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Opioid and tobacco co-use among black adults with chronic musculoskeletal pain: relations to pain experience, substance misuse, and mental health

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Thesis

OPIOID AND TOBACCO CO-USE AMONG BLACK ADULTS WITH CHRONIC MUSCULOSKELETAL PAIN: RELATIONS TO PAIN EXPERIENCE, SUBSTANCE MISUSE, AND MENTAL HEALTH

by

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ABSTRACT

Background: Not all patients benefit equally from recent advances in chronic musculoskeletal pain care. Black adults in America suffer from greater chronic musculoskeletal pain and related consequences such as opioid and substance misuse than White adults. Internal and external factors such as perceived discrimination, hopelessness, pain catastrophizing, healthcare access, and healthcare provider bias, strongly impact the chronic MSK pain and related outcomes. However, to my knowledge no studies have evaluated the impact of co-use of substances such as tobacco with prescription opioids among Black individuals. I examined chronic musculoskeletal pain and related outcomes in Black adult smokers and nonsmokers, a population cohort that is often overlooked for research studies. This study enrolled 368 Black individuals with chronic MSK pain, 156 of which used tobacco products. I administered self-report questionnaires to investigate differences in their pain intensity, pain-related interference/disability, substance misuse, substance dependence, anxiety, and depression levels. My findings suggested that smoking tobacco products can indeed exacerbate chronic musculoskeletal pain intensity, pain-related interference/disability, substance

misuse, substance dependence, anxiety, and depression in Black adults who use opioid medications.

Keywords: Chronic Musculoskeletal Pain, Black Individuals, Health Disparities, Tobacco Usage, Emotional Distress, Pain Intensity, Pain Interference

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LIST OF ABBREVIATIONS

ASSIST ..... Alcohol, Smoking and Substance Involvement Screening Test

BUSPH ..... Boston University School of Public Health

CDC ..... Center for Disease Control and Prevention

CITI ..... Collaborative Institutional Training Initiative

GAD-2 ..... Generalized Anxiety Disorder-2

GCPS ..... Graded Chronic Pain Scale

IRB ..... Institutional Review Board

MSK ..... Musculoskeletal

nAChRs ..... Nicotinic Acetylcholine Receptors

NSAIDs ..... Nonsteroidal Anti-Inflammatory Drugs

OTC ..... Over the Counter

PHQ-2 ..... Patient Health Questionnaire-2

PHRC ..... Partners Health Research Committee

PTSD ..... Post-Traumatic Stress Disorder

QOL ..... Quality of Life

SD ..... Standard Deviation

SDS ..... Severity of Dependence Scale

WHO ..... World Health Organization

INTRODUCTION

Millions of Americans experience chronic MSK pain every year, but not all are impacted equally. Sociodemographic variables serve as some of the most significant determinants of health outcomes on both the macroscopic and microscopic level, especially in regard to chronic musculoskeletal (MSK) pain. Despite significant steps toward racial equality in the United States, inequalities in health outcomes still persist across racial categories, including Black individuals. These outcomes can be particularly impacted by factors such as perceived discrimination, and structural issues that limit Black individuals' access to healthcare. Between the evaluation and medical interventions of chronic MSK pain in White Americans and Black Americans there is a significant disparity (Ezenwa and Fleming, 2012) insofar as their pain experience, pain-related substance misuse, and pain-related emotional distress and mental health.

Research suggests that Black individuals are particularly vulnerable to chronic MSK pain, poor treatment outcomes, and greater pain-related disability (Morales and Yong, 2021). In general, Black individuals with chronic MSK pain experience greater pain intensity, pain-related disability, pain-related opioid use and other substance use. In addition, Black individuals with chronic MSK pain experience higher rates of co-morbid depression, anxiety, PTSD, and other psychiatric disorders than non-Hispanic White individuals (Edwards et al., 2005; Green et al., 2003). Knowledge regarding factors associated with worse outcomes among Black persons with chronic MSK pain is of clinical importance.

Chronic MSK pain is outlined as pain that lasts for three months or longer, and serious adverse outcomes may arise if chronic MSK pain is not properly treated or left untreated (Wyatt, 2013). The associations between smoking and chronic MSK pain, and psychological distress have been detailed extensively; in fact, the co-use of tobacco products with prescription opioids is suggested to exacerbate chronic MSK pain, and its related states and conditions. Indeed, states of psychological distress like maladaptive pain coping and pain catastrophizing have been noted to be greater amongst Black individuals compared to White individuals (Forsythe et al., 2011). This could be due to the impact of perceived discrimination that has an established connection to the bidirectional relationship for chronic MSK pain, psychological distress, disability, and substance misuse amongst Black individuals. perceived discrimination impacts chronic MSK pain by increasing levels of psychological and emotional distress (Brown et al., 2018), making Black populations particularly vulnerable. Greater levels of pain-related substance use and disability in Black populations can be attributed to perceived discrimination, which often stems from healthcare access-related factors such as receiving less pain education, fewer necessary treatments, medications or surgical interventions, and/or fewer referrals to specialists due to racial biases (Hirsch et al., 2015; Orhan et al., 2018; Simon, 2012). In addition to discrimination within the healthcare system, Black individuals were found to report more barriers related to access to culturally-informed evidence-based pain care (Joo, & Liu, 2020). These structural limitations can lead to a greater negative collective impact on both physical and

psychological health in Black chronic MSK pain patients who smoke, worsening their substance/tobacco use and chronic MSK pain related outcomes as a result.

Despite these disparities, the majority of psychosocial research and theory development in chronic musculoskeletal pain and substance/tobacco use comorbidity has been conducted with predominantly non-Hispanic White populations (Emerson et al., 2020). This clearly reflects the lack of chronic MSK pain research on smoking and nonsmoking Black adults with the co-use of prescription opioids. For instance, there are notable studies investigating models of exaggerated pain perception which have only recruited samples of all White Europeans or predominately White Americans (Gheldof et al., 2010; Cook et al., 2006). A recent study found evidence that race and ethnicity do indeed play an important role in the interrelationships amongst chronic MSK pain, and emotionally distressed states like depression and anxiety which can bring about greater amounts of pain catastrophizing (Terry et al., 2022). Often, many randomized controlled trials testing for psychosocial interventions for chronic MSK pain, like therapy tests assessing commitment and acceptance, are conducted in predominately White European countries. This data then cannot be accurately applied to populations because it is not a diverse representative, for these countries either hold an insignificant amount of Black individuals or do not report participants' racial or ethnic backgrounds (Buhrman et al., 2013; Scott et al., 2018; Wetherell et al., 2011). There is also a lack of research for smoking status and its impact in the context of chronic MSK pain.

In chronic MSK pain research, an etic approach is often taken instead of an emic approach. An etic study is a research approach which is conducted from the perspective

of various groups to learn about the universality of behaviors (Valichko et al., 2015) while an emic approach focuses on the behaviors and perspectives of a specific group (Valichko et al., 2015). Proponents of the emic perspective postulate that studies should be performed and analyzed with specific cultural contexts in mind (Valichko et al., 2015). Many researchers are beginning to understand that the etic and emic strategies are not mutually exclusive nor incompatible, but instead lie on an overlapping continuum (Cheung et al., 2011; Helfrich, 1999). Thus, the distinction between etic and emic studies has been reformulated to designate the two termini of a continuum that spans from universal outlooks (etic) to culturally specific outlooks (emic) (Valichko et al., 2015). Solely utilizing an etic approach in research can be detrimental to minority groups, such as Black Americans, as the scope of the study is limited. Since chronic MSK pain research is predominantly conducted on White Americans, this 'universal' outlook is not applicable to subcultures. This inevitably creates a health disparity amongst Black Americans who suffer from chronic MSK pain at rates similar to, if not higher than, White Americans.

Predictors of chronic MSK pain have been investigated in a variety of studies with White individuals. Smoking in conjunction with prescription opioid use has been noted as a major predictor. In fact, individuals with chronic MSK pain often begin to smoke tobacco products to mitigate their pain, but tobacco usage only provides a brief sense of relief, and instead will aggravate their pain long term. The literature suggests that in chronic MSK pain patients, there are correlations between smoking status and greater intensity of chronic MSK pain, emotional distress, use of prescription opioid

drugs, and disability status. However, there are very few definitive studies specifically determining these health outcomes among smoking and non-smoking Black individuals. A better understanding of psychosocial risk, maintenance factors implicated in chronic MSK pain, and related outcomes among Black individuals could help with the conduct of direct clinical assessment and therapeutic programing in a more efficient manner for this population.

Evaluation of the underlying psychosocial and societal implications of chronic MSK pain and comorbid outcomes in minority individuals requires examination of the contextual variables relevant to the Black experience. Improved conceptual models of chronic MSK pain experience, emotional distress, and substance misuse in Black American smokers and nonsmokers with chronic MSK pain will better the understanding of the topic, thus leading to improved healthcare and outcomes for Black patients.

Specific Objectives

This thesis will evaluate the health disparities in chronic MSK pain and pain treatment, specifically testing a model of chronic MSK pain among a large sample (N = 368) of smoking and nonsmoking Black individuals with chronic MSK pain. I will examine the implications of smoking on their pain experience, substance misuse, substance dependence, and mental health among Black individuals who use opioid medications. Additionally, an examination of differences in demographic factors between smokers and non-smokers will be conducted. A better understanding of factors of

maintenance and psychosocial risk implicated in chronic MSK pain and related outcomes among Black individuals could help with the conduct of direct clinical assessment and therapeutic programming in a more efficient manner for this population. I hope to this knowledge help with tailoring interventions to more effectively target this population and reduce health disparities.

METHODS

Study Design and Setting.

After gaining IRB approval, I recruited participants through Qualtrics Panels (Qualtrics, Provo Utah). Qualtrics Panels is an online research tool powered by Qualtrics that matches pools of interested research participants to appropriate survey studies. Qualtrics staff identified potentially eligible participants based on my inclusion/exclusion criteria (e.g., identify as Black, are 18 years of age or older, endorse chronic MSK pain) and sent them an invitation to participate via invitation through the online panel. Participants received a link to my survey, starting with a study fact sheet, and then completed a series of questionnaires. I recruited 368 Black individuals with chronic musculoskeletal pain (212 non-smoking, 156 smoking) and administered a survey comprising of several validated questionnaires assessing smoking status, opioid use, and psychosocial factors implicated in pain/disability.

The study fact sheet administered is included in the appendix.

Inclusion criteria was utilized to determine the eligibility of participants in this study. Participants had to be an adult of 18 years or older, this inclusion criteria had no upper limit on age because research suggests that chronic MSK pain can be particularly disabling among older adults. Participants had to identify as Black, since I was studying the experience of Black individuals who suffer from chronic MSK pain. English fluency and literacy were expected to ensure that participants have a thorough understanding of what the study entails, and that they are able to provide valid data. Participants were also asked to report chronic non-cancerous musculoskeletal pain (i.e., pain for at least three

months). For, pain for at least 3 months is a standard criterion for chronic pain. Non-response to analgesics (i.e., persistency) increases the reliability of detecting persons with clinically significant pain. Eligible participants were also at the time of the study taking a pain medication (e.g., prescription, over the counter (OTC), opioid). This requirement is because I was interested in people who were currently receiving treatment for chronic pain and still reporting persistent pain.

Two exclusion criterions were also utilized to determine the eligibility of participants in this study. If a participant was determined to fit one of more of my exclusion criterions, they were rendered ineligible to participate in the study. The first exclusion criterion being if a participant had limited mental capacity and was unable to give informed, voluntary, written consent to participate. This was intended to ensure that all participants can read and understand my study materials and provide informed consent. This was particularly important because I had no upper age limit for inclusion in my study. The second exclusion criterion was if the primary source of pain is cancer related or not musculoskeletal. For, cancer-related stress or primary non-musculoskeletal pain could confound the impact of musculoskeletal pain.

Measures.

Demographics Questionnaire

Demographics of Black individuals with chronic MSK pain who participated in the study were taken, and then analyzed based on the participants co-use of tobacco products. Participants were asked about their age, sex, gender identity, relationship status, income, employment status, education level, insurance status/type, medical conditions, injury history, surgical history, substance use history, history of mental disorders, and

current medications. As well as their use of opioids, prescription drugs, or other prescribed analgesics.

Alcohol, Smoking and Substance Involvement Screening Test

The 8 item-questionnaire, Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) is intended to measure the risk of an extensive range of substances and their misuse, including but not limited to tobacco products, alcoholic substances, cannabis, and cocaine (Humeniuk et al., 2008). It was formed for the World Health Organization (WHO) through the international collaboration of various clinicians and researchers to help in identifying substance use affiliated health threats and substance use disorders early on.

The ASSIST tool has been used extensively by other works, documenting its validity and reliability (Humeniuk et al., 2008). Participants first indicate if they have ever used any of the listed substances. If yes, they then are asked to rate the frequency and urge for each substance they use as well as problems or consequences that have arisen from their use of the substance on a 5-point Likert scale. According to Rogers et al. the "total scores for each substance are calculated as well as a risk level, where higher scores indicated greater substance involvement, including frequency of use and problems associated with use." In this current study, the question 'have you used tobacco products in the past 3 months,' was used to classify participants as habitual tobacco users or not. I used a previous validated study to define habitual tobacco use as daily, almost daily, or weekly use (Stanton et al., 2021) The total substance involvement scores for tobacco,

alcohol, cannabis, and cocaine were computed by summing all the questionnaire items correlated with each particular substance. The smoking status of participants was also determined through the ASSIST questionnaire.

Patient Health Questionnaire-2

The patient health questionnaire-2 (PHQ-2) is a 2-item self-report measure created to assess depression. It is rated on a 5-point Likert scale from 0 (not at all), 1 (several days), 2 (more than half the days) to 3 (nearly every day). PHQ-2 is a validated, and modified version of PHQ-9. It contains the first two questions of the PHQ-9, which has scores ranging from '0' to '6' (Korenke et al., 2021). The total score for depression is made up of the sum of the two depression items which have been previously validated from PHQ-9 (Lowe et al., 2010). PHQ-2 values that are greater than or at three indicate depressive symptoms, and participants are recommended to conduct a clinical interview to assess for major depressive disorder (Korenke et al., 2021). In this current study, I used the total score for depression for my analysis.

Generalized Anxiety Disorder Scale

The generalized anxiety disorder scale (GAD-2) is a brief 2-item screening tool for generalized anxiety. The GAD-2 is validated and modified form of the seven-item GAD-7 scale that combines the first two questions of the GAD-7, which address integral mechanisms of any anxiety disorder (Sapra et al., 2020). GAD-2 score is calculated by assigning scores of 0, 1, 2, and 3, to the response categories of 'not at all', 'several days',

'more than half the days', and 'nearly every day', respectively, and summing together the total scores for the questionnaire items. It is used as an initial screening tool for generalized anxiety disorder, with a score of three points as the minimum for identifying possible situations in which further diagnostic evaluation for generalized anxiety disorder is necessary (Kroenke et al., 2007). Despite usually utilizing GAD-2 as a tool for initial screening, in this current study I am using GAD-2 to calculate a total score.

Severity of Dependence Scale

The severity of dependence scale (SDS) is a 5-item self-administered questionnaire which assesses the severity of an individual's dependence to opioids (Gossop et al., 1995). Responses are rated on a 4-point scale from 0 (Never/ Almost Never) to 3 (Always/ Nearly Always), and all items are summed for a total score (Iraurgi Castillo et al., 2010). There are varying cut-offs for the measurement of the psychological dependence on various drugs (Gossop et al., 1995). In this current study, I used the total score for dependence for my analysis.

Graded Chronic Pain Scale

The graded chronic pain scale (GCPS) assesses pain intensity and pain interference/disability on a 7-item self-report scale (Von Korff et al., 1992). Prior studies have established convincing psychometric properties of the GCPS amongst individuals who suffer from chronic MSK pain (Von Korff et al., 1992). Items concerning pain intensity are rated on 10-point scale from 0 (no pain) to 10 (pain as bad as could be) and

are added together. Items concerning pain interference/disability are rated on a 10-point scale from 0 (no interference) to 10 (unable to carry on any activities) and added together, creating two separate total scores. Higher scores suggest the participant suffers from more intense and disabling pain that interferes with their daily life. In this current study, I used the total scores for intensity and interference for my analysis.

All questionnaires used in this study are included in the appendix.

Consent Measures.

Individuals who chose to participate in this study provided implied consent based on their review of the study fact sheet in Qualtrics, and a subsequent completion of a brief survey verifying eligibility. All potential participants were provided with a study fact sheet as the first page of the Qualtrics survey. The study fact sheet provides detailed information on the purpose of the study, the nature of study questionnaires, and the potential benefits/risks associated with participating. All participants were ensured that participation is strictly voluntary and confidential.

In addition, the study fact sheet informed the participants about the confidentiality measures that the research group took during the process. Only members of the research team would have access to the data, and surveys would be de-identified to remove identifiable or confidential information. The study fact sheet included pertinent information on study design, risks and benefits, the fact that participants can withdraw from the study at any time, and the voluntary nature of the research and confidentiality.

Participants were encouraged to review the study fact sheet in its entirety before continuing to complete the brief Qualtrics survey.

The study fact sheet also contained the names and numbers of members of study staff that participants can contact if they have additional questions or concerns. Due to the nature of this study and the minimum risk, we waived the written documentation of informed consent. Participants who reviewed the study fact sheet as the first page of the Qualtrics survey and advanced to complete the brief survey were considered to have provided implied consent to participate in the study. Study staff documented implied consent by retaining a list of names of the participants who completed the Qualtrics survey. The implied consent process was executed in a manner consistent with the Institutional Review Board (IRB) approved protocol, and the most recent version of the IRB-approved protocol was used.

Participants were also informed on the consent form that if they needed emotional support after the questionnaires or interview, that they may reach out to the study PI, who, if needed, assisted in providing support and referral information. All study staff participated in the National Institute of Health required training for conduct studies that involve human subjects. All study staff passed the Collaborative Institutional Training Initiative (CITI) course. Training for all staff included but is not limited to human subjects, informed consent, good clinical practice, quality management, confidentiality and reporting of adverse events.

There was no risk of physical injury to participants. All participants also had the contact information for the PI, a clinical psychologist with expertise in risk assessment,

and were informed to contact the study investigators if they experience any distress answering the questionnaires or during their participation in the study. Risk for emotional distress, on the other hand, while completing questionnaires was determined to potentially occur. However, this was considered minimal and temporary. All participants were provided a debriefing document at the end of the survey, which included direction to seek psychological care if the distress experienced due to an individuals' participation in the research was unmanageable.

Confidentiality Measures.

In regard to confidentiality, as in any research study, there is a small risk that it may be breached; all efforts to minimize this risk were taken. The study staff were trained on the importance of maintaining confidentiality, and data was kept confidential, accessible solely to trained staff on the study. It will not and has not been used in clinical care nor in future research.

Throughout the study subjects were monitored for the occurrence of events defined as any undesirable experience or unanticipated risk. Lack of effect of treatment was not considered an event. All adverse events were reported on an adverse event form. The PI had the responsibility of reporting serious adverse events (death, life threatening illness or injury, serious injury, or permanent disability) and all adverse events were be reported per partners human research committee (PHRC) guidelines. Adverse events were documented in the event that a patient spontaneously reports an adverse event, or an adverse event that was discovered during the assessment process. All adverse events were

to be reported by the PI to the Office of Research Compliance within 5 working days / 7 calendar days of the date the investigator first discovered the issue.

Unique participant ID numbers were randomly generated and assigned when the survey link was clicked and a new survey entry was activated. No identifying information was be collected. The research complied with all the guidelines and requests of the Mass General Brigham Human Research Office/Institutional Review Board. Recruitment materials had the web address for the screening survey for those who were interested in participating. All the information was stored on Qualtrics. There was no physical data in the laboratory that identifies the participants. Participants had the freedom to choose to not answer any questions or provide any information they do not wish to or do not feel comfortable sharing. They had the option of sharing as much or as little information as they choose.

As noted above, study data was not linked to any identifying information; rather, study ID numbers were assigned and used to identify participants. All study forms were stored in locked storage spaces, to which only study staff had access. All study staff completed required partners human subjects trainings prior to the start of study procedures (MGH Research Institute).

Data Collection.

All data was collected during the anonymous, single assessment where patients completed several questionnaires independently of one another. All data was collected online through the Qualtrics survey. At the completion of data collection, the data were

downloaded onto a computer in the PI's office. This computer was connected to a secure server and the dataset was saved on the encrypted network drive. The data were only accessible to the PI, faculty sponsor, and supporting lab members. The Qualtrics survey was deactivated once the data collection was completed.

There were no direct benefits to participating in this study. However, a participant may have benefitted from learning about the impact of psychosocial factors on their experience of chronic MSK pain. Participants were reimbursed via the Qualtrics Survey Panel that they are a member of. Reimbursement was placed into their Qualtrics accounts in the form of Qualtrics participation credit.

Data Analysis.

I compared the population of participants who smoked tobacco and the participants who did not smoke tobacco to determine if there was a difference between the two groups. I analyzed their demographics with a t-test (age) and a chi-squared test (gender identity, annual income, employment status, education, and insurance). I also tested the differences in Black smokers and nonsmokers levels of depression and anxiety, the intensity of their chronic MSK pain, the extent to which their pain hindered their engagement with daily activities, and the severity of their dependence on their prescription opioid drugs for pain management, as well as, their co-use of alcohol, cannabis, and cocaine. This was done to determine if these were higher amongst the smoking population. I calculated descriptive statistics (group statistics, an independent

samples test) and utilized a t-test to determine if there was a significant difference between the means of the two groups amongst the categories

For the ASSIST, PHQ-2, GAD-2, SDS, and GCPS questionnaires, each of the survey's total scores were compared between the participants who smoked tobacco products alongside their prescription opioids and participants who did not smoke tobacco products. In order to determine the relationship between what these questionnaires were testing and smoking amongst Black chronic MSK pain patients.

Inferential Statistics

For the demographic analysis, (i.e. differences between the smokers and non-smokers) I used a t-test for age and Pearson's chi-squared test for the other variables. Pearson's chi-squared test is used to establish whether there is a distinction of statistical significance between the anticipated frequencies and the observed frequencies in the listed categories of the categorical data table (Sullivan, BUSPH). Fisher's exact test was also implemented to ascertain if there were any nonrandom correlations between the variables of positive and negative smoking status. For the analysis of my main hypothesis, I utilized a two sample t-test to determine if the two population means that I am testing (tobacco product smoking and nonsmoking participants) are equal or have significant differences between them. I calculated two sets of values in which equal variances were assumed and then not assumed. The assumption of equal variances, is an assumption that despite the different groups being compared they hold the same or a similar variance, even if they came from dissimilar population cohorts (Salkind, 2010). In

the instance, where equal variances cannot be assumed, the calculation is found using un-pooled variances (when the variances of the two populations are unequal) and with a slight modification to the degrees of freedom (Salkind, 2010). In order to evaluate the variances' equality for the variables and outcomes calculated for the smoking and non-smoking groups I implemented Levene's test. Some common statistical procedures presuppose that variances of the groups from which the varying samples are gathered are of an equivalent value, Levene's test evaluates this presupposition (Habib, 2015).

RESULTS

Descriptive Statistics

I examined demographic differences in participants who smoked tobacco products and participants who did not smoke tobacco products. In regard to age, after conducting a t-test, there were no significant differences found between the two groups (Table 1 and 2). Additionally, I used chi-squared tests to determine that gender identity (χ^2 (2) = 1.36, P = 0.51) annual income (χ^2 (7) = 10.4, P = 0.17), employment status (χ^2 (6) = 4.05, P = 0.67), and insurance (χ^2 (1) = 0.001, P = 0.98) were not significant indicators. However, the chi-squared test did reveal that for education level (χ^2 (5) = 13.34, P = 0.02) there was a significant difference (Table 3). Demonstrating that Black smokers with chronic MSK pain had lower levels of education than those that did not co-use tobacco products.

Table 1. Participant Age Group Statistics

Outcome	Smoking Status	Sample Size (n = 368)	Mean Age	Standard Deviation	Standard Error Mean
Participant Age	Opioid Only Use	212	35.29	11.665	0.801
	Tobacco-Opioid Co-Use	156	36.68	9.569	0.766

Table 2. Participant Age Independent Samples Data

Demographic Measure	Variance Assumption	Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Participant Age	Equal variances assumed	9.133	0.003	-1.214	366	0.225
	Equal variances not assumed			-1.251	361.65	0.212

Legend for Table 2: "F" – (the f-value is a measure to help answer the notion "is the variance between the means of two populations significantly different?"). "Sig" – (statistical significance, it is a term utilized to affirm that it is improbable an observation could have happened under a statistical test's null hypothesis. The value of significance is commonly represented by a value of probability, or a p-value). "t" – (t-test, is utilized to analyze the difference of averages between two data sets). "dF" – (degrees of freedom, references the maximum amount of logically independent values in the sample of data, i.e. values that possess the freedom to hold variance). "Sig (2-tailed)" – (this is a two tailed value of statistical significance that utilizes the p-value to evaluate the null hypothesis again an alternative hypothesis in two directions, rather than just one)

Table 3. Descriptive Statistics of Demographics and Smoking Status in Black Individuals

Outcome	Tobacco-Opioid Co-Use (n = 156)	Opioid Only Use (n = 212)	Significance, P*
Gender Identity			
Female	78	107	
Male	77	105	Ns
Transgender	1	0	
Annual Income			
Less than $10,000	12	29	
$10,000 to less than $15,000	15	23	
$15,000 to less than $20,000	16	17	
$20,000 to less than $25,000	20	16	Ns
$25,000 to less than $35,000	25	20	
$35,000 to less than $50,000	18	26	
$50,000 to less than $75,000	28	48	
$75,000 or more	22	33	
Employment			
Employed full time	100	133	
Employed part time	26	29	
Unemployed			
Looking for work	10	11	Ns
Not looking for work	4	10	
Retired	5	7	
Student	2	8	
Disabled	9	14	
Education Level			
Less than High School	3	2	
High school diploma/ equiv.	55	61	
Some college, no degree	47	42	< 0.03
	18	31	
	25	53	

Associate's degree	8	23	
Bachelor's degree			
Graduate degree			
Insurance			
Yes	8	11	Ns
No	148	201	

**Ns = not significant*

In Black individuals with chronic MSK pain, depression and anxiety, the intensity of their pain and its hinderance to engagement with daily activities, the severity of their dependence on prescription opioid drugs for pain management, and their co-use of alcohol, cannabis, and cocaine, there was statistical significance shown between the 156 smoking participants and the 212 non-smoking participants in all the tested categories.

Table 4. Primary Outcomes Group Statistics

Questionnaires	Tobacco Smoking Status*	N**	Mean	Standard Deviation	Standard Error Mean
Patient Health Questionnaire-2 Score	No	212	3.0943	1.76	0.121
	Yes	156	3.5192	1.66	0.133
Generalized Anxiety Disorder-2 Score	No	212	3.0236	1.79	0.123
	Yes	156	3.5385	1.82	0.146
Graded Chronic Pain Scale (Intensity) Score	No	212	6.3066	2.12	0.145
	Yes	156	7.1731	1.77	0.141

Graded Chronic Pain Scale (Interference) Score	No	212	12.1038	4.32	0.297
	Yes	156	13.9038	3.61	0.289
Severity of Dependence Score	No	212	10.3491	3.69	0.254
	Yes	156	11.4615	3.96	0.317
ASSIST Alcohol Score	No	212	11.3085	8.14	0.574
	Yes	156	15.3910	10.49	0.840
ASSIST Cannabis Score	No	212	10.2139	9.84	0.694
	Yes	156	12.8910	10.94	0.876
ASSIST Cocaine Score	No	212	4.6766	7.85	0.554
	Yes	156	7.6667	10.26	0.822

**No = non-smoking, Yes = smoking*
***N = Number of participants*

Table 5. Primary Outcomes Independent Samples Data

Questionnaires	Variance Assumption	Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Patient Health Questionnaire-2 Score	Equal variances assumed	0.517	0.472	-2.34	366	0.020
	Equal variances not assumed			-2.36	344.23	0.019
Generalized Anxiety Disorder-2 Score	Equal variances assumed	0.315	0.575	-2.71	366	0.007
	Equal variances not assumed			-2.70	330.29	0.007

Graded Chronic Pain Scale (Intensity) Score	Equal variances assumed	5.225	0.023	-4.15	366	0.000
	Equal variances not assumed			-4.26	360.21	0.000
Graded Chronic Pain Scale (Interference) Score	Equal variances assumed	2.249	0.135	-4.22	366	0.000
	Equal variances not assumed			-4.34	360.14	0.000
Severity of Dependence Score	Equal variances assumed	1.544	0.215	-2.76	366	0.006
	Equal variances not assumed			-2.74	320.47	0.006
ASSIST Alcohol Score	Equal variances assumed	19.54	0.000	-4.13	355	0.000
	Equal variances not assumed			-4.01	285.27	0.000
ASSIST Cannabis Score	Equal variances assumed	2.588	0.109	-2.42	355	0.016
	Equal variances not assumed			-2.39	314.64	0.017
ASSIST Cocaine Score	Equal variances assumed	20.79	0.000	-3.11	355	0.002
	Equal variances not assumed			-3.01	282.61	0.003

Legend for Table 5: “F” – (the f-value is a measure to help answer the notion “is the variance between the means of two populations significantly different?”). “Sig” –

(statistical significance, it is a term utilized to affirm that it is improbable an observation could have happened under a statistical test's null hypothesis. The value of significance is commonly represented by a value of probability, or a p-value). "t" – (t-test, is utilized to analyze the difference of averages between two data sets). "dF" – (degrees of freedom, references the maximum amount of logically independent values in the sample of data, i.e. values that possess the freedom to hold variance). "Sig (2-tailed)" – (this is a two tailed value of statistical significance that utilizes the p-value to evaluate the null hypothesis again an alternative hypothesis in two directions, rather than just one)

Mental Health

Depression

There was a significant difference in PHQ-2 total depression scores, in participants who reported smoking tobacco products (mean = 3.52, standard deviation = 1.66, standard error mean = 0.133) when compared to participants who did not report smoking tobacco products (mean = 3.09, standard deviation = 1.76, standard error mean = 0.121). Demonstrating a significant difference in regard to depression between the two groups (Table 4 and 5). Black tobacco co-users with chronic MSK pain had greater levels of depression than non-smokers.

Anxiety

The mean difference between people who reported that they smoke tobacco (mean = 3.54, standard deviation = 1.82, standard error = 0.146) and people who reported that they do not smoke tobacco (mean = 3.02, standard deviation = 1.78, standard error = 0.123) held statistical significance, such that the use of tobacco alongside prescription opioid drugs amongst African Americans was correlated with significantly higher GAD-2 anxiety test scores (Table 4 and 5).

Pain Experience

Pain Intensity

In regard to, GCPS pain intensity scores, I saw statistically significant variances between participants that use tobacco with their prescription opioids (mean = 7.17, standard deviation = 1.77, standard error = 0.141) and those that do not smoke and solely use their prescription opioids (mean = 6.31, standard deviation = 2.12, standard error = 0.145). Signifying, that the co-use of tobacco with prescription opioid drugs increases the intensity of chronic MSK pain experienced (Table 4 and 5).

Pain Interference/Disability

When analyzing GCPS pain interference/disability scores, I noted statistically significant differences between smoking (mean = 13.9, standard deviation = 3.61, standard error = 0.289) and non-smoking (mean = 12.1, standard deviation = 4.32, standard error = 0.297) prescription opioid using participants. Indicating, that participants

who smoked tobacco products experienced an increase in the impact of their chronic MSK pain symptoms on their behavior when compared to those who did not smoke tobacco products (Table 4 and 5).

Substance Use

Severity of Opioid Dependence

Participants that co-use tobacco (mean = 11.5, standard deviation = 3.96, standard error = 0.317) documented significantly raised SDS total scores compared to participants that only use prescription opioids (mean = 10.3, standard deviation = 3.69, standard error = 0.254). Indicating, that participants who smoked tobacco products were more likely to use and become dependent on their prescription opioids than those who did not smoke tobacco products (Table 4 and 5).

Alcohol

As seen in Table 2 and 3, for ASSIST alcohol involvement scores, participants who used tobacco products alongside their prescription opioids reported greater ASSIST alcohol scores (mean = 15.4, standard deviation = 10.5, standard error = 0.840) relative to those who did not use tobacco products (mean = 11.3, standard deviation = 8.14, standard error = 0.574). Showing, that participants who smoked tobacco products were more likely to co-use alcohol than those who did not smoke tobacco products.

Cannabis

Participants who reported smoking tobacco products reported greater ASSIST scores on cannabis (mean = 12.9, standard deviation = 10.94, standard error = 0.876) than those that did not smoke tobacco products (mean = 10.2, standard deviation = 9.84, standard error = 0.694). Indicating, that participants who smoked tobacco products in conjunction with their prescription opioid medications were more likely to co-use cannabis than those who did not smoke tobacco products (Table 4 and 5).

Cocaine

Participants who reported smoking tobacco products reported greater ASSIST scores on cocaine (mean =7.67, standard deviation = 10.3, standard error = 0.822)) than those that did not smoke tobacco products (mean = 4.68, standard deviation = 7.85, standard error = 0.554). Signifying, that participants who smoked tobacco products were more likely to co-use cocaine than those who did not smoke tobacco products (Table 4 and 5).

DISCUSSION

The major findings of this study are that pain intensity, pain interference, substance misuse, and emotional distress levels are significantly higher in Black individuals with chronic MSK pain who use tobacco products than those who do not use tobacco products. Although demographic factors like age, gender identity, annual income, employment status, and insurance were not significantly different in participants, there was a significant difference in education levels between smokers and nonsmokers, indicating that a participants' level of education plays a role in smoking status. There was also a trend for Black smokers to have greater dependence on prescription opioids to mitigate their pain than nonsmokers, and they were found to be more likely to use other substances such as alcohol, cannabis, and cocaine alongside their prescription opioids. Moreover, Black smokers demonstrated higher levels of depression and anxiety, as well as increased levels of chronic MSK pain intensity and pain-related interference/disability. The results portray the consequences of chronic MSK pain in conjunction with smoking status and its impact on multiple aspects of a participant's life, including the degree to which the co-use of opioid medications and tobacco products to treat pain can deter a Black individual from engaging in social and recreational activities.

Chronic MSK pain is one of the most common reasons as to why the general population seeks medical care. It represents a major clinical, economic, and social problem that profoundly impacts patients and their quality of life (Wyatt, 2013). The concomitance of tobacco smoking with the use of prescription opioids in the framework

of chronic MSK pain poses a critical to proper management of pain and correlated outcomes (Young-Wolff et al., 2017).

In prior literature, smoking was found to be correlated with a raised risk of developing chronic MSK pain (Young-Wolff et al., 2017). Increasing the level of exposure to a stimulus is associated with increasing the risk of the outcome, and this is demonstrated with the amount of cigarettes smoked habitually and the associated increase in likelihood of suffering from chronic MSK pain (Young-Wolff et al., 2017). Smokers, in general, have been found to account a greater amount of painful physical areas, greater levels of pain intensity, more limitations due to their condition, and higher rates of long-term disability relative to non-smokers (John et al., 2006; Shi et al., 2010). My study confirms that this also applies to Black individuals, and that positive smoking status is correlated with more intense symptoms of chronic MSK pain.

Chronic MSK pain also contributes to initiation and maintenance of tobacco product usage (Ditre et al., 2011). Participants with chronic MSK pain often use tobacco products to distract them, ease physical discomfort caused by their condition, and cope with pain-related depression and anxiety (Hooten et al., 2011; Ditre et al., 2013). For example, according to Young-Wolff et al. (2017) "the activation of nicotinic acetylcholine receptors (nAChRs) increases hypothalamic-pituitary-adrenocortical activity, which triggers the release of norepinephrine and serotonin." Consequently, nicotine can have analgesic effects, which reduces a patient's awareness of and sensitivity to painful stimuli. However, this relief is fleeting; smoking after a period of nicotine deprivation increases an individual's pain tolerance, while withdrawal from

nicotine can influence neurophysiologic mechanisms linked with pain and is correlated with higher levels of pain sensitivity (Shi et al., 2010).

Patients who are chronically exposed to tobacco products may increase their sensitivity to pain over time, due to the sensitization of their pain receptors (Ditre et al., 2011). Accordingly, patients who use tobacco products are found to need more pain-relieving treatments and need higher dosages of prescription opioids when compared to non-smokers. Smokers are also more probable than non-smokers to be on continuous opioid therapy treatments for chronic MSK pain (Boudreau et al., 2009). Consequently, the use of tobacco products may be a predictor of prescription opioid misuse and the development of substance dependence in chronic MSK pain patients (Fishbain et al., 2012).

In my study analyzing the severity of participant dependence on opioid medications, the SDS questionnaire helped us to investigate participant feelings on their use of opioid medications. The survey asked about their worries and difficulties in using and stopping the use of the mentioned substance. It also inquired if they believed their substance use was out of control. Among smokers, the SDS seems to assess the mental mechanisms of dependence, such as a sense of losing control that relates to motivations to quit and psychological affect (Mercincavage et al., 2016). I found a positive correlation between the use of tobacco products and higher scores on the SDS questionnaire, demonstrating that in Black Americans with chronic MSK pain, the use of tobacco products predicts a higher level of risk to potentially misuse and become dependent on prescription opioids.

Previous research by the National Institute of Drug Abuse determined that individuals who used tobacco products at the initiation of the study and then continued to use tobacco products three years afterwards were approximately 1.5 times more presumably to use other substances, and twice as presumable to develop a substance use disorder at the follow-up interview than individuals who had quit smoking (Sarlin, 2018). This demonstrates that smoking may increase the likelihood of substance misuse, suggesting that cigarettes are a "cue" for the use of other substances, and that nicotine may cause increased cravings for stimulants, depressants, and opiates.

In my study, I implemented the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) to determine whether the co-use of tobacco products increased the use of other substances, when a participant experiences chronic MSK pain. According to Humeniuk et al. (2010) the ASSIST survey "aims to help promote screening and brief interventions for psychoactive substance use by health professionals to facilitate prevention, early recognition, and management of substance use disorders in health care systems with the ultimate goal of reducing the disease burden attributable to psychoactive substance use worldwide." My study investigated the participants' level of use of certain substances, as well as their desire or urge to use these substances. My findings corroborated the hypothesis that tobacco product use in Black individuals increased the use of other substances

Participants who used tobacco products alongside prescription opioids reported greater ASSIST alcohol scores relative to those who did not use tobacco products, confirming my speculation that participants with chronic MSK pain who smoked tobacco

products were more likely to co-use alcohol than those who did not smoke tobacco products. Alcohol consumption and tobacco use are often closely linked behaviors, and my study also suggests a concurrent alcohol and tobacco dependence (Drobes, 2012). Not only are people who smoke tobacco more likely to drink, but in turn, people who drink more alcohol often smoke more tobacco products (Drobes, 2012). Thus, triggering the vicious cycle where greater tobacco product usage leads to more intense chronic MSK pain in individuals.

The same is applicable to cannabis usage; participants with chronic MSK pain who reported smoking tobacco products reported greater ASSIST scores on cannabis than those that did not smoke tobacco products. This indicates that participants suffering from chronic MSK pain who smoked tobacco products in conjunction with their prescription opioid medications were more likely to co-use cannabis than those who did not smoke tobacco products (Ramo et al., 2013).

Lastly, ASSIST cocaine involvement scores were significantly elevated in participants with chronic MSK pain who smoked tobacco products compared to those who did not smoke tobacco products. This signifies that participants suffering from chronic MSK pain who smoked tobacco products were more likely to co-use cocaine than those who did not smoke tobacco products (Epstein et. al, 2010). In addition, Brewer et. al (2013) states that "several researchers have observed that stimulant use can also lead to increased consumption of nicotine/cigarettes," leading to a vicious cycle of dependence (Roll et al., 1997; Wooters et al., 2008). These findings validate that amongst Black Americans with chronic MSK pain, the co-use of tobacco increases the use of other

substances like alcohol, cannabis, and cocaine. According to Yoon (2015) "nicotine can serve as a prime for the use of other drugs, which in the case of the opioid system may be bidirectional." Black individuals with chronic MSK pain who smoke demonstrate more intense chronic MSK pain symptoms and outcomes and have a higher incidence of prescription opioid usage, as well as other substances (Yoon, 2015).

Although several research works have analyzed tobacco users with chronic MSK pain, most are limited to White patients. Despite my findings, the understanding of the raised danger for opioid misuse, disability, and emotional distress among Black patients is limited. Foremost, to my awareness, no other research works have assessed if tobacco usage is correlated with Black patients' struggles with managing chronic opioid treatment. Comprehending Black tobacco users' experiences with pain intensity, interference, substance misuse, substance dependence, depression, and anxiety can help to inform treatment programs aimed at improving chronic MSK pain and psychological outcomes, mitigating difficulties within this cohort of patients.

Racial health disparities are particularly striking in the realm of chronic MSK pain. The condition of chronic MSK pain and the burden that comes with its management was discovered to be more prevalent amongst lower socioeconomic classes and minority races. Studies have discovered that chronic illness, emotional distress, and indicators of lower financial status (such as low levels of education and Medicaid insurance) are correlated with higher occurrences of intense pain (Wyatt, 2013). Fortunately, there are various effective pharmacologic and therapeutic interventions that can be implemented to manage and treat pain. Wyatt (2013) states that "pain can be managed with a range or

combination of treatments such as nonsteroidal anti-inflammatory drugs (NSAIDs) and other nonopioid medications, physical therapy, psychological interventions, alternative medicine, referral to a specialist, or opioids." The participants in my study were administered prescription opioids by their healthcare provider to manage and treat their chronic MSK pain.

The level of care given is often contingent on the patient's race, as Black Individuals are systematically inadequately treated for pain relative to White Individuals. Research shows that that Black patients are prescribed pain medication less than White patients, and in instances when they are prescribed medication, they receive smaller doses. For example, Todd et al. (2000) reported a retrospective study which "found that Black patients were significantly less likely than White patients to analgesics for extremity fractures in the emergency department, despite having comparable self-reports of pain." Consequently, Black individuals who do not receive proper opioid therapy to treat their chronic MSK condition may turn to other substances to mitigate their pain, like tobacco which then can increase their use of other substances as well.

Another study investigated Black and White patients with chronic MSK pain, and Black individuals were discovered to experience worse outcomes in multiple areas of psychosocial functioning (Ruehlman et al., 2005). More pain-related interference with daily living and social activities, as well as greater levels of disability and deficiencies in coping (Morales and Yong, 2021) were reported. However, there are few studies investigating the relationship between chronic MSK pain experience in Black individuals who use tobacco products, which I have demonstrated to exacerbate pain symptoms.

Smoking has been found to increase a participant's chronic MSK pain-related disability, which reduces their levels of physical, social, and emotional functioning overall. This facilitates an environment where participants are more likely to avoid meaningful physical and social activities due to their chronic MSK pain symptoms. Although this 'avoidance' may reduce emotional distress short-term, it may also lead to a less active and meaningful life over time. Pain interference is an important factor in the relationship between chronic MSK pain symptoms and daily functioning in Black individuals, and smoking only serves to aggravate the impact of pain symptoms on participants (Wicksell et al., 2016).

In my study, the pain experience of smoking and non-smoking Black individuals with chronic MSK pain was analyzed through the graded chronic pain scale (GCPS), which evaluates the interference of pain with daily life as well as pain intensity. For GCPS pain interference scores, I observed statistically significant differences in participants who co-used tobacco and participants who solely used prescription opioids to manage their pain, indicating that tobacco products exacerbate the effects of pain symptoms on participants' behavior.

Furthermore, there was a statistically significant difference in GCPS pain intensity scores between those that co-use tobacco with prescription opioids and those that only use prescription opioids. The results suggest that Black individuals who co-use tobacco products with prescription opioid drugs experience greater chronic MSK pain intensity. A toxic cycle is then created, for greater pain intensity is often correlated with a greater intake of prescription opioids (Menendez and Ring, 2016). Additionally, increases

in chronic MSK pain intensity can result in states of emotional distress such as depression and anxiety, which can lead to ineffective coping strategies (cognitive and or behavioral mechanisms individuals adopt to manage pain) (Menendez and Ring, 2016).

The correlation between chronic MSK pain and emotional distress is well established in White individuals. This study investigates whether the variable of emotional distress is strongly associated in Black individuals with chronic MSK pain who use tobacco products alongside their opioid medications. To assess depression scores amongst smoking and non-smoking Black individuals with chronic MSK pain, I utilized the patient health questionnaire (PHQ-2). In participants who reported smoking tobacco products, there was a significant elevation in PHQ-2 total depression scores when compared to participants who did not report smoking tobacco products. According to Marcus et al. (2012) "depression is characterized by a pervasive low mood, loss of interest in usual activities and diminished capacity to experience gratifying emotion." Within this definition there is an entire continuum of severity, symptoms, and predictors collected with their own categorizations. Depression can cause pain, and pain can cause depression (Sheng et. al, 2017). Chronic MSK pain in conjunction with the use of tobacco products and depression can result in a vicious cycle in which pain aggravates depressive symptoms, and then the subsequent depression exacerbates the painful sensations.

Chronic MSK pain is also associated with anxiety disorders (Lucchetti et. al, 2012). As Woo (2010) states "with depression, pre-existing, semidormant characteristics of the individual before the onset of pain symptoms are activated and exacerbated by the

stress" of dealing with a chronic MSK pain condition. In my study, I utilized the generalized anxiety disorder scale (GAD-2) to determine the mean difference between people who reported that they smoke tobacco and people who reported that they do not smoke tobacco. My results showed statistically significantly higher GAD-2 anxiety total scores in Black individuals co-using tobacco with prescription opioid drugs.

Anxiety is a physiological state identified and distinguished by mechanisms of emotion, cognition, and behavior which produce worry and fear in individuals. Often anxiety, as Woo (2010) describes it, is "accompanied by physical sensations such as heart palpitations and shortness of breath whilst the cognitive mechanism involves an expectation of a certain danger." The co-existence of chronic MSK pain and anxiety in Black individuals is unsurprising, as both prompt an ever-looming sense of danger and the requirement for action which outlines the value of survival to the individual (Woo, 2010). Woo (2010) also states that "anxiety is thought to be an important mediator in the cognitive constructs of catastrophizing, hypervigilance and fear avoidance in the exacerbation of chronic MSK pain experiences." Research has demonstrated that tobacco usage raises levels of tension and anxiety. Nicotine quickly mimics a state of relaxation, so individuals who use tobacco products believe that it lessens anxiety. However, the feeling of relief is only momentary and shortly brings about cravings for tobacco products and symptoms of withdrawal. Anxiety is a common withdrawal symptom in people detoxing from tobacco, alcohol, or certain drugs (Becker, 2012).

As I discovered, the use of tobacco products exacerbates depression and anxiety in Black individuals with chronic MSK pain, contributing to an overall state of poor

mental health. In previous works, on initial assessment Black individuals with chronic MSK pain reported significantly more pain related disturbances and as Green et. el (2003) states "more symptoms consistent with post-traumatic stress disorder and depression than White individuals." However, other factors such as discrimination and perceived bias have also been recognized as potential sources of worse chronic MSK pain results and higher levels of anxiety and depression in Black individuals (Morales and Yong, 2021).

According to Unger (2018), "associations between perceived discrimination and physical health outcomes are typically explained in terms of stress processes; discrimination is a potent stressor that activates the body's stress responses, leading to a chronic increase in allostatic load and eventual morbidity and mortality." Perceived discrimination impacts chronic MSK pain patients by increasing psychological distress (Brown et al., 2018). Black individuals who co-use tobacco products have been noted to perceive injustice and discrimination regarding their chronic MSK pain, attributing their suffering to negligence in their care (Brown et al., 2018). The phenomenon of stereotype endorsement, where a minority patient's own internalized stigmas affect the management of their chronic MSK pain, also plays a role. Moreover, perceived discrimination has been associated with cigarette smoking and other substance use among members of disadvantaged minority groups, including Black individuals (Unger, 2018). The harmful idea that Black individuals are less sensitive to pain than White individuals has formerly been noted in children, healthcare professionals, and Black patients (Trawalter et al., 2012; Dore et al., 2014). However, when compared to White people, Black individuals

were found to endure greater chronic MSK pain related states and symptoms across most contexts. Thus, this discrepancy may be worsened when the biases and misperceptions of Black individuals with chronic MSK pain who use opioid medications and co-use tobacco products and their healthcare providers are taken into account. For, according to the Truth Initiative Program (2017), "black people smoke at a similar rate compared to white people, with 16.7 percent smoking every day or some days, but they are more likely to die from a tobacco-related disease than white people." Limited access to quality health care coverage can reduce Black chronic MSK pain patients access to tobacco co-use with prescription opioid cessation therapies and other evidence-based approaches, leading to greater rates of mortality in Black individuals who smoke (Heckman et. al, 2021).

In my study, participant demographics did not significantly differ between Black individuals who co-used tobacco products with their prescription opioids and those that did not, except for education level. I asked participants to specify if they had less than a high school education, a high school diploma, some college experience with no degree awarded, an associate's degree, a bachelor's degree, or a graduate degree. A chi-squared test revealed that there was a significant difference between Black smokers and non-smokers based on education level. The higher the education level, the less likely an individual was to smoke. A CDC study from 2014 also noted a correlation between smoking and education level stating: "26.5 percent of those who did not graduate from high school and 26.4 percent who had a high school diploma or general equivalency diploma were current smokers, compared with 19.7 percent who had attended some

college and 7.9 percent with a college degree." Further, education is an important indicator of socioeconomic status. Lower socioeconomic status is also associated with significant detrimental effects on daily chronic MSK pain. The financial burden of pain management can exacerbate a patient's vulnerability to pain (Rios and Zautra, 2011). A study found that patients with greater levels of financial stress had greater pain in response to daily financial worries than their counterparts with little or no financial stress (Rios and Zautra, 2011). Furthermore, participants in the sample who were not employed and who reported higher levels of financial anxiety exhibited the most pain reactivity in response to daily financial worries (Rios and Zautra, 2011). Future research should further investigate the interaction of education level, socioeconomic status, and smoking status in Black individuals with chronic MSK pain.

A number of limitations should be considered when considering the findings from this study. It should be considered that the participant sample in this study was chosen through Qualtrics Panels, an online research tool powered by Qualtrics that matches pools of interested research participants to appropriate survey studies. I sent potential participants an invitation through the online panel. However, my pool for participant recruitment identification as Black, 18 years of age or older, and as having a chronic MSK pain condition, was not validated by any other source except the Qualtrics Panel. In addition, more specific information regarding their chronic MSK pain would have been useful to confirm the correlations between the outcomes and smoking status amongst Black individuals. Data on the physical dependence of tobacco products in Black chronic MSK pain individuals would have been desirable and beneficial to the study since the

SDS mainly examines non-physical mechanisms of dependence, like the sense of losing control,) that are associated with motivations to abstain from a behavior and psychological affect. Assessing the viewpoint of healthcare prescribers on chronic MSK pain in Black smokers and non-smokers through questionnaires could have contributed another dimension to the results, however this component was not examined in my study. Moreover, data for my study was gathered by self-report questionnaires and inherently subject to bias. Perhaps, future studies should incorporate objective measures, which could be done through patient chart records, and the findings in my study should be cross-referenced and validated in a study with another sample.

Despite these limitations, my study addresses a significant gap in literature regarding the impact of co-use of tobacco and opioid medication usage in Black individuals with chronic MSK pain. The findings in this study also provides important information about the impact of smoking and chronic MSK pain on functionality (i.e. disability/interference) to health care providers who work with Black chronic MSK pain patients. Well-validated measures of chronic MSK pain experience in Black individuals are integral to research on better, more comprehensive pain treatment outcomes. Given the substantial need for such research regarding Black individuals chronic MSK pain, identifying the differences between smokers and non-smokers in this population is an important part of creating a sufficient foundation for future treatment studies to build upon.

This study supplements the growing support of findings proposing that instead of utilizing universal models, research done on specific population cohorts can be

particularly illuminating, allowing for a more comprehensive treatment of patients. In analyzing the co-use of tobacco products with prescription opioid treatments among Black individuals with chronic MSK pain, I discovered the impact of tobacco usage on this population. Pain intensity, pain interference/disability, depression, anxiety, opioid dependence, and substance use were all found to be increased in the smoking group of participants. With these results, I can work on tailoring interventions to more effectively treat Black individuals with chronic MSK pain and reduce health disparities (i.e. adding smoking cessations to the curriculum of chronic MSK pain management programs for Black individuals). I hope that this understanding of psychosocial risk and maintenance factors implicated in chronic MSK pain and related outcomes among Black individuals, aid in the conduct of direct clinical assessment and therapeutic programming in a more efficient manner for this population.

APPENDIX A
Questionnaires

Graded Chronic Pain Scale

1. How would you rate your facial pain on a 0 to 10 scale AT THE PRESENT TIME, that is right now, where 0 is "no pain" and 10 is "pain as bad as could be". *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as could be

2. In the PAST SIX MONTHS, how intense was your WORST facial pain? *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as could be

3. In the PAST SIX MONTHS, on the AVERAGE, how intense was your facial pain? (That is, your usual pain at times you were experiencing pain.) *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as could be

4. About how many days in the LAST SIX MONTHS have you been kept from your usual activities (work, school, housework) because of facial pain? (EVERY DAY = 180)

			DAYS

5. In the PAST SIX MONTHS, how much has facial pain interfered with your daily activities rated on a scale from 0 to 10, where 0 is "No interference" and 10 is "Unable to carry on any activities"? *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No interference										Unable to carry on any activities

6. In the PAST SIX MONTHS, how much has facial pain interfered with your ability to take part in recreational, social, and family activities? *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No interference										Unable to carry on any activities

7. In the PAST SIX MONTHS, how much has facial pain interfered with your ability to work (including housework)? *(Circle number)*

0	1	2	3	4	5	6	7	8	9	10
No interference										Unable to carry on any activities

Severity of Dependence Scale (SDS)

Circle the answer that best applies to how you have felt about your use of _____ over the last twelve months.

	Never/ Almost Never	Sometimes	Often	Always/ Nearly Always
Do you think your use of (substance) was out of control?	**0**	**1**	**2**	**3**
Did the prospect of missing a fix, shot or dose make you feel anxious or worried?	**0**	**1**	**2**	**3**
Did you worry about your use of (substance)?	**0**	**1**	**2**	**3**
Did you wish you could stop?	**0**	**1**	**2**	**3**

	Not Difficult	Quite Difficult	Very Difficult	Impossible
How difficult did you find it to stop or go without (substance)?	**0**	**1**	**2**	**3**

SDS total _____

Patient Health Questionnaire-2 (PHQ-2)

Over the last *2 weeks*, how often have you been bothered by any of the following problems?	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3

For office coding: _____*0*_____+_____+_____+_____

= Total Score _____

Adapted from the patient health questionnaire (PHQ) screeners (www.phqscreeners.com). Accessed October 6, 2016. See website for additional information and translations.

A. WHO - ASSIST V3.0

INTERVIEWER ID		COUNTRY		CLINIC	
PATIENT ID		DATE			

INTRODUCTION ***(Please read to patient)***

Thank you for agreeing to take part in this brief interview about alcohol, tobacco products and other drugs. I am going to ask you some questions about your experience of using these substances across your lifetime and in the past three months. These substances can be smoked, swallowed, snorted, inhaled, injected or taken in the form of pills (show drug card).

Some of the substances listed may be prescribed by a doctor (like amphetamines, sedatives, pain medications). For this interview, we will not record medications that are used as prescribed by your doctor. However, if you have taken such medications for reasons other than prescription, or taken them more frequently or at higher doses than prescribed, please let me know. While we are also interested in knowing about your use of various illicit drugs, please be assured that information on such use will be treated as strictly confidential.

NOTE: BEFORE ASKING QUESTIONS, GIVE ASSIST RESPONSE CARD TO PATIENT

Question 1
(if completing follow-up please cross check the patient's answers with the answers given for Q1 at baseline. Any differences on this question should be queried)

In your life, which of the following substances have you ever used? *(NON-MEDICAL USE ONLY)*	**No**	**Yes**
a. Tobacco products (cigarettes, chewing tobacco, cigars, etc.)	0	3
b. Alcoholic beverages (beer, wine, spirits, etc.)	0	3
c. Cannabis (marijuana, pot, grass, hash, etc.)	0	3
d. Cocaine (coke, crack, etc.)	0	3
e. Amphetamine type stimulants (speed, diet pills, ecstasy, etc.)	0	3
f. Inhalants (nitrous, glue, petrol, paint thinner, etc.)	0	3
g. Sedatives or Sleeping Pills (Valium, Serepax, Rohypnol, etc.)	0	3
h. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)	0	3
i. Opioids (heroin, morphine, methadone, codeine, etc.)	0	3
j. Other - specify:	0	3

Probe if all answers are negative:
"Not even when you were in school?"

If "No" to all items, stop interview.

If "Yes" to any of these items, ask Question 2 for each substance ever used.

Question 2

In the past three months, how often have you used the substances you mentioned *(FIRST DRUG, SECOND DRUG, ETC)*?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
a. Tobacco products (cigarettes, chewing tobacco, cigars, etc.)	0	2	3	4	6
b. Alcoholic beverages (beer, wine, spirits, etc.)	0	2	3	4	6
c. Cannabis (marijuana, pot, grass, hash, etc.)	0	2	3	4	6
d. Cocaine (coke, crack, etc.)	0	2	3	4	6
e. Amphetamine type stimulants (speed, diet pills, ecstasy, etc.)	0	2	3	4	6
f. Inhalants (nitrous, glue, petrol, paint thinner, etc.)	0	2	3	4	6
g. Sedatives or Sleeping Pills (Valium, Serepax, Rohypnol, etc.)	0	2	3	4	6
h. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)	0	2	3	4	6
i. Opioids (heroin, morphine, methadone, codeine, etc.)	0	2	3	4	6
j. Other - specify:	0	2	3	4	6

If "Never" to all items in Question 2, skip to Question 6.

If any substances in Question 2 were used in the previous three months, continue with Questions 3, 4 & 5 for each substance used.

Question 3

During the past three months, how often have you had a strong desire or urge to use *(FIRST DRUG, SECOND DRUG, ETC)*?	Never	Once or Twice	Monthly	Weekly	Daily or Almost Daily
a. Tobacco products (cigarettes, chewing tobacco, cigars, etc.)	0	3	4	5	6
b. Alcoholic beverages (beer, wine, spirits, etc.)	0	3	4	5	6
c. Cannabis (marijuana, pot, grass, hash, etc.)	0	3	4	5	6
d. Cocaine (coke, crack, etc.)	0	3	4	5	6
e. Amphetamine type stimulants (speed, diet pills, ecstasy, etc.)	0	3	4	5	6
f. Inhalants (nitrous, glue, petrol, paint thinner, etc.)	0	3	4	5	6
g. Sedatives or Sleeping Pills (Valium, Serepax, Rohypnol, etc.)	0	3	4	5	6
h. Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)	0	3	4	5	6
i. Opioids (heroin, morphine, methadone, codeine, etc.)	0	3	4	5	6
j. Other - specify:	0	3	4	5	6

Generalized Anxiety Disorder 2-item (GAD-2)

Share

The Generalized Anxiety Disorder 2-item (GAD-2) is a very brief and easy to perform initial screening tool for generalized anxiety disorder.[1]

Over the **last 2 weeks**, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	+1	+2	+3
2. Not being able to stop or control worrying	0	+1	+2	+3

APPENDIX B

Study Fact Sheet

Chronic Musculoskeletal Pain among Black Individuals: Study Information

Study Title: Chronic Musculoskeletal Pain among Black Individuals

Principal Investigator: Jafar Bakhshaie, MD, PhD

Study Contact Information: You can contact the study investigator, Dr. Jafar Bakhshaie, by calling him at: 617-643-0673, or by email: **jbakhshaie@mgh.harvard.edu**.

Why is this research being done? We hope to learn from your experience of chronic musculoskeletal pain. Our goal is to gather information about risk factors that may be unique to Black individuals with chronic pain and the ways in which the lived experience of black individual impacts pain.

What will happen in this research study? If you are interested in participating, you will indicate your voluntary consent to participate by clicking "I agree" on the online portal. You may review information over the telephone or over the Mass General Brigham Zoom platform with a member of our study staff if you would like. You will be invited to participate in an online survey through a secure link consisting of multiple questionnaires about your experience living with chronic pain. Your responses will be completely confidential. You will complete this session on your own by using your Qualtrics Panels account. You can complete the session anywhere that you have access to a computer and the internet. We expect that you will be in this research study for a total of one online assessment session. This survey will take approximately 25 minutes to complete. If you need support after the questionnaires or interview, you can contact Dr. Jafar Bakhshaie and he will provide assistance.

How many people will participate in this research study? Approximately 400 people will participate in this study.

Will I be paid to take part in this research study? You will receive credit through your Qualtrics Panels account.

If you take part in this research study, how will we protect your confidentiality and data security? As in any research study, there is a small risk that confidentiality may be breached; all efforts to minimize this risk will be taken. The study staff are trained on the importance of maintaining confidentiality. All data will be kept confidential, under lock

and key, accessible only to trained study staff. It will not be used in clinical care nor in future research.

What are the risks and possible discomforts from being in this research study? You may experience psychological distress while answering some of the questions in this study. Any distress that you may experience is likely to be minimal and temporary. Although you do not have the choice to skip over any question, you can choose to withdraw from the study if you do not feel comfortable answering any question. You may choose to leave the research at any time, but you will not receive compensation unless you complete the full survey. If you stop being in the research, already collected data may not be removed from the study record. You will receive credit through your Qualtrics Panels account. Additional risks include the potential for loss of privacy and the potential privacy and confidentiality limitations related to communicating with study staff over the Mass General Brigham Zoom platform and/or non-secure email.

What are the benefits of participating in this research study? You may benefit from learning about your experience of chronic pain.

What should you do if you want to stop taking part in the study? Participation is voluntary and you can stop at any time. If you wish to discontinue the survey, you may simply exit the survey window and your responses will not be recorded.

If you have questions or concerns about this research study, whom can you contact? Dr. Jafar Bakhshaie is the person in charge of this research study. If you have questions about enrolling in the study or questions about the survey, you can contact him at 617-643-0673. If you'd like to speak to someone not involved in this research about your rights as a research subject, or any concerns or complaints you may have about the research, contact the Partners Human Research Committee at (857) 282-1900.

We are required by the Health Insurance Portability and Accountability Act (HIPAA) to protect the privacy of health information obtained for research. This is an abbreviated notice and does not describe all details of this requirement. During this study, identifiable information about you or your health will be collected and shared with the researchers conducting the research. In general, under federal law, identifiable health information is private. However, there are exceptions to this rule. In some cases, others may see your identifiable health information for purposes of research oversight, quality control, public health and safety, or law enforcement. We share your health information only when we must, and we ask anyone who receives it from us to protect your privacy.

You may print a copy of this document for your reference. Consent: By clicking the "next" button below, YOUR FREE AND INFORMED CONSENT IS IMPLIED and indicates that you understand the above conditions of participation in this study. If after reading this form you wish to not participate in the study, please exit the survey now.

REFERENCES

Anderson, K. O., Green, C. R., & Payne, R. (2009). Racial and ethnic disparities in pain: Causes and consequences of unequal care. *The Journal of Pain*, *10*(12), 1187–1204. https://doi.org/10.1016/j.jpain.2009.10.002

Becker H. C. (2012). Effects of alcohol dependence and withdrawal on stress responsiveness and alcohol consumption. *Alcohol Research: Current Reviews*, *34*(4), 448–458.

Boudreau, D., Von Korff, M., Rutter, C. M., Saunders, K., Ray, G. T., Sullivan, M. D., Campbell, C. I., Merrill, J. O., Silverberg, M. J., Banta-Green, C., & Weisner, C. (2009). Trends in long-term opioid therapy for chronic non-cancer pain. *Pharmacoepidemiology and Drug Safety*, *18*(12), 1166–1175. https://doi.org/10.1002/pds.1833

Brewer, A. J., Mahoney, J. J., Nerumalla, C. S., Newton, T. F., & De La Garza, R. (2013). The influence of smoking cigarettes on the high and desire for cocaine among active cocaine users. *Pharmacology Biochemistry and Behavior*, *106*, 132–136. https://doi.org/10.1016/j.pbb.2013.03.008

CDC Data. (2014). *Oncology Times*, *36*(12), 63–64. https://doi.org/10.1097/01.cot.0000451745.43195.e5

Ditre, J. W., Brandon, T. H., Zale, E. L., & Meagher, M. M. (2011). Pain, nicotine, and smoking: Research findings and mechanistic considerations. *Psychological Bulletin*, *137*(6), 1065–1093. https://doi.org/10.1037/a0025544

Ditre, J. W., Zale, E. L., Kosiba, J. D., & Zvolensky, M. J. (2013). A pilot study of pain-related anxiety and smoking-dependence motives among persons with chronic pain. *Experimental and Clinical Psychopharmacology*, *21*(6), 443–449. https://doi.org/10.1037/a0034174

Dore, R. A., Hoffman, K. M., Lillard, A. S., & Trawalter, S. (2014). Children's racial bias in perceptions of others' pain. *British Journal of Developmental Psychology*, *32*(2), 218–231. https://doi.org/10.1111/bjdp.12038.

Drobes D. J. (2002). Concurrent Alcohol and Tobacco Dependence: Mechanisms and Treatment. *Alcohol Research & Health*, *26*(2), 136–142.

Edwards, R. R., Moric, M., Husfeldt, B., Buvanendran, A., & Ivankovich, O. (2005). Ethnic similarities and differences in the chronic pain experience: A comparison of

African American, Hispanic, and White Patients. *Pain Medicine*, *6*(1), 88–98. https://doi.org/10.1111/j.1526-4637.2005.05007.x

Epstein, D. H., Marrone, G. F., Heishman, S. J., Schmittner, J., & Preston, K. L. (2010). Tobacco, cocaine, and heroin: Craving and use during daily life. *Addictive behaviors*, *35*(4), 318–324. https://doi.org/10.1016/j.addbeh.2009.11.003

Ezenwa, M., & Fleming, M. (2012). Racial disparities in pain management in Primary Care. *The Journal of Pain*, *13*(4). https://doi.org/10.1016/j.jpain.2012.01.088

Fetvadjiev, V. H., & van de Vijver, F. J. R. (2015). Measures of personality across cultures. *Measures of Personality and Social Psychological Constructs*, 752–776. https://doi.org/10.1016/b978-0-12-386915-9.00026-7

Fishbain, D. A., Cole, B., Lewis, J. E., & Gao, J. (2012). Is smoking associated with alcohol-drug dependence in patients with pain and chronic pain patients? an evidence-based Structured Review. *Pain Medicine*, *13*(9), 1212–1226. https://doi.org/10.1111/j.1526-4637.2012.01446.x

Garber, J., P., S. M. E., & Abramson, L. Y. (1980). *Human helplessness: Theory and Applications*. Cambridge University Press.

Gaskin, D. J., & Richard, P. (2012). The economic costs of pain in the United States. *The Journal of Pain*, *13*(8), 715–724. https://doi.org/10.1016/j.jpain.2012.03.009

Gossop, M., Darke, S., Griffths, P., Hando, J., Powis, B., Hall, W., & Strang, J. (1995). The severity of Dependence Scale (SDS): Psychometric Properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction*, *90*(5), 607–614. https://doi.org/10.1046/j.1360-0443.1995.9056072.x

Green, C. R., Baker, T. A., Sato, Y., Washington, T. L., & Smith, E. M. (2003). Race and chronic pain: A comparative study of young black and white Americans presenting for management. *The Journal of Pain*, *4*(4), 176–183. https://doi.org/10.1016/s1526-5900(02)65013-8

Green, C. R., Baker, T. A., Smith, E. M., & Sato, Y. (2003). The effect of race in older adults presenting for chronic pain management: A comparative study of black and White Americans. *The Journal of Pain*, *4*(2), 82–90. https://doi.org/10.1054/jpai.2003.8

Grol-Prokopczyk, H. (2016). Sociodemographic disparities in chronic pain, based on 12-year Longitudinal Data. *Pain*, *158*(2), 313–322. https://doi.org/10.1097/j.pain.0000000000000762

Habib, M. K. (2015). Handbook of Research on advancements in robotics and mechatronics. *Advances in Computational Intelligence and Robotics*, 916–918. https://doi.org/10.4018/978-1-4666-7387-8

Heckman, B. W. (2021, August 26). *How to reduce racial disparities in smoking deaths*. Scientific American. Retrieved from https://www.scientificamerican.com/article/how-to-reduce-racial-disparities-in-smoking-deaths/

Hooten, M. W., Shi, Y., Gazelka, H. M., & Warner, D. O. (2011). The effects of depression and smoking on pain severity and opioid use in patients with chronic pain. *Pain*, *152*(1), 223–229. https://doi.org/10.1016/j.pain.2010.10.045

Hooten, W. M., Vickers, K. S., Shi, Y., Ebnet, K. L., Townsend, C. O., Patten, C. A., & Warner, D. O. (2011). Smoking cessation and chronic pain: Patient and Pain Medicine Physician attitudes. *Pain Practice*, *11*(6), 552–563. https://doi.org/10.1111/j.1533-2500.2011.00462.x

Humeniuk, R., Ali, R., Babor, T. F., Farrell, M., Formigoni, M. L., Jittiwutikarn, J., de Lacerda, R. B., Ling, W., Marsden, J., Monteiro, M., Nhiwatiwa, S., Pal, H., Poznyak, V., & Simon, S. (2008). Validation of the alcohol, smoking and Substance Involvement Screening Test (assist). *Addiction*, *103*(6), 1039–1047. https://doi.org/10.1111/j.1360-0443.2007.02114.x

Iraurgi Castillo, I., González Saiz, F., Lozano Rojas, O., Landabaso Vázquez, M. A., & Jiménez Lerma, J. M. (2010). Estimation of cutoff for the Severity of Dependence Scale (SDS) for opiate dependence by ROC analysis. *Actas espanolas de psiquiatria*, *38*(5), 270–277.

John, U., Hanke, M., Meyer, C., Völzke, H., Baumeister, S. E., & Alte, D. (2006). Tobacco smoking in relation to pain in a national general population survey. *Preventive Medicine*, *43*(6), 477–481. https://doi.org/10.1016/j.ypmed.2006.07.005

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The patient health questionnaire-2. *Medical Care*, *41*(11), 1284–1292. https://doi.org/10.1097/01.mlr.0000093487.78664.3c

Kroenke, K., Spitzer, R. L., Williams, J. B. W., & Löwe, B. (2010). The patient health questionnaire somatic, anxiety, and depressive symptom scales: A systematic

review. *General Hospital Psychiatry*, *32*(4), 345–359. https://doi.org/10.1016/j.genhosppsych.2010.03.006

Kroenke, K., Spitzer, R. L., Williams, J. B. W., Monahan, P. O., & Löwe, B. (2007). Anxiety disorders in primary care: Prevalence, impairment, comorbidity, and detection. *Annals of Internal Medicine*, *146*(5), 317. https://doi.org/10.7326/0003-4819-146-5-200703060-00004

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.

Löwe, B., Wahl, I., Rose, M., Spitzer, C., Glaesmer, H., Wingenfeld, K., Schneider, A., & Brähler, E. (2010). A 4-item measure of depression and anxiety: Validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *Journal of Affective Disorders*, *122*(1-2), 86–95. https://doi.org/10.1016/j.jad.2009.06.019

Lucchetti, G., Oliveira, A. B., Mercante, J. P., & Peres, M. F. (2012). Anxiety and fear-avoidance in musculoskeletal pain. *Current pain and headache reports*, *16*(5), 399–406. https://doi.org/10.1007/s11916-012-0286-7

Marcus, M., Yasamy, M. T., van Ommeren, M. van, Chisholm, D., & Saxena, S. (2012). Depression: A global public health concern. *PsycEXTRA Dataset*. https://doi.org/10.1037/e517532013-004

Massachusetts General Hospital. (n.d.). *MGH Research Institute*. Human Subjects Research (CITI Training). Retrieved from https://learn.partners.org/courseversion/168/

Meints, S. M., Miller, M. M., & Hirsh, A. T. (2016). Differences in pain coping between black and White Americans: A meta-analysis. *The Journal of Pain*, *17*(6), 642–653. https://doi.org/10.1016/j.jpain.2015.12.017

Menendez, M. E., & Ring, D. (2016). Factors associated with greater pain intensity. *Hand Clinics*, *32*(1), 27–31. https://doi.org/10.1016/j.hcl.2015.08.004

Mercincavage, M., Smyth, J. M., Branstetter, S. A., & Catley, D. (2015). Exploring the severity of dependence scale (SDS) as a possible measure of nicotine dependence. *Substance Abuse*, *37*(2), 323–329. https://doi.org/10.1080/08897077.2015.1062459

Morales, M. E., & Yong, R. J. (2020). Racial and ethnic disparities in the treatment of chronic pain. *Pain Medicine*, *22*(1), 75–90. https://doi.org/10.1093/pm/pnaa427

Pain and ethnicity. (2013). *AMA Journal of Ethics*, *15*(5), 449–454. https://doi.org/10.1001/virtualmentor.2013.15.5.pfor1-1305

Ramo, D. E., Delucchi, K. L., Hall, S. M., Liu, H., & Prochaska, J. J. (2013). Marijuana and tobacco co-use in young adults: patterns and thoughts about use. *Journal of Studies on Alcohol and Drugs*, *74*(2), 301–310. https://doi.org/10.15288/jsad.2013.74.301

Rios, R., & Zautra, A. J. (2011). Socioeconomic disparities in pain: The role of economic hardship and daily financial worry. *Health Psychology*, *30*(1), 58–66. https://doi.org/10.1037/a0022025

Rogers, A., Bakhshaie, J., Buckner, J., Orr, M., Paulus, D., Ditre, J., & Zvolensky, M. (2019). (177) opioid and cannabis co-use among adults with chronic pain: Relations to substance misuse, mental health, and Pain experience. *The Journal of Pain*, *20*(4). https://doi.org/10.1016/j.jpain.2019.01.097

Roll, J. M., Higgins, S. T., & Tidey, J. (1997). Cocaine use can increase cigarette smoking: Evidence from laboratory and naturalistic settings. *Experimental and Clinical Psychopharmacology*, *5*(3), 263–268. https://doi.org/10.1037/1064-1297.5.3.263

Ruehlman, L. S., Karoly, P., & Newton, C. (2005). Comparing the experiential and psychosocial dimensions of chronic pain in African Americans and Caucasians: Findings from a National Community Sample. *Pain Medicine*, *6*(1), 49–60. https://doi.org/10.1111/j.1526-4637.2005.05002.x

Salkind, N. (2010). Encyclopedia of Research Design. *SAGE Publications*, *1*. https://doi.org/10.4135/9781412961288

Sapra, A., Bhandari, P., Sharma, S., Chanpura, T., & Lopp, L. (2020). Using generalized anxiety disorder-2 (GAD-2) and gad-7 in a primary care setting. *Cureus*. https://doi.org/10.7759/cureus.8224

Sheng, J., Liu, S., Wang, Y., Cui, R., & Zhang, X. (2017). The Link between Depression and Chronic Pain: Neural Mechanisms in the Brain. *Neural Plasticity*, *2017*, 9724371. https://doi.org/10.1155/2017/9724371

Shi, Y., Weingarten, T. N., Mantilla, C. B., Hooten, W. M., & Warner, D. O. (2010). Smoking and pain. *Anesthesiology*, *113*(4), 977–992. https://doi.org/10.1097/aln.0b013e3181ebdaf9

Stanton, A. M., Lee, J. S., Wirtz, M. R., Andersen, L. S., Joska, J., Safren, S. A., van Zyl-Smit, R., & O'Cleirigh, C. (2021). Tobacco use and health-related quality of life among individuals with depression who are receiving treatment for HIV in Cape Town, South Africa. *International Journal of Behavioral Medicine*, *28*(4), 417–430. https://doi.org/10.1007/s12529-020-09951-z

Stanton, A. M., Lee, J. S., Wirtz, M. R., Andersen, L. S., Joska, J., Safren, S. A., van Zyl-Smit, R., & O'Cleirigh, C. (2021). Tobacco use and health-related quality of life among individuals with depression who are receiving treatment for HIV in Cape Town, South Africa. *International Journal of Behavioral Medicine*, *28*(4), 417–430. https://doi.org/10.1007/s12529-020-09951-z

Sullivan, L. (n.d.). *Hypothesis Testing - Chi Squared Test*. Boston University School of Public Health. Retrieved from https://sphweb.bumc.bu.edu/otlt/mph-modules/bs/bs704_hypothesistesting-chisquare/bs704_hypothesistesting-chisquare_print.html?bcsi-ac-1890e3206a556864=2791AF9A00000002%2FPrfdhWtq8ilAdnRhdjFogRgDw68DQAAAgAAAAmVMwCEAwAAFAAAABDmCAA

Todd, K. H., Deaton, C., D'Adamo, A. P., & Goe, L. (2000). Ethnicity and analgesic practice. *Annals of Emergency Medicine*, *35*(1), 11–16. https://doi.org/10.1016/s0196-0644(00)70099-0

Tobacco is a social justice issue: Racial and ethnic minorities. Truth Initiative. (2017, February 3). Retrieved from https://truthinitiative.org/research-resources/targeted-communities/tobacco-social-justice-issue-racial-and-ethnic-minorities

Trawalter, S. (n.d.). *Black Americans are systematically under-treated for pain. why?* Frank Batten School of Leadership and Public Policy | University of Virginia. Retrieved from https://batten.virginia.edu/about/news/black-americans-are-systematically-under-treated-pain-why

Trawalter, S., Hoffman, K. M., & Waytz, A. (2012). Racial bias in perceptions of others' pain. *PloS One*, *7*(11). https://doi.org/10.1371/journal.pone.0048546

U.S. Department of Health and Human Services. (2021, May 10). *Cigarette smoking increases the likelihood of drug use relapse*. National Institutes of Health. Retrieved from https://nida.nih.gov/news-events/nida-notes/2018/05/cigarette-smoking-increases-likelihood-drug-use-relapse

Unger J. B. (2018). Perceived Discrimination as a Risk Factor for Use of Emerging Tobacco Products: More Similarities Than Differences Across Demographic Groups and Attributions for Discrimination. *Substance Use & Misuse*, *53*(10), 1638–1644. https://doi.org/10.1080/10826084.2017.1421226

Unpooled variances: Stat 500. PennState: Statistics Online Courses. (n.d.). Retrieved March 6, 2022, from https://online.stat.psu.edu/stat500/lesson/7/7.3/7.3.1/7.3.1.2

Von Korff, M., Ormel, J., Keefe, F. J., & Dworkin, S. F. (1992). Grading the severity of chronic pain. *Pain*, *50*(2), 133–149. https://doi.org/10.1016/0304-3959(92)90154-4

Wicksell, R. K., Kanstrup, M., Kemani, M. K., & Holmström, L. (2016). Pain interference mediates the relationship between pain and functioning in pediatric chronic pain. *Frontiers in Psychology*, *7*. https://doi.org/10.3389/fpsyg.2016.01978

Woo, A. K. M. (2010). Depression and anxiety in pain. *Reviews in Pain*, *4*(1), 8–12. https://doi.org/10.1177/204946371000400103

Wooters, T. E., Neugebauer, N. M., Rush, C. R., & Bardo, M. T. (2007). Methylphenidate enhances the abuse-related behavioral effects of nicotine in rats: Intravenous self-administration, drug discrimination, and locomotor cross-sensitization. *Neuropsychopharmacology*, *33*(5), 1137–1148. https://doi.org/10.1038/sj.npp.1301477

Wyatt, R. (2013, May 1). *Pain and Ethnicity*. Journal of Ethics | American Medical Association. Retrieved March 6, 2022, from https://journalofethics.ama-assn.org/article/pain-and-ethnicity/2013-05

Yoon, J. H., Lane, S. D., & Weaver, M. F. (2015). Opioid Analgesics and Nicotine: More Than Blowing Smoke. *Journal of Pain & Palliative Care Pharmacotherapy*, *29*(3), 281–289. https://doi.org/10.3109/15360288.2015.1063559

Young-Wolff, K. C., Klebaner, D., Weisner, C., Von Korff, M., & Campbell, C. I. (2017). Smoking status and opioid-related problems and concerns among men and women on chronic opioid therapy. *The Clinical Journal of Pain*, *33*(8), 730–737. https://doi.org/10.1097/ajp.0000000000000461

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