Published in final edited form as:

Subst Use Misuse. 2019 ; 54(7): 1138–1145. doi:10.1080/10826084.2018.1563186.

Characteristics of Urban Inpatient Smokers With and Without Chronic Pain: Foundations for Targeted Cessation Programs

Gwendolyn R Cody, BS,

New York University School of Medicine, New York, New York.

Binhuan Wang, PhD,

Department of Population Health, New York University School of Medicine, New York, New York.
650 1st Ave FL5, New York, NY 10016, binhuan.wang@nyumc.org

Alissa R Link, MPH, and

Department of Population Health, New York University School of Medicine, New York, New York.,
227 East 30th Street, Suite 721, New York, NY 10016, alissa.link@gmail.com

Scott E Sherman, MD, MPH

Department of Population Health, New York University School of Medicine, New York, New York;
Department of Medicine, VA New York Harbor Healthcare System, New York, New York;
Department of Medicine, New York University School of Medicine, New York, New York., 227 East
30th Street, Suite 721, New York, NY 10016, scott.sherman@nyumc.org

Abstract

Background—Cigarette smoking and chronic pain are prevalent, comorbid conditions with significant consequences for individuals and society. Despite overlap between smoking and chronic pain, and pain's role as a potential barrier to quitting, there are no validated interventions targeted for smokers with chronic pain (SWCPs).

Objective—To compare characteristics of urban inpatient smokers with and without chronic pain to inform the development of SWCP-targeted cessation interventions.

Methods—This study reports partial results from a randomized comparative effectiveness trial of two smoking cessation interventions (NCT01363245). Participants were enrolled at two safety net hospitals in New York, NY in 2011–2014. Data was collected from the electronic health record and an interviewer-administered survey. Participants were considered to have chronic pain if they affirmed having “long-lasting, persistent, or chronic pain in the last six months” on survey.

Results—Among smokers assessed for pain (n=1093), the prevalence of chronic pain was 44%. SWCPs were more likely to report depressive symptoms and to have a history of psychiatric diagnosis (non-substance related) than smokers without pain. Severe problems with mobility and with performing usual activities were more common in SWCPs. No significant difference was

Corresponding author contact information: Gwendolyn R Cody, 227 East 30th Street, Suite 721, New York, NY 10016, Phone: 914-646-9096, Fax: 941-548-1595, gwendolyn.cody@nyumc.org.

DECLARATION OF INTERESTS

The authors report no conflict of interest.

observed in sex, race, education, nicotine dependence level, confidence in quit ability, or history of substance misuse.

Conclusions/Importance—Chronic pain in smokers admitted to safety net hospitals is prevalent and associated with hindered mobility, history of psychiatric diagnosis, and prescription opioid use. Urban safety net hospitals are an appropriate setting in which to pilot SWCP-targeted cessation programs, which should be designed with consideration for patients' psychiatric history and mobility status.

INTRODUCTION

Cigarette smoking and chronic pain are prevalent, often comorbid, conditions with significant consequences for both individuals and society. In the US, an estimated 36 million adults smoke cigarettes (Jamal et al., 2016), and more than 25 million adults experience chronic pain (Nahin, 2015). Individuals with chronic pain are twice as likely as those without chronic pain to be nicotine dependent (Zvolensky, McMillan, Gonzalez, & Asmundson, 2009). The combined economic impact of smoking and chronic pain in the US is substantial, amounting to more than \$800 billion in health care costs and productivity loss each year (Gaskin and Richard, 2012; US Department of Health and Human Services, 2014). Cigarette smoking remains the leading cause of preventable death in the US (US Department of Health and Human Services, 2014).

Despite the common overlap between smoking and pain and the fact that pain may be a barrier to quitting (Ditre, Brandon, Zale, & Meagher, 2011; Zale, Ditre, Dorfman, Heckman, & Brandon, 2014), to our knowledge, there are no validated interventions targeted toward smokers in pain (Hooten et al., 2014). Suggestions have been made to integrate pain management and smoking cessation programs, or to design new, targeted cessation programs for smokers with pain (Clinical Practice Guideline Treating Tobacco Use and Dependence Update Panel, 2008; Hahn, Rayens, Kirsh, & Passik, 2006; Hooten, et al., 2014). A 2011 systematic review highlighted the need for more research to effectively inform the development and integration of treatments for pain and smoking (Ditre, et al., 2011). Though depression has been shown to mediate partially the association between smoking and pain (Goesling, Brummett, & Hassett, 2012; Hooten, Shi, Gazelka, & Warner, 2011; van Hecke et al., 2014; Zale, Maisto, & Ditre, 2016), whether the population of smokers with pain and the population of smokers without pain differ in other significant ways is unclear.

The aim of our current study is to compare the characteristics of smokers with chronic pain to the characteristics of smokers without chronic pain from a subset of patients enrolled in a smoking cessation trial. The results may inform the development of smoking cessation programs tailored to meet the needs of these two subgroups.

METHODS

This study reports partial results from a randomized comparative effectiveness trial of two smoking cessation interventions. The randomized comparative effectiveness trial was approved by the IRBs at the enrolling institutions and by the CHART Data Safety and Monitoring Board established by NIH. The main results are published elsewhere (Sherman

et al., 2016). The survey and analytic methods are available from the grant principal investigator, while the de-identified data are available through the CHART Consortium.

Setting and participants

Study participants were enrolled at two safety net hospitals in New York, NY: Bellevue Hospital Center and the VA New York Harbor Healthcare System, both affiliated with NYU School of Medicine. One thousand six hundred eighteen participants enrolled in the study; data from the subset of 1093 who were asked about their pain status are analyzed here. Patients admitted to the hospital for any reason, and who were documented as smokers by admission records, were recruited at the bedside by research staff. Major inclusion criteria were: 18 years of age, smoked cigarette(s) during prior 30 days, active US phone number, able to provide consent in English, Spanish, or Mandarin. Major exclusion criteria were: pregnant or breastfeeding, cognitive or physical barriers to consenting or participating, or discharge to an institution where telephone counseling was not readily available (e.g., prison). If enrolled, participants were randomized at the time of discharge to one of two smoking cessation interventions: standard counseling from the New York State Smokers Quitline or intensive telephone counseling delivered by study staff. More details about the interventions and trial conduct can be found in the protocol paper (Grossman et al., 2012) and the main results paper (Sherman et al., 2016).

Assessments

Data was collected from surveys and electronic health record (EHR) chart abstraction. Study participants completed an interviewer-administered baseline survey at the time of enrollment. The survey assessed sociodemographic characteristics, smoking history, pain status, substance use, and quality of life. Pain questions were not originally included in the baseline survey; the survey was revised to include additional questions after recruiting began. Only participants who took the revised surveys (1093 of 1618) are included in our present analysis. Participants were considered to have chronic pain if they affirmed having “long-lasting, persistent, or chronic pain in the last six months” on survey.

Measures

Pain—Study participants who on baseline interviewer-administered survey endorsed having chronic pain in the prior six months were then asked about the severity of their pain. This verbal question was worded as follows, “On a scale of 0–10 (zero being no pain, 10 being the worst pain), what would you rate your pain on average over the past month *before* you were hospitalized?”

Hazardous Drinking by AUDIT-C—The Alcohol Use Disorders Identification Test (AUDIT-C) is a validated 3-item alcohol screen scored on a 0–12 scale. Hazardous drinking is defined as an AUDIT-C score ≥ 3 for females and ≥ 4 for males.

Depressive Symptoms by PHQ-2—Patients were screened for recent depressive symptoms using the Patient Health Questionnaire-2 (PHQ-2). The PHQ-2 is a validated tool (Lowe, Kroenke, & Grafe, 2005), generally used as a “first step” approach for the diagnosis

of depression. In our study, a score ≥ 3 on a 0–6 scale was considered positive for depressive symptoms.

Obesity—Obesity was defined as body mass index ≥ 30.0 as calculated from the EHR.

General Health Status by EQ-5D-5L—EuroQol five dimension questionnaire (EQ-5D) is a standardized tool for measuring general health status. Its dimensions are mobility, self-care, usual activity, pain/discomfort, anxiety/depression (Rabin and de Charro, 2001). In the 5L version of this questionnaire, each dimension is reported on a 5-level scale.

Statistical Analysis

All analyses were conducted with SAS 9.4 (SAS Institute, 2014). Independent covariates included sociodemographic factors, tobacco use habits, other types of substance use, and measures of general health status. Chi-squared tests were used to evaluate the associations between categorical variables, and Wilcoxon Rank Sum tests were applied to assess associations between continuous variables and categorical variables. Logistic regression analyses were applied to estimate odds ratios for experiencing chronic pain in the prior six months. In addition, multivariate analyses were conducted to quantify the effect of all important confounders on experiencing chronic pain in the prior six months to eliminate potential selection bias. A two-sided p -value < 0.05 was considered to be statistically significant.

RESULTS

In the study, 1093 people were asked about their pain status. The majority (96%, $n=1054$) were admitted to the medicine, psychiatry, or surgery services. Many study participants had medical histories significant for diabetes (20%), chronic obstructive pulmonary disease (COPD) (12%), asthma (14%), heart failure (4.9%), coronary artery disease (16%), cerebrovascular disease (4.7%), and or HIV (6.5%). Of the 1093 participants, 483 (44%) reported experiencing chronic pain in the prior six months. The majority (72%, $n=350$) rated their pain in the past month to be 7 or greater on a scale from 0–10. Approximately two-thirds of smokers with pain reported using pain medication and most commonly reported that these medications “somewhat” controlled their pain.

As shown in Table 1, smokers who reported chronic pain at baseline were more likely to be insured by the VA and less likely to be uninsured than smokers without chronic pain. People with pain were less likely to be employed than those without pain (OR 0.63, 95% CI [0.48, 0.82]). The groups did not differ significantly by sex, race, ethnicity, or education level.

Smokers with pain had a longer smoking history than smokers without pain (28.7 yrs vs 24.6 yrs, $p<0.001$). The groups were not significantly different in regard to level of nicotine dependence (measured by time to first cigarette after waking up), number of cigarettes smoked per smoking day, or confidence in ability to quit/stay quit.

Other substance use factors were assessed. Smokers with pain were more likely to have used prescription opioids in the past three months (OR 1.77, 95% CI [1.18, 2.65]), but were not

more likely to have recently used street opioids. Overall, smokers with pain did not have a greater history of alcohol or substance misuse.

Smokers with chronic pain were more likely to have poorer general health based on assessments of mobility, self-care, and ability to perform usual activities. Over 60% of those in pain experienced some level of mobility problems. Smokers with pain had much greater odds of reporting severe mobility problems (OR 6.41, 95% CI [4.25, 9.68]). Similarly, nearly 50% of the population in pain reported some level of difficulty performing their usual activities. Smokers with pain were also more likely to report depressive symptoms at the time of the baseline survey (OR 1.55, 95% CI [1.21, 1.98]) and to have a history of a non-substance related psychiatric diagnosis (OR 1.33, 95% CI [1.05, 1.69]).

On multivariable analysis (Table 2), we found that history of non-substance related psychiatric diagnosis (OR 1.75, 95% CI [1.29, 2.36]), prescription opioid use in past three months (OR 2.31, 95% CI [1.44, 3.70]), mild and severe mobility problems (OR 3.19, 95% CI [2.30, 4.41]; OR 6.00, 95% CI [3.53, 10.18]), and severe problems performing usual activities (OR 2.73, 95% CI [1.54, 4.86]) were independently associated with chronic pain. When controlling for other characteristics, smokers with pain had lower odds of severe problems with self-care (OR 0.23, 95% CI [0.09, 0.61]). Depressive symptoms were not independently associated with pain status.

DISCUSSION

In our current study, chronic pain was prevalent in smokers admitted to safety net hospitals. The majority of those in pain rated their pain to be 7 or greater on a scale from 0–10. When compared to smokers without pain, smokers with pain were older, more likely to be insured by the VA, and less likely to be employed. Smokers with pain were also more likely to report depressive symptoms and recent prescription opioid use, and more likely to have a history of non-substance related psychiatric diagnosis. Severe problems with mobility and ability to perform usual activities were much more common among smokers with pain than smokers without pain. The two groups did not differ significantly by sex, race, ethnicity, education level, level of nicotine addiction, confidence in ability to quit, or history of alcohol or substance misuse. In a multivariable analysis, chronic pain was independently associated with several characteristics. Smokers with pain, compared to smokers without pain, had more than twice the odds of prescription opioid use in past three months and had more than 1.7 times the odds of carrying a non-substance related psychiatric diagnosis. Additionally, smokers with pain were found to have three and six times the odds of mild and severe mobility problems, respectively. Similarly, their odds of having severe problems performing usual activities were increased more than 2.7-fold. These findings are consistent with what is known about chronic pain in the general population: it is associated with psychiatric diagnoses such as anxiety and depression, is frequently treated with prescription opioids (Caudill-Slosberg, Schwartz, & Woloshin, 2004; Levy, Paulozzi, Mack, & Jones, 2015), and limits the mobility of those affected (Institute of Medicine (US) Committee on Advancing Pain Research, 2011).

Pain may serve as a barrier to smoking cessation (Ditre, et al., 2011; Zale, et al., 2014), and targeted smoking cessation programs that meet the needs of smokers in pain will be an important next step in the evolution of smoking cessation efforts. Our data suggest that the population of smokers with pain may differ from the population of smokers without pain in some important ways. First, we found that smokers with pain had higher rates of depressive symptoms and non-substance related psychiatric history. These findings are consistent with multiple past studies – two based at pain clinics (Goesling, et al., 2012; Hooten, et al., 2011), and one from a general population database (van Hecke, et al., 2014) – that found depression to be a mediator between smoking and pain. Findings about depression as a mediator between smoking and pain have been summarized in a review (Zale, et al., 2016). Previous studies have shown that affective distress, pain-related anxiety (Hooten et al., 2009), and suicidal ideation (Fishbain, Lewis, Gao, Cole, & Steele Rosomoff, 2009) are also more common among smokers with pain. Both tobacco and pain have been independently associated with an increased prevalence of alcohol and substance use disorders (Ditre, et al., 2011), but we found no difference in the rates of hazardous drinking or illicit substance use between the populations of smokers with and without pain. This lack of difference could be due to the already high prevalence of hazardous drinking in *both* groups, and our three-month window for drug use might have been an insufficient interval to capture a difference between groups. The relationship between smoking, pain, and other types of non-substance related psychiatric disorders is not well characterized and was not analyzed in the current study. Because both tobacco and pain have been independently associated with psychiatric diagnoses, the prevalence of psychiatric history in smokers with pain may be higher than the prevalence of psychiatric history in the general population of persons with chronic pain.

Smokers with pain had more severe and higher rates of mobility problems and problems performing their usual activities than smokers without pain. Over 60% of smokers with pain reported having at least mild mobility problems, and 58% had at least mild problems performing usual activities. The odds of smokers in pain having severely limited mobility was six times the odds for smokers without pain. The significant effect chronic pain has on the functioning and limitations of these individuals cannot be ignored. These limitations must be considered when designing smoking cessation interventions for smokers with pain to ensure the interventions are accessible, as will be discussed further.

Surprisingly, our data revealed that smokers in pain were not significantly less confident about their ability to quit smoking or stay quit. This observation is inconsistent with the extant literature. A cross-sectional study found that positive pain status was associated with reduced self-efficacy for future quit attempts, although this may have been mediated by failed past quit attempts (Zale, et al., 2014). A study of light smokers also found that smokers with pain reported lower confidence about their ability to quit (Ditre, Kosiba, Zale, Zvolensky, & Maisto, 2016). Of note, the participants in the aforementioned studies were recruited from the general population, not an inpatient setting, and the participants were younger (particularly in Ditre) than in our current study. In our case, the context of being an inpatient may have altered individuals' perceived self-efficacy, or the study may have selected for patients who were more confident in their ability to quit. Importantly, self-efficacy has been shown to be a predictor of future abstinence (Gwaltney, Metrik, Kahler, & Shiffman, 2009).

This study has several weaknesses. First, there are limitations to the measures and methods used to assess patient characteristics. For example, the PHQ-2 is a screening tool that assesses depressive symptoms, but it neither confers a diagnosis of nor tracks the severity of depression. The results of the EuroQol general health dimensions are reported on a three-level severity scale (none, mild, severe), which has lower discriminatory power than the five-level scale. These characteristics, among others, were assessed by interviewer-administered scripted survey, so results could also be affected by variability between interviewers. A second limitation of this study is that although smokers in urban safety net hospitals are an important subset of the smoking population, they are not representative of all smokers. Smokers with and without pain in a suburban or rural ambulatory setting may differ in important ways not captured here. Over 30% of the smokers included in this analysis were patients at the VA, a hospital system whose patient base differs significantly from the patient base even at other types of safety net hospitals. Additionally, although the recruitment of patients for this study involved the identification of every admitted smoker, only 10% of current smokers enrolled in study, and then only 68% of those enrolled received a survey that assessed pain status. A recent longitudinal study of over 19,000 adults found that individuals with lower socioeconomic status were more likely to experience pain-related disability (Grol-Prokopczyk, 2017). Because our study recruited exclusively from safety net hospitals, our findings may overestimate the national rate and severity of pain-related disability, one type of disability that would be captured by the EQ-5D.

Although the population of smokers in urban safety net hospitals may not be representative of the population of smokers nationwide, they represent an important subgroup for the development of smoking cessation programs for people with pain. Smokers in pain may be highly likely to be found in the inpatient setting due to decreased health status and additional comorbidities associated with smoking and pain. More than half of the VA smokers in the current study experienced chronic pain, and more than one third of the smokers in pain were insured by the VA. In a 2005 survey of the VA enrollee population, 22.2% were current smokers (Institute of Medicine, 2009). Data collected in 2010–2014 suggest that pain afflicts 65.5% of veterans, with rates of severe pain significantly higher than the general population (9.1% vs 6.4%) (Nahin, 2017). The VA would be an appropriate setting in which to pilot smoking cessation programs for people in pain. One such protocol, though not confined to inpatient recruitment, began recruiting at the VA Connecticut Healthcare System in January 2018 (<https://clinicaltrials.gov/ct2/show/NCT02971137>). More studies like this are needed, and these programs should take into account the high prevalence of psychiatric disorders and hindered mobility among this population of smokers.

In order to address the multiple comorbidities in smokers with chronic pain, a multidisciplinary team is needed, and a multimodal approach to smoking cessation should be considered. Ideally, general practitioners, mental health professionals, pain doctors, and physical therapists would all play a role in helping a person quit and stay quit. It is appropriate, if not preferable, for cessation counseling to be administered over the phone or using other forms of telemedicine/mobile applications given the severely hindered mobility status of smokers with chronic pain. Materials such as nicotine gum or patches should also be made easily available (e.g. by mail) so mobility is not a barrier. That said, every effort should be made to help smokers with pain improve their mobility and ability to perform

usual activities, in addition to the severity of their pain. One meta-analysis found self-efficacy to be negatively correlated with both impairment and pain severity (Jackson, Wang, Wang, & Fan, 2014). Reducing impairment may improve self-efficacy and therefore quit rates as self-efficacy has been shown to predict future abstinence (Gwaltney, et al., 2009). Physical therapy and improved pain control may play an important role in helping smokers with pain to quit. Smokers with chronic pain had more than twice the odds of using prescription opioids, suggesting their chronic pain may be managed with chronic opioid therapy. These patients should be evaluated by a pain specialist to determine whether chronic opioid therapy is appropriate given the increased risk of opioid abuse among smokers and people with psychiatric diagnoses (Passik et al., 2000; Webster and Webster, 2005). Finally, the multidisciplinary and multimodal approach could include a mental health component to address the psychiatric needs of this patient population. Mental illness has been associated with a lower likelihood of smoking cessation (Centers for Disease Control and Prevention, 2013), so it is conceivable that improved psychiatric care could give patients with chronic pain a better chance of cessation. Psychiatric care could also be administered by phone or other form of telemedicine.

ACKNOWLEDGEMENTS

The data analysis performed here was not preregistered with an independent, institutional registry. The content of this work is solely the responsibility of the authors and does not necessarily represent the official views of NIH or the Department of Veterans Affairs or the US Government.

FUNDING

This work was supported by a grant (1U01HL105229) and Hurricane Sandy Supplement (3U01HL105229-04S1) from the National Heart, Lung and Blood Institute at the National Institutes of Health, and also in part by a New York University CTSA grant (UL1TR000038) from the National Center for Advancing Translational Sciences at the National Institutes of Health. One of the authors (SES) is also supported by a grant from the National Institute on Drug Abuse (1K24DA038345) and by the VA New York Harbor Healthcare System.

REFERENCES

- Caudill-Slosberg MA, Schwartz LM, & Woloshin S (2004). Office visits and analgesic prescriptions for musculoskeletal pain in US: 1980 vs. 2000. *Pain*, 109(3), pp. 514–519. doi:10.1016/j.pain.2004.03.006 [PubMed: 15157714]
- Centers for Disease Control and Prevention. (2013). Vital signs: current cigarette smoking among adults aged ≥ 18 years with mental illness - United States, 2009–2011. *MMWR Morb Mortal Wkly Rep*, 62(5), pp. 81–87. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/23388551> [PubMed: 23388551]
- Clinical Practice Guideline Treating Tobacco Use and Dependence Update Panel. (2008). A Clinical Practice Guideline for Treating Tobacco Use and Dependence: 2008 Update. A US Public Health Service Report. *Am J Prev Med*, 35(2), pp. 158–176. doi:10.1016/j.amepre.2008.04.009 [PubMed: 18617085]
- Ditre JW, Brandon TH, Zale EL, & Meagher MM (2011). Pain, nicotine, and smoking: research findings and mechanistic considerations. *Psychol Bull*, 137(6), pp. 1065–1093. doi:10.1037/a0025544 [PubMed: 21967450]
- Ditre JW, Kosiba JD, Zale EL, Zvolensky MJ, & Maisto SA (2016). Chronic Pain Status, Nicotine Withdrawal, and Expectancies for Smoking Cessation Among Lighter Smokers. *Ann Behav Med*, 50(3), pp. 427–435. doi:10.1007/s12160-016-9769-9 [PubMed: 26813264]
- Fishbain DA, Lewis JE, Gao J, Cole B, & Steele Rosomoff R. (2009). Are chronic low back pain patients who smoke at greater risk for suicide ideation? *Pain Med*, 10(2), pp. 340–346. doi: 10.1111/j.1526-4637.2009.00570.x [PubMed: 19254332]

- Gaskin DJ, & Richard P (2012). The economic costs of pain in the United States. *J Pain*, 13(8), pp. 715–724. doi:10.1016/j.jpain.2012.03.009 [PubMed: 22607834]
- Goesling J, Brummett CM, & Hassett AL (2012). Cigarette smoking and pain: depressive symptoms mediate smoking-related pain symptoms. *Pain*, 153(8), pp. 1749–1754. doi:10.1016/j.pain.2012.05.014 [PubMed: 22703693]
- Grol-Prokopczyk H (2017). Sociodemographic disparities in chronic pain, based on 12-year longitudinal data. *Pain*, 158(2), pp. 313–322. doi:10.1097/j.pain.0000000000000762 [PubMed: 28092650]
- Grossman E, Shelley D, Braithwaite RS, Lobach I, Goffin A, Rogers E, Sherman S (2012). Effectiveness of smoking-cessation interventions for urban hospital patients: Study protocol for a randomized controlled trial. *Trials*, 13(1). doi:10.1186/1745-6215-13-126
- Gwaltney CJ, Metrik J, Kahler CW, & Shiffman S (2009). Self-efficacy and smoking cessation: a meta-analysis. *Psychol Addict Behav*, 23(1), pp. 56–66. doi:10.1037/a0013529 [PubMed: 19290690]
- Hahn EJ, Rayens MK, Kirsh KL, & Passik SD (2006). Brief report: pain and readiness to quit smoking cigarettes. *Nicotine Tob Res*, 8(3), pp. 473–480. doi:10.1080/14622200600670355 [PubMed: 16801305]
- Hooten WM, Shi Y, Gazelka HM, & Warner DO (2011). The effects of depression and smoking on pain severity and opioid use in patients with chronic pain. *Pain*, 152(1), pp. 223–229. doi:10.1016/j.pain.2010.10.045 [PubMed: 21126821]
- Hooten WM, Townsend CO, Bruce BK, Schmidt JE, Kerkvliet JL, Patten CA, & Warner DO (2009). Effects of smoking status on immediate treatment outcomes of multidisciplinary pain rehabilitation. *Pain Med*, 10(2), pp. 347–355. doi:10.1111/j.1526-4637.2008.00494.x [PubMed: 18721171]
- Hooten WM, Townsend CO, Hays JT, Ebnet KL, Gauvin TR, Gehin JM, ... Warner DO (2014). A cognitive behavioral smoking abstinence intervention for adults with chronic pain: a randomized controlled pilot trial. *Addict Behav*, 39(3), pp. 593–599. doi:10.1016/j.addbeh.2013.11.010 [PubMed: 24333035]
- Institute of Medicine. (2009). *Combating Tobacco Use in Military and Veteran Populations*. Washington, DC: The National Academies Press.
- Institute of Medicine (US) Committee on Advancing Pain Research, C., and Education. (2011). *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. Washington (DC).
- Jackson T, Wang Y, Wang Y, & Fan H (2014). Self-efficacy and chronic pain outcomes: a meta-analytic review. *J Pain*, 15(8), pp. 800–814. doi:10.1016/j.jpain.2014.05.002 [PubMed: 24878675]
- Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, & Graffunder CM (2016). Current Cigarette Smoking Among Adults - United States, 2005–2015. *MMWR Morb Mortal Wkly Rep*, 65(44), pp. 1205–1211. doi:10.15585/mmwr.mm6544a2 [PubMed: 27832052]
- Levy B, Paulozzi L, Mack KA, & Jones CM (2015). Trends in Opioid Analgesic-Prescribing Rates by Specialty, U.S., 2007–2012. *Am J Prev Med*, 49(3), pp. 409–413. doi:10.1016/j.amepre.2015.02.020 [PubMed: 25896191]
- Lowe B, Kroenke K, & Grafe K (2005). Detecting and monitoring depression with a two-item questionnaire (PHQ-2). *J Psychosom Res*, 58(2), pp. 163–171. doi:10.1016/j.jpsychores.2004.09.006 [PubMed: 15820844]
- Nahin RL (2015). Estimates of pain prevalence and severity in adults: United States, 2012. *J Pain*, 16(8), pp. 769–780. doi:10.1016/j.jpain.2015.05.002 [PubMed: 26028573]
- Nahin RL (2017). Severe Pain in Veterans: The Effect of Age and Sex, and Comparisons With the General Population. *J Pain*, 18(3), pp. 247–254. doi:10.1016/j.jpain.2016.10.021 [PubMed: 27884688]
- Passik SD, Kirsh KL, McDonald MV, Ahn S, Russak SM, Martin L, ... Portenoy RK (2000). A pilot survey of aberrant drug-taking attitudes and behaviors in samples of cancer and AIDS patients. *J Pain Symptom Manage*, 19(4), pp. 274–286. [PubMed: 10799794]

- Rabin R, & de Charro F (2001). EQ-5D: a measure of health status from the EuroQol Group. *Ann Med*, 33(5), pp. 337–343. [PubMed: 11491192]
- SAS Institute. (2014). SAS (Version 9.4) Cary, NC: SAS Institute Inc.
- Sherman SE, Link AR, Rogers ES, Krebs P, Ladapo JA, Shelley DR, ... Grossman E (2016). Smoking-cessation interventions for urban hospital patients: A randomized comparative effectiveness trial. *American Journal of Preventive Medicine*, 51(4), 566–577. doi: 10.1016/j.amepre.2016.06.023 [PubMed: 27647057]
- US Department of Health and Human Services. (2014). The Health Consequences of Smoking–20 Years of Progress: A Report of the Surgeon General Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
- van Hecke O, Torrance N, Cochrane L, Cavanagh J, Donnan PT, Padmanabhan S, ... Smith BH (2014). Does a history of depression actually mediate smoking-related pain? Findings from a cross-sectional general population-based study. *Eur J Pain*, 18(9), pp. 1223–1230. doi:10.1002/j.1532-2149.2014.00470.x [PubMed: 24577799]
- Webster LR, & Webster RM (2005). Predicting aberrant behaviors in opioid-treated patients: preliminary validation of the Opioid Risk Tool. *Pain Med*, 6(6), pp. 432–442. doi:10.1111/j.1526-4637.2005.00072.x [PubMed: 16336480]
- Zale EL, Ditte JW, Dorfman ML, Heckman BW, & Brandon TH (2014). Smokers in pain report lower confidence and greater difficulty quitting. *Nicotine Tob Res*, 16(9), pp. 1272–1276. doi: 10.1093/ntr/ntu077 [PubMed: 24827790]
- Zale EL, Maisto SA, & Ditte JW (2016). Anxiety and Depression in Bidirectional Relations Between Pain and Smoking: Implications for Smoking Cessation. *Behav Modif*, 40(1–2), pp. 7–28. doi: 10.1177/0145445515610744 [PubMed: 26467214]
- Zvolensky MJ, McMillan K, Gonzalez A, & Asmundson GJ (2009). Chronic pain and cigarette smoking and nicotine dependence among a representative sample of adults. *Nicotine Tob Res*, 11(12), pp. 1407–1414. doi:10.1093/ntr/ntp153 [PubMed: 19828432]

Table 1:

Baseline Characteristics of Smokers by Chronic Pain Status

Characteristic	No Pain (N=610)	Pain (N=483)	P-value	Odds Ratio [95% CI]
SOCIODEMOGRAPHIC				
Age, years, M (SD)	46.8 (14.0)	49.8 (13.0)	<0.001 *	-
Female	118 (19%)	101 (21%)	0.50	1.11 [0.82 – 1.49]
Race	-	-	0.47	-
- White	189 (32%)	137 (29%)	-	-
- Black	232 (39%)	192 (41%)	-	-
- Asian	24 (4.0%)	10 (2.1%)	-	-
- Native Hawaiian/Pacific Islander	1 (0.1%)	2 (0.4%)	-	-
- American Indian/Alaska Native	13 (2.2%)	9 (1.9%)	-	-
- Multiple races	37 (6.2%)	37 (7.9%)	-	-
- Other	102 (17%)	84 (18%)	-	-
Hispanic ethnicity	194 (32%)	178 (37%)	0.08	1.25 [0.97 – 1.61]
Employed	202 (33%)	115 (24%)	<0.001 *	0.63 [0.48 – 0.82] *
Primary insurance (self-reported)	-	-	<0.001 *	-
- Public	274 (45%)	218 (45%)	-	-
- Private	56 (9.2%)	40 (8.3%)	-	-
- VA	158 (26%)	180 (37%)	-	-
- None	120 (20%)	45 (9.3%)	-	-
TOBACCO				
Number of days smoked in last 30	24.7 (7.65)	25.5 (7.00)	0.14	-
Cigarettes per day, M (SD)	12.2 (9.80)	12.4 (9.75)	0.70	-
Years smoked, M (SD)	24.6 (14.7)	28.7 (14.7)	<0.001 *	-
Level of confidence in quitting	-	-	0.53	-
OTHER SUBSTANCE USE				
Cannabis use in past 3 months	203 (33%)	176 (36%)	0.28	1.15 [0.90 – 1.48]
Cocaine use in past 3 months	111 (18%)	111 (23%)	0.05	1.34 [1.00 – 1.80]
Sedative use in past 3 months	69 (11%)	51 (11%)	0.69	0.93 [0.63 – 1.36]
Street opioid use in past 3 months	63 (10%)	68 (14%)	0.06	1.42 [1.00 – 2.05]
Prescription opioid use in past 3 months	46 (7.5%)	61 (13%)	0.005 *	1.77 [1.18 – 2.65] *
Hazardous drinking ^a	277 (45%)	216 (45%)	0.82	0.97 [0.77 – 1.24]
History of alcohol or substance misuse	381 (62%)	286 (59%)	0.27	0.87 [0.68 – 1.11]
OTHER MENTAL HEALTH				
History of psychiatric diagnosis, non-substance related	289 (47%)	263 (54%)	0.02 *	1.33 [1.05 – 1.69] *
Depressive symptoms ^b	213 (35%)	217 (46%)	<0.001 *	1.55 [1.21 – 1.98] *
GENERAL HEALTH STATUS				

Characteristic	No Pain (N=610)	Pain (N=483)	P-value	Odds Ratio [95% CI]
Obesity ^c	153 (26%)	153 (32%)	0.02 *	1.38 [1.05 – 1.80] *
Mobility problems ^d	-	-	-	-
- Mild	125 (21%)	197 (41%)	<0.001 *	[2.90 – 5.10] *
- Severe	38 (6.2%)	100 (21%)	<0.001 *	6.41 [4.25 – 9.68] *
Self-care problems ^d	-	-	-	-
- Mild	38 (6.2%)	89 (19%)	<0.001 *	2.34 – 5.22] *
- Severe	15 (2.4%)	18 (3.8%)	0.10	1.79 [0.89 – 3.59]
Usual activity problems ^d	-	-	-	-
- Mild	133 (22%)	146 (30%)	<0.001 *	1.47 – 2.58] *
- Severe	35 (5.8%)	87 (18%)	<0.001 *	4.41 [2.89 – 6.73] *

^a AUDIT-C score 3 for females, 4 for males

^b PHQ-2 score 3

^c BMI 30.0

^d Measured by one of the 5 dimensions of the EQ-5D. Referent = “no problems” in that category

* Indicates p-value < 0.05

Table 2:

Multivariable Analysis of Baseline Characteristics Associated with Chronic Pain

Characteristic	P-value	Odds Ratio [95% CI]
Age	0.89	1.00 [0.98 – 1.02]
Female	0.71	1.07 [0.74 – 1.54]
Race-ethnicity ^a	0.07	-
- Hispanic	0.008 *	1.68 [1.15 – 2.48] *
- Asian	0.85	0.92 [0.36 – 2.31]
- Black	0.06	1.46 [0.99 – 2.15]
- Other	0.08	1.69 [0.94 – 3.03]
Time to first cigarette ^b	0.60	-
- 6–30 min	0.23	1.27 [0.86 – 1.86]
- 31–60 min	0.64	1.11 [0.71 – 1.75]
- 60+ min	0.30	1.21 [0.85 – 1.72]
Years smoked	0.14	1.01 [1.00 – 1.03]
Prescription opioid use in past 3 months	<0.001 *	2.31 [1.44 – 3.70] *
Hazardous drinking	0.22	1.20 [0.90 – 1.59]
History of alcohol or substance misuse	0.39	0.87 [0.63 – 1.20]
History of psychiatric diagnosis, non-substance related	<0.001 *	1.75 [1.29 – 2.36] *
Depressive symptoms	0.65	1.07 [0.80 – 1.44]
Obesity	0.40	1.14 [0.84 – 1.55]
Mobility problems ^c	<0.001 *	-
- Mild	<0.001 *	3.19 [2.30 – 4.41] *
- Severe	<0.001 *	6.00 [3.53 – 10.18] *
Self-care problems ^c	0.001 *	-
- Mild	0.14	1.45 [0.89 – 2.38] *
- Severe	0.003 *	0.23 [0.09 – 0.61] *
Usual activity problems ^c	0.002 *	-
- Mild	0.12	1.31 [0.93 – 1.84] *
- Severe	<0.001 *	2.73 [1.54 – 4.86] *

^aWe created a composite of race and ethnicity data. The categories were as follows: Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, Non-Hispanic Other.

^bSelf-reported time to first cigarette after waking up in the morning. Referent = within 5 minutes.

^cMeasured by one of the 5 dimensions of the EQ-5D. Referent = “no problems” in that category.

* Indicates p-value < 0.05.