

ASSOCIATIONS BETWEEN CHRONIC PAIN AND USE OF
PHARMACOTHERAPY FOR SMOKING CESSATION

A Thesis

by

EMILY LYNN ZALE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2012

Major Subject: Psychology

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ABSTRACT

Associations Between Chronic Pain and Use of
Pharmacotherapy for Smoking Cessation. (August 2012)

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Chronic pain and tobacco dependence are two highly prevalent and comorbid conditions. The rate of smoking among persons in pain may be greater than twice the rate observed in the general population. Smokers tend to experience more adverse pain-treatment outcomes than do nonsmokers, and there is mounting evidence to suggest that smokers with comorbid pain disorders may have more difficulty abstaining from tobacco. The main goal of the current study was to examine cross-sectional relations between chronic pain status and past use of pharmacotherapy for smoking cessation. We also tested associations between chronic pain status and frequency of past quit attempts. Data were derived from a nationally-representative survey of households in the continental United States. After adjusting for sociodemographic factors, substance use, mood and anxiety disorders, and number of attempts to quit smoking, smokers with chronic pain were found to be 1.67 times more likely to endorse past use of pharmacotherapy for smoking cessation, relative to smokers with no chronic pain. Chronic pain status was not associated with number of past attempts to quit smoking. These data suggest that smokers with chronic pain are motivated to quit smoking, and

may be particularly amenable to pharmacologic intervention. Results are discussed with regard to clinical implications and directions for future research.

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1. INTRODUCTION

1.1 Introduction to Tobacco Smoking and Chronic Pain

1.1.1 Tobacco smoking

Tobacco use remains the leading preventable cause of mortality in the United States, resulting in 443,000 deaths and \$193 billion in health-related economic losses each year (CDC, 2008). Smoking has been identified as a causal agent in multiple forms of cancer, cardiovascular diseases, and respiratory diseases (DHHS, 2004). Despite known health risks, nearly 21% (47 million) of adults in the United States are current smokers. The prevalence of cigarette smoking has remained stable since 2004 (CDC, 2004, 2010), which may indicate that there are subpopulations of smokers who face unique challenges to quitting (Borrelli, 2010). To that end, smokers with comorbid medical conditions (e.g., chronic pain) have been identified as important targets for smoking cessation interventions (Fiore et al., 2008).

1.1.2 Chronic pain

Pain is a national health concern that affects up to 43% (116 million) of American adults (IOM, 2011; Tsang et al., 2008). Pain motivates at least 50% of physician visits each year (Mayo Clinic, 2001; Turk & Melzack, 2011), and according to recent estimates by the National Academies of Sciences, pain is responsible for up to \$635 billion annually in direct health care expenditures and lost productivity (IOM, 2011). Chronic pain can be differentiated from acute pain by duration, intensity,

This thesis follows the style of *Health Psychology*.

and associated disability, yet researchers have not reached a consensus regarding a definition that encompasses all domains (Turk & Melzack, 2011). Therefore, chronic pain is typically distinguished from acute pain by duration, with most studies utilizing cutoffs ranging from 3-6 months (e.g., Ekholm, Gronbaek, Peuckmann, & Sjogren, 2008; Jakobsson, 2008; Strine & Hootman, 2007; Zvolensky, McMillan, Gonzalez, & Asmundson, 2010). In addition to physical impairment and disability, chronic pain has been associated with increased absence from work and unemployment, reduced participation in social or recreational activities, lower perceived social support, and increased suicidality (Braden & Sullivan, 2008; Carr & Moffett, 2005; Closs, 2009; Ilgen, Zivin, McCammon, & Valenstein, 2008).

1.1.3 Comorbidity between pain and smoking

The prevalence of smoking among persons with chronic pain is approximately twice that observed in the general population. Reports of smoking prevalence among clinical pain samples indicate 49-68% of treatment seeking pain patients are current smokers (Hooten, Shi, Gazelka, & Warner, 2011; Jamison, Stetson, & Parris, 1991; Michna et al., 2004). Epidemiological studies have also reported that persons with chronic pain were almost twice as likely to be smokers, even after controlling for relevant demographic characteristics and comorbid conditions (e.g., Strine & Hootman, 2007; Zvolensky et al., 2010). For example, in a nationally representative sample of adults in the United States, 42% of persons with medically-unexplained chronic pain were current smokers, and persons with chronic back or neck pain were almost twice as likely (OR = 1.95, 95% CI = 1.41-2.68) to meet DSM-IV criteria for nicotine

dependence, relative to persons without pain (Zvolensky, McMillan, Gonzalez, & Asmundson, 2009). Similar prevalence rates and odds ratios that further substantiate the comorbidity of pain and smoking in nationally representative samples have been reported in Denmark (Ekholm et al., 2008), Norway (Brage & Bjerkedal, 1996), Sweden (Hagg, Fritzell, & Nordwall, 2002; Jakobsson, 2008), Canada (Zvolensky et al., 2010), and the United Kingdom (Palmer, Syddall, Cooper, & Coggon, 2003).

1.2 The Effects of Smoking on Pain

1.2.1 Painful conditions associated with smoking

Tobacco smoking has been associated with the onset and progression of numerous painful medical conditions, and there is recent evidence that smoking may be a unique causal agent in the development of rheumatoid arthritis and low back pain (e.g., Shiri, Karppinen, Leino-Arjas, Solovieva, & Viikari-Juntura, 2010; Sugiyama et al., 2010). Smoking has been associated with arthritis disease progression and severity (e.g., Saag et al., 1997), and a recent meta-analysis demonstrated a dose-response relation between back pain and the number of cigarettes smoked per day (Shiri et al., 2010). Smoking has also been associated with the prevalence/severity of chronic headaches (Aamodt, Stovner, Hagen, Brathen, & Zwart, 2006; Payne et al., 1991), painful oral diseases (Johnson & Slach, 2001; Winn, 2001), fibromyalgia (e.g., Lee et al., 2010), menstrual pain (Gold et al., 2007), pregnancy related pelvic pain (Biering, Aagaard Nohr, Olsen, Nybo Andersen, & Juhl, 2010), Buerger's disease (Quintas & Albuquerque, 2008), and pain associated with HIV (Patel et al., 2006), osteoarthritis (Amin et al., 2007), and sickle cell disease (Cohen, DeBaun, Blinder, Strunk, & Field, 2010).

1.2.2 Smoking and pain treatment

There is evidence that, relative to nonsmokers, smokers are less likely to complete treatment for chronic pain, and more likely to report post-treatment affective distress and health-role limitations (Hooten et al., 2009). Smoking has been shown to impair the efficacy of several treatments for rheumatoid arthritis (e.g., Harty & Veale, 2010), and smokers are more likely to experience adverse outcomes following surgical pain interventions (Glassman et al. 2007). There is also evidence that smokers are more likely than nonsmokers to hold multiple opioid medication prescriptions (Skurtveit, Furu, Selmer, Handal, & Tverdal, 2010), and that smokers tend to use greater quantities of analgesic medications (Hooten, Shi, et al., 2011) for longer periods of time (Krebs et al., 2010). Finally, it appears that smokers are less likely than nonsmokers to return to work following treatment for chronic pain (Fishbain et al., 2008).

1.2.3 Pain-inhibitory effects of nicotine in animals

Although smoking contributes to the development and worsening of pain, there is paradoxical evidence that nicotine may also have acute pain-inhibitory effects. In animal models, nicotine administered subcutaneously has been shown to inhibit pain induced by thermal and mechanical stimulation (e.g., Aceto, Bagley, Dewey, Fu, & Martin, 1986; Block, Chin, Wu, & Zbuzek, 1993; Rowley & Flood, 2008; Rowley, Payappilly, Lu, & Flood, 2008; Tripathi, Martin, & Aceto, 1982). Similar results were also obtained when nicotine was administered via cigarette smoke in an environmental chamber (Anderson et al., 2004; Simons et al., 2005). However, there is evidence that the acute pain-inhibitory effects of nicotine may subside following chronic nicotine administration.

Chronic exposure to both subcutaneous nicotine and tobacco smoke have been shown to result in nicotine tolerance, and a decline in previously observed analgesic effects (Carstens, Anderson, Simons, Carstens, & Jinks, 2001; Galeote, Kieffer, Maldonado, & Berrendero, 2006; Simons et al., 2005).

1.2.4 Pain-inhibitory effects of nicotine in humans

Clinical and laboratory studies have also demonstrated that acute nicotine administration may have pain-inhibitory effects in humans. For example, clinical evidence indicates that nicotine may reduce post-operative pain and analgesic requirements among nonsmokers, although these effects have not been demonstrated in smokers (e.g., Habib et al., 2008; Hong, Conell-Price, Cheng, & Flood, 2008; Olson, Hong, Conell-Price, Cheng, & Flood, 2009; Turan et al., 2008). Laboratory studies have also demonstrated that acute nicotine administration may increase pain tolerance and threshold ratings (e.g., Perkins, Grobe, Stiller, & Scierka, 1994; Pomerleau, Turk, & Fertig, 1984; Silverstein, 1982). However, a substantial number of studies (n=8) have not observed such effects (Jarvik, Caskey, Rose, Herskovic, & Sadeghpour, 1989; Knott, 1990; Knott & De Lugt, 1991; Mueser, Waller, Levander, & Schalling, 1984; Shiffman & Jarvik, 1984; Sult & Moss, 1986; Unrod, Kassel, & Robinson, 2004; Waller, Schalling, Levander, & Edman, 1983). To integrate these findings, we recently conducted a meta-analysis (Ditre, Heckman, Zale, & Herrick, in preparation) which revealed a small, but positive effect of nicotine on both pain tolerance (Hedge's $g = .26$) and threshold (Hedge's $g = .27$).

1.3 The Effects of Pain on Smoking

1.3.1 Cross-sectional evidence

Researchers have proposed that the avoidance, relief, or both, of pain is a powerful behavioral reinforcer that may be an important mechanism in the maintenance of tobacco smoking and nicotine dependence (Fertig, Pomerleau, & Sanders, 1986; Fishbain et al., 2007; Jarvik et al., 1989; Pomerleau, 1986; Silverstein, 1982; Zvolensky et al., 2009). Indeed, a growing body of research provides evidence that pain may be a potent motivator of smoking behavior. For example, smokers receiving pain treatment consistently endorse smoking in response to pain (Hooten, Vickers, et al., 2011; Jamison et al., 1991). In a qualitative study of smokers with chronic pain, participants reported that smoking provides distraction from both physical pain and pain-related distress, and they identified distraction as a primary motive of their smoking behavior (Hooten, Vickers, et al., 2011). Multiple studies have also observed a dose-response relation between pain intensity and daily cigarette consumption, such that greater pain intensity was associated with increased cigarette consumption (e.g., Hahn, Rayens, Kirsh, & Passik, 2006; Riley, Tomar, & Gilbert, 2004; Saag et al., 1997).

1.3.2 Experimental evidence

Ditre and Brandon (2008) conducted the first laboratory study designed to test the effects of pain on smoking motivation. Relative to controls, smokers who underwent experimental pain induction reported greater urge and demonstrated decreased latency to smoke. In a follow-up study, Ditre et al. demonstrated that the relationship between pain and smoking motivation can be successfully manipulated by invoking social-cognitive

constructs (Ditre, Heckman, Butts, & Brandon, 2010). Specifically, pain-induced urge to smoke was attenuated by use of a pain-coping strategy (i.e., distraction), and similar effects were observed when smokers' expectations for smoking-related pain relief were challenged prior to pain induction. These results indicate that pain-coping and smoking-related outcome expectancies may be important targets of tailored smoking cessation interventions for smokers with comorbid pain disorders.

1.4 Reciprocal Relation Between Pain and Smoking

While smoking has been associated with the cause and course of chronic pain conditions, there is also reason to believe that pain motivates continued smoking behavior. By integrating findings from both directions of empirical inquiry, Ditre & Brandon (2008) hypothesized a reciprocal relation between pain and smoking that interacts in the manner of a positive feedback loop, with the end result being increased pain and the maintenance of tobacco dependence. Extrapolating from the hypothesized model, there is reason to predict that smokers with chronic pain may experience more difficulty abstaining from tobacco.

1.5 Pain and Smoking Cessation

Consistent with evidence that pain motivates smoking, there is also reason to believe that pain may serve as a significant barrier to smoking cessation. For example, smokers in pain tend to report greater difficulty and less confidence in quitting relative to their pain-free counterparts (Ditre, Zale, Heckman, Brandon, in preparation). Patients undergoing pain treatment have also reported limited confidence in their ability to additionally cope with the stress of quitting smoking (Hooten, Vickers, et al., 2011).

Finally, there is longitudinal evidence that smokers with a history of migraine pain were more likely to have tried unsuccessfully to quit smoking than were persons without migraine pain (Waldie, McGee, Reeder, & Poulton, 2008).

Based on results from experimental studies conducted in animals and humans, there is reason to believe that pain may precipitate relapse to smoking. Animal models of stress-induced relapse (Sinha, Shaham, & Heilig, 2011) have demonstrated that following extinction of nicotine-self administration, exposure to a painful stressor (e.g., electric shock) reinstated drug-seeking behavior (Bruijnzeel, Prado, & Isaac, 2009; Zislis, Desai, Prado, Shah, & Bruijnzeel, 2007). In addition, a recent human experimental study demonstrated that relapse to smoking was predicted by greater pain reactivity prior to quitting (Nakajima & al'Absi, 2011). Taken together, evidence from animal and human studies suggests that smokers may be vulnerable to pain-induced relapse to smoking.

1.6 Pharmacologic Treatments for Tobacco Dependence

According to the Clinical Practice Guidelines for Treating Tobacco Use and Dependence, all persons who are attempting to quit smoking should be encouraged to use one or more FDA-approved pharmacologic aids (Fiore et al., 2008). Current first-line smoking cessation agents include five forms of nicotine replacement therapy (NRT), the antidepressant bupropion (*Zyban*), and the partial nicotine agonist/antagonist varenicline tartrate (*Chantix*). Each of these medications has demonstrated efficacy in improving smoking cessation outcomes, essentially doubling the rates of successful

quitting, relative to placebo (e.g., Fiore et al., 2008; Huang, Li, Yang, Jiang, & Wu, 2012).

1.7 Summary and Current Investigation

Tobacco dependence and chronic pain are two highly prevalent and comorbid conditions that engender substantial burdens upon individuals and health care systems. Although tobacco smoking remains the leading preventable cause of morbidity and mortality in the United States, nearly 20% of American adults continue to smoke tobacco (CDC, 2011). Like smoking, chronic pain is a critical national health problem that affects over 100 million adults, with an annual economic cost of up to \$560 billion (IOM, 2011). Clinical and epidemiological data indicate that the prevalence of tobacco smoking among persons in pain may be greater than twice the rate observed in the general population (Ditre, Brandon, Zale, & Meagher, 2011; Shi, Weingarten, Mantilla, Hooten, & Warner, 2010; Zvolensky et al., 2009).

Smoking has been identified as a unique causal agent in the onset and progression of chronic pain (e.g., Shiri et al., 2010; Sugiyama et al., 2010), and there is some evidence that smokers (relative to nonsmokers) experience more severe pain (e.g., Ditre et al., 2011) and poorer pain-treatment outcomes (Fishbain et al., 2008; Glassman et al., 2007). Conversely, pain has been shown to increase desire to smoke (Ditre & Brandon, 2008; Ditre et al., 2010), greater pain has been associated with increased cigarette consumption (e.g., Hahn et al., 2006; Riley et al., 2004; Saag et al., 1997), and pain patients have endorsed tobacco smoking as a means of coping with pain (Hooten, Vickers et al., 2011; Jamison et al., 1991; Patterson et al., 2012). Consistent with these

observations, Ditre et al. (2011) proposed a reciprocal model of pain and smoking that is hypothesized to act in the manner of a positive feedback loop, resulting in greater pain, increased smoking, and the maintenance of tobacco dependence.

With regard to smoking cessation, researchers have suggested that specific subpopulations of smokers may experience unique challenges when attempting to quit (e.g., Borrelli, 2010), and there is mounting evidence that recurring pain may present a significant barrier to smoking cessation. Smokers in pain tend to endorse less confidence in quitting (Hooten, Vickers, et al., 2011), greater difficulty when attempting to quit (Waldie et al., 2008), and poorer abstinence-related outcomes (Waldie et al., 2008). Interestingly, there is reason to believe that pain may not adversely influence motivation to quit smoking. For example, Hahn et al. (2006) observed no difference in self-reported motivation to quit as a function of past-week pain status.

Given evidence of complex interactions and significant comorbidity between pain and tobacco smoking, it is important to examine how approaches to quitting may differ between smokers with and without chronic pain. We are not aware of any previous studies that examined associations between chronic pain and either the likelihood of having used pharmacotherapy for smoking cessation, or the frequency of having engaged a serious quit attempt. Specifically, we hypothesized that smokers who endorsed any chronic pain (relative to no chronic pain) would be more likely to have utilized pharmacologic aids for smoking cessation. Secondary analyses were conducted to examine past use of pharmacotherapy across chronic pain sub-types. We also sought to explore associations between chronic pain status and frequency of past quit attempts.

2. METHOD

2.1 Data Source

Data were derived from the National Comorbidity Survey-Replication (NCS-R), a nationally-representative, two-part survey of households in the continental United States. Face-to-face interviews were conducted with 9,282 English-speaking adults between February 2001 and April 2003. Part I of the survey collected demographic information and screened for psychiatric disorders, and Part II assessed smoking history and health status. A detailed description of recruitment, survey administration, and weighting procedures is provided by Kessler et al. (2004). Analyses were restricted to respondents who endorsed current smoking ($N = 1,636$).

2.2 Measures

2.2.1 *Chronic pain status*

Participants were asked: “Have you ever had any of the following: arthritis or rheumatism; chronic back or neck problems; frequent or severe headaches; any other chronic pain?” Participants were also asked whether they ever had medically-unexplained chronic pain, which was defined as pain lasting at least six months that interfered with daily activities, caused emotional distress, and for which there was no apparent physical cause. Participants provided separate (yes/no) responses for each type of pain, and these responses were combined to generate a dichotomous "chronic pain status" (any/none) variable.

2.2.2 Past utilization of pharmacotherapy for smoking cessation

Participants were asked: “Have you ever in your life used any of the following types of treatments to help you cut down or quit smoking: nicotine patch or nicotine gum; a prescription medicine?” Participants provided separate (yes/no) responses for nicotine patch/gum and prescription medication, which were combined to create a dichotomous "any pharmacotherapy/no pharmacotherapy" variable.

2.2.3 Frequency of past attempts to quit smoking

Participants were asked to report the number of different times they had made a serious attempt to quit smoking. Responses were open ended and recorded as a continuous variable.

2.2.4 Lifetime substance use and mood disorders

The World Health Organization’s Composite International Diagnostic Interview (WHO-CIDI; Kessler & Ustun, 2004) was used to assess lifetime history of Alcohol Abuse/Dependence, Drug Abuse/Dependence (excluding nicotine), Major Depressive Disorder, Dysthymia, and Generalized Anxiety Disorder. Each disorder was assessed individually using Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria. Alcohol and Drug Abuse/Dependence were combined to create a dichotomous (yes/no) “substance use disorder” variable. Major Depressive Disorder and Dysthymia were combined to generate a dichotomous “mood disorder” variable.

2.3 Data Analytic Approach

Multiple logistic regression was conducted to test the hypothesized association between chronic pain status and past use of pharmacotherapy for smoking cessation.

Secondary analyses tested relations between chronic pain sub-types and past use of either NRT or prescription cessation medications. Linear regression was conducted to explore the association between chronic pain status and number of past attempts to quit smoking. All analyses incorporated weights as provided by NCS-R, and employed the Taylor series linearization method to adjust for the complex sampling design (Wolter, 1985). Analyses controlled for the influence of relevant sociodemographic (age, gender, race/ethnicity, education, income, and marital status) and psychiatric (lifetime substance use, anxiety, and mood disorders) factors, and number of past quit attempts.

3. RESULTS

3.1 Sample Characteristics

Survey respondents were predominantly white (73%), with an average age of 41.30 years ($SD = 15.99$). Gender was fairly evenly distributed (52% male), and the majority of participants did not meet criteria for lifetime substance use (70%), anxiety (89%), or depressive disorders (80%). With regard to smoking history, respondents reported smoking an average of 16 cigarettes per day ($SD = 12.03$) for a mean duration of 20 years ($SD = 15.18$). Smokers also reported having made an average of 6.04 ($SD = 41.29$) serious attempts to cut down or quit smoking in their lifetime. Less than half (41%) of respondents endorsed having ever used any pharmacological aids to cut down or quit smoking. Chi-square and linear regression analyses revealed that smokers who endorsed any chronic pain (relative to no chronic pain) tended to be older, married, female, and white (see Table 1). Smokers with comorbid chronic pain were also more likely to have been diagnosed with a lifetime mood or anxiety disorder (both $ps < .001$).

3.2 Use of Pharmacotherapy for Smoking Cessation

As hypothesized, analyses revealed a significant, positive relation between chronic pain status and past use of pharmacotherapy to cut down or quit smoking (see Table 2). Specifically, smokers who endorsed any chronic pain were 67% more likely to have used any pharmacotherapy for smoking cessation, when compared to smokers with no chronic pain (95% CI = 1.24-2.24, $p < .001$). Follow-up analyses indicated that smokers with comorbid pain were more likely to have used nicotine patch or gum (AOR = 1.56, 95% CI = 1.18-2.06, $p < .01$), but not prescription cessation medications (AOR =

Table 1
Sociodemographic Characteristics, Substance Use and Mood Disorders, and Use of Pharmacotherapy for Smoking Cessation by Chronic Pain Status

	No Chronic Pain <i>n</i> (%)	Any Chronic Pain <i>n</i> (%)	Total Sample <i>n</i> (%)
Gender**			
Male	311 (56.6%)	451 (48.4%)	762 (51.8%)
Female	279 (43.4%)	584 (51.6%)	863 (48.2%)
Race/Ethnicity			
White*	428 (69.6%)	769 (75.2%)	1197 (72.9%)
Black	70 (9.5%)	136 (4.3%)	206 (11.2%)
Hispanic***	57 (15.9%)	57 (8.3%)	114 (11.4%)
Other	35 (5.1%)	73 (4.2%)	108 (4.5%)
Education			
0-11 Years	122 (24.7%)	244 (25.7%)	366 (25.3%)
12 Years	115 (39.4%)	383 (38.7%)	609 (39.0%)
12-15 Years	169 (25.2%)	279 (24.9%)	448 (25.0%)
≥16 Years	73 (10.8%)	129 (10.7%)	202 (10.7%)
Marital Status			
Married/Cohabiting**	283 (45.4%)	547 (52.6%)	830 (49.6%)
Divorced/Separated/Widowed*	113 (20.8%)	289 (26.7%)	402 (24.3%)
Never Married*	194 (33.8%)	199 (20.6%)	393 (26.1%)
Substance Use Disorder	211 (28.4%)	385 (31.0%)	596 (29.9%)
Mood Disorder***	158 (15.7%)	325 (23.4%)	483 (20.2%)
Generalized Anxiety Disorder***	69 (6.2%)	198 (14.4%)	267 (11%)
Use of Pharmacotherapy			
Any Pharmacotherapy***	122 (31.8%)	329 (46.0%)	451 (40.6%)
Nicotine Patch/Gum***	108 (28.6%)	296 (41.2%)	404 (36.4%)
Prescription	570 (13.4%)	130 (17.8%)	179 (16.1%)
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Age***	38.22 (15.72)	43.48 (15.84)	41.30 (15.99)
Income	50,497(43,426)	49,217 (44,035)	49,908 (43,748)

Note. Inconsistencies between *n* and % are due to effects of the weighting procedure. All *ns* were unweighted. All %s were weighted.

** $p < .01$. *** $p < .001$.

1.27, 95% CI = 0.85-1.90, $p = .26$). Secondary analyses revealed that arthritis/rheumatism, chronic back/neck pain, and frequent/severe headaches were each individually associated with a greater likelihood of having used any pharmacotherapy to cut down or quit smoking (all $ps < .05$; see Table 3). Again, these associations were primarily driven by past use of nicotine patch or gum (all $ps < .05$), but not prescription medications (all $ps > .12$).

3.3 Past Attempts to Quit Smoking

We observed no evidence of an association between chronic pain status and number of past attempts to cut down or quit smoking ($b = 3.16$, $t(1072) = 1.62$, $p = .11$). Similar null findings were observed for each chronic pain sub-type, including arthritis/rheumatism ($p = .53$), chronic back/neck pain ($p = .88$), frequent/severe headaches ($p = .68$), other chronic pain ($p = .19$), and medically-unexplained chronic pain ($p = .52$).

Table 2
Multiple Logistic Regression Analysis of the Association Between Chronic Pain Status and Past Use of Any Pharmacotherapy to Cut Down or Quit Smoking

	Past Use of Any Pharmacotherapy					
	β	SE	Wald's χ^2	OR	95% CI	<i>p</i>
Primary Predictor						
Chronic Pain Status	0.51	0.15	11.57	1.67	1.24-2.24	< .001
Covariates						
Gender (male)	-0.24	0.17	1.98	0.79	0.56-1.10	.16
Race/Ethnicity						
Other	–	–	–	–	–	–
White	-0.14	0.40	0.12	0.87	0.40-1.90	.73
Black	-1.02	0.46	5.02	0.36	0.15-0.88	.03
Hispanic	-1.28	.53	5.82	0.28	0.10-0.79	.02
Education						
0-11 years	–	–	–	–	–	–
12 years	0.35	0.17	4.04	1.42	1.01-1.99	.04
13-15 years	0.23	0.25	0.89	1.26	0.78-2.06	.35
≥16 Years	0.51	0.31	2.76	1.67	0.91-3.03	.10
Marital Status						
Married	–	–	–	–	–	–
Divorced/Widowed/Separated	0.03	0.24	0.02	1.03	0.64-1.66	.90
Never Married	-0.29	0.26	1.19	0.75	0.45-1.26	.28
Substance Use Disorder	0.48	0.15	10.64	1.61	1.21-2.14	.001
Mood Disorder	0.00	.22	0.00	1.00	0.65-1.53	.99
Generalized Anxiety Disorder	0.27	0.19	1.98	1.21	0.90-1.91	.16
Age	0.01	0.01	3.76	1.01	1.00-1.03	.05
Income	0.00	0.00	1.55	1.00	1.00-1.00	.21
Number of Past Quit Attempts	0.00	0.00	0.30	1.00	0.99-1.01	.58
Overall Model Evaluation	χ^2	<i>df</i>	<i>p</i>			
Likelihood Ratio Test	85.19	16	< .001			
Score Test	79.69	16	< .001			
Wald Test	208.51	16	< .001			

Note. All degrees of freedom (*df*) = 1, unless otherwise noted. SE = standard error. OR = odds ratio. CI = confidence interval.

Table 3
Odds of Past Use of Pharmacotherapy to Cut Down or Quit Smoking by Chronic Pain Sub-Type

	Past Use of Pharmacotherapy		
	Any Pharmacotherapy AOR (95% CI)	Nicotine Patch/Gum AOR (95% CI)	Prescription Medication AOR (95% CI)
Any Chronic Pain	1.67 (1.24-2.24)***	1.56 (1.18-2.06)**	1.27 (0.84-1.90)
Arthritis/Rheumatism	1.50 (1.05-2.13)*	1.55 (1.13-2.14)*	1.36 (0.88-2.09)
Back/Neck	1.43 (1.06-1.93)*	1.49 (1.13-1.97)**	0.93 (0.71-1.23)
Headaches	1.62 (1.15-2.26)**	1.54 (1.07-2.23)*	1.20 (0.82-1.77)
Medically-Unexplained	1.42 (0.75-2.69)	1.56 (0.79-3.07)	1.50 (0.97-2.32)
Other	1.09 (0.70-1.70)	1.16 (0.74-1.84)	1.46 (0.90-2.39)

Note. AOR = odds ratio adjusted for age, gender, race/ethnicity, education, income, marital status, and substance use, mood and anxiety disorders. CI = confidence interval.

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

4. SUMMARY AND CONCLUSIONS

Results indicated that smokers with chronic pain were more likely to have utilized pharmacotherapy for smoking cessation than were smokers with no chronic pain. Similar associations were observed between individual chronic pain sub-types and the likelihood of having used NRT for smoking cessation. Persons who utilize pharmacotherapy for smoking cessation tend to endorse greater nicotine dependence, more severe withdrawal from smoking, and expectations for greater difficulty quitting (Shiffman, Brockwell, Pillitteri, & Gitchell, 2008; Shiffman, Di Marino, & Sweeney, 2005). There is somewhat parallel evidence that smokers with comorbid pain disorders are more likely to meet criteria for nicotine dependence (Zvolensky et al., 2009), and less confident in their ability to abstain from smoking (Hooten, Vickers, et al., 2011). Collectively, these data seem consistent with a reciprocal model of pain and smoking in which pain is hypothesized to motivate smoking and maintain tobacco dependence (Ditre et al., 2011).

One explanation for our primary finding may be that persons in pain anticipate greater difficulty abstaining from smoking, which, in turn, makes them more likely to seek out and employ pharmacological interventions. Another possibility could be that smokers with chronic pain are simply more likely to encounter a variety of health care providers (possibly as a function of their underlying pain disorder) who recommend or prescribe pharmacotherapy for smoking cessation. Indeed, pain motivates approximately half of all annual physician visits in the United States (Mayo Clinic, 2001; Turk &

Melzack, 2011), and Clinical Practice Guidelines recommend that health care providers advise and assist smokers with quitting at every visit (Fiore et al., 2008).

Exploratory analyses revealed no evidence of an association between chronic pain status and frequency of past attempts to quit smoking. This finding is consistent with the results of a previous study that found no relation between pain and self-reported desire to quit smoking (Hahn et al., 2006), and with reports that smokers undergoing treatment for pain are highly motivated to quit (Hooten et al., 2009; Hooten, Vickers, et al., 2011). Thus, although recurring pain may present a significant barrier to smoking cessation, there is no evidence to suggest that pain may reduce motivation to quit smoking or the likelihood of engaging a serious quit attempt.

Several limitations of the current study bear noting. First, the cross-sectional nature of these findings precludes discussion of temporal precedence and any inferences regarding direction of causality. Second, respondents were not asked to report the duration of abstinence achieved when using pharmacotherapy. Therefore, these data cannot speak to the efficacy of pharmacotherapy for smoking cessation/reduction among persons with chronic pain. Third, a substantial number of respondents endorsed more than one type of chronic pain (55% of smokers who endorsed pain), and use of both nicotine patch/gum and prescription medication (30% of smokers who endorsed pharmacotherapy use), which may have limited our ability to differentiate between chronic pain sub-types and use of specific pharmacotherapies.

Research in the area of pain and smoking has increased dramatically in recent years, and there is an emerging literature which suggests that complex interactions

between these two conditions may influence their respective treatment trajectories (Ditre et al., 2011). With regard to smoking cessation, it is encouraging to note that a subpopulation of smokers who may be expected to have greater difficulty quitting (i.e., those with chronic pain), appear highly receptive to utilizing first-line agents for smoking cessation. Indeed, these individuals may be receptive to a variety of treatment modalities, especially if they come to understand that continued smoking may exacerbate or maintain their pain. Also, given the chronic nature of both conditions, smokers with comorbid pain may be good candidates for a chronic disease management approach to treating tobacco addiction (e.g., Joseph et al., 2011). Future research should employ a prospective analysis of how persons with chronic pain approach smoking cessation (inclusive of both behavioral and pharmacological interventions), and the extent to which chronic pain status may predict smoking abstinence-related outcomes.

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