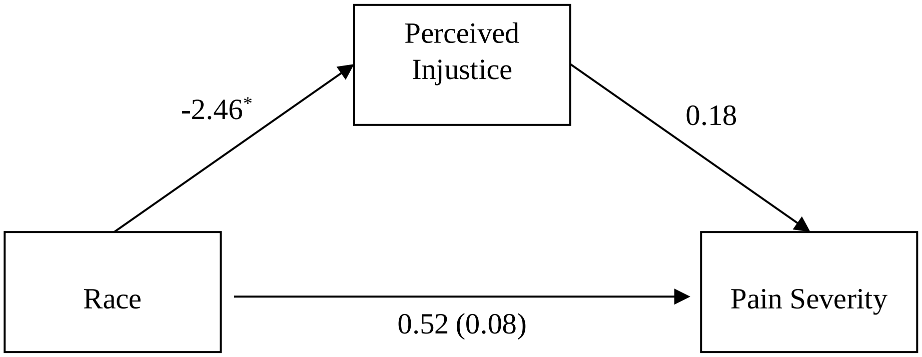


Figure 4. Standardized Regression Coefficients for the Relationship between Race and Pain Severity (SF-MPQ-PRI) through Perceived Injustice (IEQ) Controlling for Functional Disability

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, depression, and functional disability). The standardized regression coefficient between race and pain severity, without perceived injustice entered as a potential mediator, is in parentheses.
* $p < .05$ ** $p < .01$, *** $p < .001$

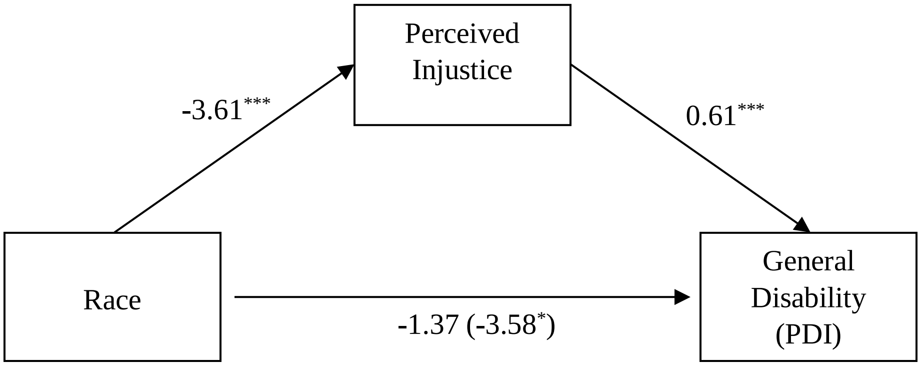


Figure 5. Standardized Regression Coefficients for the Relationship between Race and General Disability (PDI) as Mediated by Perceived Injustice (IEQ)

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity, and depression). The standardized regression coefficient between race and general disability, without perceived injustice entered as a mediator, is in parentheses.
* $p < .05$ ** $p < .01$, *** $p < .001$

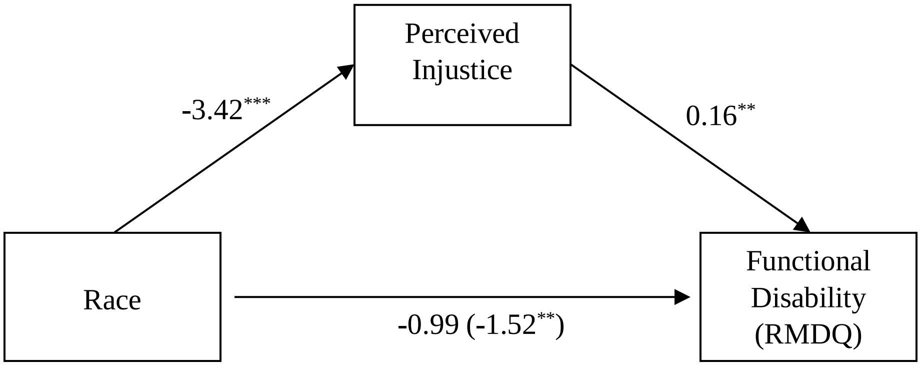


Figure 6. Standardized Regression Coefficients for the Relationship between Race and Functional Disability (RMDQ) as Mediated by Perceived Injustice (IEQ)

Note: Model adjusted for relevant demographic, psychosocial, and pain variables (i.e., age, education, income, pain severity, and depression). The standardized regression coefficient between race and functional disability, without perceived injustice entered as a mediator, is in parentheses.

* $p < .05$ ** $p < .01$, *** $p < .001$

APPENDIX A

SUMMARY OF PAIN-RELATED PERCEIVED INJUSTICE STUDIES

Appendix A: Summary of Pain-Related Perceived Injustice Studies

Author/Date	*Study Description/Sample Type*		*Main Findings*
Sullivan et al. (2008)	**Study 1**: 226 individuals in rehabilitation clinic with various musculoskeletal conditions; 85 individuals interviewed at one-year follow-up **Study 2**: 70 individuals in rehabilitation clinic with various pain conditions resulting from work accident or motor vehicle injury	**Racial Demographic:** Not Reported **Study 1**: Prospective **Study 2**: Prospective	**Study 1**: Higher levels of perceived injustice as measured by the Injustice Experience Questionnaire (IEQ) were associated with greater pain severity, pain catastrophizing, pain-related fear, depression, and self-reported disability. In addition, regression analysis revealed that perceived injustice and pain catastrophizing significantly predicts pain severity above and beyond age and sex, and perceived injustice and pain catastrophizing significantly predicts depression above and beyond age, sex, and pain severity. However, while pain catastrophizing and pain-related fear significantly predicts disability above and beyond age, sex, and pain severity, perceived injustice does not. **Study 2**: Individuals reported greater perceived injustice under conditions where fault of injury could be clearly ascribed to another person (i.e., motor vehicle accident group reported greater IEQ scores than work accident group).
Sullivan et al. (2009)	112 individuals being treated for whiplash injuries in rehabilitation clinic	**Racial Demographic:** Not Reported **Study Type:**	Greater levels of pain-related perceived injustice were significantly associated with more

		Prospective	symptoms of post-traumatic stress.
Sullivan, Davidson, Garfinkel, Siriapaipant, & Scott (2009)	85 individuals with whiplash injuries from rear-collision motor vehicle accidents	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Individuals with high pain-related perceived injustice displayed more protective pain behaviors than individuals with low perceived injustice. Perceived injustice significantly predicts self-reported disability, controlling for protective pain behaviors.
Rodero et al. (2012)	250 individuals with fibromyalgia	**Racial Demographic:** 100% of sample identified as White European **Study Type:** Cross-Sectional	Perceived injustice accounted for significant variance in fibromyalgia-related health status, health-related anxiety, and health-related depression after controlling for pain intensity.
Scott & Sullivan (2012)	107 individuals with chronic musculoskeletal pain	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Pain-related perceived injustice moderates the relationship between pain severity and depression. Pain severity was significantly associated with depression at high, but not low, levels of perceived injustice.
Scott, Trost, Bernier, & Sullivan, (2013)	173 individuals with chronic musculoskeletal pain	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	The relationship between perceived injustice and pain intensity was completely mediated by state anger and anger inhibition. In addition, the relationship between perceived injustice and depression was partially mediated by state anger, trait anger, and anger inhibition. Perceived injustice accounts for significant variance in

			depression and disability, controlling for pain intensity.
Scott, Trost, Milioto, & Sullivan (2013)	103 individuals with whiplash injuries from rear-collision motor vehicle accidents	**Racial Demographic:** Not Reported **Study Type:** Prospective	Perceived injustice measured at post-treatment significantly predicts return to work, controlling for post-treatment pain severity.
Ferrari & Russell (2014)	62 individuals with fibromyalgia and 64 individuals with rheumatoid arthritis	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Individuals with fibromyalgia report greater pain-related perceptions of injustice compared to individuals with rheumatoid arthritis. However, this group difference was no longer significant after controlling for pain severity, age, gender, anxiety, and depression.
Yakobov et al., (2014)	116 individuals with knee osteoarthritis recovering from total knee arthroplasty (TKA)	**Racial Demographic:** Not Reported **Study Type:** Prospective	High levels of perceived injustice measured prior to surgery significantly predicts long-term persistence of pain after TKA.
Scott, Trost, Milioto, & Sullivan (2015)	53 individuals with whiplash injuries from rear-collision motor vehicle accidents	**Racial Demographic:** Not Reported **Study Type:** Prospective	Pre-treatment perceived injustice significantly predicts percent change in symptoms of depression, when controlling for duration of work absence.
Trost et al. (2015)	155 individuals with mixed trauma, admitted to a Level 1 trauma center	**Racial Demographic:** White (n = 87) Black (n = 35) Hispanic (n = 22) Other (n = 4) Not Reported (n = 7) **Study Type:**	Black individuals reported greater perceptions of injustice than White individuals. In addition, individuals with lower socioeconomic status reported greater perceived injustice after trauma. Perceived injustice

		Prospective	significantly predicts pain severity, depression, mental quality of life, and post-traumatic symptoms controlling for age at injury, education level, and income.
van Leeuwen et al. (2016)	124 individuals admitted to an orthopedic hand surgery and trauma outpatient clinic	**Racial Demographic:** White (n = 106) “Other” (n = 18) **Study Type:** Cross-Sectional	Higher perceived injustice was associated with lower physical functioning and higher pain severity; however, this relationship did not remain significant when controlling for depression, pain self-efficacy, and catastrophizing.
Yamada et al. (2016)	71 individuals with injury-related pain conditions in Japan	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Higher perceived injustice was associated with higher pain severity and higher pain catastrophizing. Liability for injury on another and pain duration over a year significantly predict perceptions of injustice.
Miller, Scott, Trost, & Hirsh (2016)	139 pediatric chronic pain patients admitted to a pain clinic	**Racial Demographic:** White (n = 128) Black (n = 7) Hispanic (n = 1) Refused to Report (n = 3) **Study Type:** Cross-Sectional	In a pediatric sample, higher levels of perceived injustice were associated with poorer emotional, social, and school functioning, in addition to greater pain intensity, catastrophizing and functional disability. Pain-related perceived injustice significantly predicts pain intensity emotional functioning, social functioning, school functioning, and disability, controlling for age and gender.

Trost, Monden, Buelow, Boals, & Scott (2016)	45 individuals with recent spinal cord injury (SCI) who were admitted to an inpatient rehabilitation clinic	**Racial Demographic:** White (n = 28) Black (n = 7) Hispanic (n = 4) Asian (n = 3) American Indian/Alaska Native (n = 1) Native Hawaiian/Pacific Islander (n = 1) Biracial (n = 1) **Study Type:** Cross-Sectional	Higher levels of perceived injustice were associated with higher likelihood of future litigation, greater attribution of responsibility for injury to other person(s), and less forgiveness. Logistic regression revealed that perceived injustice uniquely differentiated between individuals who foresaw involvement in litigation from those who did not.
Sullivan, Adams, Yakobov, Ellis, & Thibault (2016)	88 work-disabled individuals with chronic musculoskeletal pain, and 87 work-disabled individuals with major depression	**Racial Demographic:** Not Reported **Study Type:** Prospective	In both samples, higher levels of perceived injustice as measured by the Injustice Experiences Questionnaire – Short Form (IEQ-SF) was associated with greater pain severity, depressive symptoms, and disability. Individuals with major depression reported greater levels of perceived injustice compared to individuals with chronic musculoskeletal pain.
Sturgeon et al. (2016)	302 patients in a tertiary care pain clinic	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Social isolation mediated the relationship between perceptions of injustice and anger, while social satisfaction and pain-related interference did not.
Scott et al. (2016)	86 individuals with chronic musculoskeletal pain	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Individuals frequently identified employers/colleagues, insurers, other vehicle drivers, health care providers, family, friends, significant others, and society as sources of injustice. Common reasons

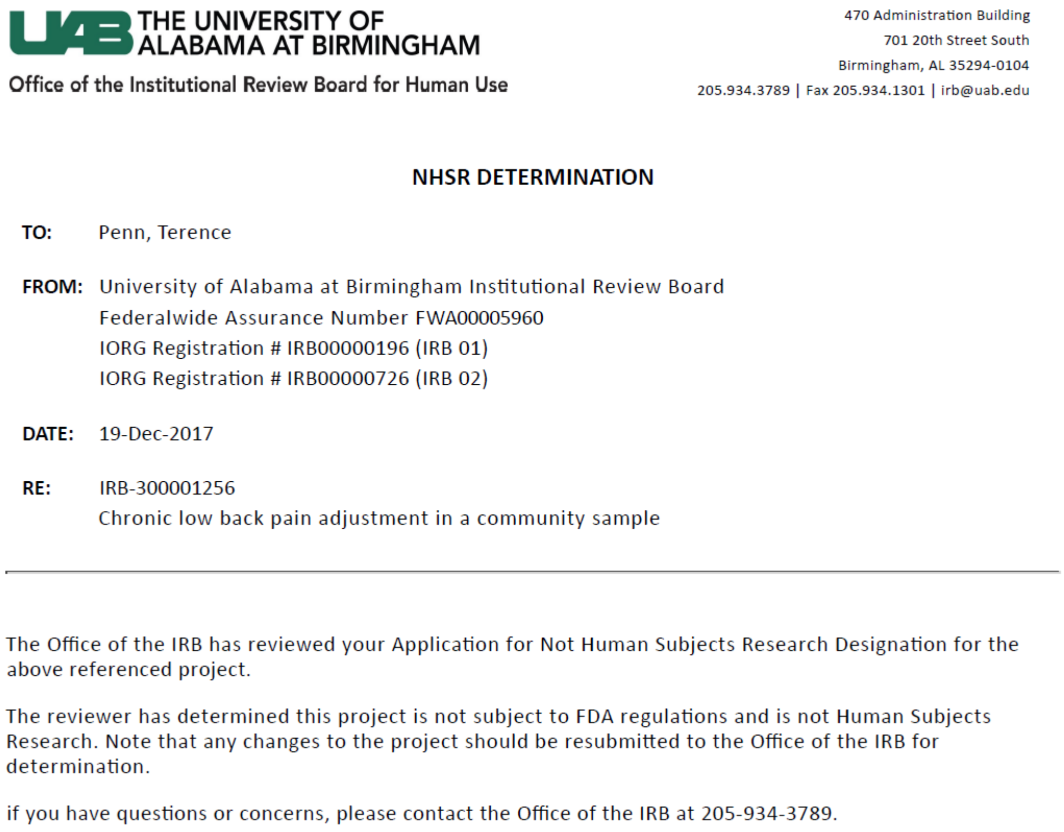
			for identifying these sources included their contribution to the injury, punitive responses toward individuals' expression of pain, and inadequate treatment or assessment of pain. Individuals injured in a motor vehicle accident identified more sources of injustice than those injured at work. In addition, women were more likely than men to identify health care providers, family, and other vehicle drivers as sources of injustice.
Trost, Ryckeghem, Scott, Guck, & Vervoort (2016)	53 individuals with chronic low back pain	**Racial Demographic:** White (n = 38) Black (n = 9) Hispanic (n = 3) Multi-Racial (n = 3) **Study Type:** Cross-Sectional	Perceived injustice was associated with greater attentional bias (AB) to pain stimuli. In a dot-probe task, individuals with higher levels of perceived injustice rated faces as angrier and sadder.
Scott, Milioto, Trost, & Sullivan (2016)	66 individuals with chronic musculoskeletal pain in a rehabilitation program	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Higher levels of perceived injustice were associated with poorer quality of the therapeutic working alliance. In addition, anger expression mediated the relationship between perceived injustice and the working alliance.
Yakobov, Scott, Thibault, & Sullivan (2016)	71 individuals with whiplash injuries from motor vehicle accidents receiving treatment in a	**Racial Demographic:** Not Reported **Study Type:** Prospective	Reductions in perceived injustice was associated with reductions in pain severity and disability. In addition, reductions in disability significantly predicted reductions in perceived injustice.

	functional recovery program		
Agtarap, Scott, Warren, & Trost (2016)	206 individuals with mixed trauma, admitted to a Level 1 trauma center	**Racial Demographic:** White (n = 150) Black (n = 43) Native American/Alaskan Native (n = 3) Asian (n = 1) Multi-Racial (n = 8) Unobtainable (n = 1) **Study Type:** Prospective	At one-year follow-up, higher levels of perceived injustice were associated with greater pain-related fear, pain catastrophizing, pain severity, depressive symptoms, and post-traumatic symptoms. In addition, perceived injustice was negatively associated with resilience and quality of life.
Pâquet et al. (2016)	Women diagnosed with provoked vestibulodynia (PVD; n = 50) and their partners (n = 50)	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Higher levels of perceived injustice were associated with greater sexual distress and depression for both women with PVD and their partners. In addition, higher levels of perceived injustice were associated with lower sexual satisfaction for partners but not for women with PVD.
Carriere, Martel, Kao, Sullivan, & Darnall (2017)	344 individuals with chronic pain in a tertiary pain treatment center	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Higher levels of perceived injustice were associated with more opioid prescriptions. Furthermore, pain behavior mediated the relationship between perceived injustice and opioid prescriptions.

Giummarra et al. (2017)	364 individuals with trauma-related injury	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Perceived injustice uniquely mediated the relationship between injury compensation and return to work, after controlling for age at injury, trauma severity, and pain severity. In addition, perceived injustice was elevated following compensable injury compared to non-compensable injury.
Mohammadi et al., (2017)	184 family caregivers of individuals with chronic musculoskeletal pain	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Individuals who performed more caregiving tasks were more likely to report perceptions of injustice. In addition, perceived injustice was associated with greater burden, distress, and anger among caregivers. Perceived injustice mediated the relationship between caregiving demands, burden, and distress.
Margiotta et al., (2017)	80 chronic pain patients in Ireland	**Racial Demographic:** Not Reported **Study Type:** Cross-Sectional	Individuals with pain related to trauma and motor vehicle accidents were more likely to have a clinical severe score of perceived injustice than all other causes of pain (47% vs 23%). In addition, perceived injustice was strongly associated with pain catastrophizing ($r = .60$, $p < .001$) but weakly associated with pain severity ($r = .25$, $p < .05$)

APPENDIX B

UAB OFFICE OF THE IRB NHSR DETERMINATION LETTER



THE UNIVERSITY OF
ALABAMA AT BIRMINGHAM
Office of the Institutional Review Board for Human Use

470 Administration Building
701 20th Street South
Birmingham, AL 35294-0104
205.934.3789 | Fax 205.934.1301 | irb@uab.edu

NHSR DETERMINATION

TO: Penn, Terence

FROM: University of Alabama at Birmingham Institutional Review Board
Federalwide Assurance Number FWA00005960
IORG Registration # IRB00000196 (IRB 01)
IORG Registration # IRB00000726 (IRB 02)

DATE: 19-Dec-2017

RE: IRB-300001256
Chronic low back pain adjustment in a community sample

The Office of the IRB has reviewed your Application for Not Human Subjects Research Designation for the above referenced project.

The reviewer has determined this project is not subject to FDA regulations and is not Human Subjects Research. Note that any changes to the project should be resubmitted to the Office of the IRB for determination.

if you have questions or concerns, please contact the Office of the IRB at 205-934-3789.