Original Investigation

Chronic pain and cigarette smoking and nicotine dependence among a representative sample of adults

Michael J. Zvolensky, Katherine McMillan, Adam Gonzalez, & Gordon J. G. Asmundson

Abstract

Introduction: Individuals with chronic pain problems are at an increased risk for certain types of substance abuse and dependence. Recent work suggests that there is a significant association between chronic pain and cigarette smoking; however, it is unclear as to whether pain–smoking effects are evident above and beyond sociodemographic factors and cooccurring substance use disorders. The present investigation examined the relation between lifetime and current (past year) chronic pain and cigarette smoking status and nicotine dependence.

Methods: This investigation comprised a large representative sample of English-speaking adults ($n = 9,282$) residing in the United States. Data were collected primarily through face-to-face interviews conducted between February 2001 and April 2003.

Results: After adjusting for sociodemographic variables and the presence of a lifetime substance use disorder, individuals with a lifetime history of chronic neck or back pain were significantly more likely to be current smokers and to be diagnosed with lifetime as well as current nicotine dependence. Although there was no significant incremental relation between current chronic neck and back pain and being a current smoker, there was a significant association with lifetime and current nicotine dependence. Similar relations were evident among those with and without medically unexplained chronic pain in regard to smoking status and lifetime and current nicotine dependence.

Discussion: Findings are discussed in terms of better understanding the chronic pain–smoking association.

Introduction

Chronic pain, often defined as pain that persists for periods of longer than 3 months and for which there is no biological value (International Association for the Study of Pain, 1986), continues to be a major health concern in the United States and beyond. For example, estimates suggest that chronic pain impacts more than 75 million persons in the United States alone, contributing to more than $60 billion in lost productivity per year (McCarberg & Billington, 2006). Similar findings are evident in other regions of the world (Ohayon & Schatzberg, 2003). Moreover, chronic pain significantly negatively affects physical health, psychological functioning, and social well-being as well as global indices of quality of life, illustrating its clinical significance (Argoff, 2007; Turk & Melzack, 2001).

There is an increasing recognition that persons with chronic pain problems are at an increased risk for certain types of substance abuse and dependence (Denisco, Chandler, & Compton, 2008; Fishbain, Rosomoff, & Rosomoff, 1992). Perhaps the most widely publicized drug of abuse among those with chronic pain are opioids (Compton & Volkow, 2006), although other types of substance use disorders have also received scientific and clinical attention (e.g., alcohol use disorder; Brennan, Schutte, & Moos, 2005; Jamison, Kauffman, & Katz, 2000). There is significantly less empirical information pertaining to linkages between cigarette smoking and chronic pain (Freedman, Saulino, Overton, Holding, & Kornbluth, 2008). Such an oversight is unfortunate, as smoking remains a leading cause of morbidity and mortality in industrialized countries despite systematic efforts to prevent and control the use of tobacco (Centers for Disease Control and Prevention, 2008).

Of the work that has been completed on chronic pain and smoking, a number of intriguing, albeit initial, findings have

Michael J. Zvolensky, Ph.D., *Department of Psychology, University of Vermont, Burlington*

Katherine McMillan, *Anxiety and Illness Behaviours Laboratory and Department of Psychology, University of Regina, Regina, Saskatchewan, Canada*

Adam Gonzalez, B.A., *Department of Psychology, University of Vermont, Burlington*

Gordon J. G. Asmundson, Ph.D., *Anxiety and Illness Behaviours Laboratory and Department of Psychology, University of Regina, Regina, Saskatchewan, Canada*

Corresponding Author:

Michael J. Zvolensky, Ph.D., *Department of Psychology, University of Vermont, 2 Colchester Avenue, John Dewey Hall, Burlington, VT 05405-0134, USA. Telephone: 802-656-8994; Fax: 802-656-8783; E-mail: michael.zvolensky@uvm.edu*

emerged. In one recent study among a large Danish adult sample (n = 10,916), rates of cigarette smoking were significantly higher for those with chronic pain compared with those without (Ekholm, Gronbaek, Peuckmann, & Sjogren, 2009). However, it is presently unclear whether such pain–smoking effects are evident above and beyond sociodemographic factors and cooccurring substance use disorders. Other works have often found that among treatment-seeking adult chronic pain patients, smoking is associated with affective distress (Fishbain et al., 2007; Hooton et al., in press; John, Meyer, Rumpf, & Hapke, 2009; McGeary, Mayer, Gatchel, & Anagnostis, 2004). For example, Weingarten et al. (2008) found that smokers with chronic pain compared with nonsmokers with chronic pain presenting to a chronic pain treatment center were significantly more likely to endorse greater pain intensity and more functional impairment. Some scholars have suggested that individuals with chronic pain may be motivated to smoke because they believe smoking will help them cope with pain and other forms of affective distress (e.g., depression, anxiety; Ditre & Brandon, 2008; Jamison, Stetson, & Parris, 1991).

Although promising, extant work on chronic pain and smoking is limited. The vast majority of work has found that smoking among individuals with chronic pain is often significantly associated with greater levels of negative affect. Perhaps most notably, it remains unclear the extent to which current and lifetime history of chronic pain is associated with cigarette smoking and nicotine dependence in a representative sample and whether such a relation is evident after adjusting for sociodemographic variables and cooccurring substance use disorders. The purpose of the present study therefore was to examine the relation between chronic pain and cigarette smoking and nicotine dependence using a large representative survey (National Comorbidity Survey Replication [NCS-R]; Kessler et al., 2004) of adults conducted in the United States. Analyses were conducted among those in the NCS-R reporting chronic neck or back pain and those reporting medically unexplained chronic pain (i.e., chronic pain in any body region without demonstrable organic pathology). While both these conditions are consistent with contemporary definitions of chronic pain (International Association for the Study of Pain, 1986), and we had no a priori expectations of differential patterns of results (as reflected in our hypotheses below), analyses were conducted separately given that the former identifies specific anatomical regions of pain (i.e., neck or back), whereas the latter may involve more diffuse or nonmusculoskeletal pain sites. It was hypothesized that after adjusting for sociodemographic variables (age, marital status, income, education, race, and sex) and the presence of a lifetime substance use disorder (excluding nicotine dependence), lifetime and current chronic pain would be significantly associated with both smoking status and nicotine dependence. These hypotheses were guided by the findings of Ekholm et al. (2009) and related indirect work among nonrepresentative samples, denoting a possible chronic pain–smoking relation (e.g., McGeary et al., 2004).

Methods

Participants

The NCS-R is a large nationally representative survey of English-speaking household residents living in the United States. Data were gathered from residents 17 years and older between February 2001 and April 2003, with an overall response rate of 70.9%. All interviews were conducted face-to-face by trained lay interviewers unless a telephone interview was requested by the participant. Part 1 of this survey (n = 9,282) included a core diagnostic assessment administered to all respondents. Part 2 (n = 5,692) was administered to a subsample of the original Part 1 respondents, oversampling those with clinically significant psychopathology. Part 2 included assessments of additional disorders as well as correlates of the original Part 1 disorders. The data were weighted to reflect the population distribution for a range of sociodemographic characteristics. Additional information on the NCS-R methodology can be found elsewhere (Kessler et al., 2004). Participants included 4,139 men (M_{Age} = 43.9, SD = 17.0) and 5,143 women (M_{Age} = 45.4, SD = 17.9). Participants' mean age of initial smoking was 15 (SD = 6). Ethnicity was as follows: 72.1% Caucasian, 13.3% Black, 9.5% Hispanic, and 5.1% categorized as "Other." Pain severity was assessed by asking participants, "On a scale from 0 to 10, where 0 is 'no pain' and 10 is 'pain as bad as you can imagine,' what number best describes your pain at its worst in the past 12 months?" Similar levels of pain severity were reported by those who experienced lifetime (M = 8.2, SD = 1.7) or past year (M = 8.2, SD = 1.7) chronic neck and back pain as well as those with lifetime (M = 8.0, SD = 1.8) or past year (M = 8.0, SD = 1.8) medically unexplained chronic pain. Finally, treatment was assessed by asking participants how many doctors they had seen about their pain. Participants in all four pain groups reported seeing similar numbers of doctors regarding their pain, with numbers ranging from 3.8 (SD = 4.1) for those who reported lifetime medically unexplained chronic pain to 4.0 (SD = 4.7) for those with past year medically unexplained chronic pain.

Measures

Smoking, mood, anxiety, and substance use disorders. Smoking status was determined through self-report and was dichotomized into current smoker and nonsmoker. The nonsmoker category included those individuals who reported that they had never smoked, were ex-smokers, or had smoked only a few times. The survey did not specify a minimum length of abstinence from smoking for individuals who reported that they were ex-smokers. Nicotine dependence, alcohol abuse, alcohol dependence, drug abuse, drug dependence, mood disorders (bipolar I and II, dysthymia, and major depression), and anxiety disorders (agoraphobia with or without panic disorder, generalized anxiety disorder, panic disorder, posttraumatic stress disorder, social phobia, and specific phobia) were diagnosed using the World Health Organization's Composite International Diagnostic Interview (WHO-CIDI; Kessler & Ustun, 2004). The WHO-CIDI is designed for use by trained nonclinician interviewers and allows generation of diagnoses based on either the International Classification of Diseases-10th Edition (ICD-10) or the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria, the latter of which was used in this study.

Chronic pain. Lifetime chronic neck or back pain was assessed through self-report. Participants were asked, "The next few questions are about health problems you might have had at any time in your life. Have you ever had any of the following?" This was followed by a list of medical conditions including chronic neck or back pain. Past year chronic neck or back pain was assessed by asking, "Did you still have chronic neck or back pain or receive any treatment for it at any time during the past

12 months?" Medically unexplained chronic pain was defined in the NCS-R as "pain lasting six months or longer that is severe enough either to interfere a lot with your normal activities or to cause a lot of emotional distress and that a doctor cannot find a physical cause to explain."

Data analytic approach

Statistical analyses were conducted using SUDAAN software for survey data analyses (SUDAAN version 9.01; Research Triangle Institute, 2004) with the appropriate weights provided by the NCS-R to more accurately represent the U.S. population. Estimates of variance were conducted using the Taylor series linearization procedure to correct for the complex statistical sampling procedures employed by the NCS-R. All substance use diagnoses were made in accordance with the *DSM-IV* diagnostic criteria. The lifetime substance use disorder variable was created by combining the lifetime alcohol abuse, alcohol dependence, drug abuse, and drug dependence variables. Nicotine dependence was assessed separately from drug dependence and was not included in the NCS-R drug dependence variable. Cross-tabulations were calculated to determine both the prevalence of smoking as well as lifetime and past year nicotine dependence among participants with or without lifetime or current (past year) chronic neck and back pain or medically unexplained chronic pain. Subsequently, multiple logistic regressions were performed with the smoking and nicotine dependence variables after adjusting for sociodemographic variables of age, sex, race, education, income, and marital status as well as lifetime substance use disorders.

Results

Sociodemographics in relation to chronic pain variables

Individuals with lifetime chronic neck or back pain differed from those without lifetime chronic neck or back pain with regard to age, education, marital status, and racial distributions. Specifically, those with lifetime current neck or back pain tended to be older, tended to have less formal education, were less likely to report never having been married, and were more likely to be Caucasian than those without lifetime chronic neck or back pain (see Table 1). Those who reported current (past year) chronic neck or back pain were also more likely to be older, less likely to report having never been married, and more likely to be Caucasian than those who did not report current chronic neck or back pain. In addition, these participants were more likely to be male and report lower annual household income than those without current chronic neck or back pain (see Table 1).

Participants who reported lifetime medically unexplained chronic pain demonstrated a somewhat different pattern of results. These individuals did not differ from those without current medically unexplained chronic pain on any of the sociodemographic variables examined; however, to maintain consistency in statistical analyses, the same sociodemographic variables were controlled for in subsequent analyses. In contrast, those who reported current medically unexplained chronic pain differed from those without in their education, marital status, and income distributions. Similar to those who reported chronic neck or back pain, these participants tended to report less for-mal education, were less likely to report having never been married, and reported a lower annual household income than those without current medically unexplained chronic pain (see Table 1).

Lifetime chronic pain in relation to current smoking and lifetime and current nicotine dependence

Lifetime chronic neck or back pain was examined in relation to smoking status and current (past year) as well as lifetime nicotine dependence. After adjusting for sociodemographic variables (age, marital status, income, education, race, and sex) and the presence of a lifetime substance use disorder (excluding nicotine dependence), the relationship between chronic pain, smoking, and nicotine dependence was strong. Specifically, individuals with a lifetime history of chronic neck or back pain were 1.31 times more likely to smoke cigarettes ($p < .01$; 95% *CI*: 1.09–1.57), 1.77 times more likely to be diagnosed with lifetime nicotine dependence ($p < .001$; 95% *CI*: 1.40–2.24), and 2.43 times more likely to meet criteria for current (past year) nicotine dependence ($p < .001$; 95% *CI*: 1.63–3.60) than those without a lifetime history of chronic neck or back pain (see Table 2).

Current chronic pain in relation to current smoking and lifetime and current nicotine dependence

When current (past year) chronic neck or back pain was examined in relation to smoking status, and lifetime and current (past year) nicotine dependence, a slightly different pattern emerged. Although current and lifetime nicotine dependence were still strongly related to current chronic pain ($p < .001$), the relationship between current chronic pain and smoking status was not significant after adjusting for both sociodemographic variables and the presence of a lifetime substance use disorder. Specifically, individuals with current chronic neck or back pain were 1.95 times more likely to be diagnosed with lifetime nicotine dependence (95% *CI*: 1.55–2.44) and 2.30 times more likely to be diagnosed with current nicotine dependence (95% *CI*: 1.71–3.11) than those without current chronic neck or back pain (see Table 3).

Lifetime medically unexplained chronic pain in relation to current smoking and lifetime and current nicotine dependence

Individuals with lifetime medically unexplained chronic pain were significantly more likely to be current smokers ($p < .05$) or to endorse the criteria for current (past year) or lifetime nicotine dependence ($p < .01$) than individuals without a history of chronic pain after adjusting for both sociodemographic variables and the presence of a lifetime substance use disorder. Specifically, individuals with a lifetime history of medically unexplained chronic pain were 1.47 times more likely to be current smokers ($p < .05$; 95% *CI*: 1.30–2.09), 1.68 times more likely to have lifetime nicotine dependence ($p < .05$; 95% *CI*: 1.02–2.76), and 2.08 times more likely to be diagnosed with current nicotine dependence ($p < .01$; 95% *CI*: 1.25–3.44) than their counterparts without a history of chronic pain (see Table 4).

Table 1. Sociodemographic factors in chronic pain

	No LT chronic back and neck pain (n = 3,787), n (%)	LT chronic back and neck pain (n = 1,905), n (%)	No PY chronic back and neck pain (n = 4,379), n (%)	PY chronic back and neck pain (n = 1,313), n (%)	No LT medically unexplained (n = 5,289), n (%)	LT medically unexplained (n = 400), n (%)	No PY medically unexplained (n = 5,444), n (%)	PY medically unexplained (n = 196), n (%)
Age (years)								
17–19	176 (5.6)	47 (3.2)	189 (5.2)	34 (3.5)	215 (5.0)	8 (2.4)	217 (4.9)	6 (4.7)
20–29	888 (21.7)	260 (11.3)	970 (20.3)	178 (11.8)	1,094 (18.9)	54 (14.0)	1,108 (18.7)	25 (12.5)
30–39	847 (19.2)	340 (15.8)	948 (18.7)	239 (16.0)	1,116 (18.2)	71 (18.9)	1,144 (18.3)	36 (18.3)
40–49	754 (19.6)	458 (23.4)	893 (20.0)	319 (23.5)	1,117 (20.6)	92 (21.5)	1,160 (20.8)	42 (21.2)
50+	1,122 (34.0)	800 (46.4)	1,379 (35.8)	543 (45.2)	1,747 (37.3)	175 (43.3)	1,815 (37.3)	87 (43.22)
Chi square		75.9***		50.7***		8.12		4.94
Sex								
Male	1,613 (47.8)	769 (44.8)	1,867 (47.8)	515 (43.4)	2,241 (47.4)	140 (39.7)	2,287 (47.0)	70 (43.9)
Female	2,174 (52.2)	1,136 (55.2)	2,512 (52.2)	798 (56.6)	3,048 (52.6)	260 (60.3)	3,157 (53.0)	126 (56.1)
Chi square		2.38		4.69*		2.96		0.31
Education (years)								
0–11	522 (15.5)	327 (19.7)	623 (15.9)	226 (20.4)	780 (16.6)	67 (18.7)	795 (16.6)	48 (24.6)
12	1,125 (32.0)	587 (33.8)	1,315 (32.6)	397 (32.4)	1,579 (32.2)	133 (37.8)	1,638 (32.4)	56 (31.1)
13–15	1,162 (28.3)	547 (25.7)	1,348 (28.3)	361 (24.2)	1,591 (27.8)	118 (24.2)	1,632 (27.7)	64 (29.9)
16+	978 (24.2)	444 (20.7)	1,093 (23.2)	329 (23.1)	1,339 (23.4)	82 (19.3)	1,379 (23.4)	28 (14.5)
Chi square		9.47*		5.66		7.23		13.03**
Marital status								
Married/cohabitating	2,128 (54.7)	1,108 (59.0)	2,484 (55.6)	752 (57.6)	3,026 (56.0)	208 (55.8)	3,106 (55.9)	105 (57.7)
Separated/divorced/widowed	751 (19.2)	488 (24.6)	885 (19.8)	354 (25.0)	1,108 (20.5)	130 (25.9)	1,162 (20.7)	61 (26.7)
Never married	908 (26.1)	309 (16.4)	1,010 (24.6)	207 (17.4)	1,155 (23.55)	62 (18.3)	1,176 (23.4)	30 (15.6)
Chi square		35.92***		25.93***		6.30		8.66*
Household income ($)								
0–19,999	740 (20.8)	442 (24.8)	866 (20.9)	316 (26.4)	1,062 (21.8)	119 (24.6)	1,102 (21.9)	73 (31.9)
20,000–34,999	605 (16.1)	316 (15.5)	694 (15.7)	227 (16.7)	844 (15.7)	77 (20.2)	865 (15.6)	40 (19.8)
35,000–59,999	848 (21.3)	437 (22.3)	983 (21.4)	302 (22.3)	1,211 (21.7)	74 (19.9)	1,244 (21.7)	30 (19.4)
60,000+	1,594 (41.8)	710 (37.5)	1,836 (41.9)	468 (34.6)	2,172 (40.9)	130 (35.3)	2,233 (40.8)	53 (29.0)
Chi square		4.42		15.0**		6.97		11.74*
Race								
White	2,740 (70.9)	1,140 (77.3)	3,174 (71.7)	1,006 (77.3)	3,894 (72.9)	285 (70.9)	4,008 (72.8)	139 (73.2)
Black	516 (13.8)	201 (9.0)	583 (13.2)	134 (9.0)	663 (12.3)	53 (12.8)	683 (12.4)	26 (10.6)
Hispanic	364 (11.5)	163 (10.1)	426 (11.3)	101 (10.0)	487 (11.0)	39 (12.9)	499 (10.9)	21 (12.8)
Other	167 (3.9)	101 (3.6)	196 (3.8)	72 (3.7)	245 (3.8)	23 (3.5)	254 (3.8)	10 (3.4)
Chi square		15.45**		9.38*		0.52		0.96

Note. All *n*s were unweighted. All percents were weighted. LT = lifetime; PY = past year.
*p ≤ .05; **p ≤ .01; ***p ≤ .001.

Table 2. Lifetime chronic neck or back pain, smoking status, and nicotine dependence

	Lifetime chronic neck or back pain		AOR-1	AOR-2
	No ($n = 3,808$), n (%)	Yes ($n = 1,913$), n (%)		
Current smoker ($n = 1,643$)	1,005 (23.4)	638 (30.1)	1.31 (1.09–1.57)**	1.25 (1.04–1.49)*
Lifetime nicotine dependence ($n = 626$)	343 (6.4)	283 (12.6)	1.77 (1.40–2.24)***	1.49 (1.17–1.90)**
Past year nicotine dependence ($n = 312$)	158 (2.8)	154 (7.0)	2.43 (1.63–3.60)***	2.09 (1.37–3.18)**

Note. All *n*s were unweighted. All percents were weighted. AOR-1 indicates adjustments for age, marital status, income, education, race, sex, and any lifetime substance use disorder; and AOR-2, adjustments for age, marital status, income, education, race, sex, and any lifetime mood, anxiety, or substance use disorder.

$*p \leq .05$; $**p \leq .01$; $***p \leq .001$.

Current medically unexplained chronic pain in relation to current smoking and lifetime and current nicotine dependence

After adjusting for both sociodemographic variables and the presence of a lifetime substance use disorder, current medically unexplained chronic pain was significantly related to smoking status and lifetime and current nicotine dependence. Specifically, individuals with past year medically unexplained chronic pain compared with those without such problems were 1.69 times more likely to be current smokers (95% *CI*: 1.08–2.63), 1.71 times more likely to have lifetime nicotine dependence (95% *CI*: 1.02–2.68), and 2.51 (95% *CI*: 1.54–4.09) times more likely to meet criteria for current nicotine dependence ($p < .001$; see Table 5).

Supplementary analyses

Finally, in a supplementary effort to explore the study hypotheses, all the data were reanalyzed after adjusting for the previously described covariates as well as the addition of lifetime mood and anxiety disorders. Individuals with a lifetime history of chronic neck or back pain were 1.25 times more likely to smoke cigarettes ($p < .05$; 95% *CI*: 1.04–1.49), 1.49 times more likely to be diagnosed with lifetime nicotine dependence ($p < .01$; 95% *CI*: 1.17–1.90), and 2.09 times more likely to meet criteria for current (past year) nicotine dependence ($p < .01$; 95% *CI*: 1.37–3.18) than those without a lifetime history of chronic neck or back pain (see Table 2).

Regarding current (past year) chronic neck or back pain, after adjusting for the previously described covariates as well as the addition of lifetime mood and anxiety disorders, individuals with current (past year) chronic neck or back pain were 1.61 times more likely to be diagnosed with lifetime nicotine dependence ($p < .001$; 95% *CI*: 1.29–2.01) and 1.95 times more likely to be diagnosed with current nicotine dependence ($p < .001$; 95% *CI*: 1.95–2.68) than those without current chronic neck or back pain (see Table 3).

Regarding lifetime and current (past year) medically unexplained chronic pain, after adjusting for the previously described covariates as well as the addition of lifetime mood and anxiety disorders, individuals with lifetime or current (past year) medically unexplained chronic pain were significantly more likely to be diagnosed with current nicotine dependence ($ps < .05$) than those without lifetime or current medically unexplained chronic pain (see Tables 4 and 5).

Discussion

The purpose of the present study was to examine the relation between the experience of chronic pain, both lifetime and current (past year), and cigarette smoking and nicotine dependence using a large representative survey of adults from the United States.

Consistent with prediction, after adjusting for sociodemographic variables (age, marital status, income, education, race, and sex) and the presence of a lifetime substance use disorder, individuals with a lifetime history of chronic neck or back pain were significantly more likely to be current smokers and to be diagnosed with lifetime nicotine dependence as well as current nicotine dependence. A slightly different pattern emerged for

Table 3. Past year chronic neck or back pain, smoking status, and nicotine dependence

	Past year chronic neck or back pain		AOR-1	AOR-2
	No ($n = 4,403$), n (%)	Yes ($n = 1,318$), n (%)		
Current smoker ($n = 1,643$)	1,199 (24.4)	444 (29.6)	1.18 (0.92–1.51)	1.11 (0.88–1.40)
Lifetime nicotine dependence ($n = 626$)	415 (6.8)	211 (14.4)	1.95 (1.55–2.44)***	1.61 (1.29–2.01)***
Past year nicotine dependence ($n = 312$)	199 (3.2)	113 (7.8)	2.30 (1.71–3.11)***	1.95 (1.41–2.68)***

Note. All *n*s were unweighted. All percents were weighted. AOR-1 indicates adjustments for age, marital status, income, education, race, sex, and any lifetime substance use disorder; and AOR-2, adjustments for age, marital status, income, education, race, sex, and any lifetime mood, anxiety, or substance use disorder.

$*p \leq .05$; $**p \leq .01$; $***p \leq .001$.

Table 4. Lifetime medically unexplained chronic pain, smoking status, and nicotine dependence

	Lifetime medically unexplained chronic pain		AOR-1	AOR-2
	No (n = 5,313), n (%)	Yes (n = 401), n (%)		
Current smoker (n = 1,640)	1,503 (24.8)	137 (35.0)	1.47 (1.03–2.09)*	1.37 (0.96–1.95)
Lifetime nicotine dependence (n = 625)	548 (7.9)	77 (14.5)	1.68 (1.02–2.76)*	1.28 (0.79–2.07)
Past year nicotine dependence (n = 311)	268 (3.8)	43 (8.6)	2.08 (1.25–3.44)**	1.64 (1.00–2.68)*

Note. All *n*s were unweighted. All percents were weighted. AOR-1 indicates adjustments for age, marital status, income, education, race, sex, and any lifetime substance use disorder; and AOR-2, adjustments for age, marital status, income, education, race, sex, and any lifetime mood, anxiety, or substance use disorder.

  *$p \le .05$; **$p \le .01$; ***$p \le .001$.

current chronic neck or back pain and the tobacco variables. Here, there was no significant effect between current chronic neck or back pain and being a current smoker, but there was a significant incremental relation for lifetime and current nicotine dependence. These data collectively suggest a relatively robust association between lifetime and current chronic neck or back pain and nicotine dependence (lifetime and current) and a slightly less strong association with smoking status per se. A similar pattern of findings emerged for medically unexplained chronic pain. Specifically, individuals with lifetime medically unexplained chronic pain were significantly more likely to be current smokers and meet criteria for lifetime or current nicotine dependence than individuals without a history of medically unexplained chronic pain after adjusting for both sociodemographic variables and the presence of a lifetime substance use disorder. After adjusting for these, current medically unexplained chronic pain was significantly related to smoking status and lifetime as well as current nicotine dependence. It is indeed notable that both types of chronic pain problems were related to smoking and nicotine dependence variables evident above and beyond the covariates. Thus, there is a meaningful degree of clinical significance to the observed findings in that they cannot be better accounted for by variables known to cooccur with chronic pain and tobacco use and its disorders.

It is noteworthy that we also conducted a supplementary set of post-hoc analyses. These analyses were identical to the a priori set of tests with the exception that we included an additional covariate of any lifetime anxiety or mood disorder at the same step as the other covariates. Results of these analyses indicated a generally similar pattern of findings to those reported earlier. Specifically, individuals with a lifetime history of chronic neck or back pain were significantly more likely to be current smokers and to be diagnosed with lifetime or current nicotine dependence. A similar, but not entirely uniform, pattern of findings was evident when current (past year) chronic neck or back pain was examined. Here, individuals with current (past year) chronic neck or back pain were significantly more likely to meet criteria for lifetime or current nicotine dependence than their counterparts. No such effect was evident for current smoking status. In regard to medically unexplained chronic pain, whether indexed from a lifetime or current (past year) timeframe, there was a significant association only for current (past year) nicotine dependence. Collectively, these data are consistent with the perspective that chronic pain, particularly neck or back pain, is systematically associated with nicotine dependence, even after adjusting for cooccurring mood and anxiety disorders.

Overall, the current findings add uniquely to extant scientific knowledge concerning chronic pain and smoking. The results suggest that chronic pain is often related to cigarette smoking and nicotine dependence from a lifetime and current (past year) perspective. Such relations invite theorizing as to why such an association may exist and (a) what role smoking may play in the onset and course of chronic pain and (b) the role of chronic pain in smoking onset and maintenance. Although the present data cannot disentangle such complex and intriguing questions, it is notable that basic research has found that the presence of chronic pain may alter the reinforcing effects of

Table 5. Past year medically unexplained chronic pain, smoking status, and nicotine dependence

	Past year medically unexplained chronic pain		AOR-1	AOR-2
	No (n = 5,470), n (%)	Yes (n = 196), n (%)		
Current smoker (n = 1,632)	1,554 (24.9)	78 (42.3)	1.69 (1.08–2.63)*	1.52 (0.98–2.36)
Lifetime nicotine dependence (n = 622)	581 (8.1)	41 (17.6)	1.71 (1.02–2.86)*	1.20 (0.74–1.94)
Past year nicotine dependence (n = 310)	283 (3.8)	27 (12.5)	2.51 (1.54–4.09)***	1.83 (1.15–2.90)*

Note. All *n*s were unweighted. All percents were weighted. AOR-1 indicates adjustments for age, marital status, income, education, race, sex, and any lifetime substance use disorder; and AOR-2, adjustments for age, marital status, income, education, race, sex, and any lifetime mood, anxiety, or substance use disorder.

  *$p \le .05$; **$p \le .01$; ***$p \le .001$.

drugs (e.g., Jacobs, Smith, de Vries, & Schoffelmeer, 2003). Although it is unclear whether chronic pain affects nicotine administration or its reinforcing value per se, smoking may serve important affect regulation functions for smokers with chronic pain. These individuals, specifically, may expect tobacco use to help alleviate aversive mood and somatosensory states and be especially motivated to smoke for affect regulation purposes. Although the objective mood-dampening qualities of smoking are quite complex (Kassel, Stroud, & Paronis, 2003), in the absence of other more adaptive coping strategies, smokers with chronic pain may learn to rely on smoking to manage noxious internal states in the relatively short term. Over longer periods of time, however, smoking itself can lead to increased risk of aversive internal states via a number of routes, including nicotine-based withdrawal symptoms, health impairment, and physical illness. In such a scenario, a forward feed cycle may develop, whereby smoking is used as a coping strategy for managing aversive states in the short term, yet paradoxically confers longer-term risk for physical health and, perhaps, chronic pain problems.

There are a variety of limitations and directions for future investigations that should be noted. First, the cross-sectional design of this study does not permit causal conclusions regarding the direction of the observed associations. Future prospective work using longitudinal data could be useful next steps for work directed at isolating onset and patterning between chronic pain and smoking as well as nicotine dependence. Secondly, although these results are generalizable to the adult U.S. population, it is not clear whether they are applicable internationally. Future studies examining the cross-national stability of the current findings are therefore important. And finally, the present study was focused on clarifying whether a relation was evident between chronic pain and smoking and nicotine dependence among adults. Future investigations could usefully build upon such work by attempting to explicate mediating and moderating processes involved in such linkages. The present findings highlight a notable association between chronic pain and smoking as well as nicotine dependence among adults in the United States. Given the observed relations in the present and other related studies (Ekholm et al., 2009), greater degrees of clinical attention could possibly be directed at addressing tobacco use in the context of chronic pain.

Funding

Declaration of Interests

All authors declare that they have no competing interests.

References

Argoff, C. E. (2007). The coexistence of neuropathic pain, sleep, and psychiatric disorders: A novel treatment approach. *Clinical Journal of Pain*, *23*, 15–22.

Brennan, P. L., Schutte, K. K., & Moos, R. H. (2005). Pain and use of alcohol to manage pain: Prevalence and 3-year outcomes among older problem and non-problem drinkers. *Addiction*, *100*, 777–786.

Centers for Disease Control and Prevention. (2008). *Targeting tobacco use: The nation's leading cause of preventable death 2008*, Retrieved April 1, 2009, from http://www.cdc.gov/nccdphp/publications/aag/pdf/osh.pdf

Compton, W. M., & Volkow, N. D. (2006). Major increases in opioid analgesic abuse in the United States: Concerns and strategies. *Drug and Alcohol Dependence*, *81*, 103–107.

Denisco, R. A., Chandler, R. K., & Compton, W. M. (2008). Addressing the intersecting problems of opioid misuse and chronic pain treatment. *Experimental and Clinical Psychopharmacology*, *16*, 417–428.

Ditre, J. W., & Brandon, T. H. (2008). Pain as a motivator of smoking: Effects of pain induction on smoking urge and behavior. *Journal of Abnormal Psychology*, *117*, 467–472.

Ekholm, O., Gronbaek, M., Peuckmann, V., & Sjogren, P. (2009). Alcohol and smoking behavior in chronic pain patients: The role of opioids. *European Journal of Pain*, *13*, 606–612.

Fishbain, D. A., Lewis, J. E., Cole, B., Cutler, R. B., Rosomoff, H. L., & Rosomoff, R. S. (2007). Variables associated with current smoking status in chronic pain patients. *Pain Medicine*, *8*, 301–311.

Fishbain, D. A., Rosomoff, H. L., & Rosomoff, R. S. (1992). Review article: Drug abuse, dependency, and addiction in chronic pain patients. *Clinical Journal of Pain*, *8*, 77–85.

Freedman, M., Saulino, M., Overton, A., Holding, M., & Kornbluth, I. (2008). Therapeutics in pain management. *Archives of Physical Medicine and Rehabilitation*, *89*, S56–S60.

Hooton, W. M., Townsend, C. O., Bruce, B. K., Schmidt, J. E., Kerkvliet, J. L., Patten, C. A., et al. (in press). Effects of smoking status on immediate treatment outcomes of multidisciplinary pain rehabilitation. *Pain Medicine*.

International Association for the Study of Pain. (1986). Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. *Pain*, *3*, 1–222.

Jacobs, E. H., Smith, A. B., de Vries, T. J., & Schoffelmeer, A. N. (2003). Neuroadaptive effects of active versus passive drug administration in addiction research. *Trends in Pharmacological Sciences*, *24*, 566–573.

Jamison, R. N., Kauffman, J., & Katz, N. P. (2000). Characteristics of methadone maintenance patients with chronic pain. *Journal of Pain and Symptom Management*, *19*, 53–62.

Jamison, R. N., Stetson, B. A., & Parris, W. C. (1991). The relationship between cigarette smoking and chronic low back pain. *Addictive Behaviors*, *16*, 103–110.

John, U., Meyer, C., Rumpf, H., & Hapke, U. (2009). Nicotine dependence criteria and nicotine withdrawal symptoms in

relation to pain among an adult general population sample. *European Journal of Pain*, 13, 82–88.

Kassel, J. D., Stroud, L. R., & Paronis, C. A. (2003). Smoking, stress, and negative affect: Correlation, causation, and context across stages of smoking. *Psychological Bulletin*, 129, 270–304.

Kessler, R. C., Berglund, P., Chiu, W. T., Demler, O., Heeringa, S., Hiripi, E., et al. (2004). The US National Comorbidity Survey Replication (NCS-R): Design and field procedures. *International Journal of Methods in Psychiatric Research*, 13, 69–92.

Kessler, R. C., & Ustun, T. B. (2004). The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *International Journal of Methods in Psychiatric Research*, 13, 93–121.

McCarberg, B. H., & Billington, R. (2006). Consequences of neuropathic pain: Quality-of-life issues and associated cost. *American Journal of Managed Care*, 12, S263–S268.

McGeary, D. D., Mayer, T. G., Gatchel, R. J., & Anagnostis, C. (2004). Smoking status and psychosocioeconomic outcomes of functional restoration in patients with chronic spinal disability. *Spine Journal*, 4, 170–175.

Ohayon, M. M., & Schatzberg, A. F. (2003). Using chronic pain to predict depressive morbidity in the general population. *Archives of General Psychiatry*, 60, 39–47.

Research Triangle Institute. (2004). *Software for Survey Data Analyses (SUDAAN) version 9.01*. Research Triangle Park, NC: Author.

Turk, D. C., & Melzack, R. (2001). *Handbook of pain assessment* (2nd ed.). New York: Guilford Press.

Weingarten, T. N., Moeschler, S. M., Ptaszynski, A. F., Hooten, W. M., Beebe, T. J., & Warner, D. O. (2008). An assessment of the association between smoking status, pain intensity, and functional interference in patients with chronic pain. *Pain Physician*, 11, 643–653.