The Impact of Clinical Education on Student Physical Therapists' Attitudes, Beliefs, and Knowledge of Chronic Pain

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Abstract

Chronic pain is a complex and costly condition requiring a team-based, biopsychosocial approach for optimal management. Physical therapists are an integral part of this treatment team, yet the literature shows that physical therapists may not hold sufficient knowledge of pain science nor optimally adhere to a biopsychosocial approach. These suboptimal attitudes, beliefs, and knowledge may start in pre-professional education, as entry-level physical therapy curricula have been shown not to provide sufficient pain education. Experiential learning theory suggests increased exposure to learning opportunities with patients experiencing chronic pain would optimize skill and knowledge acquisition. Clinical education is the primary mode of experiential learning for physical therapy students; however, there is a paucity of research on how clinical education impacts pain knowledge, attitudes, and beliefs.

Objectives: The purpose of the proposed study was to examine the effect of exposure to patients with chronic pain during clinical education rotations on U.S. physical therapy students' attitudes, beliefs, and knowledge of chronic pain management.

Method: This study used a nonexperimental, correlational, pretest-posttest design using the Revised Neurophysiology of Pain Questionnaire and the Health Care Providers' Pain and Impairment Scale to examine changes in attitudes, beliefs, and knowledge of chronic pain around individual clinical education rotations.

Results: The survey collected 97 completed responses, from which only 16 matched pre/post-clinical rotation pairings were identified. A mixed model analysis of data yielded results that were not statistically significant and no null hypotheses were rejected except for a moderate, positive linear relationship between CI board certification and students' pain knowledge.

Conclusion: This study supports the findings of prior research indicating that attitudes, beliefs, and knowledge improve as students progress through entry-level curriculum, but questions remain regarding the impact of clinical education specifically. Additional research is needed in this arena.

Keywords: chronic pain, physical therapy, education, experiential learning

To my incredible support system, Will and Evie,

Will, your support has been my anchor. Our shared love for learning has been a driving force, and during the demanding times, your unwavering support allowed me the space to delve into my studies. Your ability to seamlessly step up, creating room for my educational pursuits, has been a true partnership in every sense.

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List of Abbreviations

ACEs.....Adverse Childhood Events

APTA.....American Physical Therapy Association

BMI.....Body Mass Index

CAPTE.....Commission on Accreditation in Physical Therapy Education

CDC .....Centers for Disease Control and Prevention

CPGs …….Clinical Practice Guidelines

DCE.....Director(s) of Clinical Education

FPL.....Federal Poverty Level

FSBPT……Federation of State Boards of Physical Therapy

HC-PAIRS .....Health Care Providers Pain and Impairment Relationship Scale

IASP.....International Association for the Study of Pain

IOM CAPR .....Institute of Medicine Committee on Advancing Pain Research

MCID…….Minimal Clinically Important Difference

NCHS.....National Center for Health Statistics

NHIS .....National Health Interview Survey

NPQ.....Neurophysiology of Pain Questionnaire

NPTE……..National Physical Therapy Exam

PABS-PT.....Pain Attitude and Beliefs Scale for Physiotherapists

PEM……Pain Education Manual

rNPQ .....Revised Neurophysiology of Pain Questionnaire

SES.....Socioeconomic Status

WHO.....World Health Organization

Chapter One

Introduction

Despite being principal healthcare providers for individuals with chronic pain, studies have shown that novice physical therapists do not feel confident in their ability to manage this condition and may not adhere to the clinical practice guidelines (CPGs) for this patient population (Chance-Larsen et al., 2020; Cowell et al., 2018; Magalhães et al., 2012). This failure to adhere to CPGs is particularly concerning given that "pain" is the most common presenting symptom at physical therapy evaluations (American Physical Therapy Association [APTA], 2021a) and physical therapists are frequently involved in the treatment of people with chronic pain (Institute of Medicine Committee on Advancing Pain Research [IOM CAPR], 2011). Failure to provide optimal physical therapy care to this patient population can result in significant societal expense, as chronic pain impacts an estimated 50 to 116 million United States (U.S.) adults (Centers for Disease Control and Prevention [CDC], 2023; IOM CAPR, 2011; National Center for Health Statistics [NCHS], 2019). In 2011, chronic pain was estimated to cost approximately $560–635 billion annually (IOM CAPR, 2011), and more recent estimates put cost at over $650 billion per year (Rickard et al., 2023; Turk & Patel, 2022).

Chronic pain is defined as pain lasting more than 3 to 6 months and outlasting the anticipated time necessary for tissue healing (National Center for Complementary and Integrative Health [NCCIH], 2018). Functions and structures across multiple body systems are impacted by chronic pain, including central and peripheral neurologic changes, cardiovascular deconditioning, musculoskeletal deconditioning, and psychological effects (IOM CAPR, 2011). Individuals with chronic pain may demonstrate social withdrawal, kinesiophobia, and reduced activity leading to significant social dysfunction (Verbunt et al., 2003). Given the

interconnectedness of physiologic, psychologic, and social impacts, current CPGs recommend a biopsychosocial approach to the management of patients with chronic pain (Adams & Turk, 2018; IOM CAPR, 2011). This approach emphasizes conservative care, caution with opioid medications, integration of psychological treatment, attention to social factors, pain education, and an emphasis on patient self-management and return to function (IOM CAPR, 2011).

Studies have demonstrated that physical therapists' attitudes, beliefs, and knowledge of chronic pain management significantly impact their clinical decision-making and adherence to CPGs (Alshehri et al., 2020; Chance-Larsen et al., 2020). Moreover, patients under the care of physical therapists with poor attitudes and beliefs toward chronic pain demonstrated increased levels of fear avoidance behavior (Alshehri et al., 2020).

Pain knowledge is most frequently measured in the literature using the Revised Neurophysiology of Pain Questionnaire (rNPQ) (Gardner et al., 2017). Physical therapists' attitudes and beliefs towards pain management are often quantified using the Health Care Providers Pain and Impairment Relationship Scale (HC-PAIRS) or the Pain Attitude and Beliefs Scale for Physiotherapists (PABST-PT) (Bishop et al., 2007; Gardner et al., 2017; Lewis & Battaglia, 2019). Current research would suggest that given this link between patient outcomes and physical therapists' attitudes, beliefs, and knowledge of chronic pain, these should be a targeted learning outcome for entry-level professional curricula.

According to experiential learning theory, active and reflective experience is essential for learning. Learning is defined as the creation of knowledge through interactions between the learner and the learning environment (Kolb & Kolb, 2009). The learner must experience four stages of a cycle to effectively learn something: concrete experience, reflective observation, abstract conceptualization, and active experimentation (McCarthy, 2010). Research on nurses

has strongly supported that the process of developing clinical skills depends upon progressively challenging experiential learning (Benner, 1984, 2004; Hill, 2017). A robust body of literature also supports experiential learning for the development of clinical reasoning in rehabilitation professionals (Coker, 2010; Knecht-Sabres, 2013; Smith & Crocker, 2017).

The average entry-level doctoral physical therapy program is 80% didactic and 20% clinical (Ingram & Roesch, 2012). While experiential learning may exist in the didactic portion of the curriculum in the form of standardized patients and practical examinations, the bulk of opportunity for experiential learning falls in the clinical education curriculum. Given the high variability of clinical sites, clinical instructors, and available patient census, there is little consistency in the patient populations to which the student may be exposed, and student physical therapists may have limited opportunity for exposure to patients with chronic pain during this portion of the curriculum (McCallum et al., 2013). According to experiential learning theory, this lack of exposure could result in insufficiently developed knowledge, attitudes, and beliefs toward patients with chronic pain.

Purpose of the Research

The purpose of this study was to examine the association of exposure to patients with chronic pain during clinical education rotations with U.S. physical therapy students' attitudes, beliefs, and knowledge of chronic pain management, controlling for sequence, duration, and setting of the rotation, and clinical instructor preparation. The independent variable "exposure to patients with chronic pain" is defined as both the number of patients seen and the percentage of the overall caseload during the clinical rotation. The dependent variable "knowledge" is defined as the student's score on the rNPQ and the dependent variable "pain attitudes and beliefs" is defined as the student's score on the HC-PAIRS. Sequence of the clinical education rotation is

defined as either initial (first experience), intermediate (mid-didactic curriculum), or terminal (a final clinical experience at which entry-level performance is expected upon completion). Duration of the clinical rotation is defined as the number of weeks the student is engaged in patient care at the clinical site, and setting of the clinical rotation is defined as the practice environment (e.g., outpatient, acute care, inpatient rehabilitation). To assess the preparation of the clinical instructor, students were asked to report if their instructor had completed a doctorate, any post-graduation residencies, fellowships, or board certifications.

Research Questions and Hypotheses

The primary research questions and hypotheses (null and alternate) are:

Q1. Is clinical education significantly associated with changes in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

H1.1o: Students will not demonstrate significantly improved attitudes or beliefs toward chronic pain management following clinical education experiences.

H1.1a: Students will demonstrate significantly improved attitudes and beliefs toward chronic pain management following clinical education experiences.

H1.2o: Students will not demonstrate significantly improved knowledge of chronic pain management following clinical education experiences.

H1.2a: Students will demonstrate significantly improved knowledge of chronic pain management following clinical education experiences.

Q2. Is the percentage of caseload/number of patients with chronic pain seen associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

H2.1o: The number of patients with chronic pain that students encounter while in clinical education experiences will not significantly correlate with improvement in physical therapy students' attitudes and beliefs toward chronic pain management.

H2.1a: The number of patients with chronic pain that students encounter while in clinical education experiences will significantly correlate with improvement in physical therapy students' attitudes and beliefs towards chronic pain management.

H2.2o: The number of patients with chronic pain that students encounter while in clinical education experiences will not significantly correlate with improvement in physical therapy students' knowledge of chronic pain management.

H2.2a: The number of patients with chronic pain that students encounter while in clinical education experiences will significantly correlate with improvement in physical therapy students' knowledge of chronic pain management.

Q3. Is sequence of the clinical education experience associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

H3.1o: Sequence of the clinical experience will not significantly correlate with changes in physical therapy students' attitudes and beliefs toward chronic pain management.

H3.1a: Sequence of the clinical experience will significantly correlate with changes in physical therapy students' attitudes and beliefs toward chronic pain management.

H3.2o: Sequence of the clinical experience will not significantly correlate with changes in physical therapy students' knowledge of chronic pain management.

H3.2a: Sequence of the clinical experience will significantly correlate with changes in physical therapy students' knowledge of chronic pain management.

Q4. Is the setting of the clinical education experience associated with progression in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

H4.1o: The setting of the clinical experience will not be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.

H4.1a: The setting of the clinical experience will be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.

H4.2o: The setting of the clinical experience will not be significantly associated with physical therapy students' knowledge of chronic pain management.

H4.2a: The setting of the clinical experience will be significantly associated with physical therapy students' knowledge of chronic pain management.

Q5. Is the preparation of the clinical instructor associated with progression in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

H5.1o: The preparation of the clinical instructor will not be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.

H5.1a: The preparation of the clinical instructor will be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.

H5.2o: The preparation of the clinical instructor will not be significantly associated with physical therapy students' knowledge of chronic pain management.

H5.2a: The preparation of the clinical instructor will be significantly associated with physical therapy students' knowledge of chronic pain management.

Implications of the Research

Understanding the development of students' knowledge, attitudes, and beliefs towards chronic pain management in clinical education experiences and identifying the elements of

clinical rotations that might optimally support this development could allow program faculty to develop more effective clinical learning experiences. With optimized experiential learning opportunities, entry-level physical therapists will be more prepared to manage patients with chronic pain and will be more likely to follow CPGs resulting in improved outcomes and reduced costs for people with chronic pain.

Organization of the Study

This study is divided into five chapters. The first chapter provided an introduction to the study. The second chapter provides an in-depth literature review of chronic pain, the role of physical therapists in the care team for chronic pain, and the educational preparation of physical therapists. The third chapter outlines the methods of the study. The fourth and fifth chapters present the results and conclusions drawn from the data.

Chapter Two

Review of the Literature

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" (IASP, 2020, para. 3). Chronic pain is generally defined as pain lasting longer than 3 to 6 months, and outlasting the typical time needed for tissue healing (NCCIH, 2018; Nicholas et al., 2019; Treede et al., 2019; Zajacova et al., 2021). Once pain becomes chronic, it is maladaptive and no longer associated with physical damage—if it ever was—and can result in significant dysfunction and suffering (Zajacova et al., 2021). The U.S. National Pain Strategy recommends stratification of chronic pain into an additional category of "high-impact chronic pain," which includes individuals whose pain significantly interferes with life activities (Dahlhamer et al., 2018).

Many common conditions have chronic pain as a symptom, such as fibromyalgia, chronic nonspecific low back pain, arthritis, irritable bowel syndrome, diabetes, migraines, cancer, chronic fatigue syndrome, endometriosis, and more (Johns Hopkins Medicine, 2022; National Institute of Neurological Disorders and Stroke, 2019). This type of chronic pain is generally classified as chronic secondary pain, where pain is a symptom of a different diagnosis (Treede et al., 2019). However, chronic pain can also be labeled as its own diagnosis: chronic pain syndrome or chronic primary pain; these labels are applied when other diagnoses have been ruled out by healthcare providers (Carnago et al., 2021; Nicholas et al., 2019; Treede et al., 2019).

The World Health Organization (WHO) International Classification of Diseases 11th revision has added "chronic primary pain" as a diagnostic code for healthcare providers (Doheny, 2022; WHO, 2022). However, many healthcare providers have not yet adopted the

verbiage “chronic primary pain” or “chronic secondary pain” given their relative novelty. Instead, many healthcare professionals classify pain by the involved body region or underlying etiology (Turk & Patel, 2022).

The most recent prevalence estimates for chronic pain range from 20.9 to 22.6% in U.S. adults and is estimated to cost over $650 billion in direct healthcare expenses, lost productivity, and lost wages (NCHS, 2022; Rickard et al., 2023, Turk & Patel, 2022). In 2015, 16.2% of all adult outpatient healthcare visits were attributed to chronic pain, a notable increase from 11.3% in 2000 (Turk & Patel, 2022). Individuals with pain and severe pain-related functional or social interference were more likely to have six or more outpatient office visits per year compared to those who experienced only minimal or moderate interference (Nahin et al., 2019). A survey of U.S. Workers’ Compensation claims estimated that 75% of annual claims expenditures were attributed to just 7% of the workers’ population that presented with chronic low back pain (Turk & Patel, 2022). Furthermore, individuals with severe pain-related functional or social interference are more likely to use strong opioids and report multiple opioid prescriptions (Nahin et al., 2019). Overutilization and misuse of opioid medications for pain management contributed to the rise of a national opioid epidemic and more than a half million people have died from opioid-involved overdoses in the United States since 1999 (CDC, 2022).

Once pain becomes chronic, it can alter an individual’s function, life, and community participation resulting in dysfunction, disability, and social withdrawal (IOM CAPR, 2011). This dysfunction and disability can lead to a cycle of deconditioning and muscle atrophy. Chronic pain can also cause multi-system sequelae including sympathetic nervous system dysregulation, gastrointestinal dysfunction, and elevated blood pressure (Fine, 2011; Treede et al., 2019). Chronic pain has also been shown to occur concurrently with psychological symptoms including

stress, anger, fear, anxiety, and depression (Fine, 2011; IOM CAPR, 2011). The complex, multisystemic nature of chronic pain makes it difficult to define, study, and manage.

Causes of Chronic Pain

There are three main subtypes of pain: nociceptive, neuropathic, or nociplastic (Cohen et al., 2021). Nociception, related to tissue damage, is the most common form of chronic pain; this type encompasses conditions like arthritis, rheumatic conditions, and some types of low back pain (Cohen et al., 2021). Neuropathic pain is associated with damage or disease of the somatosensory nervous system and is estimated to account for ~15-25% of chronic pain; neuropathic pain is seen in diabetic peripheral neuropathy, neuralgias, and radiculopathies (Cohen et al., 2021). Nociplastic pain occurs when the central nervous system abnormally processes pain in the absence of tissue damage or pathology; diagnoses that involve nociplastic pain include fibromyalgia, chronic nonspecific low back pain, and irritable bowel syndrome (Cohen et al., 2021). Recent research indicates that pain can be of mixed types, particularly in cancer-related pain and back pain (Cohen et al., 2021).

Dysregulation of the hypothalamus-pituitary-amygdala axis and neuroinflammatory states have also been identified as potential contributors to the development of chronic pain (Prego-Domínguez et al., 2021). Finally, there is evidence that genetics play a role in the development of chronic pain; pain sensitivity and pain tolerance can be genetically determined, and chronic pain has been seen to cluster in families (Mills et al., 2019). Over 150 genes have been associated with chronic pain via inflammatory markers, immune functioning, and stress pathways, but a “chronic pain gene” has not been isolated (Mills et al., 2019).

Risk Factors for Chronic Pain

Beyond genetics, many social and personal factors are associated with an increased risk for developing chronic pain. However, many of these factors demonstrate a bidirectional association, so risk factors often also appear in the demographic and environmental epidemiologic data (Cohen et al., 2021; Mills et al., 2019).

Social factors such as ethnicity and cultural background, socioeconomic status (SES), employment status, and occupation have all been identified as risk factors for chronic pain (Mills et al., 2019). Psychological distress, post-traumatic stress disorder, a history of violence, trauma, or abuse, and adverse childhood events (ACEs) are also risk factors (Cohen et al., 2021; Mills et al., 2019; Prego-Domínguez et al., 2021). Fifty-five percent of children who experience multiple ACEs develop chronic pain later in life (Cohen et al., 2021; Mills et al., 2019).

Behavioral factors like smoking, alcohol intake, low physical activity, poor nutrition, lack of sunshine/vitamin D, and personal attitudes and beliefs about pain have also shown a bidirectional association as both risk factors and important environmental epidemiologic datapoints (Mills et al., 2019). Tobacco use demonstrates a dose-dependent association with risk for chronic pain—increased smoking results in increased pain intensity and increased painful sites (Mills et al., 2019). Smoking is also a risk factor for opioid misuse (Zajacova et al., 2021).

Medical factors associated with increased risk include multi-morbidity, obesity, poor mental health, prior surgical interventions, or prior pain experiences (Mills et al., 2019). The presence of acute or chronic pain at another body site is the most important risk factor for the development of chronic pain (Mills et al., 2019). This relationship is found to be dose-dependent—more severe pain or more painful sites results in higher risk (Mills et al., 2019). Importantly, effective management of acute pain can be protective against developing chronic

pain (Mills et al., 2019). Post-operative chronic pain impacts approximately 10% of surgical patients overall but is most common post amputation (50-85% impacted), post cardiac surgery (30-55%), post breast surgery (20-50%), and post thoracotomy (5-65%) (Mills et al., 2019). Risk factors for this type of chronic pain include the presence of pre-operative pain, poorly managed acute post-operative pain, perioperative anxiety, and post-operative infection (Mills et al., 2019).

Multi-morbidity is also an important risk factor for chronic pain. Up to 88% of individuals with chronic pain have additional chronic diseases (Mills et al., 2019). Individuals with neurologic disorders have double the prevalence of chronic pain, with individuals with spinal cord injury being most affected (Mills et al., 2019). Almost one-third of individuals with chronic obstructive pulmonary disease and coronary artery disease report chronic pain (Mills et al., 2019). Forty percent of obese individuals report chronic pain, and the relative rate increases as body mass index (BMI) increases; compared to individuals with a healthy BMI, the relative rate of chronic pain in individuals with a BMI of 35-39 (Class 2 obesity) was 136%, and 254% in individuals with a BMI > 40 (Class 3 obesity) (Mills et al., 2019).

Epidemiology of Chronic Pain

Given the bidirectional associations of chronic pain and multiple risk factors, higher rates of chronic pain are often seen in populations and regions where these risk factors are prevalent; low SES, low education levels, high unemployment, and high rates of physically laborious occupations are all socioeconomic harbingers for chronic pain (Dahlhamer et al., 2018; Mills et al., 2019; Prego-Domínguez et al., 2021). Similarly, populations with high multi-morbidity, prior surgeries, high rates of mental illness, smoking, high alcohol intake, sedentary lifestyle, and poor nutrition are also likely to have higher rates of chronic pain (Mills et al., 2019).

Demographics

Chronic pain has been difficult to objectively study and measure due to the varying definitions of pain used, variable study methodologies and populations, and the inherent subjectivity of pain (Turk & Patel, 2022; Velly & Mohit, 2018). However, several demographic factors have been consistently associated with higher prevalence of chronic pain: age, sex, race/ethnicity, and veteran status. The prevalence of chronic pain increases with age regardless of sex (see Table 1) (Dahlhamer et al., 2018; Rickard et al., 2023; Yong et al., 2022). There is also a higher prevalence of chronic pain in women compared to men (NCHS, 2019; Rikard et al., 2023). Women tend to report more sites of pain, are more likely to use maladaptive coping strategies, and are more likely to seek medical treatment for their pain (Mills et al., 2019).

Table 1

Prevalence of Chronic Pain by Sex and Over the Lifespan

Group	**Chronic Pain**	**High Impact Chronic Pain**
Men, age-adjusted	18.8% (18.0-19.6)	6.2% (5.7-6.7)
Women, age-adjusted	20.5% (19.7-21.3)	7.7% (7.2-8.2)
By age, men and women		
18-24 years	7.5% (6.3-9.0)	1.3% (0.7-2.0)
25-44 years	13.7% (12.8-14.6)	3.5% (3.0-4.0)
45-64 years	26.8% (25.7-27.9)	10.0% (9.3-10.8)
65-84 years	30.0% (28.8-31.3)	10.4% (9.6-11.2)
85 years and over	34.3% (30.6-38.2)	14.3% (11.8-17.2)

Note. Data from 2021 National Health Interview Survey (NHIS). 95% CI (Rickard et al., 2023)

Research has been mixed regarding the prevalence of chronic pain in racial and ethnic groups. The most recent NHIS data reports an age-adjusted prevalence of chronic pain was highest in American Indian/Alaskan Native (AI/AN) adults (28.0%), followed by non-Hispanic White (21.8%) and non-Hispanic Black adults (18.2%) (Rikard et al., 2023). Some researchers suggest that non-Hispanic White adults experience less pain and pain-related disability than Black individuals (Mills et al., 2019). NHIS data found age-adjusted rates of high-impact chronic pain to be 12.8% for AI/AN adults, 7.6% for Black adults, and 6.5% for White adults. However, a study that adjusted data for income, adverse life events, and employment status found that differences in prevalence of chronic pain amongst racial/ethnic groups were significantly attenuated (Mills et al., 2019).

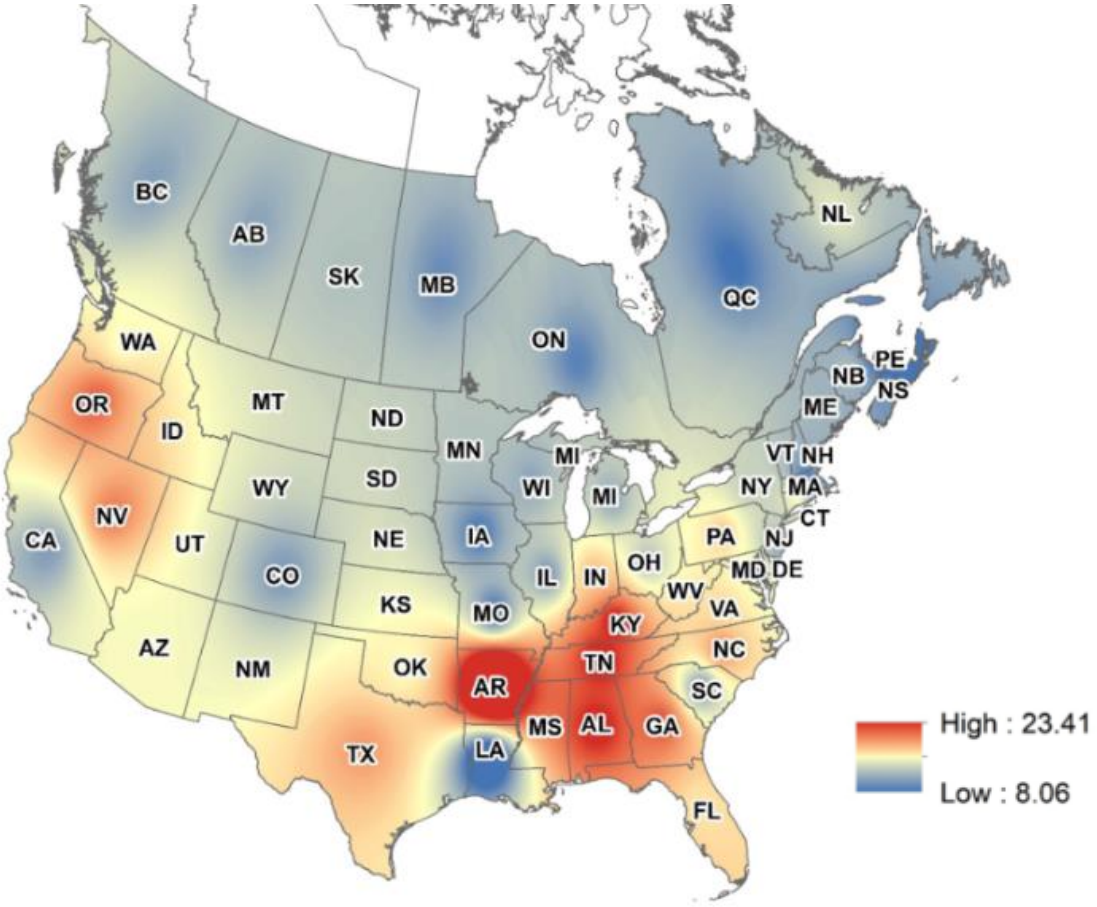
Another minority group in which chronic pain has been found to be more prevalent is veterans with an age-adjusted prevalence of 27.5% (95% CI [24.9, 30.1]) versus 19.2% in non-veterans (Rikard et al., 2023). Researchers anticipate that stress, trauma, post-traumatic stress disorder, and allostatic load similar to that seen in racial/ethnic minorities may be responsible for this increased prevalence (Dahlhamer et al., 2018).

Environmental Attributes

A variety of environmental factors have also been found to be associated with higher prevalence of chronic pain, including SES, education level, employment status, and locality. A higher age-adjusted prevalence of chronic pain is seen in rural residents (24% vs. 18.4% urban), and those states in the South, West, and Appalachian regions of the United States are particularly impacted (see Figure 1; Dahlhamer et al., 2018; Zajacova et al., 2021, 2022).

Figure 1

Geography of Pain in the United States



Note: Scores are weighted mean pain scores (range 0-55). (Zajacova et al., 2022)

Individuals with low SES demonstrate a higher prevalence and higher reported severity of chronic pain (Mills et al., 2019); those with low SES have a 1.31 odds ratio (95% CI [1.2, 1.42]) for chronic pain compared to those with high SES, and individuals with mid-level SES demonstrate an odds ratio of 1.16 (95% CI [1.09, 1.23]) (Prego-Domínguez et al., 2021). Adults living below the federal poverty level (FPL) demonstrate an age-adjusted prevalence of chronic pain of 28.8% (95% CI [26.6, 31.0]) which decreases to 24.1% (95% CI [22.6, 25.6]) at 100-200% of the FPL and 20.9% (95% CI [19.9, 22.0]) at 200-400% of the FPL (Dahlhamer et al.,

2018; Rikard et al., 2023; NCHS, 2016). Individuals who are homeless are estimated to have a chronic pain prevalence of 47-63% (Cohen et al., 2021).

A significant contributor to higher pain prevalence in those with low SES may be related to increased frequency of manual jobs, heavy workloads, and high stress working environments (Mills et al., 2019). Unemployment has also been found to occur concurrently with chronic pain—29.5% versus 14.5% in employed individuals (Dahlhamer et al., 2018). Additionally, lower education level is tied to increased prevalence of chronic pain (Mills et al., 2019). The rate of chronic pain in adults with a bachelor's degree or higher (12.4%) is significantly lower than that seen in individuals with only a high school degree or GED (22.6%) or in those that have not completed high school (23.7%) (Dahlhamer et al., 2018).

Morbidity and Mortality

Chronic pain can significantly impact an individual's quality of life, functional ability, work ability, and lifespan. Individuals with chronic pain are far more likely to report difficulty completing errands (21.5% vs. 4.9% in those without chronic pain), participating in social activities (25.4% vs. 5.7%), encounter more work limitations (48.8% vs. 15%), and miss more workdays per year (10.3 days vs. 2.9) (Yong et al., 2022a). This amounts to approximately $79.9 billion in lost wages and almost $300 billion in lost productivity per year (Yong et al., 2022).

Sleep disturbances are highly prevalent in individuals with chronic pain and have been shown to have a bidirectional relationship; chronic pain can cause sleep disturbance and sleep disturbance can increase the intensity of pain (Mills et al., 2019). Some studies have found a pooled prevalence of sleep disturbances across all chronic pain diagnoses to be anywhere from 50% to 75% (versus 23.3% for those without chronic pain) (Mills et al., 2019; Sun et al., 2021). Sleep disturbances are most prevalent in fibromyalgia (95.5%) and least prevalent in rheumatoid

arthritis (65.4%) (Sun et al., 2021). In all associated diagnoses, rates of sleep disturbance can be confounded by comorbid depression (Sun et al., 2021).

Psychiatric health conditions have also shown bidirectional associations with chronic pain. It is estimated that individuals with chronic pain are four times more likely to have anxiety (4-38%) or depression (20-50% prevalence). Individuals with post-traumatic stress disorder, childhood traumas, and those who have experienced significant adversity are also at increased risk for developing chronic pain (Mills et al., 2019). The severity of chronic pain is positively correlated with the severity of psychopathology (Cohen et al., 2021; Mills et al., 2019; Velly & Mohit, 2018). The prevalence of suicidal ideation in individuals with chronic pain ranges from 5-50% and suicidal attempts occur in 5-14%, versus 4.3% and 0.6% respectively in the general adult population (Ivey-Stephenson et al., 2022; Mills et al., 2019; Velly & Mohit, 2018). Increased risk of suicide in the setting of chronic pain is associated with veteran status (hazard ratio = 1.3), severe and longstanding chronic pain, helplessness and hopelessness, and comorbid sleep disturbance (Velly & Mohit, 2018).

There is also a bidirectional association between chronic pain and substance use disorders (Velly & Mohit, 2018). The rate of anxiety disorders is highest (37%) in patients receiving opioid medications (Velly & Mohit, 2018). Opioid medications are commonly used to manage both acute and chronic pain conditions, but it is estimated that 10-30% of patients with chronic pain misuse opioids and opioid use can actually contribute to the chronification of pain (Cohen et al., 2021; Compton & Jones, 2019). Opioid-related emergency room visits increased 99.4% from 2005 to 2014, and another 30% from 2016 to 2017, and can be a significant healthcare expenditure (Compton & Jones, 2019; Jackson et al., 2020). Males are more likely to misuse opioid medications than females (4.7% vs. 3.7%, respectively), and individuals ages 18-25 were

at highest risk of misuse (Compton & Jones, 2019). A prior history of psychological stress, trauma, or poor social support are risk factors for opioid misuse in individuals with chronic pain (Cohen et al., 2021).

Understanding the mortality impact of chronic pain is challenging due to the wide variety of definitions and associated diagnoses. Documented cause of death is typically attributed to the primary diagnosis; however, the presence of chronic pain can impact 10-year survival rates for multiple medical diagnoses (Mills et al., 2019). For example, individuals with cancer who are "resilient to pain"—low disability despite high pain levels—have improved 10-year survival compared to those who did not demonstrate this resilience (78.9% vs. 68.1% survived) (Elliott et al., 2014; Mills et al., 2019). This same pattern has been seen in individuals with ischemic heart disease or respiratory diseases—those with severe chronic pain are twice as likely to die within 10 years as those who have mild or no pain (Mills et al., 2019).

Incidence and Prevalence

The estimated worldwide prevalence of chronic pain in adults is approximately 20% (Turk & Patel, 2022). The most recent estimates for the United States exceed this at 22.6% (NCHS, 2022). This represents an increase from 2019, which found a prevalence of 20.5% (95% CI [19.9, 21.2%]) (NCHS, 2019; Yong et al., 2022). The most affected body regions for those who reported chronic pain were the back and hips, knees, or feet (NCHS, 2022). Chronic arthritic pain—pain attributed to rheumatological conditions—is estimated to have a prevalence of 23% (Velly & Mohit, 2018). The prevalence of chronic pain due to arthritic etiologies is anticipated to increase from 23% to 26% by 2040 (Velly & Mohit, 2018).

Researchers and health officials anticipate a continued rise in the prevalence of chronic pain in general in the wake of COVID-19 (Zajacova et al., 2021). Many factors may contribute

to this: post-viral syndromes, reduced physical activity, lack of access to medical care, post-viral syndromes, social isolation, social stressors, anxiety, and economic collapse (Zajacova et al., 2021). Recent studies of individuals post COVID infection found that those who experienced moderate or severe symptoms were 1.28 times more likely (95% CI [1.09, 1.51]) to report chronic pain than those who had not experienced a COVID infection (Romeiser et al., 2023). A survey conducted by the CDC found that 13.1% of U.S. adults initiated or increased their substance use in the first year of the pandemic (Czeisler et al., 2020), and the rate of drug-overdose related deaths increased by 30% between 2019 and 2020 (Lee & Singh, 2023). Other studies found increased suicidal ideation (10.7% vs. 4.3% prevalence), anxiety (25.5% vs. 8.1%), and depression (24.3% vs. 6.5%) in the general public compared to pre-pandemic data from 2018 to 2019 (Czeisler et al., 2020). Given that these are both risk factors and comorbidities of chronic pain, it is unsurprising that experts fear a rise in chronic pain as well.

Medical Management of Chronic Pain

Given the interconnectedness of multi-systemic physiological and psychological effects, current CPGs for the management of chronic pain recommend a multidisciplinary, biopsychosocial approach (Adams & Turk, 2018; Hylands-White et al., 2016; Oliveira et al., 2018; Reid et al., 2015). These guidelines call for conservative care, caution with opioid medications, integrated physiological and psychological care, and an emphasis on active patient involvement with the goal of increasing function (IOM CAPR, 2011). Providers who adhere to the more traditional biomedical approach are more likely to use passive treatments, order more imaging, prescribe more medication, and recommend rest and restrictions at work, which do not align with current CPGs (Caneiro et al., 2021; Christe et al., 2021; Gardner et al., 2017; Magalhães et al., 2012).

The typical biomedical model—an emphasis on physiology and organic pathology to explain disease and illness—has long been a standard approach in healthcare. However, in the mid- to late-20th century, George Engel published a set of papers questioning this model and encouraging the development of a new medical model—the biopsychosocial model (Engel, 1960, 1977). This model looks not just at the measurable biological factors of disease and illness, but also integrates the psychological and social factors that may influence disease and illness processes (Engel, 1960, 1977).

Since its inception, the biopsychosocial model has been heavily studied and utilized across health professions, yet critiques of this model remain. Critics assert the approach is overly generic or vague, insufficiently structured to aid healthcare providers in identifying relevant psychosocial factors, and blurs the boundaries of healthcare providers' scopes of practice (Farre & Rapley, 2017; Ghaemi, 2011; Mescouto et al., 2020). In modern healthcare and healthcare professional education, many still adhere to the biomedical approach for patient diagnosis and management (Farre & Rapley, 2017; Mescouto et al., 2020). However, a biomedical-based education can promote maladaptive beliefs that could negatively impact patient care decisions across a variety of health professions (Christe et al., 2021; Gibbs et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022). Additionally, providers who take a biomedical approach are much less likely to engage in multidisciplinary management (Kusnanto et al., 2018). Multidisciplinary care is a cornerstone of chronic pain management, and a willingness to engage in team-based care is vital (IOM CAPR, 2011).

There exist several barriers and enablers to healthcare professionals adopting a biopsychosocial approach to patient management. A 2021 systematic review of 25 studies published between 2007 and 2019 identified barriers and enablers at three levels: the clinical

level, the service level, and the system level. This multi-tiered approach to barriers and enablers indicates that more than individual, clinician-patient context can impact the approach that healthcare professionals take; institutional or organizational contexts, and the health system or health policy can play into clinical attitudes and behaviors. These barriers and enablers were consistent across multiple professions: medicine, physical therapy, occupational therapy, psychology, and chiropractic (Ng et al., 2021). Primary barriers and enablers to adopting a biopsychosocial approach at the individual level can be found in Table 2.

Table 2

Barriers and Enablers to Adopting a Biopsychosocial Approach

Barriers	**Enabler**
• Lack of understanding of what "biopsychosocial" actually means • Lack of confidence in assessing and addressing psychosocial factors • An overly strong biomedical identity or mechanical focus • Incomplete understanding of the CPGs for pain • Lack of interpersonal skills and difficulty forging a strong therapeutic alliance between client and clinician	• Knowing how to screen for psychosocial factors • Understanding the neuroscience of pain • Empathy • Ability to use patient-centered communication, build a strong therapeutic alliance, and engage the client in self-management

(Ng et al., 2021)

Also important to a biopsychosocial approach was a provider's understanding of their own clinical scope, knowing when to refer out to another provider, yet maintaining a "flexible professional identity" to allow necessary adaptation to individual patient contexts (Ng et al., 2021, p. 24). Confidence in a biopsychosocial attitude and this flexible professional identity

could be further developed by upskilling—attending continuing education or postgraduate training (Ng et al., 2021). There is evidence that competency-based training in healthcare education, particularly those that integrate IASP pain-specific competency curricula, may be beneficial in upskilling the healthcare workforce as a whole (Ng et al., 2021).

At the organizational or health service provision level, a biopsychosocial attitude can be enabled through team-based approaches to care, support from peers skilled in managing psychosocial factors, and clinical leadership vocally supportive of the current CPGs (Ng et al., 2021). These enablers are highly dependent on the accessibility of interdisciplinary teammates and available resources for ongoing professional development (Ng et al., 2021). Physical therapists are frequently members of this team due to their expertise with pain and overall effectiveness in reducing pain and improving function (APTA, 2021b).

Physical Therapists as a Part of the Treatment Team

According to the APTA, physical therapists are "movement experts who improve quality of life through prescribed exercise, hands-on care, and patient education" (APTA, n.d.-a, para. 1). Physical therapists can diagnose and treat numerous health conditions that may impact individuals across the lifespan and are adept at establishing both restorative and preventative plans of care to improve function (APTA, n.d.-a). As of 2016, all entry-level physical therapy programs in the United States confer only the Doctor of Physical Therapy (DPT) degree (APTA, n.d.-a). However, some practicing physical therapists may still have a certificate, baccalaureate, or master's degree depending upon how long they have been in practice; a bachelor's degree was required as of 1978, and a post-baccalaureate degree was required as of 2002 (Moffat, 2012).

As of 2021, the Bureau of Labor Statistics estimated that just over 225,000 physical therapists were employed in the United States (Bureau of Labor Statistics, 2021). The APTA

estimates slightly more at 238,256 (APTA, 2023). Physical therapists work in a variety of settings, with recent estimates indicating that 36% work in outpatient clinics, 29% in hospitals, 11% in home health, and 5% in residential care facilities (Bureau of Labor Statistics, 2021). A physical therapist on average will see 10 to 32 individual patients each week. Hospital and outpatient-based clinicians see the highest number (25-30 individual patients) and inpatient rehab facility-based clinicians see the fewest (10 individual patients; APTA, 2017).

Given that the most common primary symptom reported at physical therapy evaluations is "pain" (APTA, 2021a), most physical therapists can expect to manage pain at some point. It does not appear that any research has specifically assessed the frequency of patients with chronic pain across settings for physical therapists. However, given that more than one in five American adults will experience chronic pain (Yong et al., 2022), it can be safely hypothesized that physical therapists will see a high number of these individuals during their clinical careers. Yet, despite the likelihood of encountering patients with chronic pain and being frequently called upon to participate in multidisciplinary management, research has shown that many physical therapists do not adhere to the recommended biopsychosocial management approach (Alshehri et al., 2020; Chance-Larsen et al., 2020; Gardner et al., 2017).

Attitudes, Beliefs, and Knowledge of Chronic Pain

A 2018 scoping review of pain knowledge, attitudes, beliefs, and skills in health professionals and healthcare students identified 56 studies published between 1992 and 2017 (Thompson et al., 2018). The rate of publications indicates that this subject has been increasingly studied over the past 25 years, particularly in medicine, nursing, physical therapy, and occupational therapy. Knowledge of chronic pain is typically defined as knowledge of the neurophysiology of pain (Adillón et al., 2015; Colleary et al., 2017; Mankelow et al., 2020).

Attitudes and beliefs are most often defined as the management approach taken—biomedical or biopsychosocial.

Measuring Attitudes, Beliefs, and Knowledge

Thompson and colleagues' (2018) scoping review identified that, in the past 25 years, a variety of tools have been used to measure healthcare students' attitudes, beliefs, and knowledge of pain. Some of the most used are the Neurophysiology of Pain Questionnaire, the revised Neurophysiology of Pain Questionnaire, the Knowledge and Attitudes Survey Regarding Pain, the Revised Knowledge and Attitudes Survey Regarding Pain, the Schutte Emotional Intelligence Scale, the Health Care Providers' Pain and Impairment Relationship Scale, the Pain Attitudes and Beliefs Scale, the Pain Knowledge Questionnaire, the Pain Knowledge and Attitude Questionnaire, and the Pain Knowledge and Beliefs Questionnaire (Thompson et al., 2018).

In recent physical therapy-specific literature, pain knowledge is most frequently measured using the Neurophysiology of Pain Questionnaire (NPQ) or the revised NPQ (rNPQ) (Adillón et al., 2015; Colleary et al., 2017; Mankelow, Ryan, Morris, et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022; Mankelow, Ryan, Taylor, Atkinson et al., 2022). At 19 and 12 items respectively, these scales consist of true/false questions that measure a provider's knowledge of pain neuroscience. A higher score indicates increased knowledge (Catley et al., 2013). The NPQ demonstrates good test-retest reliability with a pre-education ICC of .971 (95% CI [.925, .987]) and a post-education ICC of .989 (95% CI [.981, .984]) (Catley et al., 2013). The original NPQ demonstrated a person separation index of .84, which is sufficiently sensitive to distinguish between high and low scorers, but a Rasch analysis of the NPQ demonstrated that the tool contained several redundant or inconsistent items, which led to the development of the

rNPQ. Internal consistency of this revised version demonstrated a person separation index of .82, which indicates it is more sensitive than the original NPQ (Catley et al., 2013). A suggested minimal clinically important difference (MCID) for the rNPQ is 7.3% based on half the baseline standard deviation of a systematic review and synthesis of findings from prior applicable studies (Mankelow, Ryan, Taylor, Atkinson, et al., 2022).

For physical therapists, attitudes and beliefs are frequently measured using the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS), the Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT), or both (Bishop et al., 2007; Gardner et al., 2017; Lewis & Battaglia, 2019). Interviews and focus groups are also utilized to garner qualitative data about attitudes and beliefs toward chronic pain management (Cowell et al., 2018; Roitenberg & Shoshana, 2019).

The HC-PAIRS is a 15-item scale, scored 15 to 105, developed to identify healthcare providers' attitudes and beliefs about their patients' ability to function with chronic pain. Higher scores on the HC-PAIRS indicate a negative attitude, demonstrating a provider's increased belief that chronic pain justifies functional impairment and disability (Rainville et al., 1995). The HC-PAIRS has demonstrated good internal consistency (Cronbach's alpha = 0.92) and test-retest reliability (ICC = 0.84, 95% CI [0.78, 0.89]) (Magalhães et al., 2011; Moran et al., 2017). A suggested MCID for the HC-PAIRS is 4.6% based on half the baseline standard deviation of a systematic review and synthesis of findings from prior applicable studies (Mankelow, Ryan, Taylor, Atkinson, et al., 2022). No gold standard exists for measuring these constructs, but when comparing the HC-PAIRS to the PABS-PT, construct validity ranges from weak to moderate (r = 0.19 to 0.62) (Magalhães et al., 2011). Validity of the HC-PAIRS has also been examined by correlating clinician recommendations for work and physical activity with HC-PAIRS scores;

this demonstrated adequate validity (r = 0.25 to 0.45), indicating that clinicians with a high HC-PAIRS score were more likely to recommend activity limitation (Houben et al., 2004).

The PABS-PT began as a 31-item scale and has since been refined to 19 items to measure treatment orientation (Houben, Ostelo, et al., 2005). However, some studies still utilize a 20-item version. Both the 20-item and the 19-item include two subscales: biomedical and biopsychosocial. A high score on either or both subscales indicates an increased tendency to adhere to that treatment approach. It is possible to score highly on both subscales (Houben, Gijsen, et al., 2005; Houben, Ostelo, et al., 2005; Mutsaers et al., 2012; Ostelo et al., 2003). The PABS-PT has also demonstrated good internal consistency (Cronbach's alpha = 0.73-0.74 for the biomedical subscale and 0.67-0.68 for the biopsychosocial subscale) and test-retest reliability (ICC = 0.80, 95% CI [0.72, 0.87] for the biomedical subscale and 0.70, 95% CI [0.57, 0.94] for the biopsychosocial scale) (Magalhães et al., 2011). Again, construct validity between the HC-PAIRS and PABS-PT is weak to moderate (Houben et al., 2004; Mutsaers et al., 2012). A gold standard for this construct does not exist, but when comparing PABS-PT outcomes to clinical decisions made by therapists, several studies have demonstrated positive results (Mutsaers et al., 2012). Responsiveness has been deemed as "positive" in that educational interventions positively impact PABS-PT scores, but no minimal clinically important difference has been suggested (Mutsaers et al., 2012).

To examine the impact of attitudes, beliefs, and knowledge on clinical management decisions, case vignettes or chart reviews are typically utilized (Alshehri et al., 2020; Ballengee et al., 2020; Chance-Larsen et al., 2020; Colleary et al., 2017; Domenech et al., 2011; Gardner et al., 2017). Significant heterogeneity in studies, difficulty accessing and assessing patient records

for studies, and the financial implications of observing clinical records over time make analysis of plans of care and patient outcomes difficult (Mankelow, Ryan, Taylor, Atkinson, et al., 2022).

Current Attitudes, Beliefs, and Knowledge

As discussed, healthcare providers who adhere to a biomedical approach tend to utilize passive treatments, overutilize imaging and medication, and reinforce overreliance on medical care for individuals with chronic pain (Alshehri et al., 2020; Caneiro et al., 2021; Gardner et al., 2017; Mankelow, Ryan, Taylor, Casey, et al., 2022). This increased utilization and reliance on healthcare services results in increased financial and time expenditures for patients and the healthcare system. Patients being treated through a biomedical approach are typically advised to rest more, reduce activity at work, and avoid pain-inducing functional activities resulting in increased disuse, disability, and work absences (Caneiro et al., 2021; García-Martínez et al., 2022; Magalhães et al., 2012). This potential for added cost and increased disability demonstrates just how vitally important healthcare providers' attitudes, beliefs, and knowledge of chronic pain are to optimizing patient outcomes. Yet a synthesis of findings concludes that students across disciplines continue to lack knowledge and hold negative attitudes and beliefs toward chronic pain indicating a significant gap in health professional pain education (Thompson et al., 2018).

Physical therapists have consistently been identified as achieving some of the highest levels of pain neuroscience knowledge and most positive attitudes and beliefs towards chronic pain (Adillón et al., 2015; Carroll et al., 2020; de Jesus-Moraleida et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022; Mukoka et al., 2019). A 2022 international study examining pain knowledge, attitudes, and beliefs across nursing, midwifery, and allied health professional students found that physical therapy educational curricula included higher amounts of pain-

specific education than the other professions (Mankelow, Ryan, Taylor, Casey, et al., 2022). Despite this finding, the authors identified several areas of concern: 1) measures of attitudes, beliefs, and knowledge of chronic pain management for physical therapists remain quite low, 2) physical therapists' clinical management decisions do not consistently match current CPGs, and 3) physical therapists report decreased confidence in managing patients with chronic pain.

Attitudes and Beliefs, the HC-PAIRS. Average HC-PAIRS scores of practicing physical therapists range from 45.45 to 31.72 in the literature (Chance-Larsen et al., 2020; Jacobs et al., 2016; Magalhães et al., 2012), and 67.92 to 41.35 in physical therapy students (de Jesus-Moraleida et al., 2021; Mankelow, Ryan, Morris, et al., 2021; Mukoka et al., 2019; Quinn et al., 2014; Springer et al., 2018; Talmage et al., 2020). Higher scores for physical therapy students indicate they hold more negative attitudes and beliefs toward chronic pain than practicing physical therapists. Studies that have followed physical therapy students longitudinally or cross-sectionally through the entry-level curriculum have found that HC-PAIRS scores go down—indicating an improvement in attitudes and beliefs towards chronic pain—as their education progresses (Mankelow, Ryan, Morris, et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022; Quinn et al., 2014; Springer et al., 2018). Post-graduation factors associated with lower HC-PAIRS scores (more positive attitudes) include board certification, residency or fellowship training, and working in a hospital-based outpatient setting; working in a private practice outpatient setting is associated with a higher HC-PAIRS score (Rufa et al., 2022).

Attitudes and Beliefs, the PABS-PT. Because studies may use the 19- or 20-item PABS-PT scale, direct numerical comparison of scores is not advisable. Studies that have utilized the PABS-PT have reached mixed conclusions for both physical therapists and physical therapy students. Some studies found that practicing physical therapists hold a strongly

biopsychosocial lens (Benny & Evans, 2020; Jacobs et al., 2016), while others found a mildly more biomedical lens (Alshehri et al., 2020; Magalhães et al., 2012). Two of these studies noted that physical therapists with less experience tended to score higher on the biomedical subscale (Benny & Evans, 2020; Magalhães et al., 2012). In physical therapy students, some studies indicate a moderate preference for a biomedical lens (Bareiss et al., 2019; Saracoglu et al., 2021), while others indicate a very strong preference for a biopsychosocial approach (Ballengee et al., 2020; Gibbs et al., 2021). Two studies assessing physical therapy students noted that tendencies to a biomedical approach lessen as students progress through the physical therapy curriculum (Bareiss et al., 2019; Saracoglu et al., 2021).

In practicing physical therapists, higher biopsychosocial and lower biomedical approaches are associated with board certification, residency or fellowship training, and working in a hospital-based outpatient setting (Rufa et al., 2022). Once again, working in a private practice outpatient setting is associated with potentially more negative attitudes and beliefs given a higher tendency toward a biomedical approach and lower biopsychosocial beliefs (Rufa et al., 2022). Researchers have hypothesized that private practice outpatient clinicians' negative attitudes and beliefs may be due to the fast pace, limited resources, and financial challenges of the setting. In contrast, hospital-based outpatient clinics tend to have greater resources and a more academically minded culture, which may allow for increased opportunities for continuing education (Rufa et al., 2022).

Knowledge, the NPQ. Studies have consistently found that physical therapists score higher than other health professions on the NPQ (Adillón et al., 2015; Mankelow, Ryan, Taylor, Casey, et al., 2022; Mukoka et al., 2019), but scores remain quite low, with the average ranging from 40% to 75% (Bareiss et al., 2019; Mankelow, Ryan, Taylor, Casey, et al., 2022; Saracoglu

et al., 2021; Springer et al., 2018; Talmage et al., 2020). Several studies again pointed out that NPQ scores increased significantly as physical therapy students progressed through their education (Adillón et al., 2015; Bareiss et al., 2019).

Progression with Experience. Studies utilizing these measures have seen significant improvement in pain attitudes, beliefs, and knowledge with increased experience (Lewis & Battaglia, 2019; Mankelow, Ryan, Taylor, Casey, et al., 2022; Quinn et al., 2014; Springer et al., 2018; Wassinger, 2021). This is particularly evident for physical therapy students in the later years of their educational programs, and some researchers hypothesize this is due to the integration of knowledge into clinical practice through clinical education experiences (Mankelow, Ryan, Taylor, Casey, et al., 2022; Quinn et al., 2014; Springer et al., 2018). Despite this hypothesis, there appear to be no major studies to date that specifically examine the impact of these clinical experiences on physical therapy students' attitudes, beliefs, and knowledge of chronic pain. Instead, most studies examine didactic pain science courses (Ballengee et al., 2020; Bareiss et al., 2019; Colleary et al., 2017; Cox et al., 2017; Domenech et al., 2011; Wassinger, 2021) pain curricula or elective.

While attitudes, beliefs, and knowledge of chronic pain have been shown to improve throughout a physical therapist's education and professional career, clinical decision-making by physical therapists does not consistently match current CPGs (Alshehri et al., 2020; Chance-Larsen et al., 2020). Chart reviews and patient case scenarios have revealed that physical therapists, particularly those who scored high on the PABS-PT biomedical subscale, continue to prescribe passive treatments, manual therapy, and bracing (Alshehri et al., 2020). Moreover, many practicing physical therapists report feeling uncomfortable managing the psychosocial aspects of chronic pain conditions (Brunner et al., 2018; Cowell et al., 2018; Jacobs et al., 2016;

Roitenberg & Shoshana, 2019). These findings indicate an ongoing need for improving physical therapists' attitudes, beliefs, and knowledge of chronic pain.

Improving Attitudes, Beliefs, and Knowledge

Research supports education targeted toward developing a biopsychosocial approach to improve attitudes, knowledge, and clinical behaviors for chronic pain management. A recent systematic review and meta-analysis indicated an 11.3% improvement in attitudes, an 18.8% improvement in knowledge, and significant positive changes in clinical behavior by health professionals following targeted education (Mankelow, Ryan, Taylor, Casey, et al., 2022). Thompson and colleagues' scoping review (2018) of pain education across disciplines concluded that if students are exposed to pain-specific education, their knowledge, attitudes, and beliefs improved but were still reported as suboptimal (Thompson et al., 2018). A recent metasynthesis of qualitative studies found that while targeted education can shift physical therapists' approach from biomedical to biopsychosocial, this does not always translate to increased confidence in managing chronic pain (Holopainen et al., 2020).

Chronic pain education for physical therapists varies in the literature with approaches including single lectures, stand-alone electives/courses, e-learning modules, semester-long courses, and curricular threads throughout the entry-level curriculum (Ballengee et al., 2020; Chance-Larsen et al., 2020; Colleary et al., 2017; Cox et al., 2017; Thompson et al., 2018; Wassinger, 2021). Recent systematic reviews indicate that training method and duration varies significantly, and there is little consensus on the most effective method for chronic pain education (Holopainen et al., 2020; Mankelow, Ryan, Taylor, Casey, et al., 2022). Furthermore, analysis of curricula across healthcare disciplines found that there were few standards for pain

education from accrediting bodies and policymakers, and the number of hours of pain education in entry-level health profession curricula was highly variable (Thompson et al., 2018).

One systematic review identified that pain neuroscience education resulted in a mean improvement of 18.8% on the rNPQ (95% CI [12.4, 25.3]), though the method of training varied widely, from a single 70-minute session to 15 hours of training over 2 weeks, to 10 one-on-one coaching sessions studies (Mankelow, Ryan, Taylor, Atkinson, et al., 2022). The same variety existed in training approaches for altering attitudes and behaviors. The mean improvement was -11.28% (95% CI [-20.4, -2.2]) on the HC-PAIRS indicating improved attitudes (Mankelow, Ryan, Taylor, Atkinson, et al., 2022). The heterogeneity of educational interventions and study methods limits overall strength of the findings and recommendations (Mankelow, Ryan, Taylor, Atkinson, et al., 2022). Notably, studies with longer educational interventions did not necessarily create a greater impact in pain knowledge, attitudes, or beliefs, and the authors suggested that length of the intervention does not necessarily align with the strength of the pedagogical strategies utilized (Mankelow, Ryan, Taylor, Atkinson, et al., 2022).

Regardless of education structure, most findings concur that providing targeted pain education early, in the entry-level training for physical therapists, will be most effective in creating significant and lasting change in pain attitudes, beliefs, and knowledge (Colleary et al., 2017; de Jesus-Moraleida et al., 2021; Domenech et al., 2011; Holopainen et al., 2020; Mankelow, Ryan, Taylor, Atkinson, et al., 2022). Developers of pain education competencies across a variety of health professions agree that early pain education has multiple benefits: emphasizes the importance of critical competencies and skills, supports a humanistic approach to healthcare, and can potentially reverse the disconnect that can sometimes occur between what is taught in entry-level education and the situations that actually arise in practice (Fishman et al.,

2013; Helms et al., 2023). While the effect sizes for improvements in pain knowledge is similar between healthcare professionals and healthcare students, studies find that students tend to show the greatest mean differences in behaviors and attitudes, so students may be more open to change in these arenas and benefit more from targeted biopsychosocial education (Mankelow, Ryan, Taylor, Atkinson, et al., 2022).

Some authors hypothesize that the failure of targeted pain education to achieve significant, consistent, and lasting improvements has to do with improper implementation of pain education in practice (Thompson et al., 2018). Barriers to implementation include curricular bloat—or lack of time to include pain education—less than ideal pedagogical approaches, needing to increase student confidence, and difficulty facilitating knowledge translation into clinical practice from didactic environments (Thompson et al., 2018). According to focus groups and interviews of clinicians, PT students, and faculty, in order to increase the acceptability and feasibility of pain education in physical therapy training, the material should meet four primary dimensions: 1) ensure pain education is authentic and high fidelity to actual patient scenarios, 2) clearly demonstrate the value added by such education, 3) ensure learning is active and engaging for students, and 4) be upfront about the challenges of pain management and understanding PT scope of practice within that (Thompson et al., 2023).

Researchers suggest that including repeated exposure to content, opportunities for scaffolding of content, use of metacognition, and other methods to improve translation of knowledge and skills into real client situations will optimize learning (Thompson et al., 2018). Furthermore, didactic content emphasizing interdisciplinary approaches, adopting consistent shared terminology around pain, emphasizing positive prognoses for patients with chronic pain, and the importance of early referral can also positively impact health science students' ability to

manage individuals with chronic pain (Helms et al., 2023). After analyzing 25 years of pain education in healthcare, Thompson and colleagues' final suggestion is "to advance pain education by shifting the delivery from a theory dense [environment] to a clinical environment where contextual decision-making in practice is encouraged" (Thompson et al., 2018, p. 2155).

Experiential Learning Theory for Attitudes, Beliefs, and Knowledge

Experiential learning theory is founded on the belief that participation in concrete experiences is the foundation for building and testing cognitive maps that learners can apply to future situations. According to the founding theorist, "learning, change, and growth are seen to be facilitated best by an integrated process that begins with here-and-now experience followed by collection of data and observations about that experience" (Kolb, 1984, p. 21). The four necessary processes for experiential learning are 1) participation in concrete experiences, 2) reflecting on the experience, 3) developing concepts and generalizations about the experience, and 4) testing the implications of those concepts in new experiences (Kolb, 1984).

Experiential learning is a primary foundational theory in health sciences education across various professions—medicine, nursing, and rehabilitation—and is used for various educational applications including teaching, curriculum development, implementation, and program evaluation (Lacasse et al., 2019). Competency-based education frequently used in medical schools emphasizes the approach of "practice education." This "practice" approach focuses on the application of knowledge and skills into real clinical environments through increasingly complex scenarios and emphasizes the importance of multiple exposures throughout the curriculum to optimize conceptual learning (Arwood et al., 2015). This competency-based pedagogy further echoes experiential learning theory by recommending a best practice of follow-up debriefing sessions and reflective writing (Arwood et al., 2015).

The outcomes of experiential learning are positive across a variety of professions. Nursing students demonstrate increased skill acquisition, improved academic performance, deeper learning, and increased engagement during classes following experiential learning (Hill, 2017). A qualitative study of medical students revealed a consistent theme that clinical and personal experience significantly impacts beliefs about pain; clinical placements and the associated patient exposures and clinical conversations with clinical mentors were found to be beneficial for improving understanding of the pain experience and promoting holistic care (Inman & Ellard, 2022).

Furthermore, experiential learning has been identified as one of the most effective methods for improving occupational and physical therapy students' interpersonal skills, professional skills, and clinical reasoning. Studies have found that occupational therapy students demonstrate enhanced understanding and application of didactic coursework, improved personal and professional skills, and improved clinical reasoning following experiential learning (Coker, 2010; Knecht-Sabres, 2013). Physical therapy students likewise demonstrated improved interpersonal skills, confidence, and self-ratings of ability to apply classroom knowledge (Smith & Crocker, 2017). Another study found that dosing of experiential learning is important; "high dose" (15 hours per semester) experiential learning for physical therapy students resulted in significantly greater increases in self-perceived clinical reasoning and self-efficacy compared to "low dose" (3 hours per semester) experiential learning (Flowers et al., 2020). The importance of high dose learning mirrors that described in competency-based educational approaches and experiential learning theory (Arwood et al., 2015).

Clinical experiences are the primary mode of experiential learning in physical therapy educational programs (Smith & Crocker, 2017). In a 2012 cross-sectional survey sent to 207

accredited PT Programs, approximately 90% of respondents reported using clinical education experiences as a primary mode of clinical reasoning development. Clinical education rotations place students in the clinical environment with real patients to practice the affective, cognitive, and psychomotor skills they acquired during the didactic portion of the curriculum (Smith & Crocker, 2017). All students are paired with one or more licensed physical therapists that serve as clinical instructors to oversee their practice and provide feedback (CAPTE, 2020). These vital learning experiences allow students to actively engage in Kolb's four experiential learning processes.

Current Trends in Physical Therapy Education

Entry-level physical therapy programs in the United States culminate in a DPT degree and are typically a 3-year, full-time program that includes didactic and clinical education components. The average program is 80% didactic and 20% clinical education (Commission on Accreditation in Physical Therapy Education [CAPTE], 2022b). CAPTE, the sole accrediting body for U.S. physical therapy programs, requires a minimum of 30 weeks, or 960 hours, of full-time clinical education for all entry-level programs (CAPTE, 2023). They require that students demonstrate entry-level skills in a variety of clinical settings and with a variety of diagnoses across the lifespan; however, there are no specific requirements for duration and setting for each clinical experience (CAPTE, 2020; Ingram & Roesch, 2012). There are also no defined requirements for exposure to any particular diagnosis (including chronic pain) during clinical education.

Until the adoption of new accreditation standards in October 2023, CAPTE's standards for program accreditation did not include any mandates about the integration of pain or chronic illness in the curriculum beyond stating:

> The curriculum includes organized sequences of learning experiences that prepare students to provide physical therapy care to individuals with diseases/disorders involving the major systems, individuals with multiple system disorders, and individuals across the lifespan and continuum of care, including individuals with chronic illness. (CAPTE, 2020, p.22)

The word "pain" occurred only once in the previous 36-page accreditation standards document (CAPTE, 2020, p. 30). The new standards adopted in October 2023 include "pain" six times; twice in the context of "pain and pain experiences" as a required topic to be covered during the curriculum (CAPTE, 2023, p. 41), the same usage under required examination and screening skills (CAPTE, 2023, p. 43), and again under required intervention skills (CAPTE, 2023, p. 45). This emphasis on "pain and pain experiences" in examination and intervention is a notable increase from prior versions. This improvement may be a reflection of suggestions made to CAPTE and significant efforts in research in pain education over the past decade.

In the early 2010s, the IASP convened nine working groups to establish recommended entry-level pain education curricula for multiple health professions, including medicine, nursing, psychology, occupational and physical therapy (IASP, 2018a). Consistent with current clinical practice recommendations, these curricula strongly emphasize a multidisciplinary, biopsychosocial approach. The IASP recommends that the pain curricula be embedded within the general pre-licensure curricula with "content and competencies horizontally and vertically aligned to other units of study such as physiology, anatomy, kinesiology, orthopedics, manual therapy, or physical agents" (IASP, 2018b, para. 11). While the IASP physical therapy curriculum does recommend that educators and clinical supervisors have formal academic qualifications that include a background in pain science, it does not specifically address the

utilization of clinical education in furthering these learning objectives. Of note, integration of the IASP pain education curricula into standard entry-level DPT curricula has not yet been widely accepted or mandated by CAPTE.

Around this same time, a separate interprofessional group of subject-matter experts was convened to examine current literature on pain education in multiple health science entry-level curricula (Fishman et al., 2013). Through their 2-year, iterative process, they also identified that pain education was lacking across all healthcare professions and so they developed four recommended pain management domains and core competencies: 1) Multidimensional nature of pain, 2) Pain assessment and measurement, 3) Pain management, and 4) Clinical conditions/contextual influences (Fishman et al., 2013). This executive panel collaborated with the IASP curricula teams in the development of their suggested competencies and acknowledged that their final domains and competencies paralleled those defined by the IASP. The authors suggested that this alignment would encourage and support educators in developing multidisciplinary curricula that included these competencies (Fishman et al., 2013). They also suggested that accrediting bodies and policymakers consider these competencies when writing their standards.

In 2014, a group of physical therapist pain experts advocated for the application of these competencies into physical therapy curricula specifically (Bement et al., 2014). The authors recognized that current physical therapy curricula emphasized a biomechanical approach to disease management and rarely focused on pain science (Bement et al., 2014). They introduced the recommended domains of competency and illustrated ways in which these domains could be applied to existing physical therapy curricula. Their recommendations addressed only the didactic portion of the curricula—pain-specific courses, threaded pain content in existing

courses, case-based learning, and in-laboratory simulations or standardized patients (Bement et al., 2014). No suggestions were made specific to the approximately 20% of the entry-level education spent in clinical education. However, the authors did suggest that clinical instructors should strive to stay current with pain knowledge and act as "pain experts on the pain management team" (Bement et al., 2014, p. 460).

A 2015 survey of physical therapy programs in the United States found that on average, only 31 hours of the didactic curriculum was devoted to pain education and 61% of faculty felt this was insufficient (Bement & Sluka, 2015). Of the faculty surveyed, less than 50% of respondents reported being familiar with the newly developed recommended curricula for pain education. In 2018, the APTA House of Delegates passed a motion to endorse the IASP pain curriculum and encouraged physical therapist educators to integrate those competencies into existing curricula (APTA, 2018).

In 2021, the APTA Pain Special Interest Group and the Academy of Orthopaedic Physical Therapy published the Pain Education Manual (PEM) to provide further guidance on implementing the IASP pain curriculum including specific curricular planning, course objectives, suggested resources, and additional teaching suggestions (Shepherd et al., 2022). Within this document is the first pointed emphasis on the role of clinical education in teaching student physical therapists about pain. The manual identifies the many topics of pain education that can be reinforced within clinical education: the ability to diagnose pain, screening for risk factors, assessing and managing pain, and engaging in interprofessional pain management (Shepherd et al., 2021). Additionally, the manual urges clinical instructors and academic faculty to integrate the IASP domains of competence and identified seven learning outcomes specific to clinical education (see Table 3) (Shepherd et al., 2021). The authors provide examples and suggestions

for specific clinical instruction and methods for assessing student performance in the clinic using existing tools such as the Clinical Performance Instrument, which is currently the most widely used assessment tool for physical therapy clinical education (Shepherd et al., 2021). Finally, the authors make suggestions for clinical instructor qualifications and professional development (Shepherd et al., 2021).

Table 3

IASP Learning Outcomes for Clinical Education

1. Understand and explain the biopsychosocial model and its relevance to pain, one's response to pain, and the impact of pain on one's life. 2. Apply knowledge of basic science of pain to person-centered assessment and management of pain. 3. Assess or measure the biological, physical, and psychosocial factors that contribute to pain, impairment, and disability using valid and reliable assessment tools. 4. Develop an evidence-based management program in collaboration with the client/patient/family, directed at modifying pain and encouraging helpful behaviors, promoting tissue healing, improving function, reducing disability, and facilitating recovery. 5. Implement management that includes patient education, active approaches such as functionally oriented behavioral-movement reeducation approaches and exercise, passive approaches such as manual therapy (where indicated and avoiding erroneous and potentially catastrophic rationales such as 'realignment,' 'stabilizing,' 'correcting'), and the application of electro-physical agents as indicated. 6. Demonstrate awareness of other professionals' skills and competencies to enable appropriate and timely collaboration on referral. 7. Communicate appropriate information to other health professionals involved in providing patient care to optimize interdisciplinary management, including medical and surgical, behavioral, and psychological, or pharmacological approaches.

(Shepherd et al., 2021, p. 24)

Shepherd and colleagues (2022) suggested several updates to CAPTE standards to reflect pain education competencies and worked with CAPTE officials to increase emphasis on pain science in physical therapy programs nationwide. As mentioned, several additions of "pain and pain experiences" were added to the October 2023 version of the CAPTE standards, but these updates do not appear to fully reflect the suggested changes promoted by Shepherd et al. (2022) and the IASP.

Furthermore, the National Physical Therapy Exam (NPTE)—which is the board exam all student physical therapists must pass before they can become licensed—had no guidelines to include pain-specific content until January 2024 (Shepherd et al., 2022). Pain exists within the NPTE under the "systems interactions" category, which makes up only eight to 10 questions on the 180-item exam. Until January 2024, the blueprint for exam questions did not specifically require the word "pain," which meant that exam writers did not *need* to include test questions specific to pain and the pain experience (Shepherd et al., 2022). Entry-level physical therapy programs must teach content that will ultimately lead to passing the NPTE; a lack of emphasis on pain in the NPTE may convey a lack of importance and does not incentivize programs to change their existing curricula to integrate more pain-specific content. This lack of pain content on the NPTE also makes assessing new graduates' competence and understanding of pain difficult (Shepherd et al., 2022).

Over the past decade, pain experts within the physical therapy community collaborated with the Federation of State Boards of Physical Therapy (FSBPT)—who create the NPTE—to enact changes for pain content (Shepherd et al., 2022). Perhaps a reflection of these efforts, the newest NPTE content outline effective January 2024 specifically lists "Dimensions of pain (acute or persistent) that impact patient/client management (e.g., psychological, social,

physiological, neurological, mechanical)" as an element of "Systems Interactions" (FSBPT, 2023, p. 10). It will be some time before the impact of this new element on program curricula and new graduate competence can be assessed.

Future Directions in Research

Despite a strong push to incorporate pain competencies into didactic and clinical curricula, clinical education making up a significant portion of the entry-level physical therapy curriculum, and evidence that increased experience would improve attitudes, beliefs, and knowledge, research specific to the impact of clinical education on chronic pain management is sparse. It is reasonable to hypothesize that more exposure to patients with chronic pain would allow for more experiential learning opportunities. In turn, this has the potential to impact physical therapy students' attitudes, beliefs, and knowledge of chronic pain more positively.

However, there is little consistency in the setting, patient population, and clinical instruction during clinical education experiences, and frequent encounters with patients with chronic pain cannot be guaranteed (McCallum et al., 2013). Certain clinical practice settings could offer more opportunity for this exposure but research examining the prevalence of chronic pain by setting is lacking and warrants more attention.

Additionally, the importance of deliberate practice and structured feedback to experiential learning should not be ignored. It is possible that a clinical instructor's knowledge of chronic pain and post-graduate education or certifications could influence the ability to give appropriate feedback and therefore influence the success of the experiential learning process. This would support IASP and PEM recommendations that clinical supervisors have formal academic qualifications and a background in pain science. Despite increasing discussion in current literature about the importance of developing clinical instructor competencies, there are

currently no competencies or formal requirements in place (Bilyeu et al., 2021; Ingram & Roesch, 2012). There is a clinical instructor credentialing program offered by the APTA, but it is not specific to pain science, nor is completion of this course mandatory (APTA, n.d.-b). It could be important to understand what elements of clinical instructor preparation provides the most beneficial learning experience for student physical therapists when it comes to chronic pain.

Given the prevalence and cost of chronic pain, healthcare providers must be adequately prepared to manage it. Research has demonstrated the importance of early, integrated pain science education for physical therapy students. Furthermore, experiential learning is a highly effective way to improve professional skills and clinical reasoning. To maximize learning, it would be important to examine if chronic pain attitudes, beliefs, and knowledge are significantly impacted by clinical education experiences, as well as what elements of the clinical experience may be most impactful (e.g., volume of patients with chronic pain, setting of the clinical experience, the qualifications or preparation of the clinical instructor). Knowing this information allows physical therapy program faculty to optimize the clinical education component of their curriculum and cultivate optimal attitudes, beliefs, and knowledge of chronic pain management.

Chapter Three

Methods

Study Design

This study used a nonexperimental, correlational, pretest-posttest design to investigate the relationship between clinical education and student physical therapists' attitudes, beliefs, and knowledge of chronic pain management. Independent variables of interest during the clinical education rotation include 1) the general completion of a full-time clinical experience, 2) percent of caseload that is chronic pain during that clinical experience, 3) the sequence of the clinical experience (initial [first experience], intermediate [mid-didactic curriculum], or terminal [a final clinical experience at which entry-level performance is expected upon completion]), 4) setting of the clinical experience (practice environment—e.g., outpatient, acute care, inpatient rehabilitation), and 5) presence of a clinical instructor with advanced preparation—including completion of a doctorate, residency/fellowship, or board certification.

Instruments

Knowledge of chronic pain was measured using the revised Neurophysiology of Pain Questionnaire (rNPQ). The rNPQ is a 12-item, true/false scale designed to measure knowledge of pain neuroscience (Appendix A). Scores can range from zero to 12 with higher scores indicating increased knowledge (Catley et al., 2013). As discussed in Review of the Literature, the rNPQ has been shown to be a reliable and valid measure of this construct. Permission was received from the author of the instrument to be utilized in this research.

Attitudes and beliefs toward chronic pain were measured using the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS). The HC-PAIRS is a 15-item scale, scored 15 to 105, developed to identify healthcare providers' attitudes and beliefs about

their patients' ability to function with chronic pain (Appendix B). Higher scores on the HC-PAIRS indicate a negative attitude, demonstrating a provider's increased belief that chronic pain justifies functional impairment and disability (Rainville et al., 1995). As discussed in the Review of Literature, the HC-PAIRS has been shown to be a reliable and valid measure of this construct. Multiple attempts were made to contact both the primary and secondary authors of this tool to obtain permission to utilize it in this study, but contact could not be established. The wording of the HC-PAIRS includes "chronic back pain" as the diagnosis of interest, despite numerous studies using the scale to assess knowledge of chronic pain beyond the back region. To better refine the HC-PAIRS to the purposes of this study, the word "back" was omitted to simply state "chronic pain."

Participants and Sampling

Participants of the current study were students from four CAPTE accredited physical therapy programs in the United States. These programs are a convenience sample from the investigator's established professional network but represent a variety of institution types (see Table 4).

Table 4

Target Programs

School	**Institution Type**	**Carnegie Classification**	**Average Cohort Size**
Mary Baldwin University (MBU), Fishersville, VA	Small, Private	Doctoral/Professional University	30
Radford University (RU), Roanoke, VA	Medium, Public	Doctoral/Professional University	30
Washington University in St. Louis (WUSTL), St. Louis, MO	Large, Private	R1: Doctoral University – Very high research activity	88
Winston Salem State University (WSSU), Winston-Salem, NC	Small, Public, HBCU	Doctoral/Professional University	28

For a repeated measures, two-tailed t-test with 80% power, 0.3 effect size, and $\alpha = .05$, according to G*power (Faul et al., 2007), a sample size of 90 participants with matched pre-rotation and post-rotation surveys would be needed. This study collected data from mid-April 2023 through the end of December 2023. According to posted curriculum data, this timeframe had the potential to capture 11 clinical rotations across the four programs (see Table 5). This allowed potential data capture from a total of approximately 352 students and 498 student clinical experiences—because some of these clinical experiences were from the same students in sequential rotations during the curriculum, a mixed model analysis was required.

Table 5

Target Programs Clinical Education Rotation Curricula

School	**Sequence of Rotations: Program Year, Total Weeks, Academic Semester**	**Approximate Cohort Size**
Mary Baldwin University (MBU), Fishersville, VA (MBU, 2022)	1st: year 1, 4 weeks, Apr-May* 2nd: year 2, 4 weeks, Apr-May* 3rd: year 3, 16 weeks, Aug-Dec* 4th: year 3, 16 weeks, Jan-Apr	30
Radford University (RU), Roanoke, VA (RU, 2022)	1st: year 1, 12 weeks, May-Aug* 2nd: year 2, 12 weeks, May-Aug* 3rd: year 3, 12 weeks, Jan-Apr	30
Washington University in St. Louis (WUSTL), St. Louis, MO (WUSTL, 2022)	1st: year 1, 8 weeks, May-Jul* 2nd: year 2, 8 weeks, Jan-Feb 3rd: year 3, 10 weeks, Jul-Sep* 4th: year 3, 12 weeks, Sep-Dec*	88
Winston Salem State University (WSSU), Winston-Salem, NC (WSSU, 2017)	1st: year 2, 8 weeks, Mar-May 2nd: year 2, 8 weeks, Oct-Dec* 3rd: year 3, 8 weeks, Jul-Sep* 4th: year 3, 8 weeks, Oct-Dec*	28

* rotation could be captured during the study timeline

Institutional Review Board

The Radford University Institutional Review Board provided expedited review for the study (approval #2023-052-RUC). During the survey, students were asked to create a unique

identifier that would be used to match the pretest to the posttest. Researchers did not have access to institutional identification numbers or databases to identify student participants. All data was stored securely in Qualtrics, Excel, and a password-protected laptop depending upon the stage of the project. Data will be stored in a password-protected drive for a minimum of 3 years post completion of the study. Only the capstone author, committee members, and affiliated statisticians had access to the raw data, though participating programs/Director(s) of Clinical Education (DCE) will have access to a summary report.

Because ID numbers were not matched to student names or student institutions, there was no risk that any breach of data would allow the collected data to be tied back to the student participants or participating institutions. If there were to be a data breach, the DCE of the participating programs would be notified so that information could be disseminated to the participating students. Students would be invited to contact the Primary Investigator with any questions or concerns.

Research Procedures

To gain access to students at the correct time in the curriculum, the DCE at the target programs were contacted. The DCE was invited to participate in the study and informed of the minimal time commitments of participation, which included only sending survey links at designated times around pre-existing clinical education rotations. They were further incentivized to participate with offers to share final, deidentified data sets and results for potential program optimization. Participating programs, DCEs, or students received no additional compensation for participating. All program DCEs agreed to participate as described.

Once a DCE agreed to participate, they were asked to distribute the electronic survey link to a survey built using Qualtrics. A standard form email with the link was provided to further

simplify the dissemination process. Students were provided the link by the DCE at their program in the week before the start of the clinical experience being assessed. The first page of the online survey platform included the consent form (Appendix C). Upon consenting, students proceeded to the questionnaire, which they completed through question #35 (see Codebook, Appendix D), which includes the rNPQ, the HC-PAIRS, and some demographic and curricular questions, but omits the patient population data and clinical instructor data. Students were asked to input a unique identifier number for pretest-posttest matching purposes and could not be matched back to their institution for further identification.

The DCE was reminded to send the link again to the same students in the week following the completion of the clinical experience. The DCEs received an email reminder from a primary investigator to remind them to send this link at the required time, which again included a form email to ease distribution. Students were again asked to consent to participate via the online survey platform and complete the survey in its entirety which includes the rNPQ, the HC-PAIRS, the same demographic and curricular questions, as well as the patient population data and clinical instructor data questions post clinical rotation.

The survey process remained open through the end of the Fall 2023 semester to capture multiple clinical education rotations or multiple cohorts at each program. At the end of the Fall 2023 semester, the participating DCEs were contacted to ensure that there are no longer any students in the process of completing their clinical rotations to ensure no posttest data is outstanding.

Limitations

Given the variability in curriculum across programs (McCallum et al., 2013), the sequence and duration of each clinical experience is not consistent across programs, and the

didactic coursework completed before each rotation will not be consistent. Students could have varying levels of academic preparation before their clinical experience.

Given a lack of standards for clinical instructor training (McCallum et al., 2013), students may have differing levels of mentorship and structure while on the clinical experience, which could also impact change in attitudes, beliefs, and knowledge.

Delimitations

Given that this study is limited to entry-level physical therapy programs in the United States, it may not be generalizable to post-professional (transitional) physical therapy programs in the United States, to entry-level physical therapy programs in other countries, or to physical therapist assistant programs in any country.

Assumptions

Since physical therapy students are introduced to the concepts of diagnosis and pain early in the curriculum, and emerging diagnostic and screening skills are designated by the American Council of Academic Physical Therapy (ACAPT) as minimum requirements for readiness for full-time clinical education experiences (ACAPT, 2018; Timmerberg et al., 2019), it is assumed that students will be able to accurately identify patients with chronic pain in the clinic.

Data Analysis

Data was exported from the survey tool to Microsoft Excel 2016™ and was coded per Appendix D. The correct responses to the rNPQ (Appendix A) were coded as “1” and incorrect responses coded as “0” to facilitate scoring of the instrument in the data analysis phase. The HC-PAIRS was coded with some of the scales reversed as instructed for the tool. Recoding was completed to score the rNPQ and HC-PAIRS, as well as determine the difference between pre- and posttest scores.

Analysis of Matched Sets

Posttest surveys were linked to pretest surveys using the provided unique identifier (ID) numbers. In cases where the ID number expressed error, additional matches were identified using a cluster of shared identifiers: matching IP addresses and matching demographic information alongside an ID number that was similar indicating a typographical error or memory failure was likely, or in which the student had indicated memory failure (e.g., "I don't remember"). Ultimately, 16 matched sets were identified for analysis.

Given the small number of matched data sets, and the ability to ensure that there were no duplicated students in the data set, comparisons between pre- and posttest scores was conducted using a paired t-test to determine whether the mean between paired values is statistically different from zero. Statistical significance was set at $p < .05$ for all analyses. Mixed model analysis regression was used to measure the degree of relationship between the percentage of caseload that is chronic pain and the difference in HC-PAIRS and rNPQ scores seen while on clinical rotation. Mixed model analysis one-way ANOVA was used to measure if the sequence or setting are associated with statistically significant differences in HC-PAIRS and rNPQ score change during clinical education. For advanced CI preparation (DPT, fellowship, residency, or board certification), a mixed model analysis of three simple linear regressions and one multiple regression were performed. Any students who identified they were "unsure" of their CI's preparation were omitted from that regression. The data analysis table tying statistical tests to hypotheses can be found in Appendix E.

Analysis of Individual Data Sets

In addition to analysis of the matched data sets, the data of all completed responses were analyzed. During the data collection period, it was possible to capture surveys from two cohorts

of students at each of the four participating institutions (total of eight cohorts). For three of these cohorts, sequential rotations were captured; for example, MBU cohort A was surveyed for their second and third clinical experiences. To avoid duplication of a single participant's data in this analysis, data was examined using ID numbers or a preponderance of matching demographic information and IP addresses to identify sequential rotations for a single student. If any data sets were identified as being from the same student in sequential rotations, only their first of the sequential rotations was used and the response for the second was discarded, leaving 91 data sets for additional analysis. From the completed data sets with sequential student responses removed, the average rNPQ and HC-PAIRS scores were compared to pre- or post-clinical and sequence of the experience using a Welch's test (t-test: two-sample assuming unequal variances).

Chapter Four

Results

This chapter will cover the results of the survey and statistics related to those results. This section will begin by providing descriptive statistics of the data, addressing the research questions specifically, and then addressing additional findings and analysis from the data.

Sample

The survey collected 130 total responses between April 2023 and December 2023. Twenty submissions were incomplete and one response was completed erroneously with multiple empty questions and other selections being the same value throughout; therefore, these responses were discarded, leaving 108 responses. Of these, nine responses were completed only through the first page (the rNPQ). The mean rNPQ score was 8.45 (N = 108, SD = 1.76). Three responses were completed only through the second page (the HC-PAIRS) omitting demographic data, meaning 99 HC-PAIRS were completed. The mean HC-PAIRS score was 50.52 (SD = 8.62). Ninety-seven responses were 100% completed.

Posttest surveys were initially linked to pretest surveys using the provided unique identifier numbers; however, students surveyed clearly struggled to remember their self-selected ID numbers and only 14 pretests were successfully matched to posttests using the self-selected ID. Five additional matches were able to be identified using a cluster of shared identifiers: matching IP addresses and matching demographic information alongside an ID number that was similar. Three of these matched sets were identified as being a submission from a single student entering a sequential clinical experience and so only their first rotation survey set was used to prevent duplication of a single student's outcomes and best represent their first exposure to the survey and the tools therein. The remaining 16 matched pairs were utilized for analysis.

Analysis of Matched Sets

Of the 16 students, 13 identified as female, two identified as male, and one identified as non-binary. The ages of the students ranged from 22 to 36 with the average being 25.63 (SD = 3.75). Each sequence of clinical experience was represented in these matched sets: seven were from an initial clinical experience, four from an intermediate clinical experience, and five from a terminal clinical experience. All but two clinical experience settings were represented in this sample. Table 6 provides the distribution of settings.

Table 6

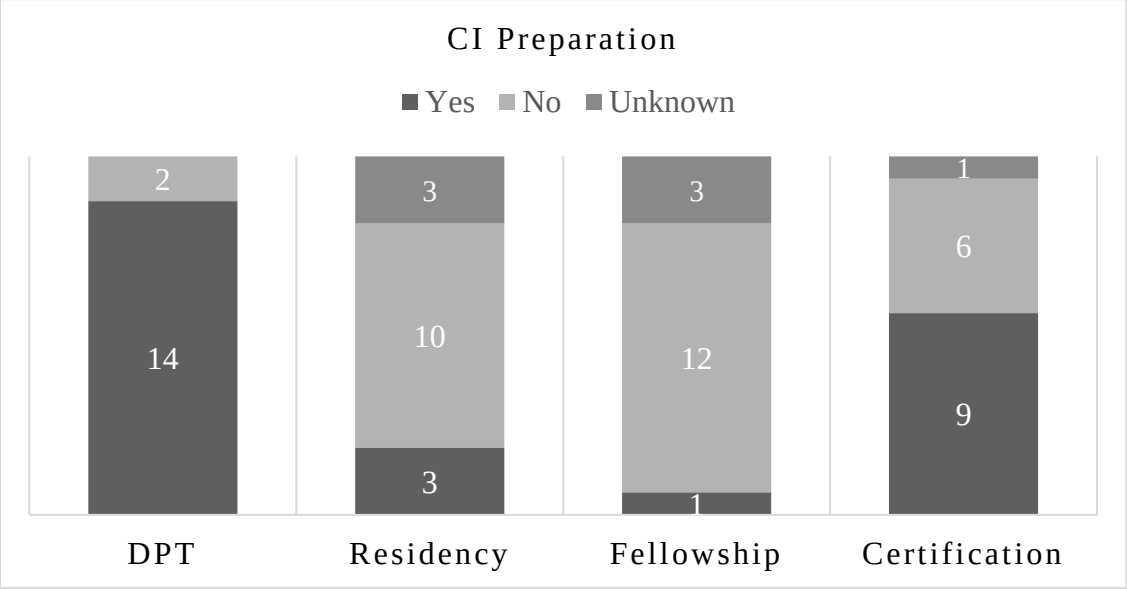
Number of Students by Clinical Experience Setting

Setting	*N*
Acute care	2
Inpatient Rehab	3
Skilled Nursing Facility	0
Home Health	0
Pediatrics	1
Outpatient Neuro	2
Outpatient Orthopedics	6
Other	2

Students from the matched data set reported a wide range of exposure to patients with chronic pain, ranging from 0% to 38.83% of their reported caseload. The mean percentage of caseload was 18.51% (SD = 12.29%). Student-reported clinical instructor preparation identified that 14 clinical instructors had obtained a DPT, three had completed a residency (three unknown), one had completed a fellowship (three unknown), and nine had obtained board certification (one unknown). Figure 2 provides a visual representation of CI preparation.

Figure 2

Clinical Instructor Preparation



Research Question 1: Is clinical education significantly associated with physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

The first hypothesis for this question was that students will demonstrate significantly improved attitudes and beliefs toward chronic pain management following clinical education experiences. The mean HC-PAIRS pre-rotation score was 53.5 (SD = 7.72). The mean post-rotation score was 52.25 (SD = 9.91). Because the small number of matched pre- to post-rotation data sets and the ability to ensure that there were no duplicated students in the sample, a paired t-test was the most appropriate statistical test to assess for statistically significant differences in the means. Despite an apparent improvement in mean attitudes and beliefs based on the decrease in mean HC-PAIRS score, the difference between the two means is not statistically significant, $t(15) = -0.66$, $p = 0.52$, and the null hypothesis cannot be rejected; clinical education was not significantly associated with physical therapy students' attitudes and beliefs about chronic pain management.

The second hypothesis was that students will demonstrate significantly improved knowledge of chronic pain following clinical education experiences. The mean rNPQ pre-rotation score was 8.5 (SD = 1.71). The mean post-rotation score was 8.75 (SD = 1.48). Despite an apparent improvement in mean knowledge based on the rNPQ score increasing, the difference between the two means is not statistically significant, $t(15) = .75$, $p = 0.47$, and the null hypothesis cannot be rejected; clinical education was not significantly associated with physical therapy students' knowledge of chronic pain management.

Research Question 2: Is the percentage of caseload/number of patients with chronic pain seen associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

The first hypothesis was that the number of patients with chronic pain that students encounter while in clinical education experiences will significantly correlate with improvement in physical therapy students' attitudes and beliefs towards chronic pain management. The mean percentage of caseload was 18.51% (SD = 12.29%). The mean pre-rotation HC-PAIRS score was 53.5 (SD = 7.72) and the mean post-rotation score was 52.25 (SD = 9.91) resulting in a mean difference in HC-PAIRS score of -1.25 (SD = 7.56). There was minimal correlation of HC-PAIRS score change with percentage of caseload, which did not reach statistical significance ($r(15) = .03$, $p = .90$). Given the lack of correlation, the original statistical analysis plan of linear regression to determine the magnitude and direction of any relationship was unnecessary. However, the planned statistical analysis was performed, which again confirmed a very small negative correlation—for every one SD increase in percent of caseload, the HC-PAIRS score would be expected to decrease by .03 SD—which also did not reach statistical significance ($R^2 = .001$, $F(15) = 0.02$, $p = .90$, $\beta = -0.03$, 95% CI [-37.33, 33.13]) and the null hypothesis cannot be

rejected; the percentage of caseload that was patients with chronic pain did not significantly predict development of physical therapy students' attitudes and beliefs about chronic pain management.

The second hypothesis was that the number of patients with chronic pain that students encounter while in clinical education experiences will significantly correlate with improvement in physical therapy students' knowledge of chronic pain. The mean pre-rotation rNPQ score was 8.5 (SD = 1.71) and the mean post-rotation score was 8.75 (SD = 1.48) resulting in a mean difference in rNPQ score of 0.25 (SD = 1.34). There was minimal correlation of rNPQ score change with percentage of caseload, which did not reach statistical significance ($r(15) = .09$, $p = .75$). Again, despite lack of significant correlation, planned linear regression was performed, which indicated for every one SD increase in percent of caseload, the rNPQ score would be expected to increase by .09 SD ($R^2 = .007$, $F(15) = 0.10$, $p = .75$, $\beta = .09$, 95% CI [-5.3, 7.17]) and the null hypothesis cannot be rejected; the percentage of caseload that was patients with chronic pain did not significantly predict development of physical therapy students' knowledge of chronic pain management.

Research Question 3: Is sequence of the clinical education experience associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

The first hypothesis was that sequence of the clinical experience will significantly correlate with changes in physical therapy students' attitudes, and beliefs toward chronic pain management. In the matched data pairs, there were seven for initial clinical experiences, four for intermediate clinical experiences, and five for terminal clinical experiences. The average pre-

rotation and post-rotation scores, as well as mean score changes for HC-PAIRS and rNPQ scores by sequence can be found in Table 7.

Table 7

Mean Score Change by Clinical Experience Sequence

Clinical Sequence	*#*	*Mean pre-rotation score*	*Mean post-rotation score*	*Mean score change*
			HC-PAIRS	
Initial	7	55.14 (SD = 6.09)	55.14 (SD = 5.52)	.00 (SD = 6.58)
Intermediate	4	54.75 (SD = 9.60)	55.25 (SD = 2.99)	.50 (SD = 7.55)
Terminal	5	50.2 (SD = 8.87)	45.8 (SD = 15.50)	-4.40 (SD = 9.40)
			rNPQ	
Initial	7	8.42 (SD = 2.15)	8.71 (SD = 1.60)	.29 (SD = 1.70)
Intermediate	4	8.5 (SD = 1)	9.5 (SD = 1)	1.00 (SD = 1.15)
Terminal	5	8.6 (SD = 1.82)	8.2 (SD = 1.64)	-.40 (SD = .55)

Terminal rotations demonstrated the greatest decrease in HC-PAIRS score (indicating improved attitudes and beliefs) and intermediate rotations actually demonstrated a mean increase in HC-PAIRS score (indicating a worsening of attitudes and beliefs). There was almost no change in mean HC-PAIRS score with initial rotations. However, using one-way ANOVA none of these observations reached statistical significance ($F(15) = .60$, $p = .56$) and the null hypothesis cannot be rejected; sequence of the clinical education experience was not significantly associated with development of physical therapy students' attitudes and beliefs about chronic pain management.

The second hypothesis was that sequence of the clinical experience will significantly correlate with changes in physical therapy students' knowledge of chronic pain. There was very minimal change in rNPQ score for all rotation sequences, but terminal rotations demonstrated the greatest change in score of one point but in a negative direction indicating knowledge decreasing. Again, there was no statistically significant association between sequence of the

clinical education sequence and rNPQ score ($F(15) = 1.26$, $p = .32$) and the null hypothesis cannot be rejected; sequence of the clinical education experience was not significantly associated with development of physical therapy students' knowledge of chronic pain management.

Research Question 4: Is the setting of the clinical education experience associated with progression in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

In the matched data pairs, there were five clinical experience settings represented. Two students indicated "other setting" for their rotation, which was a mix of two settings—these were excluded from the analysis. Mean differences for HC-PAIRS and rNPQ scores between clinical experience settings can be found in Table 8.

Table 8

Mean Score Change by Clinical Experience Setting

		HC-PAIRS		rNPQ	
Clinical Setting	*#*	*Mean change*	*SD*	*Mean change*	*SD*
1: Acute	2	7	0	0	0
2: IP Rehab	3	-0.67	11.50	0	1.73
3: SNF	0	n/a	n/a	n/a	n/a
4: HH	0	n/a	n/a	n/a	n/a
5: Peds	1	-16	n/a	0	n/a
6: OP Neuro	2	-2.50	4.95	2	0
7: OP Ortho	6	-1.33	6.09	0	1.67

One-way ANOVA was only conducted for settings that had three or more observations (inpatient rehab and outpatient ortho). The first hypothesis was that setting of the clinical experience will be significantly associated with changes in physical therapy students' attitudes and beliefs toward chronic pain management. The mean pre-rotation HC-PAIRS score for outpatient orthopedics was 56.33 (SD = 7.50), and the mean post-rotation score was 55 (SD =

5.76), resulting in a mean score difference of 1.33 (SD = 6.09). The mean pre-rotation HC-PAIRS score for inpatient rehab was 42.67 (SD = 6.51), and the mean post-rotation score was 42 (SD = 15.87), resulting in a mean score difference of -0.67 (SD = 11.50). While outpatient orthopedics had a higher average reduction in HC-PAIRS score than inpatient rehabilitation, the difference in HC-PAIRS scores by clinical education setting was not statistically significant ($F(8) = .01$, $p = .91$) and the null hypothesis cannot be rejected; setting of the clinical education experience was not significantly associated with progression in physical therapy students' attitudes and beliefs about chronic pain management.

The second hypothesis was that setting of the clinical experience will be significantly associated with changes in physical therapy students' knowledge of chronic pain. The mean pre-rotation rNPQ score for outpatient orthopedics was 8.83 (SD = .98), and the mean post-rotation score was 8.83 (SD = 1.17). For inpatient rehab, the mean pre-rotation rNPQ score was 9 (SD = 1.73), and the mean post-rotation score was also 9 (SD = 1.73). This amounts to a mean change in rNPQ score of zero for both settings and therefore there was no statistically significant difference in rNPQ score by clinical education setting ($F(8) = .00$, $p = 1$) and the null hypothesis cannot be rejected; setting of the clinical education experience was not significantly associated with progression in physical therapy students' knowledge of chronic pain management.

Research Question 5: Is the preparation of the clinical instructor associated with progression in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?

The first hypothesis was that the preparation of the clinical instructor would be significantly associated with physical therapy students' attitudes, and beliefs toward chronic pain management. The second hypothesis was that the preparation of the CI would be significantly

associated with physical therapy students' knowledge of chronic pain. Simple and multiple regression analysis can be found in Table 9.

Table 9

Clinical Instructor Preparation and Score Change Regression Statistics

	HC-PAIRS					*rNPQ*				
CI Preparation	*r*	R^2	*F*	*df*	*p*	*r*	R^2	*F*	*df*	*P*
DPT	.14	.02	.29	15	.60	.22	.05	.70	15	.42
Residency	.23	.05	.59	12	.46	.15	.02	.24	12	.63
Fellowship	.28	.08	.90	12	.36	.23	.05	.63	12	.44
Certification	.37	.14	2.08	14	.17	.52*	.27	4.80	14	.047
Multi	.45	.21	.52	12	.73	.72	0.52	2.15	12	.17

* $p < 0.05$

The only statistically significant association identified was between CI board certification and students' knowledge of chronic pain, demonstrating a moderate, positive linear correlation ($r(14) = .52$, $p < .05$). Linear regression indicated that 27% of the variability in rNPQ score change could be explained by the presence of a board-certified CI ($R^2 = .27$, $F(14) = 4.80$, $p < .05$). Otherwise, there were no statistically significant associations between HC-PAIRS or rNPQ score change and any other element of clinical instructor preparation. Therefore, the null hypotheses can only be rejected for the association of CI board certification on students' progression of chronic pain knowledge.

Additional Exploratory Data Analysis

From the 97 completed surveys, six responses were identified as a single student taking the survey across sequential rotations. To prevent duplication of a single participant's data in analysis, the later submissions of these six were discarded and 91 data sets remained for additional analysis. Students reported an extremely wide range of exposure to patients with chronic pain, ranging from 0% to 100% of their caseload with a mean of 27.67% (SD = 22.39%).

The completed data sets were grouped by pre- versus post-rotation for each of the rotation sequences—initial, intermediate, and terminal. Average rNPQ and HC-PAIRS scores were compared (see Table 10). Data was analyzed to look for any trends in knowledge, attitudes, or beliefs as clinical experiences, or education in general, progressed.

Table 10

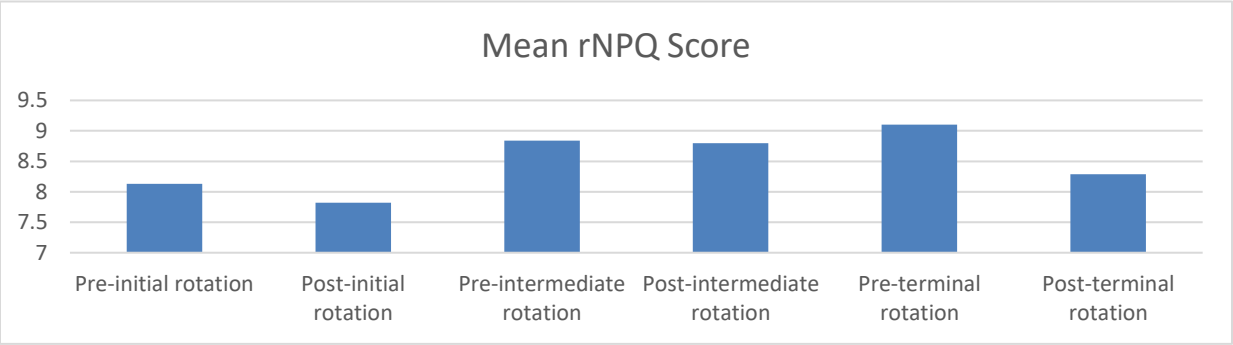
Mean Scores by Sequence

	N	*Mean rNPQ Score*	*Mean HC-PAIRS Score*
Overall	91	8.45 (SD = 1.78)	53.12 (SD = 8.86)
Pre-initial rotation	15	8.13 (SD = 2.03)	56.67 (SD = 5.65)
Post-initial rotation	17	7.82 (SD = 1.98)	56.59 (SD = 9.91)
Pre-intermediate rotation	25	8.84 (SD = 1.57)	52.6 (SD = 7.96)
Post-intermediate rotation	10	8.80 (SD = 1.54)	51 (SD = 4.85)
Pre-terminal rotation	10	9.10 (SD = 0.99)	49.50 (SD = 8.83)
Post-terminal rotation	14	8.29 (SD = 2.13)	50 (SD = 9.49)

During the initial clinical experience, the average rNPQ score changes appear to indicate decreasing knowledge of chronic pain; however, this was not statistically significant ($t(29) = 0.44$, $p = .67$). During the intermediate clinical experience, rNPQ score again appears to go down very slightly but was not statistically significant ($t(17) = 0.07$, $p = .95$). Finally, during terminal clinical experiences, rNPQ score once more appears to go down but this was still not statistically significant ($t(20) = 1.25$, $p = .22$) (see Figure 3).

Figure 3

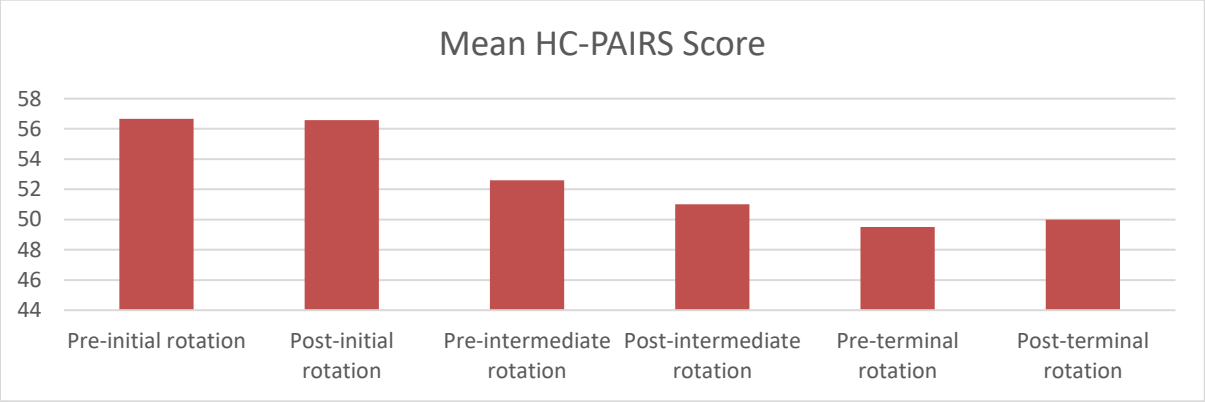
Mean rNPQ Score Over Time



Overall, the mean HC-PAIRS score decreases as the curriculum progresses. During the initial and intermediate clinical experiences, the average HC-PAIRS score goes down very slightly; however, neither were statistically significant ($t(26) = 0.03$, $p = .98$ and $t(27) = .72$, $p = .48$, respectively). During the terminal clinical experiences, the average HC-PAIRS score actually increased slightly, though this was still not statistically significant ($t(20) = -0.13$, $p = .90$) (see Figure 4).

Figure 4

Mean HC-PAIRS Score Over Time



This chapter outlined the survey results and statistical analysis of the data. Overall, response rate was low and successful matching of pre- and post-rotation surveys was limited. For the original research questions, no null hypotheses were able to be rejected due to low statistical significance except for the impact of CI board certification on students' knowledge of pain. Additional exploratory data analysis yielded some apparent trends without statistical significance. Chapter five will provide additional discussion of these results.

Chapter Five

Discussion

The purpose of this study was to examine the association of exposure to patients with chronic pain during clinical education rotations with U.S. physical therapy students' attitudes, beliefs, and knowledge of chronic pain management. The response to the survey was limited. It was possible to capture 996 surveys (pre- and post-rotation) from 498 student clinical rotations and the survey received 97 completed responses, which is a 9.74% response rate. If all students had completed their pre-/post-rotation surveys, there was a potential to capture 498 matched data sets. If duplicates of the same student (from sequential rotations) were then excluded, this would have resulted in a possible 352 matched data sets. Only 16 matched data sets were collected and identified for analysis (with duplicate students excluded), which is a 4.55% success rate for obtaining matched sets. Because of the small sample size, it is unlikely to result in a statistically significant difference due to lack of statistical power even if findings are similar to those previously reported in the literature. According to G*power (Faul et al., 2007), a sample size of 90 matched pairs would have been needed to achieve 80% power, for a moderate effect size and $\alpha = .05$. The trends and findings noted in this discussion are presented acknowledging that they are not statistically significant.

Progression Through the Curriculum

Knowledge: The rNPQ

This study found an average rNPQ score for the overall sample of 8.45 out of 12 (SD = 1.78), or 70.42%. This falls within the score range (40% to 75%) for physical therapists previously reported in the literature (Bareiss et al., 2019; Mankelow, Ryan, Taylor, Casey, et al., 2022; Saracoglu et al., 2021; Springer et al., 2018; Talmage et al., 2020). The average HC-

PAIRS score for the overall sample was 53.12 (SD = 8.86), which also falls within the score range (67.92 - 41.35) previously reported in the literature (de Jesus-Moraleida et al., 2021; Mankelow, Ryan, Morris, et al., 2021; Mukoka et al., 2019; Quinn et al., 2014; Springer et al., 2018; Talmage et al., 2020). The similarities in scores from this study to prior findings supports the potential generalizability of this study and lends validity to prior reports as well.

For the matched pairs sample (N = 16), the average rNPQ score improved from 8.5 (SD = 1.71) to 8.75 (SD = 1.48) which amounts to a 2.09% improvement in knowledge of chronic pain during the clinical rotation. This is less than the suggested MCID of 7.3% (Mankelow, Ryan, Taylor, Atkinson, et al., 2022), and also far less than the 18.8% (95% CI [12.4, 25.3]) improvement reported by Mankelow, Ryan, Taylor, Casey, et al. (2022) following targeted pain education. Certainly, general clinical education involves significant variety and variability, so cannot be expected to achieve equivalent outcomes to a more focused program.

When differentiating the matched pair sets by the sequence of rotation—initial, intermediate, and terminal—knowledge demonstrated very minimal change for any particular sequence except for a small, non-significant decrease during terminal rotations. For the entire sample, score on the rNPQ increased over the course of the curriculum. However, it appears that knowledge of chronic pain decreased during clinical rotations, and only increased during the didactic portions of the curriculum. This aligns with prior findings that rNPQ scores increase as physical therapy students' progress through their education (Adillón et al., 2015; Bareiss et al., 2019), but is inconsistent with the suggestions of Thompson and colleagues (2018) and experiential learning theory that would have anticipated a greater improvement during learning situated in a clinical environment (Kolb, 1984).

Attitudes and Beliefs: The HC-PAIRS

For the matched pairs sample, the average HC-PAIRS score improved from 53.5 (SD = 7.72) to 52.25 (SD = 9.91) during clinical rotations. This represents only a 1.19% improvement in attitudes and beliefs during the clinical rotation which falls below the recommended MCID of 4.6% (Mankelow, Ryan, Taylor, Atkinson, et al., 2022). This is also far less than the 11.28% improvement reported by Mankelow, Ryan, Taylor, Casey, et al. (2022) following targeted pain education. Again, clinical education experiences do not specifically target pain education and so outcome expectations are not equivalent.

When differentiating the matched pair sets by the sequence of rotation—initial, intermediate, and terminal—attitudes and beliefs demonstrated the greatest improvement during terminal rotations. Students in intermediate rotations actually demonstrated a worsening of attitudes and beliefs, and there was almost no change for students in their initial rotations. For the entire sample, when examining the mean HC-PAIRS at different points throughout the curriculum, attitudes and beliefs toward chronic pain steadily improve throughout, including a slight improvement while on clinical rotations except for a slight worsening during the terminal rotation. This directly contradicts the improvement seen in terminal rotations for the matched pair sample. However, the overall trend of improvement aligns with prior findings that HC-PAIRS scores improve as physical therapy students progress through their education (Mankelow, Ryan, Morris, et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022; Quinn et al., 2014; Springer et al., 2018).

Elements of the Clinical Experience

For the matched pair sets, the outpatient orthopedic setting had a slightly improved change in HC-PAIRS score. The data collected did not differentiate hospital-based outpatient

from private practice outpatient settings, so while this finding would echo reports of improved HC-PAIRS scores for physical therapists working in hospital-based outpatient setting, it would also not align with findings that individuals working in private practice outpatient settings experienced a worsening of attitudes and beliefs (Rufa et al., 2022). Setting of the clinical experience had no discernable impact on outcomes for the rNPQ. The variety of settings represented in matched pairs sample echoes the wide variability in physical therapy clinical education in general (McCallum et al., 2013).

The caseload of patients with chronic pain encountered by the surveyed students varied widely with the average being 27.67% (SD = 22.39%) for the whole data set and 18.51% (SD = 12.29%) in the matched pairs data set. This is relatively consistent with chronic pain prevalence estimates of 22.6% (NCHS, 2022). It would also not be surprising to see a higher rate of chronic pain in a physical therapy caseload given that pain is the primary complaint reported on physical therapy referrals (APTA, 2021a). For the matched pairs, for every one SD increase in percent of caseload, the HC-PAIRS score would be expected to improve by 5.34 SD, and the rNPQ score would be expected to improve by 1.23 SD. While this didn't achieve statistical significance, it parallels the suggestions of experiential learning theory as well as prior findings that repeated exposure to content and translation of knowledge into real client situations optimizes learning (Arwood et al., 2015; Coker, 2010; Knecht-Sabres, 2013, Smith & Crocker, 2017; Thompson et al., 2018). This also echoes Inman and Ellard's (2022) findings that patient exposures are beneficial for improving understanding of pain.

Student-reports identified that 87.5% of the CIs had obtained a DPT, 56.25% had obtained board certification, 18.75% had completed their residency, and 6.25% had completed a fellowship. The rate of advanced professional preparation for CIs in this sample was higher than

of the general physical therapist workforce with 11.04% obtaining board certification, 2.94% completing residencies, and 1.09% completing fellowships (APTA 2023). While the literature suggests that improved attitudes and beliefs about chronic pain management are associated with board certification, residency, or fellowship training (Rufa et al., 2022), a statistically significant moderate positive, linear relationship was only identified between rNPQ score change and CI board certification. As a single predictor, CI board certification explained 27% of the variance in changes in rNPQ scores. Otherwise, there were no other statistically significant associations between HC-PAIRS of rNPQ score change and any element of clinical instructor preparation.

Implications for Future Research

The response rate for this study was low, which significantly reduces the likelihood of achieving significant and powerful results according to G*power (Faul et al., 2007). Survey research response rate can be improved through the use of monetary incentives and increased use of pre-notifications and reminders sent directly to participants (Sammut et al., 2021). Lack of funding for this survey limited the ability to provide a monetary incentive to participants. Additionally, reminder emails were sent to DCE at each institution, which introduced an additional level of potential miscommunication or delay in reaching the participants. A method that removes the DCE as an intermediary to reach student participants may increase the ability to send reminders, but would also introduce potential error in reaching the students at the appropriate time in their curriculum. Another method to standardize and improve response rate would be to integrate the rNPQ and HC-PAIRS as part of the standard pre- and post-clinical rotation assignments. Finally, the data collection window and number of included institutions could be longer for future studies like this in order to capture more clinical rotations.

Given the statistical non-significance of most of the findings in this study, questions still remain regarding the particular impact of clinical education on student physical therapists' attitudes, beliefs, and knowledge of chronic pain. Future studies should consider capturing data on if a particular type of board certification is more impactful on pain knowledge. It would also be beneficial to measure attitudes, beliefs, and knowledge of chronic pain at various points throughout entry-level curricula to more fully understand how standard physical therapy education can best optimize these factors. Research has already demonstrated the importance of early, integrated pain science education for physical therapy students, but clinical education remains an unknown variable. Knowing more about clinical education specific to pain attitudes, beliefs, and knowledge will allow program faculty to optimize the clinical education component of their curriculum. Since physical therapists' attitudes, beliefs, and knowledge of chronic pain management significantly impact clinical decision-making and CPG adherence, this should remain an important avenue of research (Alshehri et al., 2020; Chance-Larsen et al., 2020).

Implications for Practice

While largely not achieving statistical significance, the findings of this study support prior findings that attitudes, beliefs, and knowledge of chronic pain improve as students progress through a physical therapy curriculum (Adillón et al., 2015; Bareiss et al., 2019, Mankelow, Ryan, Morris, et al., 2021; Mankelow, Ryan, Taylor, Casey, et al., 2022; Quinn et al., 2014; Springer et al., 2018). This may indicate that students early in their professional education may require more guidance and supervision when it comes to managing patients with chronic pain in a clinical setting. Clinical instructors could use this knowledge to adequately support and appropriately challenge students during early experiences in the clinic.

Additionally, there is support for the benefit of having a CI be board certified in order to optimize changes in pain knowledge. If board certification consistently results in greater impact on pain knowledge for students under their mentorship, it may be beneficial to encourage clinicians working in settings with a high prevalence of chronic pain to pursue board certification before taking on the role of CI. Similarly, it could be beneficial to match students interested in chronic pain with a CI who is board certified for optimal transfer of pain knowledge.

The variability of settings and caseloads identified during this study echo known challenges to clinical education when it comes to consistency in clinical education (Ingram & Roesch, 2012). CAPTE standards require that student physical therapists demonstrate skill across clinical settings, and with diagnoses across the lifespan, so this variability may provide partnering academic institution a greater opportunity to meet accreditation requirements (CAPTE, 2020). The findings of this study do not provide sufficient statistical support for changing requirements to exposure to patients with chronic pain, but inclusion of these individuals in a student's experience will also serve to support the breadth of exposure CAPTE requires. Clinical practices should ensure that students on-site are exposed to a variety of patients to continue to meet the accreditation needs of the schools they partner with.

Implications for Policy

The prevalence of chronic pain in the physical therapy caseloads experienced by the students in this study was between 18.51 - 27.67%. This is consistent with estimates for prevalence in the United States of 22.6% (NCHS, 2022). Chronic pain is known to be costly and a significant contributor to disability and morbidity, and so a prevalence of one in five individuals impacted should be concerning to policymakers. Additional research is necessary to better understand if policy related to healthcare, healthcare education, or patient-targeted

resources would be most impactful in reducing prevalence of chronic pain and related disability in the United States.

This study investigated the relationship between clinical education and student physical therapists' attitudes, beliefs, and knowledge of chronic pain management using a nonexperimental, correlational, pretest-posttest design with validated instruments—rNPQ and HC-PAIRS. Participants were students from a convenience sample of four United States physical therapy programs. Response rate and successful matching of pretests with posttests was low, which limited the power of the study. A mixed model analysis of data yielded results that were not statistically significant and no null hypotheses were rejected except for the impact of CI board certification on students' pain knowledge as measured by the rNPQ.

HC-PAIRS and rNPQ scores for the students in this study were similar to score ranges for physical therapists previously reported in the literature. Also supportive of previous findings, attitudes, beliefs, and knowledge were better at later points in the curriculum. The particular impact of clinical education on these outcomes remains unknown. Additional research will be needed to fully understand the impact of clinical education on the progression of attitudes, beliefs, and knowledge of chronic pain. Understanding how students develop these can assist academic faculty in optimizing pain education to better prepare entry-level clinicians to manage patients with chronic pain. In turn, this may result in improved outcomes and reduced costs for the one in five people in the United States with chronic pain.

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Appendix A

The Revised Neurophysiology of Pain Questionnaire (rNPQ)

		T	F	U
1	It is possible to have pain and not know about it.			
2	When part of your body is injured, special pain receptors convey the pain message to your brain.			
3	Pain only occurs when you are injured or at risk of being injured.			
4	When you are injured, special receptors convey the danger message to your spinal cord.			
5	Special nerves in your spinal cord convey ‘danger’ messages to your brain.			
6	Nerves adapt by increasing their resting level of excitement.			
7	Chronic pain means that an injury hasn’t healed properly.			
8	Worse injuries always result in worse pain			
9	Descending neurons are always inhibitory.			
10	Pain occurs whenever you are injured.			
11	When you injure yourself, the environment that you are in will not affect the amount of pain you experience, as long as the injury is exactly the same.			
12	The brain decides when you will experience pain.			

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Answers

Item		T	F
1	It is possible to have pain and not know about it.		#
2	When part of your body is injured, special pain receptors convey the pain message to your brain.		#
3	Pain only occurs when you are injured or at risk of being injured.		#
4	When you are injured, special receptors convey the danger message to your spinal cord.	#	
5	Special nerves in your spinal cord convey ‘danger’ messages to your brain.	#	
6	Nerves adapt by increasing their resting level of excitement.	#	
7	Chronic pain means that an injury hasn’t healed properly.		#
8	Worse injuries always result in worse pain		#
9	Descending neurons are always inhibitory.		#
10	Pain occurs whenever you are injured.		#
11	When you injure yourself, the environment that you are in will not affect the amount of pain you experience, as long as the injury is exactly the same.		#
12	The brain decides when you will experience pain.	#	

Appendix B

Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS)

	Completely Disagree	Mostly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Mostly Agree	Completely Agree
Chronic pain patients can still be expected to fulfil work and family responsibilities despite pain.							
An increase in pain is an indicator that a chronic pain patient should stop what they are doing until the pain decreases.							
Chronic pain patients cannot go about regular life activities when they are in pain.							
If their pain would go away, chronic pain patients' would be every bit as active as they used to be.							
Chronic pain patients should have the same benefits as the handicapped because of their chronic pain problem.							
Chronic pain patients owe it to themselves and those around them to perform their usual activities even when their pain is severe.							
Most people expect too much of chronic pain patients, given their pain.							
Chronic pain patients have to be careful not to do anything that might make their pain worse.							
As long as they are in pain, chronic pain patients will never be able to live as well as they did before.							
When their pain gets worse, chronic pain patients find it very hard to concentrate on anything else.							
Chronic pain patients have to accept that they are disabled persons, due to their chronic pain.							
There is no way that chronic pain patients can return to doing the things they used to do unless they first find a cure for their pain.							

Chronic pain patients find themselves frequently thinking about their pain, and what it has done to their life.							
Even though their pain is always there, chronic pain patients often do not notice it at all when they are keeping themselves busy.							
All of chronic pain patients' problems would be solved if their pain would go away.							

Note. Scoring: seven-point scale of Likert responses of 1 (completely disagree) to 7 (completely agree). Items 1, 6 and 14 were inverted as per the authors instructions

Appendix C

Consent Form

RADFORD UNIVERSITY

Radford University Cover Letter for Internet Research

You are invited to participate in a research survey, entitled "The Impact of Clinical Education on Student Physical Therapists' Attitudes, Beliefs, and Knowledge of Chronic Pain". The study is being conducted by Corey Woldenberg, Kevin Chui, Lisa Allison-Jones, and Gregory Holtzman of the Department of Public Health and Healthcare Leadership at Radford University Carilion:

101 Elm Ave., Roanoke, VA 24013

540-831-1808

cwoldenberg@radford.edu

The purpose of this study is to investigate the relationship between clinical education and student physical therapists' attitudes, beliefs, and knowledge of chronic pain management. Your participation in the survey will contribute to a better understanding of how clinical education can impact and optimize pain attitudes, beliefs, and knowledge in student physical therapists. We estimate that it will take about twenty minutes of your time to complete the questionnaire and you will be asked to take this once before your clinical rotation and once at the end of your clinical rotation. You are free to contact the investigator at the above address and phone number to discuss the survey.

There is minimal, or **no more than everyday life,** anticipated risks from participating in this research. The research team will work to protect your data to the extent permitted by

technology. It is possible, although unlikely, that an unauthorized individual could gain access to your responses because you are responding online. This risk is similar to your everyday use of the internet. During the survey, you will be asked to create a unique identification number only to tie your pre-test to your post-test. Identification numbers and IP addresses recorded during this survey will be kept during the data collection phase for tracking purposes only. A limited number of research team members will have access to the data during data collection. Identifying information will be stripped from the final dataset.

Your participation in this survey is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time without penalty. If you wish to withdraw from the study or have any questions, contact the investigator listed above. If you choose not to participate or decide to withdraw, there will be no impact on your grades/academic standing.

If you have any questions or wish to update your email address, please call Kevin Chui at (540) 831-1880 or send an email to Corey Woldenberg at cwoldenberg@radford.edu. You may also request a hard copy of the survey from the contact information above.

This study was approved by the Radford University Committee for the Review of Human Subjects Research (#2023-052-RUC). If you have questions or concerns about your rights as a research subject or have complaints about this study, you should contact Dr. Jeanne Mekolichick, Institutional Official and Associate Provost for Research, Faculty Success, and Strategic Initiatives, jmekolic@radford.edu, 540.831.6504.

If you agree to participate, please **press the arrow button at the bottom right of the screen**. Otherwise use the X at the upper right corner to close this window and disconnect.

Thank you.

Appendix D

Codebook

Question/Issue	Variable Name	Values	Data Type
*Any question or issue that is left blank or marked as not applicable will be coded in SPSS as "System Missing"			
Revised Neurophysiology of Pain Questionnaire (rNPQ)			
For the rNPQ, the correct answer was coded as "1" to allow easy scoring of the tool			
1. It is possible to have pain and not know about it.	RNPQ1	0: True 1: False 99: Unsure	Categorical (Nominal)
2. When part of your body is injured, special pain receptors convey the pain message to your brain.	RNPQ2	0: True 1: False 99: Unsure	Categorical (Nominal)
3. Pain only occurs when you are injured or at risk of being injured.	RNPQ3	0: True 1: False 99: Unsure	Categorical (Nominal)
4. When you are injured, special receptors convey the danger message to your spinal cord.	RNPQ4	1: True 0: False 99: Unsure	Categorical (Nominal)
5. Special nerves in your spinal cord convey "danger" messages to your brain.	RNPQ5	1: True 0: False 99: Unsure	Categorical (Nominal)
6. Nerves adapt by increasing their resting level of excitement.	RNPQ6	1: True 0: False 99: Unsure	Categorical (Nominal)
7. Chronic pain means that an injury hasn't healed properly.	RNPQ7	0: True 1: False 99: Unsure	Categorical (Nominal)
8. Worse injuries always result in worse pain.	RNPQ8	0: True 1: False 99: Unsure	Categorical (Nominal)
9. Descending neurons are always inhibitory.	RNPQ9	0: True 1: False 99: Unsure	Categorical (Nominal)
10. Pain occurs whenever you are injured.	RNPQ10	0: True 1: False 99: Unsure	Categorical (Nominal)
11. When you injure yourself, the environment that you are in will not affect the amount of pain you experience, as long as the injury is exactly the same.	RNPQ11	0: True 1: False 99: Unsure	Categorical (Nominal)

12. The brain decides when you will experience pain.	RNPQ12	1: True 0: False 99: Unsure	Categorical (Nominal)
Recode: rNPQ Total Score *Frequency of "1" for Q1-Q12*	NPQTOT	0 to 12	Continuous
Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS)			
13. Chronic pain patients can still be expected to fulfil work and family responsibilities despite pain.	HCPAIRS1	7: Completely disagree 6: Mostly disagree 5: Somewhat disagree 4: Neutral 3: Somewhat agree 2: Mostly agree 1: Completely agree	Categorical (Ordinal)
14. An increase in pain is an indicator that a chronic pain patient should stop what they are doing until the pain decreases.	HCPAIRS2	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
15. Chronic pain patients cannot go about regular life activities when they are in pain.	HCPAIRS3	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
16. If their pain would go away, chronic pain patients' would be every bit as active as they used to be.	HCPAIRS4	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
17. Chronic pain patients should have the same benefits as the handicapped because of their chronic pain problem.	HCPAIRS5	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
18. Chronic pain patients owe it to themselves and those around them to perform their usual	HCPAIRS6	7: Completely disagree 6: Mostly disagree 5: Somewhat disagree	Categorical (Ordinal)

activities even when their pain is severe.		4: Neutral 3: Somewhat agree 2: Mostly agree 1: Completely agree	
19. Most people expect too much of chronic pain patients, given their pain.	HCPAIRS7	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
20. Chronic pain patients have to be careful not to do anything that might make their pain worse.	HCPAIRS8	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
21. As long as they are in pain, chronic pain patients will never be able to live as well as they did before.	HCPAIRS9	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
22. When their pain gets worse, chronic pain patients find it very hard to concentrate on anything else.	HCPAIR10	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
23. Chronic pain patients have to accept that they are disabled persons, due to their chronic pain.	HCPAIR11	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
24. There is no way that chronic pain patients can return to doing the things they used to do unless they first find a cure for their pain.	HCPAIR12	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)

25. Chronic pain patients find themselves frequently thinking about their pain, and what it has done to their life.	HCPAIR13	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
26. Even though their pain is always there, chronic pain patients often do not notice it at all when they are keeping themselves busy.	HCPAIR14	7: Completely disagree 6: Mostly disagree 5: Somewhat disagree 4: Neutral 3: Somewhat agree 2: Mostly agree 1: Completely agree	Categorical (Ordinal)
27. All of chronic pain patients' problems would be solved if their pain would go away.	HCPAIR15	1: Completely disagree 2: Mostly disagree 3: Somewhat disagree 4: Neutral 5: Somewhat agree 6: Mostly agree 7: Completely agree	Categorical (Ordinal)
Recode: HC-PAIRS Total Score *Sum of Q13-Q27*	HCPTOT	15 to 105	Continuous
Demographics and Educational Questionnaire (Independent Variables)			
28. What is your age in years?	AGE	18 to N	Continuous
29. What is your gender?	GENDER	1: Male 2: Female 3: Nonbinary 99: Prefer not to disclose	Categorical (Nominal)
30. How may full-time clinical rotations are in your curriculum? (do not count integrated or ½-day clinical experiences)	TOTALCE	0 to N	Continuous
31. Which full-time clinical rotation is this one? Initial (first full-time experience), Intermediate (somewhere in the middle of your program – you have more classes to take), or Terminal (you are expected to achieve entry-level performance upon completion of the rotation)	SEQUENCE	1: Initial 2: Intermediate 3: Terminal	Categorical (Ordinal)

32. How many weeks is this current clinical rotation?	LENGTH	0 to N	Continuous
33. What best describes the setting of this current clinical rotation? (select one)	SETTING	1: Acute care 2: Inpatient Rehab 3: Skilled Nursing Facility 4: Home Health 5: Pediatrics 6: Outpatient Neuro 7: Outpatient Orthopedics 8: Other	Categorical (Nominal)
If Q33 = 8	OTHERSET	Please explain_____	Text
34. Please create a unique identifier to tie your pretest to the posttest. Make this something you are sure to remember. Suggestion**:** use your apartment/house number (123) with the last four digits of your phone number (7890) - so the number would be 1237890. Researchers will not be able to tie these unique identifiers to institutional student identification numbers, student names, or other identifying information. This is only used to match your pre-survey to your post-survey.	ID	0 to N	Continuous
35. You will take this survey again at the end of this clinical rotation. At what point are you currently taking the survey	SURVEY	1: Prior to starting the rotation 2: At the end of the rotation	Categorical (Nominal)
If Q35 = 1, survey ends			
If Q35 = 2, continue to #36			
36. How many total patients did you treat during this clinical rotation?	TOTALPTS	0 to N	Continuous
37. How many patients with chronic pain did you treat during this clinical rotation?	PAINPTS	0 to N	Continuous
Recode: Percent of population that is patients with chronic pain *(PAINPTS/TOTALPTS)*100*	PERCENT	0 to 100	Continuous
38. Has your primary clinical instructor obtained a DPT?	CIDPT	0: No 1: Yes	Categorical (Nominal)

		99: Unsure	
39. Has your primary clinical instructor completed a residency program?	CIRESID	0: No 1: Yes 99: Unsure	Categorical (Nominal)
40. Has your primary clinical instructor completed a fellowship program?	CIFELL	0: No 1: Yes 99: Unsure	Categorical (Nominal)
41. Has your primary clinical instructor obtained a specialist certification (NCS, OCS, etc.)?	CICERT	0: No 1: Yes 99: Unsure	Categorical (Nominal)
Additional Recodes – Dependent Variables			
Question/Issue	**Variable Name**	**Values**	**Data Type**
HC-PAIRS score difference from 1st to 2nd submission *HCPTOT(post-test) - HCPTOT(pre-test)*	HCPDIFF	0 to 78	Continuous
rNPQ score difference from 1st to 2nd submission *NPQTOT(post-test) – NPQTOT(pre-test)*	NPQDIFF	0 to 12	Continuous

Appendix E

Data Analysis Table

RQ1. Is clinical education significantly associated with physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?						
	Hypotheses	**IV(s)**	**IV(s) Data**	**DV(s)**	**DV Data**	**Statistical test**
H1.1a	Students will demonstrate significantly improved attitudes and beliefs toward chronic pain management following clinical education experiences.	HCPTOT pre and HCPTOT post	Categorical	Score	Continuous	Paired t-test
H1.2a	Students will demonstrate significantly improved knowledge of chronic pain management following clinical education experiences.	NPQTOT pre and NPQTOT post	Categorical	score	Continuous	Paired t-test
RQ2. Is the percentage of caseload/number of patients with chronic pain seen associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?						
	Hypotheses	**IV(s)**	**IV(s) Data**	**DV(s)**	**DV Data**	**Statistical test**
H2.1a	The number of patients with chronic pain that students encounter while in clinical education experiences will	PERCENT	Continuous	HCPDIFF	Continuous	Mixed Model Analysis: correlation and regress HCPDIFF on PERCENT

	significantly correlate with improvement of physical therapy students' attitudes and beliefs towards chronic pain management.					
H2.2a	The number of patients with chronic pain that students encounter while in clinical education experiences will significantly correlate with improvement of physical therapy students' knowledge of chronic pain management.	PERCENT	Continuous	NPQDIFF	Continuous	Mixed Model Analysis: correlation and regress NPQDIFF on PERCENT
RQ3. Is sequence of the clinical education experience significantly associated with development of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?						
	Hypotheses	**IV(s)**	**IV(s) Data**	**DV(s)**	**DV Data**	**Statistical test**
H3.1a	Sequence of the clinical experience will significantly correlate with changes in physical therapy students' attitudes and	SEQUENCE	Categorical (ordinal)	HCPDIFF	Continuous	Mixed Model Analysis: one-way ANOVA

	beliefs toward chronic pain management.					
H3.2a	Sequence of the clinical experience will significantly correlate with changes in physical therapy students' knowledge of chronic pain management.	SEQUENCE	Categorical (ordinal)	NPQDIFF	Continuous	Mixed Model Analysis: one-way ANOVA
RQ4. Is the setting of the clinical education experience associated with progression in physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?						
	Hypotheses	**IV(s)**	**IV(s) Data**	**DV(s)**	**DV Data**	**Statistical test**
H4.1a	Setting of the clinical experience will be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.	SETTING	Categorical (nominal)	HCPDIFF	Continuous	Mixed Model Analysis: one-way ANOVA
H4.2a	Setting of the clinical experience will be significantly associated with physical therapy students' knowledge of chronic pain management.	SETTING	Categorical (nominal)	NPQDIFF	Continuous	Mixed Model Analysis: one-way ANOVA

RQ5. Is the preparation of the clinical instructor associated with progression of physical therapy students' attitudes, beliefs, and knowledge of chronic pain management?						
	Hypotheses	**IV(s)**	**IV(s) Data**	**DV(s)**	**DV Data**	**Statistical test**
H5.1a	Preparation of the clinical instructor will be significantly associated with physical therapy students' attitudes and beliefs toward chronic pain management.	CIDPT CIRESID CIFELL CICERT	Nominal (dichotomous and mutually exclusive)	HCPDIFF	Continuous	Mixed Model Analysis: Correlation and 3 simple linear regressions HCPDIFF on CIDPT CIRESID CIFELL CICERTS 1 multiple regression
H5.2a	Preparation of the clinical instructor will be significantly associated with physical therapy students' knowledge of chronic pain management.	CIDPT CIRESID CIFELL CICERT	Nominal (dichotomous and mutually exclusive)	NPQDIFF	Continuous	Mixed Model Analysis: Correlation and 3 simple linear regressions NPQDIFF on CIDPT CIRESID CIFELL CICERTS 1 multiple regression