November 2021

Racial and Ethnic Differences in Chronic Pain

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RACIAL AND ETHNIC DIFFERENCES IN CHRONIC PAIN

by

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A research paper in partial fulfillment of the
Requirements for the degree of
Master of Arts

Department of Sociology
The University of Western Ontario
London, Ontario, Canada

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2021

ABSTRACT

Chronic pain literature consistently shows differences in the prevalence of chronic pain by race and ethnicity. However, these studies primarily focus on White, African American, and Hispanic respondents. This paper aims to examine differences in pain by race and ethnicity including most major racial categories as well as Asian, Native American, and multiple-race respondents. This study uses data from the 2017 and 2018 National Health Interview Survey (n=33,161). To determine the relationship between race and ethnicity and chronic pain, we conducted multiple nested logistic regression. The analysis found that African Americans [OR= 0.67, $p<0.001$], Hispanic [OR= 0.61, $p<0.001$], and Asian [OR= 0.42, $p<0.001$] respondents have lower odds of pain when compared to White participants while multiracial respondents have higher odds of chronic pain [OR = 1.28, $p<0.05$]. This study is important for future research as it shows the need for other scholars, as well as policymakers, to focus on expanding racial and ethnic categories commonly studied in chronic pain literature.

Keywords: Race, ethnicity, chronic pain, inequality, socioeconomic status, health.

When the experience of pain persists long after it has served its immediate protective function, it transforms into the pathology of chronic pain: a serious, widespread, misunderstood, and underrated disease (Thernstom, 2010). According to recent research, chronic pain is a condition that costs the United States more than $500 billion each year in treatment costs and lost work hours. The scale of this massive medical and social issue has proven difficult to measure as definitions of the condition tend to vary (Boddice, 2017). While estimates differ across contexts, populations, and especially definitions of pain, research has consistently found the prevalence of chronic pain to be around or under 40 percent (Boddice, 2017; Grol-Prokopczyk, 2017; Janevic et al., 2017). The need for research advancements in this area is of vital importance, as this long-lasting pain can permeate all aspects of an individual's life and in turn, society at large (Janevic et al., 2017). Researchers have found that demographic factors such as race, ethnicity, age, and gender are important considerations in the evaluation of health and the experience of chronic pain (C. R. Green et al., 2004). In particular, race and ethnicity have been shown in the literature to greatly influence the prevalence of chronic pain. However, current studies have focused primarily on White, African American, and Hispanic respondents. This paper will focus on racial and ethnic differences in chronic pain while including racial and ethnic categories not commonly present in chronic pain literature.

LITERATURE REVIEW

While definitions of chronic pain may vary, for the purposes of this paper, chronic pain is recognized as "pain that persists past normal healing time, and hence lacks the acute warning function of physiological nociception. Usually, pain is regarded as chronic when it lasts or recurs for more than 3 to 6 months" (Treede et al., 2015, p. 2). Despite the significant personal and social effects of chronic pain, in addition to the troubling prevalence of this affliction, sufferers

of chronic pain must battle with compassion fatigue and disbelief, often becoming victims of the etiologically induced separation of physical and mental pain in modernity. Consequently, individuals living with chronic pain are often suspicious of and prone to blaming themselves; when their pain persists, it can be augmented by shame, guilt, self-loathing, depression, self-medication, and even suicidal ideation (Boddice, 2017).

As chronic pain patients are often unable to identify or substantiate a root cause of their suffering, the presence of an injury may oftentimes go untreated or undertreated; this is not always due to a lack of available treatment, but rather can be attributed to a lack of access to such treatments through ordinary healthcare support channels. In light of this quandary, contemporary pain specialists often make reference to the biopsychosocial model of pain for its explanatory power. From this perspective, the body and mind are influenced by social and environmental factors that effectively coalesce to make a multidimensional contribution toward an individual's collective pain experience (Boddice, 2017; Fillingim, 2017). This model insists that these different sets of factors – biological, psychological, and social – interact and create a unique and personal experience of pain (Fillingim, 2017).

To understand chronic pain, it is important to understand the many facets through which an individual experiences pain. As Rob Boddice aptly suggests, "to understand pain as it is, one must understand the vast possibilities of the pain experience" (2017, p. 3). Following this line of reasoning, socio-economic status, sex, age, and racial and ethnic differences have all been found to have significant impacts on the prevalence of pain and chronic pain conditions (Fillingim, 2017; C. R. Green et al., 2004; Hirsh et al., 2014). While race is often a key predictor of chronic pain, there remains a gap within the literature for several racial categories. A significant portion of sociological literature examining racial and ethnic differences in chronic pain focuses

primarily on three racial categories: non-Hispanic White, non-Hispanic Black, and Hispanic (C. Green & Hart-Johnson, 2010; C. R. Green & Hart-Johnson, 2012; Ndao-Brumblay & Green, 2005; Portenoy et al., 2004). Therefore, this paper seeks to include a broader spectrum of racial categories, including Asian American, American Indian/Alaskan Native, and multiple race respondents to further examine racial differences in chronic pain while controlling for common confounding variables. Current research suggests that minority groups experience higher rates of chronic pain when compared to White respondents. The inclusion of additional racial and ethnic minority categories is important to determine the effect of chronic pain on a more representative racial composition of the United States for future policymakers and chronic pain scholars.

Racial and Ethnic Differences in Chronic Pain

Research suggests that race and ethnicity are important considerations in the evaluation of health and the experience of pain (Campbell & Edwards, 2012; C. R. Green et al., 2004). An understanding of racial and ethnic differences in chronic pain is essential to addressing disparities in the process of caring for and comprehensively treating pain (Losin et al., 2020). A large body of literature suggests that the experience of chronic pain can, and often does, vary significantly by race and ethnicity. More specifically, research has found that chronic pain differentially affects racial and ethnic minorities (C. R. Green et al., 2004). There are, however, a number of conflicting findings within the literature.

Racial and ethnic differences in the experience of chronic pain have received growing in academic literature over the last two decades (R. R. Edwards et al., 2005). While some studies report a higher pain prevalence among minority groups, other studies have found no difference in the prevalence of chronic pain between different racial and ethnic groups (Fillingim, 2017; Janevic et al., 2017; Lavin & Park, 2014). For example, a study conducted by Edwards et al.,

found no significant differences in pain prevalence, suggesting that racial and ethnic differences in pain may be small when these groups are closely matched on confounding variables (R. R. Edwards et al., 2005). In his study of pain prevalence, Nahin found that only small non-significant differences were present when comparing White to African American participants (Nahin, 2021). Another study, conducted by Allen et al. found that African American respondents had worse pain scores than White respondents. However, with the addition of control variables, race was no longer associated with pain, suggesting that said associations were accounted for by other covariates (Allen et al., 2010). In 2001, Edwards et al. conducted a study examining the effects of ethnic differences in clinical and experimental chronic pain. This study found that African American respondents have higher levels of clinical pain as well as pain-related disability when compared to White respondents (R. R. Edwards et al., 2001).

While highlighting disparities in the pain experience for African American respondents, another study conducted by Green and Hart-Johnson, revealed that Black race was a direct predictor of greater pain, and through pain, was an indirect predictor of depression, affective stress, PTSD, and disability (C. Green & Hart-Johnson, 2010). A similar study was conducted in which White and African American respondents were compared based on their responses to a number of vigorously tested pain questionnaires. After accounting for sociodemographic, medical, psychological, and physical confounders, no significant effect of race on pain was found (Ndao-Brumblay & Green, 2005). Further studies have suggested that White respondents report higher levels of pain than minority racial and ethnic groups (Grol-Prokopczyk, 2017; Johannes et al., 2010).

A cross-sectional telephone survey conducted by Portenoy et al. found that White respondents had pain longer but with lesser intensity than other groups, while pain-related life

interference did not differ (Portenoy et al., 2004). Another study found that while musculoskeletal pain was more common among ethnic minority respondents, while White respondents more often reported experiencing chronic face or jaw pain when compared to Black respondents (Allison et al., 2002). Consistent with the literature on health care disparities, Green et al. found that African Americans with chronic pain had higher pain severity, depression, and disability when compared to Whites with chronic pain (2004). In 2005, Chen et al. conducted a cross-sectional survey of patients with chronic non-malignant pain and their attending physicians across twelve different medical centers. Again, an analysis of Black and White patients showed that Black patients had significantly higher pain scores when compared to their White counterparts (Chen et al., 2005). These findings correspond with current literature that suggests there are racial and ethnic differences in chronic pain. However, as we can see, there are numerous conflicting results within the literature.

As we have displayed, a significant portion of the available research literature has little to say regarding racial differences in chronic pain beyond dichotomous categories of 'Black' and 'White' (Fuentes et al., 2007; Nahin, 2015). However, some authors have included Hispanic individuals in their analyses, as well. While research comparing pain among non-Hispanic Whites, Hispanics, and African Americans has yielded mixed results, there is an increasing body of research suggesting an enhancement of the chronic pain experience for African American and Hispanic patients (R. R. Edwards et al., 2005). Using the National Health Interview Survey from 2000-2005, Plesh et al. found that the prevalence of pain for Hispanic and Black females, although lower at younger ages, increased up to age 60 and remained significantly higher when compared to their non-Hispanic White counterparts (Plesh et al., 2010). The findings above showcase the idea that minority groups experience higher rates of chronic pain when compared

to non-Hispanic White respondents. Other studies have suggested that pain prevalence is lowest amongst Asians when compared to other racial and ethnic groups in the U.S. (Fillingim, 2017; Nahin, 2015). This research suggests that race and ethnicity may be particularly relevant to the prevalence of chronic pain as the biopsychosocial model suggests that pain is shaped by interactions among biological, psychological, and social variables, all of which are fundamentally ingrained in an individual's identification with one or more ethnic groups (R. R. Edwards et al., 2005).

Members of minority groups maintain, on average, lower socioeconomic status – an important predictor in the study of chronic pain (Poleshuck & Green, 2008). The literature suggests that racial and ethnic minorities are often more susceptible to chronic pain conditions. Fundamentally, the various mechanisms through which the pain experience manifests are unique and contextually dependent, including many factors related to socioeconomic standing, demographics, and adequate access to health care (Fillingim, 2017).

Demographic and Socioeconomic Influences of Race and Ethnicity on Chronic Pain

While race is often a factor, several demographic and socioeconomic factors have also been found to influence, and perhaps exacerbate, the prevalence of chronic pain among racial and ethnic minorities. This includes factors such as sex, age, marital status, level of education, employment, and income. According to the expansive sociological literature, there are a number of consistent patterns that have emerged regarding demographic and socioeconomic disparities in chronic pain: (1) women experience higher rates of chronic pain than men; (2) higher-income individuals report chronic pain less often than lower-income individuals; (3) the likelihood of experiencing chronic pain increases with age until plateauing or decreasing at age 60 (Grol-Prokopczyk, 2017).

A significant body of research suggests that chronic pain is more prevalent amongst women than men (Fillingim, 2017; C. R. Green et al., 2004; Hardt et al., 2008). On average, women are more likely than men to suffer from chronic pain conditions and although these conditions often have a far greater impact on women's physical and emotional health, their chronic pain complaints are more often handled less effectively by attending doctors when compared to men (Ndao-Brumblay & Green, 2005). A study conducted by Grol-Prokopczyk found that women are 28 percent more likely to report chronic pain and 37 percent more likely to rate such pain as 'severe' in intensity when compared to men (Grol-Prokopczyk, 2017). The literature suggests a number of different explanations for variation in the prevalence of chronic pain by sex. One such explanation suggests that fundamental neurophysiological or psychosomatic differences in the functioning of female and male pain processing systems increase a female's risk for clinical pain. Other related arguments proposed to explain apparent differences in the experience of pain between sexes include the effects of sex hormones, differences in endogenous opioid function, cognitive/affective influences, and epigenetic contributions of social factors or early-life circumstances (Fillingim, 2017).

Generally, chronic pain increases in prevalence until middle age, after which pain prevalence will often plateau. However, patterns of pain prevalence and aging are complex and tend to vary across pain conditions (Fillingim, 2017). A study conducted by Plesh et al. found that during earlier adulthood White individuals experience higher rates of pain when compared to Black or Hispanics. However, later in adulthood, this pattern is reversed, and Whites were found to have a lower pain prevalence than Black or Hispanic participants (Plesh et al., 2010). Another study by Fillingim suggests that the prevalence of joint pain, lower extremity pain, and neuropathic pains increase with age. Conversely, chronic pain conditions involving headache,

abdominal pain, back pain, and jaw/facial pain show peak prevalence in the third to fifth decade of life, after which said frequency decreases (Fillingim, 2017). In 2017, Grol-Prokopczyk conducted a 12-year longitudinal study on the disparities in chronic pain. This study found that the burden of pain is not only increasing with age, but also by birth cohort; younger birth cohorts experience higher pain levels than older ones, effectively disadvantaging younger birth cohorts (Grol-Prokopczyk, 2017). Age, therefore, remains an important variable to consider in future research on chronic pain.

Very little is known about educational disparities in pain. However, according to the literature we do have, pain is strongly influenced by educational attainment (Zajacova et al., 2020). In their longitudinal study, Grol-Prokopczyk observed a pattern toward declining pain prevalence with increasing education; from 11.2% for adults without a high school diploma to 6.3% in respondents with education past high school (2017). In a more recent study, Zajacova et al examined educational disparities in pain across different levels of education in greater detail. This study found that greater levels of education are associated with a lower prevalence of chronic pain, with two exceptions. First, adults with a GED and those 'some college' have higher pain levels than high school graduates, even though the education level is considered equivalent or higher in the case of those with 'some college.' Second, the education-pain gradient was not present for Hispanic respondents (Zajacova et al., 2020). While education is an important consideration for chronic pain research, so too are the impacts of income and employment.

The impact of chronic pain income and employment are important aspects to consider, as fewer economic resources are associated with a higher prevalence of chronic pain. In their study of racial and socioeconomic disparities, Janevic et al. found that the prevalence of chronic pain decreased significantly with increasing wealth, from 17.1 percent in the bottom wealth quartile to

5.6 percent in the highest quartile (Janevic et al., 2017). Porternoy et al. conducted a study of non-Hispanic White, non-Hispanic African American, and Hispanic subjects and found that disabling pain was positively associated with an annual income of $25,000 or less (Portenoy et al., 2004). While chronic pain can impact an individuals' earning potential, Jackson et al. found that the presence of chronic pain can also seriously impact an individual's ability to maintain employment (Jackson et al., 1996). Chronic pain scholars have found that socioeconomic status contributes sustainably to the individual pain experience. Green and Hart-Johnson found that in every case, living in a lower SES neighborhood played an important role in the outcomes for chronic pain (C. R. Green & Hart-Johnson, 2012). In light of these facts, sociodemographic and socioeconomic characteristics are important considerations when studying chronic pain across race and ethnicity.

This study focuses on racial and ethnic differences in chronic pain while including a number of racial and ethnic categories not commonly present in chronic pain literature. The goal of this study is to examine differences in chronic pain and respond to the following questions: (1) Are the differences in the prevalence of chronic pain across different race and ethnicities? And (2) how are these differences affected by certain demographic and socioeconomic factors?

METHODS

Data

This study used data from the 2017 and 2018 National Health Interview Survey. The NHIS is a nationwide annual survey specifically designed to collect information on demographic characteristics, health status, and health care use patterns within the U.S. population. The NHIS survey includes well-designed questions about chronic pain and detailed information regarding educational attainment, as well as a large set of variables pertaining to social and medical

conditions. The analytical sample is defined as “sample adult” men and women ages 25 to 64 and includes information on demographic and socioeconomic characteristics such as age, sex, race, marital status, education, income, and employment status.

Variables

Outcome is pain. The National Health Survey includes questions corresponding to five body sites representing the most common or disabling types of pain (Zajacova et al., 2021). Each of these sites was determined by asking the question: “During the past three months, did you have [low back pain, neck pain, severe head or migraine, or facial or jaw ache pain]?” The data for joint pain was collected with two questions. Participants were asked if they had any symptoms of “pain, aching, or stiffness in or around a joint.” Those who responded yes to this question were then asked a follow-up question asking whether the onset was at least three months prior to determine if the pain was chronic. Using these variables, I created a dichotomous outcome variable for pain. Participants who responded ‘yes’ or ‘no’ to these questions were included in the analysis, while respondents with missing pain values for any of the five body sites were dropped from the analysis. A total of 27 cases were dropped.

This study included demographic variables such as race sex, age, marital status, education, employment status, and income. The NHIS variable ‘sex’ measures whether a respondent is male or female. For the years 2017 and 2018, the NHIS only included whether the respondent was male or female with no ‘other’ option. I recoded this gender variable into a dummy variable of ‘female,’ where 1 represents female and 0 represents male. For age, the NHIS reports an individual’s age in years since their last birthday. For the purposes of this study, only those between 25 and 64 were included in the analysis.

The variable ‘racenew’ within the original data set from the National Health Interview

Survey provided information on the self-reported, main racial background of sample adults. For the years 2017 and 2018, this original variable included White, Black/African American, American Indian/Alaskan Native, Asian, Race group not releasable, and Multiple Race. For the purposes of this study, I created a new race variable in which the category 'race group not releasable' was recoded into an unknown category. For the purposes of this study, all racial categories are considered non-Hispanic other than the designated Hispanic category. In this paper, the terms 'White' and 'non-Hispanic White' will be used interchangeably.

For marital status, the NHIS variable 'marstat' was used. This variable reports a participant's legal marital status. For the years 2017 and 2018, this variable included a number of possible responses: NIN, married, widowed, divorced, separated, never married, and unknown marital status. All were included in the analysis but for option NIU, indicating the participants were under the age of 18 and the question was not posed to them. I recoded this into a new variable in which the categories widowed, divorced, and separated were combined into one 'previously married' category. The new marital status variable includes four categories: married, previously married, never married, and unknown.

The variable encompassing income for this study was created using the NHIS variable 'incfam97on2.' This variable provides the total grouped family income beginning in 1997 and using income brackets from 2007. Participants were grouped into four different income brackets: $0 - $34,999, $35,000 - $74,999, $75,000 - $99,999, $100,000+, not ascertained or undefined, and finally, don't know. I created a new income variable using these same income ranges; however, for the purposes of this study, the last two categories were coded together into one 'don't know' category.

The variable representing employment status in this study was recoded from the National Health Interview Survey variable ‘empstat.’ This variable reported whether a participant was a part of the labor force, either working or seeking work, and if so, whether they worked, had a job or business from which they were absent, or were looking for work or on a layoff during the past week. Responses for the years 2017 and 2018 were: NIU, working for pay at job/business, working, without pay, at job/business, with job, but not at work, unemployed, not in labor force, unknown-refused, unknown-not ascertained, unknown-don't know. For the NHIS, NIU stands for ‘not in universe.” In this case, NIU are individuals who were not asked this specific question because they were under 18 years of age at the time. I recoded this into a new employment variable. This variable includes only four categories: employed, unemployed, not in the labor force, and unknown.

Finally, a new variable was created to measure the level of education using the NHIS ‘educ’ variable. The ‘educ’ variable for sample adults reports the highest level of schooling an individual has completed, in terms of completed grades for respondents with less than a high school diploma, and in terms of degrees attained for high school graduates and those with higher education. Respondents were handed a card listing recognized categories and were required to identify the correct category. For simplicity, I recoded the NHIS variable ‘educ’ into the new education variable and included the following categories commonly used in research: less than HS+GED, high school, AA degree, Bachelor’s degree, and more than Bachelor’s degree.

Approach

The purpose of this analysis was to explore the relationship between chronic pain and racial and ethnic categories while controlling for chosen demographic and socioeconomic characteristics. First, I calculated and reported descriptive statistics for the study sample. Since the outcome variable – or presence of chronic pain – had a dichotomous outcome, I conducted multiple logistic regression for the main analysis. Logistic regression was conducted to test the odds of experiencing pain across each racial and ethnic category. Each individual independent variable was added to the regression over the course of six nested logistic regression models and the effects of the additional variables were noted at each stage. By estimating models with and without certain control variables, I was able to evaluate the influence of sociodemographic and socioeconomic variables on chronic pain for each racial and ethnic category. Following this analysis, predictive probabilities were estimated based on the logistic regression models. This step was conducted in order to estimate the average percentage of respondents with chronic pain in each race or ethnicity category. This was done to extend past a racial group's odds of having chronic pain and showcase the percent of respondents within each group that reported having chronic pain on average, or net of control variables. I calculated both 'at means' as well as 'average' predictive probabilities for each racial or ethnic group.

RESULTS

Descriptive Statistics

Table 1 shows descriptive statistics for all variables included in the analysis divided into racial and ethnic categories. Sample weights were used to correct or mediate imperfections in the sample that may lead to bias between the sample and the reference population. The sample (n=33,316) contained major racial categories in the United States including White, African American, Hispanic, Asian American, American Indian/Alaskan Native, multiple races, as well

as an unknown category. White respondents account for a significant portion of the population at 61.20 percent, African Americans account for 12.39 percent, Hispanic respondents' 17.31 percent, and Asian Americans 6.46 percent. American Indian/Alaskan Native respondents under 1 percent of the sample (0.81%), and multiple race respondent's 1.62 percent. Respondents with unknown race account for only 0.20 percent of the sample population and are not included in the reported analysis. This study did not specifically test the differences across racial and ethnic categories for control variables.

The percent of respondents who have chronic pain was 51.21 across the sample. On average, White, AIAN, and multiple race categories contained higher percentages of respondents with chronic pain. Comparatively, African American, Hispanic, and Asian American racial and ethnic categories contain a lower percentage of respondents with chronic pain. Respondent's age did not tend to vary greatly across racial and ethnic categories, with the sample average resting at approximately 44 years of age. The sample consisted of roughly half male (48.91%) and female (51.09%) participants. This pattern continued across racial and ethnic categories, as well. Of the entire sample, 58.88 percent of respondents are married, 17.05 were previously married, and 23.83 never married. African American, AIAN, and multiple race participants were less likely to be married than White or Asian American participants.

White and Asian American respondents when compared to the rest of the sample, acquired higher levels of education on average. For example, only 8.12 percent and 7.10 percent of White and Asian respondents, respectively, achieved less than a high school diploma or GED, while 27.28 percent of White respondents and 28.84 percent of Asian American respondents report at least a bachelor's degree. Comparatively, African American, Hispanic, AIAN, and Multiple race respondents more often fall in the 'less than high school and GED' category while

those who have acquired at least a bachelor's degree are less common. For example, only 14.33 percent of Hispanic respondents and 11.09% of AIAN respondents have a bachelor's while 31.06 percent and 23.89 percent of respondents in these groups have less than a high school diploma or GED.

Of the sample total, 75.26 percent of respondents are employed, 3.18% unemployed, and 20.50 percent not in the labor force. AIAN and multiple race categories did, however, contain a higher percentage of respondents not in the labor force (28.96% and 22.49%). White and Asian American respondents maintained much higher levels of income when compared to African American, Hispanic, AIAN, and multiple-race respondents. For example, White and Asian American participants had higher a higher portion of their sample in the $100,000+ category at 38.86 percent and 43.18 percent respectively, while having the lowest percentage of individuals in the $0 – $34,000 category at 15.53 percent for White respondents and 14.58 percent. In comparison, 35.30 percent African American, 29.58 percent Hispanic, 40.76 percent AIAN and 28.30 percent of multiple race respondents are in the $0 – $34,999 each year.

– Table 1 here –

Nested Logistic Regression Models

Table 2 shows logistic regression models of chronic pain within the sample population. Model 1 reports the differences in the presence of chronic pain across race and ethnicity. According to this model, African American respondents have 33 percent lower odds of chronic pain when compared to White participants [OR = 0.67, $p<0.001$]. Hispanic respondents experience 39 percent lower odds of chronic pain [OR = 0.61, $p< 0.001$] and Asian Americans have 58 percent lower odds of chronic pain [OR = 0.42, $p< 0.001$]. Differences between White participants and AIAN participants are not statistically significant in this model [$p = 0.436$].

Multiple Race participants have 18 percent higher odds of chronic pain; however, this difference is not significant in this model [p = 0.139].

Model 2 shows differences in chronic pain across race and ethnicity while controlling for sex and age. Differences in the effect of race and ethnicity on chronic pain between model 1 and model 2 are marginal. All minority racial and ethnic categories have either the same or slightly lower odds of having chronic pain with the addition of control variables. Additionally, in model 1 multiple-race respondents have 18 percent higher odds of having chronic pain, however, this difference is not significant [OR = 1.18, p<0.139]. In model 2, multiple race respondents have 28% higher odds of pain when compared to White participants [OR = 1.28, p<0.05]. In the second model, the odds of having pain for multiple race respondents becomes statistically significant. The effect of gender is also significant. When compared to male participants, female participants have 33% higher odds of chronic pain [OR = 1.33, p<0.001]. Additionally, this model found that older participants have 0.02% higher odds of pain. In other words, the odds of having chronic pain increases by 0.02% [OR = 1.02, p<0.001] with each additional year.

Model 3 shows differences in chronic pain across race and ethnicity while controlling for sex, age, and marital status. The odds of having chronic pain for each racial or ethnic category are not altered drastically from models 1 and 2 by the addition of these control variables. When compared to married participants, previously married participants – or individuals who are divorced, separated, or widowed – have 40 percent higher odds of chronic pain [OR = 1.40, p<0.001]. Differences in odds of having chronic pain amongst never married and unknown participants are not significant, [p = 0.364] and [p = 0.241], respectively.

Model 4 shows differences in chronic pain across race and ethnicity while controlling for sex, age, marital status, and education. The odds of having chronic pain are substantially the

same as previous models, however, differences in chronic pain for multiple-race respondents are no longer significant as they were in models 2 and 3 [p = 0.087]. On average, as education increases, the odds of chronic pain decrease. However, not all categories are statistically significant. Respondents with a bachelor's degree and more than a bachelor's degree are statistically significant in this model [p<0.001]. Participants with a BA have 34 percent lower odds of chronic pain when compared to those with less than high school and GED [OR = 0.66] and participants more than a bachelor's degree have 36 percent lower odds of chronic pain [OR = 0.64]. In this model, having high a school diploma is associated with 13 percent lower odds of having chronic pain [0.87, p<0.01].

Model 5 shows differences in chronic pain across race and ethnicity while controlling for sex, age, marital status, education, and employment. Pain prevalence, or the odds of having chronic pain, are substantially similar to the first four models. However, with the addition of more control variables, the education category high school is no longer significant [p = 0.119]. In this model, the prevalence of chronic pain for female respondents decreases, and female respondents now have 25 percent higher odds of having chronic pain [OR = 1.25, p<0.001]. When compared with employed participants, unemployed participants have 37 percent higher odds of chronic pain [OR = 1.37, p<0.001]. Similarly, when compared to employed participants, those not in the labor force have 54 percent higher odds of chronic pain [OR = 1.54, p<0.001].

Model 6 shows differences in chronic pain across race and ethnicity while controlling for sex, age, marital status, education, employment, and income level. Pain prevalence for each race or ethnicity category remains sustainably similar to the first five models. Results found that as income increases, the odds of having chronic pain decreases. For example, participants with an income between $35,000 and $74,999 have 12 percent lower odds of chronic pain when

compared with participants making less than $34,999 [OR =0.88, p<0.01]. Whereas participants with an income between $75,000 and $99,999 have 20% lower odds of chronic pain than those making less than $34,999 [OR = 0.80, p<0.001] and participants making $100,000 or more have 32 percent lower odds of chronic pain than those making less than $34,999 [OR = 0.68, p<0.001].

While differences in chronic pain for each racial and ethnic category from one model to the next were marginal, another pattern is noteworthy. In the absence of control variables, racial differences in chronic pain are clearly prevalent. However, in model 6, with the addition of more control variables, differences in the prevalence of chronic pain by race or ethnicity are affected. In fact, with no control variables, African American respondents have 33 percent lower odds of experiencing pain when compared to White respondents [OR = 0.67, p<0.001]; however, with the inclusion of all control variables, African American respondents have 39 percent lower odds of having chronic pain. This pattern is consistent for Hispanic and AIAN respondents as well, however, AIAN differences are not significant. For Asian American respondents, an opposite pattern emerges. In model 1 Asian American respondents have 58% lower odds of having chronic pain when compared to White respondents [OR = 0.42, p<0.001], however, net of control variables, Asian American respondents have 53% lower odds of experiencing chronic pain [OR = 0.47, p<0.001].

– Table 2 here –

Predictive Probabilities

Table 3 shows predictive and average probabilities for each racial and ethnic category at means and on average. Predictive probabilities ‘at means’ were calculated for each race or ethnicity category. This calculated the probability of a certain race or ethnicity having chronic

pain if all confounding variables are held at their means. With all control variables at their means, 56 percent of White respondents from the sample have chronic pain. In comparison, 44 percent of Black respondents have chronic pain; 42 percent of Hispanic respondents have chronic pain; 38 percent of Asian respondents have chronic pain; 50 percent of AINA respondents have chronic pain; and finally, 60 percent of multiple race participants have chronic pain. Following this, average marginal effects were calculated for each racial group; results from this analysis yielded marginal differences.

– Table 3 here –

DISCUSSION

Chronic pain literature reveals stark disparities in health and health care based on race and ethnicity (C. R. Green & Hart-Johnson, 2012). Current research suggests that minority groups experience higher rates of chronic pain when compared to White respondents (Fillingim, 2017; Lavin & Park, 2014), however, much of this research has focused on three main racial categories: White, African American, and Hispanic. The inclusion of additional racial and ethnic minority categories is important in order to determine the effect of chronic pain on a more representative racial composition of the United States for future policymakers and chronic pain scholars. In light of these facts, the purpose of this study was to examine racial and ethnic differences in the prevalence of chronic pain across major racial and ethnic groups in the United States while including minority groups not commonly examined such as Asian American, Native American, and multiracial individuals.

The main finding of this study was that African American, Hispanic, and Asian respondents have, on average, lower odds of having chronic pain when compared with that of their White counterparts. In comparison, multiracial respondents had significantly higher odds of

pain while Native American respondents had similar odds of pain when compared to White respondents. These are noteworthy findings for several reasons.

First, the available literature suggests that African American (Chen et al., 2005; C. Green & Hart-Johnson, 2010; C. R. Green et al., 2004; Ndao-Brumblay & Green, 2005) and Hispanic (R. R. Edwards et al., 2005; Nahin, 2021; Portenoy et al., 2004) individuals experience higher odds of chronic pain when compared to White individuals This study directly contradicted these findings, as we found that both African American and Hispanic respondents have significantly lower odds of chronic pain when compared to White respondents.

There are, however, several studies that do support our results. For example, Portenoy et al. found that while race or ethnicity did not predict disabling pain, socioeconomic disadvantage is the more important predictor of chronic pain (Portenoy et al., 2004). Other studies have found that racial and ethnic disparities in pain perception, assessment, and treatment are found in all settings. These studies suggest that the source of pain disparities among racial and ethnic monitories are multifaceted, involving the patient, healthcare provider, and healthcare system (C. R. Green et al., 2003). This is similar to what Fillingim suggests when discussing the biopsychosocial model. This model proposes that pain is individual and affected by biological, physiological, and social conditions that interact to create the unique experience of pain (Fillingim, 2017). Additionally, the literature indicates that differences in pain perception by race or ethnicity may contribute to differences in the prevalence of chronic pain for minority groups (2017).

This study found that with the addition of more control variables, the odds of having chronic pain for African American and Hispanic respondents becomes less likely when compared to White respondents. The literature would suggest an opposite pattern should be

present, as racial and ethnic differences in chronic pain are often the result of an individual's socioeconomic standing and access to adequate healthcare (Fillingim, 2017). However, one explanation for this could be that pain is considered a unique and personal experience. As a result, certain race or ethnicities may be less likely to report pain or may even have an altered perception of pain (Fillingim, 2017).

An opposite pattern was found for Asian Americans. That is, as more control variables were added to the regression, Asian American's have higher odds of experiencing chronic pain. In fact, with no controls, Asian American respondents had 58 percent lower odds of having chronic pain compared to only 53 percent lower odds with all control variables present. The literature may suggest this is due to the fact that as racial groups are matched on confounding variables, differences in chronic pain decrease (R. R. Edwards et al., 2005). Similarly, this finding is consistent with the literature that suggests individuals from minority groups experience higher rates of pain when compared to White individuals (Allison et al., 2002; C. Green & Hart-Johnson, 2010; C. R. Green & Hart-Johnson, 2012). More generally, our study found that Asian American's have significantly lower odds of chronic pain when compared to White respondents. This directly contradicts the available literature suggesting that Asian American's have better health outcomes when compared to White individuals.

This study also included Native American respondents; a minority group not commonly examined in chronic pain literature. We found that Native American respondents did experience lower odds of having chronic pain when compared to White respondents, however, these differences were not significant. This could be due to the fact that Native American populations have a tendency to opt-out of government-conducted surveys and because of this, the proportion Native American respondents who do experience chronic pain may not be accurately represented

in the National Health Interview Survey (Herrick et al., 2019). Likewise, this directly contradicts the well-known fact that Native American individuals have significantly poorer health outcomes when compared to Whites (Edwards et al., 2005). Further research is needed to examine and understand these findings.

This study found that differences in chronic pain for multiracial respondents are significant. When compared to White respondents, multiracial individuals have 28 percent higher odds of chronic pain. This is a noteworthy finding as the literature on chronic pain has not yet examined individuals who self-identify as multiple races. However, the literature that is available would suggest this may be because members of minority groups generally report higher rates of chronic pain when compared to White respondents (Aroke et al., 2019; R. R. Edwards et al., 2005; Lavin & Park, 2014). Similarly, a lack of association with one primary racial or ethnic group for multiracial individuals may negatively influence the prevalence of chronic pain.

The observed differences in chronic pain by race and ethnicity were not significantly altered by the addition of control variables. This contradicts a significant portion of the literature that suggests racial and ethnic differences in chronic pain can be explained primarily by the influence of demographic and socioeconomic variables. In light of this, we expected racial and ethnic differences in chronic pain to be less prevalent as more control variables were added, however, in some cases the opposite was true, specifically for African American and Hispanic respondents. The available literature suggests that socioeconomic factors should play a large role when examining the prevalence of chronic pain, as a lower socioeconomic status has been linked to poorer health outcomes. The findings from this study contradict this, suggesting that differences in chronic pain by race and ethnicity extend past socioeconomic and sociodemographic factors.

In addition to the main findings, several other patterns are noteworthy. This study found that women have higher odds of chronic pain when compared to men. This finding is corroborated by several other studies that suggest women experience higher levels of chronic pain when compared to men (C. Green & Hart-Johnson, 2010; Ndao-Brumblay & Green, 2005; Plesh et al., 2010). Another consistent finding across the literature is that as age increases, so too does the prevalence of chronic pain (C. R. Green et al., 2004; Lavin & Park, 2014; Riley et al., 2014). In this study, the impact of age remained the same net of all control variables suggesting that older respondents have higher odds of having chronic pain. These findings are consistent with the literature that women and older respondents experience higher odds of chronic pain when compared to men and younger respondents (C. Green & Hart-Johnson, 2010; Grol-Prokopczyk, 2017; Ndao-Brumblay & Green, 2005).

The literature has very little to say regarding the effect of marital status on the prevalence of chronic pain. This study found that divorced, separated, or widowed respondents have higher odds of having chronic pain when compared to married respondents. The literature that is available would suggest this is may be due to the fact that marriage is associated with longer life and better health, as it connects people to other individuals, social groups, and other social institutions, which are added sources of social benefit (Wade et al., 2013).

This study found that higher levels of education are associated with lower odds of having chronic pain. While little is known about educational disparities and chronic pain, the literature that is available does support these findings. A study conducted by Zajacova et al found that more educated Americans report significantly less pain when compared to less educated respondents (Zajacova et al., 2020). Similarly, Portenoy et al found that disabling pain is positively associated with less than a high school education and negatively associated with

having a college or graduate degree (Portenoy et al., 2004). This could be due to the fact that higher levels of education are often associated with higher levels of socioeconomic status, and this is often a prerequisite for higher educational attainment given the increasing costs of post-secondary education in the United States.

This study found that unemployed respondents as well as those not in the labor force experience higher odds of having chronic pain when compared to employed respondents. Similarly, we found that as income increases, the odds of having chronic pain decrease. A study conducted by Portenoy et al found that chronic pain is positively associated with an income of less than $25,000 and negatively associated with an income of $25,000 or more as well as being employed (Portenoy et al., 2004). Other studies suggest that chronic pain is one of the major causes of absence from work, as well as a reduced ability to perform duties at work (Hardt et al., 2008; Walid & Zaytseva, 2011). As a result, these findings are generally consistent with the literature on chronic pain.

This study had a number of limitations. To begin with, this study only had one outcome variable: any chronic pain. Other studies have included the severity of chronic pain or level of disability due to the presence of chronic pain. A second limitation of this study was the measurement of the multiple race category. The National Health Interview Survey does not define the specific racial or ethnic categories of 'multiple race' respondents. As a result, we have no way of determining the racial composition of this category. Future research should consider examining chronic pain in multiple race individuals and should make a point of defining the specific racial composition of the category. Similarly, other studies should consider focusing on Indigenous participants. Indigenous populations have a long-standing history of opting out of

national surveys. The number of respondents is often very low and not at all representative of the greater population.

CONCLUSION

Chronic pain literature consistently shows differences in the prevalence of chronic pain by race and ethnicity. Using data from the National Health Interview Survey we found that African American, Hispanic, and Asian American respondents have lower odds of chronic pain when compared to White respondents. We also found that multiple race respondents experience higher odds of chronic pain when compared to White respondents while Native American's had similar odds of pain to Whites. These findings are significant because most of the literature on chronic pain suggests that minorities have higher rates of pain. By including minorities not commonly present in chronic pain literature, this study showcases the need for a more in-depth look at racial and ethnic categories not commonly examined in the literature. In conclusion, this study is important for future research as it shows the need for other scholars, as well as policymakers, to focus on expanding racial and ethnic minorities commonly studied in chronic pain literature.

References

Allen, K. D., Oddone, E. Z., Coffman, C. J., Keefe, F. J., Lindquist, J. H., & Bosworth, H. B. (2010). Racial differences in osteoarthritis pain and function: potential explanatory factors. *Osteoarthritis and Cartilage*, *18*(2), 160–167. https://doi.org/10.1016/j.joca.2009.09.010

Allison, T. R., Symmons, D. P. M., Brammah, T., Haynes, P., Rogers, A., Roxby, M., & Urwin, M. (2002). Musculoskeletal pain is more generalised among people from ethnic minorities than among white people in Greater Manchester. *Annals of the Rheumatic Diseases*, *61*(2), 151–156. https://doi.org/10.1136/ard.61.2.151

Aroke, E. N., Joseph, P. v., Roy, A., Overstreet, D. S., Tollefsbol, T. O., Vance, D. E., & Goodin, B. R. (2019). Could epigenetics help explain racial disparities in chronic pain? In *Journal of Pain Research* (Vol. 12, pp. 701–710). Dove Medical Press Ltd. https://doi.org/10.2147/JPR.S191848

Boddice, R. (2017). *Pain: A Very Short Introduction*. Oxford University Press.

Campbell, C. M., & Edwards, R. R. (2012). Ethnic differences in pain and pain management. *Pain Management*, *2*(3), 219–230. https://doi.org/10.2217/pmt.12.7

Chen, I., Kurz, J., Pasanen, M., Faselis, C., Panda, M., Staton, L. J., O'Rorke, J., Menon, M., Genao, I., Wood, J. A., Mechaber, A. J., Rosenberg, E., Carey, T., Calleson, D., & Cykert, S. (2005). Racial differences in opioid use for chronic nonmalignant pain. In *Journal of General Internal Medicine* (Vol. 20, Issue 7, pp. 593–598). https://doi.org/10.1111/j.1525-1497.2005.0106.x

Edwards, K. (2005). Native American Health. *Journal of Cultural Diversity*, *12*(2), 35–36.

Edwards, R. R., Doleys, D. M., Fillingim, R. B., & Lowery, D. (2001). *Ethnic Differences in Pain Tolerance: Clinical Implications in a Chronic Pain Population*.

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

Fillingim, R. B. (2017). Individual differences in pain: Understanding the mosaic that makes pain personal. *Pain*, *158*(4), S11–S18. https://doi.org/10.1097/j.pain.0000000000000775

Fuentes, M., Hart-Johnson, T., & Green, C. R. (2007). *The Association among Neighborhood Socioeconomic Status, Race and Chronic Pain in Black and White Older Adults*.

Green, C., & Hart-Johnson, T. (2010). The Impact of Chronic Pain on th Health of Black and White Men. *Journal of the National Medication Association*, *102*(4), 321–331.

Green, C. R., Anderson, K. O., Baker, T. A., Campbell, L. C., Decker, S., Fillingim, R. B., Kaloukalani, D. A., Lasch, K. E., Myers, C., Tait, R. C., Todd, K. H., & Vallerand, A. H. (1526). *PA I N M E D I C I N E Volume 4 • Number 3 • 2003 The Unequal Burden of Pain: Confronting Racial and Ethnic Disparities in Pain*. https://academic.oup.com/painmedicine/article/4/3/277/1862837

Green, C. R., & Hart-Johnson, T. (2012). The association between race and neighborhood socioeconomic status in younger black and white adults with chronic pain. *Journal of Pain*, *13*(2), 176–186. https://doi.org/10.1016/j.jpain.2011.10.008

Green, C. R., Ndao-Brumblay, S. K., Nagrant, A. M., Baker, T. A., & Rothman, E. (2004). Race, age, and gender influences among clusters of african american and white patients with chronic pain. *Journal of Pain*, *5*(3), 171–182. https://doi.org/10.1016/j.jpain.2004.02.227

Grol-Prokopczyk, H. (2017). Sociodemographic disparities in chronic pain, based on 12-year longitudinal data. *Pain*, *158*(2), 313–322. https://doi.org/10.1097/j.pain.0000000000000762

Hardt, J., Jacobsen, C., Goldberg, J., Nickel, R., & Buchwald, D. (2008). Prevalence of chronic pain in a representative sample in the United States. *Pain Medicine*, *9*(7), 803–812. https://doi.org/10.1111/j.1526-4637.2008.00425.x

Herrick, R., Mendez, J. M., Pryor, B., & Davis, J. A. (2019). Surveying American Indians with Opt-In Internet Surveys. In *The American Indian Quarterly* (Vol. 43, Issue 3). Article. https://muse.jhu.edu/article/729677

Hirsh, A. T., Hollingshead, N. A., Matthias, M. S., Bair, M. J., & Kroenke, K. (2014). The influence of patient sex, provider sex, and sexist attitudes on pain treatment decisions. *Journal of Pain*, *15*(5), 551–559. https://doi.org/10.1016/j.jpain.2014.02.003

Jackson, T., Iezzi, A., & Lafreniere, K. (1996). The Differential Effects of Employment Status on Chronic Pain and Healthy Comparison Groups. In *INTERNATIONAL JOURNAL OF BEHAVIORAL MEDICINE* (Vol. 3, Issue 4).

Janevic, M. R., McLaughlin, S. J., Heapy, A. A., Thacker, C., & Piette, J. D. (2017). Racial and Socioeconomic Disparities in Disabling Chronic Pain: Findings From the Health

and Retirement Study. *Journal of Pain, 18*(12), 1459–1467. https://doi.org/10.1016/j.jpain.2017.07.005

Johannes, C. B., Le, T. K., Zhou, X., Johnston, J. A., & Dworkin, R. H. (2010). The Prevalence of Chronic Pain in United States Adults: Results of an Internet-Based Survey. *Journal of Pain*, *11*(11), 1230–1239. https://doi.org/10.1016/j.jpain.2010.07.002

Lavin, R., & Park, J. (2014). A characterization of pain in racially and ethnically diverse older adults: A review of the literature. In *Journal of Applied Gerontology* (Vol. 33, Issue 3, pp. 258–290). SAGE Publications Inc. https://doi.org/10.1177/0733464812459372

Losin, E. A. R., Woo, C. W., Medina, N. A., Andrews-Hanna, J. R., Eisenbarth, H., & Wager, T. D. (2020). Neural and sociocultural mediators of ethnic differences in pain. *Nature Human Behaviour, 4*(5), 517–530. https://doi.org/10.1038/s41562-020-0819-8

Melanie Thernstom. (2010). *The Pain Chronicles: Cures, Myths, Mysteries, Prayers, Diaries, Brain Scans, Healing, and the Science of Suffering*. Picador.

Nahin, R. L. (2015). Estimates of Pain Prevalence and Severity in Adults: United States, 2012. *Journal of Pain*, *16*(8), 769–780. https://doi.org/10.1016/j.jpain.2015.05.002

Nahin, R. L. (2021). Pain Prevalence, Chronicity and Impact Within Subpopulations Based on Both Hispanic Ancestry and Race: United States, 2010-2017. *Journal of Pain*, *22*(7), 826–851. https://doi.org/10.1016/j.jpain.2021.02.006

Ndao-Brumblay, K., & Green, C. (2005). Racial Differences in the physical and psychsocial health among black and white women with chronic pain. *Journal of the National Medical Association*, *91*(10), 1369–1377.

Plesh, O., Adams, H. S., & Ganskym, A. S. (2010). Racial/Ethnic and Gender Prevalences in Reported Common Pains in a National Sample. *Journal of Orofacial Pain*, *25*, 25–31.

Poleshuck, E. L., & Green, C. R. (2008). Socioeconomic disadvantage and pain. In *Pain* (Vol. 136, Issue 3, pp. 235–238). https://doi.org/10.1016/j.pain.2008.04.003

Portenoy, R. K., Ugarte, C., Fuller, I., & Haas, G. (2004). Population-based survey of pain in the united states: Differences among white, african american, and hispanic subjects. *The Journal of Pain*, *5*(6). https://doi.org/10.1016/j.jpain.2004.05.005

Riley, J. L., Cruz-Almeida, Y., Glover, T. L., King, C. D., Goodin, B. R., Sibille, K. T., Bartley, E. J., Herbert, M. S., Sotolongo, A., Fessler, B. J., Redden, D. T., Staud, R., Bradley, L. A., & Fillingim, R. B. (2014). Age and race effects on pain sensitivity and modulation among middle-aged and older adults. *Journal of Pain*, *15*(3), 272–282. https://doi.org/10.1016/j.jpain.2013.10.015

Treede, R. D., Rief, W., Barke, A., Aziz, Q., Bennett, M. I., Benoliel, R., Cohen, M., Evers, S., Finnerup, N. B., First, M. B., Giamberardino, M. A., Kaasa, S., Kosek, E., Lavand'homme, P., Nicholas, M., Perrot, S., Scholz, J., Schug, S., Smith, B. H., … Wang, S. J. (2015). A classification of chronic pain for ICD-11. In *Pain* (Vol. 156, Issue 6, pp. 1003–1007). Lippincott Williams and Wilkins. https://doi.org/10.1097/j.pain.0000000000000160

Wade, J. B., Hart, R. P., Wade, J. H., Bajaj, J. S., & Price, D. D. (2013). The relationship between marital status and psychological resilience in chronic pain. *Pain Research and Treatment, 2013*. https://doi.org/10.1155/2013/928473

Walid, M. S., & Zaytseva, N. (2011). *The Relationship of Unemployment and Depression with History of Spine Surgery* (Vol. 15, Issue 1).

Zajacova, A., Rogers, R. G., Grodsky, E., & Grol-Prokopczyk, H. (2020). The Relationship Between Education and Pain Among Adults Aged 30–49 in the United States. *Journal of Pain*. https://doi.org/10.1016/j.jpain.2020.03.005

Table 1. Characteristics of the Analytical Sample using the National Health Interview Survey (n=33, 316)

	Full Sample	White (n=22,215)	African American (n=3,798)	Hispanic (n=4,574)	Asian (n=1,770)	AIAN (n=330)	Multiple Race (n=528)	Unknown (n=74)
Pain	51.21	55.89	46.10	43.47	34.94	53.24	59.95	52.78
Age (mean)	44.31	45.38	43.57	41.82	42.89	44.08	41.85	41.90
Sex								
Male	48.91	49.41	45.39	50.31	46.82	50.41	50.07	44.79
Female	51.09	50.59	54.61	49.69	53.18	49.59	49.93	55.21
Marital Status								
Married	58.88	62.78	36.78	57.68	73.62	41.08	43.76	55.77
Previously Married	17.05	17.17	21.77	16.25	8.15	21.28	19.30	12.62
Never Married	23.83	19.86	41.15	25.71	17.96	37.54	36.80	28.40
Unknown	0.24	0.19	0.31	0.36	0.27	0.10	0.14	2.21
Education Level								
>HS + GED	13.00	8.12	14.48	31.06	7.10	23.89	10.90	13.29
HS	19.88	18.98	24.49	21.71	13.39	24.40	20.29	36.99
Some PS	16.26	16.12	21.02	15.25	8.80	22.90	21.11	26.97
AA	12.47	13.54	12.00	10.54	8.12	11.13	14.39	10.43
BA	23.95	27.28	17.85	14.22	33.24	11.09	19.96	7.69
BA+	13.00	15.72	9.61	6.03	28.84	5.44	13.24	4.64
Missing	0.47	0.24	0.56	1.19	0.51	1.14	0.11	0.00
Employment Status								
Employed	76.26	77.28	72.12	75.34	79.72	64.06	72.80	66.83
Unemployed	3.18	2.56	5.91	3.26	2.75	6.97	4.52	4.80
Not in labor force	20.50	20.11	21.86	21.35	17.41	28.96	22.49	28.38
Unknown	0.06	0.04	0.11	0.04	0.12	0.00	0.20	0.00
Income								
0-35K	20.73	15.43	35.30	29.58	14.59	40.76	28.30	32.25
35K-75K	25.88	24.40	27.49	32.10	19.69	26.23	26.94	59.39

75K-100K	12.99	14.56	9.53	10.24	12.37	11.88	12.88	65.95
100k +	32.59	38.86	17.46	19.02	43.18	11.48	26.44	87.35
Unknown	7.81	6.74	10.21	9.06	10.17	9.65	5.45	12.65

Table 2. Logistic Regression Models of Pain within the U.S Population, with Odds Ratios (n = 33, 316)

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Variable						
Race (White)						
Black/AA	0.67***	0.69***	0.67***	0.63***	0.63***	0.61***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Hispanic	0.61***	0.65***	0.64***	0.58***	0.59***	0.57***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Asian	0.42***	0.44***	0.45***	0.47***	0.47***	0.47***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AIAN	0.90	0.92	0.90	0.82	0.79	0.76
	(0.436)	(0.553)	(0.449)	(0.138)	(0.096)	(0.48)
Multiple Race	1.18	1.28*	1.25*	1.21	1.19	1.17
	(0.139)	(0.031)	(0.045)	(0.086)	(0.472)	(0.162)
Unknown	0.88	0.93	0.94	0.84	0.82	0.80
	(0.667)	(0.802)	(0.838)	(0.553)	(0.472)	(0.423)
Sex (Male)						
Female		1.33***	1.31***	1.32***	1.25***	1.25***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age						
25-64		1.02***	1.02***	1.02***	1.02***	1.02***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Marital Status (Married)						
Previously Married			1.40***	1.34***	1.33***	1.21***
			(0.000)	(0.000)	(0.000)	(0.000)
Never Married			1.03	1.00	0.98	0.90**
			(0.371)	(0.988)	(0.509)	(0.006)
Unknown			0.73	0.73	0.74	0.72
			(0.287)	(0.291)	(0.325)	(0.267)
Education (>HS +GED)						
HS				0.87**	0.92	0.96
				(0.008)	(0.119)	(0.442)
Some PS				1.00	1.07	1.13
				(0.959)	(0.208)	(0.023)
AA				0.95	1.04	1.17
				(0.405)	(0.477)	(0.055)
BA				0.66***	0.73***	0.82***
				(0.000)	(0.000)	(0.000)
BA+				0.64***	0.72***	0.83**
				(0.000)	(0.000)	(0.002)
Unknown				0.80	0.84	0.94

				(0.387)	(0.481)	(0.810)
Employment (Employed)						
Unemployed					1.37***	1.29***
					(0.000)	(0.001)
Not in LF					1.54***	1.46***
					(0.000)	(0.000)
Unknown					1.48	1.48
					(0.506)	(0.481)
Income (>$34,999)						
$35,000 - $74,999						0.88**
						(0.002)
$75,000 – $99,999						0.80***
						(0.000)
$100,000+						0.68***
						(0.000)
Unknown						0.66***
						(0.000)
Constant	1.26***	0.44***	0.45***	0.59***	0.58***	0.68***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	33,316	33,316	33,316	33,316	33,316	33,316

p-values in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Table 3. Predictive Probabilities with 95% Confidence Intervals (n = 33, 316)

	At Means	**Average**
Race or Ethnicity		
White	0.56 (0.55 – 0.57)	0.56 (0.55 – 0.56)
African American	0.44 (0.42 – 0.46)	0.44 (0.42 – 0.46)
Hispanic	0.42 (0.40 – 0.44)	0.42 (0.40 – 0.44)
Asian	0.37 (0.34 – 0.40)	0.38 (0.35 – 0.41)
AIAN	0.49 (0.42 – 0.56)	0.49 (0.43 – 0.56)
Multiple Race	0.60 (0.55 – 0.65)	0.59 (0.54 – 0.64)
Unknown	0.51 (0.37 – 0.64)	0.50 (0.38 – 0.63)

Figure 1. Predictive Probabilities by Race or Ethnicity.