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TREATMENT OUTCOMES
OF AN INTERDISCIPLINARY CHRONIC PAIN REHABILITATION PROGRAM
IN SMOKERS AND NONSMOKERS

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ABSTRACT

Previous research suggests there is a relationship between pain and smoking, but there is limited research on the treatment outcomes of people with chronic pain who smoke. This is particularly evident in the context of interdisciplinary chronic pain treatment programs because the only such study (Hooten et al., 2009) has not been replicated. Therefore, the current study examined the immediate treatment outcomes in patients who have been through an interdisciplinary chronic pain rehabilitation program. The treatment outcomes that were examined were depression, anxiety, pain intensity, and pain disability. Depression scores were higher both at admission and discharge for smokers when compared to nonsmokers, anxiety scores and pain intensity scores were higher at admission for smokers, but were no longer significantly different from nonsmokers at discharge, and pain disability scores for smokers and nonsmokers were not significantly different at both admission and discharge. In addition, both smokers and nonsmokers improved on all of these measures between admission and discharge. These data support the findings of Hooten et al. (2009) and provide additional evidence that comprehensive chronic pain rehabilitation programs can be effective for both smokers and nonsmokers, specifically regarding pain intensity, anxiety, depression, and pain disability outcomes.

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CHAPTER I

INTRODUCTION

1.1 Purpose

The current study will examine the immediate treatment outcomes of smokers and nonsmokers who have participated in an interdisciplinary chronic pain rehabilitation program. The variables that will be examined are ones commonly addressed in such programs: pain intensity, pain disability, anxiety, and depression. There has been only one study to date that has investigated these outcomes in an interdisciplinary chronic pain rehabilitation program (Hooten et al., 2009), which is why confirmation of the findings is necessary. The following sections of the introduction will describe the relevant literature in this area of research.

1.2 Smoking and Chronic Pain

There is a well documented association between smoking and chronic pain, with studies indicating that chronic pain may be nearly twice as prevalent in individuals who smoke when compared to the general population (Ditre, Brandon, Zale, & Meagher,

2011). Additional studies have found that smokers report more severe pain than nonsmokers with similar conditions. For instance, Edwards et al. (2006) reported results from a study that included 15,000 individuals in England who returned a questionnaire, and separated them into light smokers, moderate smokers, heavy smokers, or never smokers. They found that individuals who smoke report having more severe pain, and that heavy smokers have more severe pain than moderate smokers, who have more severe pain than light smokers.

Similarly, it has been found that smokers report more pain in more locations. In another large population study of 6,963 individuals who responded to a national general population survey, John et al (2006) found that current heavy smokers or past heavy smokers have a greater likelihood of having more pain locations and greater pain intensity. Additional reports substantiate a relationship between smoking and frequency of pain. Using a telephone survey, Strine et al. (2005) found that current smokers and former smokers reported frequent pain significantly more than individuals who had never smoked.

Other studies have explored additional aspects of the relationship between smoking and chronic pain. For instance, Mitchell et al. (2011) surveyed 6,092 women about their pain and smoking status. Specifically, women who smoke daily have more chronic pain than women who do not smoke. Furthermore, women who occasionally smoke or are former smokers also have more chronic pain, but not as much as women who smoke daily. A meta-analysis of 40 studies by Shiri, Karppinen, Leino-Arjas, Solovieva, and Viikari-Juntura (2010) demonstrated a relationship between low back pain and smoking. It was found that current smoking is related to whether or not a person

experiences chronic low back pain, along with low back pain during the last month and 12 months. Furthermore, current smokers have the most low back pain and people who have never smoked have the least amount of low back pain, with former smokers being somewhere in between. In addition, this association appears to be the strongest in adolescents and in individuals who have chronic pain, rather than in individuals who have only had pain during the past month or 12 months.

1.3 Smoking as a Risk Factor for Pain

Finally, many studies indicate that smoking itself is a risk factor for pain. For example, Alkherayf and Agbi (2009) surveyed over 73,000 people from 20-59 years of age using the Canadian Community Health Survey. They found that 15.7% of people who do not smoke, 17.2% of people who only occasionally smoke, and 23.3% of people who smoke daily have chronic low back pain. Overall, 19.6% of individuals who took this survey have chronic low back pain. In addition, there is a relationship between low back pain, smoking, and age. This relationship is stronger for individuals 20-29 years of age, as the risk of chronic low back pain is 80% more for smokers than non-smokers, while for individuals 50-59 years of age, the risk is only 24% more for smokers. There is also a relationship between smoking and gender. The risk of developing low back pain is stronger in males who smoke daily. In summary, this study found that daily smokers, especially daily smokers who are young and male, are at a higher risk than non-smokers and occasional smokers for developing low back pain.

These findings have been replicated by others. In a literature review, Ditte et al. (2011) found many other studies that give evidence that smoking is a risk factor for low

back pain, rheumatoid arthritis, headaches and oral pain, among others. Specifically, it was found that smoking may be a risk factor for the development of pain, along with the worsening of pain that already exists.

There are many theories for why smoking is a risk factor for low back pain. For instance, coughing, lifestyle, osteoporosis, and malnutrition may play a role in the development of low back pain in smokers (Ernst, 1993). Coughing, which is caused by smoking, could play a role because it can cause stress to the intervertebral discs that may lead to herniation. However, this may not be relevant because the risk for low back pain from smoking is not specific to herniated discs (Ernst, 1993). On the other hand, in an epidemiological study of low back pain, which used the records of 3920 patients, it was found that chronic cough was reported significantly more in patients who have low back pain (Frymoyer et al., 1980). In addition, while the poorer lifestyles of smokers may play a role, many studies indicate that the pain seen in smokers is above and beyond the pain that occurs from the lifestyle of these individuals (Ernest, 1993). Furthermore, smoking may lead to osteoporosis, which then leads to back pain. However, this theory does not account for the back pain seen in younger individuals (Ernst, 1993). Finally, because smoking may lead to problems with vertebral blood flow, it may cause malnutrition of the intervertebral discs, which then leads to the degeneration of these discs, and makes them more vulnerable to stress and injury, along with hindering the healing process of damage that has already taken place (Ernst, 1993; Weingarten, Shi, Mantilla, Hooten, & Warner, 2011). This may occur through vasoconstriction, carboxyhaemoglobin formation, changes in blood flow, arteriosclerotic wall changes of vessels, and impairment in fibrinolytic activity (Ernst, 1993).

In investigating the possibility that smoking may lead to the degeneration of intervertebral discs, Uematsu, Matuzaki, and Iwahashi (2001) injected 10 rabbits with either nicotine or saline. They found that rabbits that were injected with nicotine for eight weeks had significantly more disc degeneration than rabbits injected with nicotine for four weeks. Both of these groups of rabbits had significantly more disc degeneration than rabbits injected with the saline solution. This was theorized to occur because of vascular constriction, which would lead to the degeneration of the tissue that surrounds the disc (Uematsu et al., 2001). Also, it is theorized that nicotine may have direct effects on the intervertebral disc because it can directly harm tissue and decrease cell activity (Uematsu et al., 2001).

To determine if nicotine does have direct effect on cell activity, which would lead to intervertebral disc degeneration, Akmal et al. (2004) isolated intervertebral disc cells and cultured them both with and without freebase nicotine. This was done at nicotine levels commonly found in the serum of smokers. It was found that nicotine damaged disc cells and prevented cell proliferation and synthesis. This evidence suggests that nicotine promotes intervertebral disc degeneration due to the damage of disc cells.

1.4 Smoking and Overall Functioning, Mental Health, and Emotional Distress

Besides its associations with pain, there is also evidence that smoking is related to overall functioning, mental health, and emotional distress. However, as with pain, much research in this area is correlational in nature so these studies do not delineate whether smoking causes poorer functioning, poorer mental health, and emotional distress or if individuals smoke in order to cope with their emotions and problems. One study

examined 230 surveys given to chronic pain patients at a pain clinic to determine if smoking status has an effect on pain and functional interference. It was found that smokers have more pain than nonsmokers and more functional interference with regards to mood, general activity, normal work, sleep, relationships, and life enjoyment (Weingarten et al., 2008). Furthermore, smokers with the most severe nicotine dependence have even more pain and more functional interference with regards to mood, life enjoyment, and normal work.

In another study, 151 patients who have chronic pain were divided among three different groups consisting of nonsmokers, smokers who do not use cigarettes to cope with their pain, and smokers who do use cigarettes to cope with pain (Patterson et al., 2012). It was found that people who smoke to cope with pain scored worse on measures such as the Multidimensional Pain Inventory (MPI), Pain Anxiety Symptoms Scale (PASS-20), and Chronic Pain Coping Inventory (CPCI). On the other hand, the individuals in the other two groups did not significantly differ on these measures. This indicates that people who use cigarettes to cope have poorer functioning and more pain than people who do not smoke and than people who smoke but do not use cigarettes to cope with their pain. These findings support the idea that many smokers have poorer overall functioning than nonsmokers, and also demonstrate that the relationship may be more complex than previously thought.

Smoking may also be related to a person's mental health and emotional distress. Using a telephone survey, the Health-Related Quality of Life (HRQOL) was administered to individuals older than 18 years of age (Strine et al., 2005). It was found that current smokers have poorer mental health than people who never smoked. Edwards et al. (2006)

also found that smokers report having poorer mental health than nonsmokers. Another study used records from 229 patients with chronic low back pain and found that patients who smoke are more inactive, have more emotional distress, and take more medication than patients who do not smoke (Jamison, Stetson, and Parris, 1991).

In addition, smokers perform worse on the tests that measure the skills a person has for managing automatic thoughts and negative moods. For instance, Rabois and Haaga (1997) did a study in order to determine whether or not smokers who have a history of depression have as many cognitive coping strategies as smokers without a history of depression, where depression was defined as meeting the criteria for a major depressive episode. Eighty seven participants were divided into four groups: positive history for depression and current smokers, positive history for depression and never smokers, negative history for depression and current smokers, and negative history for depression and nonsmokers. All participants completed the Ways of Responding test (WOR; Barber & DeRubeis, 1992), which measures cognitive coping; they found that the individuals with a history for depression gave more maladaptive responses, while smokers gave lower quality responses, which means that they thought more negatively, overgeneralized, and did not search for as many alternative explanations. However, there was no significant difference between smokers with a history of depression versus smokers without a history of depression.

Similarly, in another study, 134 cigarette smokers aged 18-70 years of age were divided based on whether they had a history of major depression or had never been depressed (Hagga, Thorndike, Friedman-Wheeler, Pearlman, & Wernicke, 2004). However, unlike the Rabois and Haaga (1997) study, it was found that on the WOR,

smokers who had a history of major depression did not score as well as smokers who had never been depressed.

1.5 Treatment Outcomes

Thus, it appears that smoking may be related to the severity of pain, number of pain locations, frequency of pain, and chronic pain, and that smoking may be a risk factor for the development of pain. In addition, smoking may be related to overall functioning, mental health, and emotional distress. Given these relationships, the question that arises now is whether or not smoking has an impact on treatment outcomes for pain. This research is limited and also conflicting; of the few studies that have been done, some indicate that individuals who smoke have a harder time recovering from pain and do not progress as well through treatment, while others indicate that individuals who smoke progress just as well as individuals who do not smoke.

For instance, one observational study gave a questionnaire to 352 auto workers in order to determine what factors affect recovery from low back disorders. It was found that current cigarette smoking is associated with more disability (Oleske et al., 2004). Furthermore, this disability was seen at all of the follow-ups, which were at one, two, six, and twelve months after the diagnosis was made. Because participants received no treatment, this study indicates that smokers do not recover on their own within a year from low back disorders as well as nonsmokers do.

Another study was done by McCreary, Mayer, Gatchel, and Anagostis (2004) to determine whether smoking has an impact on functional restoration in patients who have chronic spinal disability. These patients took part in a chronic pain management

rehabilitation program, with 1,141 patients placed in four different groups based on how much they smoked, and were given a variety of different assessment batteries. It was found that as people increased in smoking level, the percent of people who completed the program decreased. Furthermore, smokers were more depressed at admission, but at discharge, those who completed the pain management program no longer had depression scores that were significantly higher from those of the nonsmokers. This indicates that of the smokers who completed the program, the impact of smoking did not prevent a decrease in their depression scores.

In another study, patients with chronic low back pain were separated into smokers and nonsmokers (81 and 140 individuals respectively), and after they completed a multidisciplinary pain program, their employment status was determined at one, six, twelve, and twenty-four months after discharge (Fishbain et al., 2008). At each follow up smokers were less likely to be employed when compared to nonsmokers. Furthermore, smokers who had higher pain scores over the past 24 hours were less likely to be employed than smokers who had lower pain scores.

1.6 Treatment Outcomes in an Interdisciplinary Pain Program

In the context of an interdisciplinary pain rehabilitation program, 143 patients who participated in the Mayo Clinic pain rehabilitation program were classified as smokers or nonsmokers in order to determine whether smoking has an impact on the treatment outcomes of this program (Hooten et al., 2009). Patients who smoked had poorer physical and emotional functioning at admission on all measures except for the Multidimensional Pain Inventory (MPI) pain severity and Short Form 36 Health Status

Questionnaire (SF-36) role-emotional functioning. After completion of the pain program, the patients who smoked still had poorer functioning on some measures (Center for Epidemiologic Studies-Depression scale [CES-D], SF-36 role-emotional, and Pain Catastrophizing Scale [PCS]), but these differences were no longer seen in the other measures. Furthermore, for the Pain Anxiety Symptoms Scale (PASS-20), MPI affective distress, MPI life control, and SF-36 role-emotional, an interaction between smoking status and time was observed, indicating that smokers improved more than nonsmokers on these measures.

To summarize, Hooten et al. (2009) found that even though patients who smoke had poorer functioning at the beginning of the program, they improved on many measures as much as or more than the patients who do not smoke. While smokers still had lower scores than nonsmokers on some measures, including PCS, SF-36 role emotional, and CES-D, these results suggest that in a number of important areas of psychological functioning, the treatment outcomes for smokers are not impeded by the consequences of smoking, and pain rehabilitation programs are just as successful for smokers as they are for nonsmokers.

Most of these results are consistent with previous studies that indicate that smokers have poorer functioning than nonsmokers in both physical and emotional areas, but previous research does not indicate why the smokers improved more in some areas than the nonsmokers. Hooten et al. (2009) theorize that smokers may have had more to gain from this program or that because smokers show greater depression and PCS scores than nonsmokers, they benefit more from the cognitive behavioral treatments.

1.7 Current Study

Thus, previous research suggests there is a relationship between pain and smoking, but there is limited research on the treatment outcomes of people with chronic pain who smoke. This is particularly evident in the context of interdisciplinary chronic pain treatment programs because the only such study (Hooten et al., 2009) has not been replicated. Therefore, this research will examine immediate treatment outcomes in patients who have been through an interdisciplinary chronic pain rehabilitation program. As noted, the only similar investigation to date was the previously discussed research by Hooten et al. (2009); hence the current study's objective is to see if the Hooten et al. (2009) results can be replicated in a different chronic pain rehabilitation program that employs different intervention components¹ and different outcome measures. These differences will be helpful because they will give further evidence that the results are reliable and valid, not just because they can be replicated precisely in other chronic pain management programs, but because they can be replicated in other chronic pain management programs that use different intervention components and measures, thereby enhancing generalizability. A final deviation from the research done by Hooten et al. (2009) involves the number of participants. While Hooten et al. (2009) used 193 patients from approximately a six month period, the present study will use significantly more patients from a two and a half year period, consequently yielding a significantly larger sample size.

The interdisciplinary chronic pain rehabilitation program in the present study is the CPRP program at the Cleveland Clinic. This program is for individuals who suffer from chronic pain and are affected by their pain both physically and emotionally. The day

treatment program is scheduled from 7:30AM-5PM daily, for approximately three to four weeks, and is comprehensive and interdisciplinary, involving physical therapy, occupational therapy, coping skills training, relaxation therapy, individual therapy, group therapy, medication management, monitoring of the removal of addictive substances, addiction education if needed, and follow-up services. The ultimate goal of this program is for individuals to be able to properly manage their pain for the long-term, which is comparable to the goals of the interdisciplinary pain rehabilitation program at the Mayo Clinic (Hooten et al., 2009), which also aimed to improve patient functioning in both the physical and psychosocial realms.

1.8 Hypotheses

This study will examine immediate treatment outcomes in patients who have been through the Cleveland Clinic's interdisciplinary chronic pain rehabilitation program, and it is hypothesized that the results will be similar to those found by Hooten et al. (2009).

Research questions and Hypotheses:

1. Do smokers and nonsmokers differ on demographic variables (gender, pain duration, age, and marital status)? It is hypothesized that more smokers than nonsmokers will be male and younger, but fewer smokers will be married than nonsmokers.
2. Do smokers and nonsmokers differ in pain intensity, depression, anxiety, and pain disability at admission? It is hypothesized that smokers will have a higher pain intensity score, depression score, anxiety score, and pain disability score at admission when compared to nonsmokers.

3. Do nonsmokers and smokers improve comparably between admission and discharge on measures of pain intensity, depression, anxiety, and pain disability?

It is hypothesized that smokers and nonsmokers will improve comparably between admission and discharge on pain intensity scores, depression scores, anxiety scores, and pain disability scores.

4. Do smokers and nonsmokers differ in the amount of their improvement between admission and discharge on measures of pain intensity, depression, anxiety, and

pain disability? It is hypothesized that smokers will improve more than nonsmokers between admission and discharge on pain intensity scores, anxiety scores, and pain disability scores.

5. Do smokers and nonsmokers differ in pain intensity, depression, anxiety, and pain disability at discharge? It is hypothesized that smokers will have a higher

depression score at discharge when compared to nonsmokers.

CHAPTER II

METHODS

2.1 Participants

This study employed the Institutional Review Board (IRB) approved data registry for the Cleveland Clinic Chronic Pain Rehabilitation Program and consisted of a convenience sample of patients admitted from January 2010 through June 2012. This data registry includes all of the measurements needed for this study, and therefore no other data collection was done.

2.2 Measures

The three measures that will be used in this study are the self-report of pain intensity, the Depression, Anxiety, and Stress Scale (DASS), and the Pain Disability Index (PDI). These assessments were completed by each patient at admission and again at discharge from the CPRP.

Pain intensity was measured using the patients' self report of pain on an 11 point numerical rating scale (NRS) from zero to ten. A score of zero indicates that the patient

has no pain, while a score of ten indicates that the patient has very severe pain. An indication of this measure's validity is its success in ascertaining whether changes in pain intensity have occurred (Ferreira-Valente, Paris-Ribeiro, & Jensen, 2011). In addition, when compared to other scales for rating pain intensity (Visual Analogue Scale, Verbal Rating Scale, and Faces Pain Scale-Revised), the NRS had comparable results, indicating convergent validity, and was even found to be the most responsive of the four scales (Ferreira-Valente et al., 2011).

The Depression, Anxiety, and Stress Scales (Psychology Foundation of Australia, 2011) consist of 42 items, with 14 items per scale. However, the DASS 21 is the shorter version that is used in the CPRP at the Cleveland Clinic. It consists of 21 items, with seven items per scale (Psychology Foundation of Australia, 2011). Each item has a four point scale allowing the patient to select how severely or frequently he has experienced the item during the previous week. Depression is measured by evaluating hopelessness, self-deprecation, dysphoria, devaluation of life, anhedonia, inertia, and lack of interest and involvement. Anxiety is measured by evaluating skeletal muscle effects, subjective experience of anxious affect, situational anxiety, and autonomic arousal. Stress is measured by evaluating nervous arousal, irritability, difficulty relaxing, being easily upset or agitated, over-reactivity, and impatience. Finally, scoring is easily done by adding the scores for the items in each scale (Psychology Foundation of Australia, 2011); in the case of the DASS 21, the sum is doubled.

All of the scales on the DASS have high internal consistency (Antony, Bieling, Cox, Enns, & Swinson, 1998; Crawford & Henry, 2003; Psychology Foundation of Australia, 2011). Specifically, Antony et al. (1998) found that the Cronbach's Alphas for

the DASS 21 were .94 for depression, .87 for anxiety, and .91 for stress. Furthermore, it has been found that each scale is successful at measuring what it intends to, along with measuring change over time (Psychology Foundation of Australia, 2011). Concurrent validity has also been assessed. The DASS 21 depression scale correlates well with the Beck Depression Inventory ($r=.79$), and the anxiety scale correlates well with the Beck Anxiety Inventory ($r=.85$) (Antony et al., 1998). Similarly, convergent validity has also been assessed and determined to be acceptable. For instance, the DASS depression scale correlates well with personal disturbance scale – depression (.78) and the DASS anxiety scale correlates well with the personal disturbance scale – anxiety (.72) (Crawford & Henry, 2003).

The Pain Disability Index (PDI) measures the degree to which a person's pain interferes with their daily life. It consists of seven items, in which each item is its own domain, (Family/Home Responsibilities, Recreation, Social Activity, Occupation, Sexual Behavior, Self Care, and Life Support Activities), each of which is rated on a scale from zero to ten. For each domain, a score of a zero indicates no disability, while a score of ten indicates severe disability. Scoring is done by adding up all seven of the ratings.

The PDI has been found to have high internal consistency. For instance, Tait, Chiball, and Krause (1990) found Cronbach's alpha to be .86. Furthermore, Tait et al. (1990) reported findings which are indicative of construct validity. Specifically, it was found that people who experience more psychological distress, more severe pain characteristics, and more restriction of activities have high PDI scores. Furthermore, it was also found that the PDI is related to the levels of pain behavior that patients display, which indicates that the PDI does measure disability. Finally, Pollard (1984)

demonstrated that the PDI could discriminate between people who have high disability and people who have low disability.

2.3 Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used for data analysis, with a $P < 0.05$ level of significance for all statistical tests. Demographic variables (gender, pain duration, age, and marital status) for smokers and nonsmokers were compared by using t-tests for continuous variables and chi-square analyses for categorical variables. Furthermore, a Multivariate General Linear Model was used to analyze the mean admission and discharge scores of smokers and nonsmokers for pain intensity, depression, anxiety, and pain disability. Finally, treatment outcomes were analyzed using a mixed model repeated measures analysis of variance. In addition, age was not found to be related to any of the outcome variables so it was not controlled for in the analyses.

1. The first research question is do smokers and nonsmokers differ in demographic variables? For gender and marital status a chi-square analysis was used, and for pain duration and age, an independent samples t-test was used.
2. The second research question is do smokers and nonsmokers differ in pain intensity, depression, anxiety, and pain disability at admission? A Multivariate General Linear Model was used with the independent variable being smoking status (smoker or nonsmoker) and the dependent variables being the admission scores for pain intensity, depression, anxiety, and pain disability.
3. The third research question is do nonsmokers and smokers improve comparably between admission and discharge for pain intensity, depression, anxiety, and pain

disability? A mixed model repeated analysis of variance was used, with the within-subjects independent variable time, with two levels (admission and discharge), and the between-subjects independent variable smoking status (smoker or nonsmoker). The dependent variables were pain intensity scores, depression scores, anxiety scores, and pain disability scores.

4. The fourth research question is do smokers and nonsmokers differ in the amount of their improvement between admission and discharge for pain intensity, depression, anxiety, and pain disability? The same mixed model repeated analysis of variance in the previous research question was utilized.
5. The fifth research question is do smokers and nonsmokers differ in pain intensity, depression, anxiety, and pain disability at discharge? As with the second research question, a Multivariate General Linear Model was used with the independent variable being smoking status (smoker or nonsmoker) and the dependent variables being the discharge scores for pain intensity, depression, anxiety, and pain disability.

CHAPTER III

RESULTS

3.1 Results

A total of 849 individuals were included in the data analysis. Of these individuals, 72 percent (N=567) were nonsmokers. In addition, 82 percent (N=645) of these individuals completed the Chronic Pain Rehabilitation Program. Furthermore, 64% of these individuals were female (N=544), and the mean age of these individuals was 46.4, with the youngest individual begin 18 years old, and the oldest individual being 85 years of age.

The duration of pain was not significantly different for smokers and nonsmokers, $t(466.96) = 1.87, p = .063$. The average duration of pain for smokers was 11.99 years and the average for nonsmokers was 13.55 years. Smokers were significantly younger than nonsmokers, $t(453.57) = 2.276, p = .023$. The mean age of the smokers was 44.42, while the mean age of the nonsmokers was 46.71. Smokers are significantly more likely to be male, $\chi^2(1, N=785) = 3.86, p = .049$. Marital status was also significant [$\chi^2(5, N=785) = 38.638, p = .000$], with married individuals being the least likely to smoke. Furthermore,

smokers are significantly less likely to complete the Chronic Pain Rehabilitation Program than nonsmokers, $\chi^2 (1, N=785) = 4.44, p = .035$, with 84% of nonsmokers completing the program and only 77.5% of smokers completing the program.

From the Multivariate General Linear Model, it was found that smokers had significantly higher scores than nonsmokers at admission when looking at the depression scores, anxiety scores pain intensity scores, and pain disability scores, $F (4,744) = 3.58, p = .007$. Additionally, from the univariate analyses, smokers had significantly higher depression scores, anxiety scores, pain intensity scores than nonsmokers at admission, $F (1, 744) = 11.089, p = .001, F (1, 744) = 5.921, p = .015, F (1, 744) = 5.431, p = .020$, respectively (See Table 1 for the mean admission scores). However, smokers and nonsmokers did not have significantly different scores on the PDI at admission, $F (1, 744) = 2.675, p = .102$. For these analyses, the Bonferroni correction was used, making the level of significance $P < .02$. Therefore, pain intensity was borderline because $p = .02$. From the mixed model repeated analysis of variance, time was significant for both smokers and nonsmokers, $F (4, 596) = 408.185, p = .000$. In addition, the effect size was very large, with partial eta squared equaling .734. Furthermore, from the univariate analyses, time was significant for both smokers and nonsmokers on all scores (depression, anxiety, pain intensity, and pain disability), $F (1, 596) = 526.96, p = .000, F (1, 596) = 213.938, p = .000, F (1, 596) = 684.554, p = .000, F (1, 596) = 1370.451, p = .000$, respectively. This indicates that both smokers and nonsmokers improved on all of these measures between admission and discharge. The interaction between time and smoking was not significant for any of the measures, $F (1, 593) = .726, p = .574$. From the Multivariate General Linear Model, smokers did not have significantly higher scores

than nonsmokers at discharge when looking at the depression scores, anxiety scores pain intensity scores, and pain disability scores, $F(4,619) = 2.003, p = .093$. For the following univariate analyses, the Bonferroni correction was utilized again. At discharge, smokers no longer had significantly higher anxiety scores and pain intensity scores than nonsmokers, $F(1, 619) = 2.42, p = .120$, $F(1, 619) = .36, p = .547$ (See Table 2 for the mean discharge scores). Furthermore, the PDI scores of smokers and nonsmokers were still not significantly different, $F(1, 619) = 2.32, p = .129$, and smokers still had significantly higher depression scores than nonsmokers, $F(1, 619) = 7.33, p = .007$.

CHAPTER IV

DISCUSSION

The results fit with first hypothesis that there will be more smokers who are male, more smokers who are younger, and more nonsmokers who are married as this is precisely what was found. However, these differences are not likely to be clinically significant, especially age because that the average ages of smokers and nonsmokers were both in the 40s, and the difference between the two groups was only about two years. The second hypothesis that smokers will have a higher pain intensity score, depression score, anxiety score, and pain disability score at admission when compared to nonsmokers was partially confirmed: smokers had higher depression scores, anxiety scores, and pain intensity scores at admission. However, the results did not support the hypothesis that smokers have higher pain disability scores at admission. The third hypothesis that smokers and nonsmokers will both improve between admission and discharge for pain intensity scores, depression scores, anxiety scores, and pain disability scores was supported. The fourth hypothesis that smokers will improve more than

nonsmokers between admission and discharge for pain intensity scores, anxiety scores, and pain disability scores was not supported for any of these factor variables. Finally, the fifth hypothesis that smokers will have a higher depression score at discharge when compared to nonsmokers was supported.

The main finding that this study has corroborated is that smokers and nonsmokers both improve throughout the course of this chronic pain rehabilitation program, and although the smokers had higher scores at admission on several variables, their treatment outcomes were not impeded. This confirmation of the Hooten et al. (2009) results increases the confidence that comprehensive pain management programs are effective for smokers as well as nonsmokers.

Specifically, with regards to depression scores, our data replicates both McGreary et al (2004) and Hooten et al. (2009) in that depression scores were higher both at admission and discharge for smokers when compared to nonsmokers. However, although these differences are statistically significant, the depression scores for both smokers and nonsmokers at discharge fell in the normal range. Therefore, while statistically different, this finding is not clinically significant. In addition Hooten et al. (2009) found the same results regarding anxiety scores in that they were higher at admission, but were no longer significantly different from nonsmokers at discharge. However, unlike Hooten et al. (2009), none of the interactions were significant, indicating that the smokers did not improve more than nonsmokers on any of the measures examined. One explanation for the lack of this interaction in this study is that in this specific program so much improvement is found between admission and discharge for both smokers and

nonsmokers that an interaction would not be likely to occur under these circumstances. The large effect size found supports this theory.

This study also supports the findings that smokers have more severe pain or a greater pain intensity than nonsmokers (Edwards et al., 2006; John et al., 2006; Weingarten et al., 2008) and that smokers have poorer mental health and more emotional distress than nonsmokers (Edwards et al., 2006; Hooten et al., 2009; Jamison, Stetson, and Parris, 1991; Strine et al., 2005), given that smokers had both higher depression and anxiety scores than nonsmokers at admission.

On the other hand, this study does not support the findings that smokers have more pain disability than nonsmokers as Weingarten et al. (2008) found with regards to functional interference and Hooten et al. (2009) found with regards to life interference. However, Weingarten et al. (2008) analyzed functional interference using the seven domains separately, while this study looked at functional interference as a whole. In addition, there were further differences in the domains involved. While Weingarten et al. (2008) examined functional interference using the Brief Pain Inventory (BPI), which includes general activity, mood, walking, normal work, relationships, sleep, and enjoyment of life, this study examined functional interference using the PDI, which includes the domains of Family/Home Responsibilities, Recreation, Social Activity, Occupation, Sexual Behavior, Self Care, and Life Support Activities. Although many of these domains are similar, one of the main differences is that the BPI includes the domains of mood and enjoyment of life that the PDI does not incorporate.

In addition, this study supports the results that smokers are less likely to complete pain programs (McGreary et al., 2004). On the other hand, Hooten et al. (2009) had a

similar percentage of smokers and nonsmokers who completed the program. It is possible that these different results occurred because of differences between the two programs or because of the difference in the number of people included in the two different studies. For instance, it could be that smokers were less comfortable with the psychodynamic techniques incorporated in the chronic pain rehabilitation program used in this study, but not incorporated in the chronic pain rehabilitation program that was used in the Hooten et al. (2009) research. With regards to the other demographic characteristics, Hooten et al. (2009) also found that smokers were more likely to be younger than nonsmokers, and that nonsmokers are more likely to be married. However, unlike this study, Hooten et al. (2009) did not find that males are more likely to smoke, given that they found no significant difference related to gender.

One limitation of this study is that more smokers did not complete this program than nonsmokers, which could have distorted the discharge results. Depending on the smokers' reasoning for dropping out of the program, this could have made the smokers seem as if they improve more than they actually would have if the dropout rate was not so high for smokers. On the other hand, because the results were similar to Hooten et al. (2009), where the dropout rates were not different for smokers and nonsmokers, it is likely that the results are accurate.

Another limitation of this study is that it did not account for the difference between smokers who had smoked in the past and had quit smoking by the time of their admission to the pain program, and lifelong nonsmokers. This could have limited the effects of the nonsmokers because the individuals who had quit smoking were grouped in with the nonsmokers and many studies have indicated that there are differences between

these two groups (John et al., 2006; Mitchell et al., 2011; Strine et al., 2005).

Consequently, it may be beneficial in the future research on the impact of smoking and outcomes in comprehensive chronic pain rehabilitation programs to differentiate between these groups, even if only to confirm Weingarten et al.'s (2008) finding that there are no significant outcome differences between individuals who had never smoked and those who had quit smoking.

Similarly, another limitation of this study is that it did not differentiate between individuals who are heavy smokers and those who are not. Several studies have noted differences between these two groups of smokers (Edwards et al., 2006; Mitchell et al., 2011; Weingarten et al., 2008). Therefore, this may also be a useful distinction to make in future research involving chronic pain rehabilitation programs.

In conclusion, this study found that though smokers had poorer scores on some measures at admission, their improvement in the chronic pain rehabilitation program was not hindered by smoking status, thereby supporting the results that Hooten et al (2009) found. While additional research is needed to build further confidence in the results that have been found thus far, especially regarding the various specific findings, the present study suggests that comprehensive chronic pain rehabilitation programs are effective for both smokers and nonsmokers, specifically regarding pain intensity, anxiety, depression, and pain disability outcomes.

TABLES

Table 1

Mean admission scores for the DASS – Depression, DASS – Anxiety, Pain Intensity, and PDI

Measure	<u>Nonsmokers</u>		<u>Smokers</u>		<i>F</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
DASS – Depression	18.53	12.43	21.84	11.51	11.089	.001
DASS – Anxiety	12.80	9.78	14.73	9.63	5.921	.015
Pain Intensity	6.51	2.09	6.91	2.10	5.431	.020
PDI	41.98	12.28	43.60	12.02	2.675	.102

Table 2

Mean discharge scores for the DASS – Depression, DASS – Anxiety, Pain Intensity, and PDI

Measure	<u>Nonsmokers</u>		<u>Smokers</u>		<i>F</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
DASS – Depression	6.06	7.55	8.01	9.30	7.33	.007
DASS – Anxiety	6.36	6.67	7.35	7.47	1.42	.120
Pain Intensity	3.49	2.34	3.62	2.49	.36	.547
PDI	18.20	11.98	19.94	13.29	2.32	.129

FOOTNOTES

¹The current study utilizes an interdisciplinary treatment approach that incorporates psychodynamic techniques in the psychotherapy, while in the program used by Hooten et al. (2009), the psychotherapy was purely behavioral.

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