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The Relationship between Pain and Depression in a San Antonio Mental Health Urgent Care Population

By

Leslie Dickmann

Degree to be awarded: MPH

Executive MPH

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The Relationship between Pain and Depression in a San Antonio Mental Health Urgent Care Population

By

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PhD, University of Washington, Department of Medicinal Chemistry, 2003
BS, University of Wisconsin – Madison, Department of Cell and Molecular Biology, 1995

Thesis Committee Chair: Shakira Suglia, ScD

An abstract of a thesis submitted to the Faculty of the Rollins School of Public Health of Emory University in partial fulfillment of the requirements for the degree of Master of Public Health in Executive MPH, 2018

Abstract

The Relationship between Pain and Depression in a San Antonio Mental Health Urgent Care Population

By Leslie Dickmann

Background: Pain and depression are two critical public health issues facing health care providers today, and the relationship between depression and pain is complex. The current study sets out to examine whether depression is associated with pain in a mental health urgent care population. Given the potential differences between the population used in this study and other populations used for pain and depression research (e.g. chronic pain sufferers, elderly), results from previous studies may not reflect those obtained in the current population.

Methods: The current population consists of 1,366 individuals seeking mental healthcare at the Sigma Mental Health Urgent Care (SMHUC) clinic located in San Antonio, TX. Intake data was obtained using *remindtrac*™, a health technology tool, depression was measured using the PHQ-9, and pain using a numeric rating scale. Descriptive statistics were used to characterize the population, and logistic regression was used to characterize the association between depression and pain.

Results: The mean PHQ-9 score in the urgent care population was 14.9 (SD = 7.1) indicating a moderate level of depression. The mean pain score was 3.5 (SD = 3.5) indicating a mild level of pain in this population. Pain was significantly associated with depression (OR 1.11, 95% CI 1.09 – 1.13), although only individuals with moderately severe or severe depression had a probability of moderate to severe pain > 0.5.

Conclusions: In the SMHUC population, all individuals with minimal, mild, or moderate depression (PHQ-9 < 15) have a rather low probability of moderate to severe pain. It is only in the cases of moderately severe to severe depression (PHQ-9 = 15-27) that the probability of moderate to severe pain may be a concern and may need to be monitored more closely.

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Acknowledgements

I would like to thank Drs. Shakira Suglia and Melissa Deuter for their time, guidance, and assistance throughout the thesis process and for very thoughtful feedback along the way. I would also like to thank Dr. Jeb Jones for his assistance throughout this process. Lastly, I would like to thank my fellow students and friends in the EMPH program. Without their support, kindness, and friendship, this thesis and resulting degree would not have been possible.

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Research question

The current research question is whether depression is associated with pain in a mental health urgent care population. This analysis was done using patient information obtained from the Sigma Mental Health Urgent Care (SMHUC) clinic located in San Antonio, TX. Given the potential differences between a mental health urgent care population in San Antonio and other populations in which the association between pain and depression have been studied (e.g. chronic pain sufferers, elderly), results from previous studies may not reflect those obtained in the current population. Descriptive statistics of the SMHUC population will also be presented and qualitatively compared to the wider San Antonio and Bexar County populations. This could inform practitioners as to which populations are or are not using SMHUC and could lead to better outreach to communities that are underutilizing SMHUC services.

Introduction

Depression and pain

An association between depression and pain has been previously studied, [1-4] and one author has called pain and depression "two of the most critical public health issues facing health care providers today." [4] Pain can cause depression, but the opposite is also true in that depression can cause pain and other physical symptoms. [2, 5-8] One study estimated that approximately 50% of patients suffering from depression also experienced physical pain symptoms. [9] The cycle of depression and pain can potentiate each other and assessing both pain and depression may be necessary in individuals who present with either. [1] Unfortunately, the idea of treating pain as an actual syndrome remains controversial due to unclear etiology

and social factors such as the opioid epidemic in the United States. [10] A recent commentary in the New England Journal of Medicine by Physicians for Responsible Opioid Prescribing suggests that opioid abuse is due to over-prescribing of opioids for pain and that the US medical community promotes drug-seeking behavior in individuals whose pain could be managed by other means. [11]

The current thinking is that pain and depression have shared neurobiological pathways. [3, 12-14]. However, the relationship between depression and pain is complex and likely involves multiple factors both known and unknown. A recent review on the link between pain and depression pointed out 16 different mechanisms, both biological and psychosocial, that have been shown to at least play some role in pain symptomology. [3] One hypothesis suggests that depression and potentially other mental health illnesses such as anxiety lead to neurological or cognitive changes that cause increased vulnerability to pain. [9] Evidence for this comes from studies that have looked at communities or populations of people without pain who were then exposed to psychological stressors which resulted in development of chronic pain symptoms. [9, 15] Much more research has been done on depression in populations already suffering from chronic pain. After controlling for baseline co-morbidities, many studies have shown that baseline pain is a risk factor for developing depression and that the magnitude of symptomatic pain can in some cases predict the magnitude of depression. [4, 6, 7, 16]

Both pain and mood are driven by similar neurotransmitters such as serotonin, norepinephrine, glutamate, and gamma-amino butyric acid (GABA). [4] Given this, one would expect certain anti-depressants to have analgesic effects depending on their mechanisms of action. This does appear to be the case for several anti-

depressants. For example, duloxetine is a common serotonin-norepinephrine reuptake inhibitor which is approved in the United States for major depressive disorder, generalized anxiety disorder, diabetic peripheral neuropathic pain, fibromyalgia, and chronic musculoskeletal pain. [17] Disentangling the complex interplay between pain and depression remains and active area of study, and it is hoped that further research will allow us to better understand not only the associative relationships between pain and mental health illnesses but also allow us to better understand cause and effect.

Mental Health Urgent Care

As the study population used in this analysis is composed of individuals accessing services at a mental health urgent care center, an overview of this novel system of the mental health care is presented here. Although the urgent care model has now become engrained in US health care, integrating mental health treatment into this model is a newer concept. There is limited literature available about mental health urgent care and its integration into the larger context of mental health care. As quoted from an article about integrating mental health into urgent care, "Unfortunately, although there is literature on urgent care centres, mental health centres and psychiatric emergency rooms, there is scant information about the integration of mental health services into an urgent care centre." [18] There is also a dearth of information on who uses mental health urgent care services. After an extensive literature search, no research investigations could be found on mental health urgent care outside of the Veterans Administration health care system. Two recent publications characterizing a San Diego Veteran Administration psychiatric urgent care clinic observed an exceptionally high prevalence of past suicidal

ideations and attempts particularly among homeless veterans. [19, 20] Unfortunately, neither of these studies investigated the relationship between depression and pain and no information on pain was reported. One could also argue that a population of military veterans is rather unique and likely does not reflect the wider non-veteran population in terms of mental health characteristics and outcomes. This lack of information on mental health urgent care populations has prohibited comparisons to other populations seeking mental health services and precludes assumptions as to the demographics and the relationship between depression and pain.

There are several advantages to the mental health urgent care model: [21]

- In general, patients can be seen the same day either through booking an appointment or via walk-in
- Patients can receive a full psychiatric evaluation as they would in a private practice
- If a patient already has a psychiatrist but is unable to see that practitioner due to wait times, the urgent care facility can coordinate with the patient's current practitioner
- For patients experiencing a delay in getting a first appointment, the patient can be seen and treated and either continue care at the urgent care facility or work with the urgent care facility to coordinate care with another community practitioner.

A recent article in the Los Angeles Times also highlights the fact that police are increasingly using mental health urgent care facilities as an alternative to jail beds or overcrowded psychiatric emergency rooms. [22] In August 2016, the Los Angeles

Police Department took 196 patients in mental health crisis to emergency rooms and 268 patients to an urgent care center [22] highlighting the importance of mental health urgent care centers not only to patients but also to the community as a whole. According to Mark Ridley-Thomas, a Los Angeles county supervisor, "Not only is it more humane, it is more cost effective, makes us better stewards of public resources, to build more urgent care centers than to build more jails." [22]

As the mental health urgent care model continues to grow and mature, we will be able to better assess the advantages and disadvantages of this model over others. However, limited data suggests that this model can 1) accommodate patients in crisis when other options are limited, 2) receive specialized psychiatric treatment compared to an emergency room, 3) decrease the number of people being incarcerated during mental health crises, and 4) save taxpayers money by lowering rates of emergency room use and incarceration for the mentally ill. [21, 22] A better understanding of patient demographics and outcomes in this population will also allow for comparisons to other sources of acute and chronic mental health care systems.

San Antonio, Texas

As the study population used in this analysis is composed of individuals from the San Antonio, TX metropolitan area, it is important to understand population demographics of this area when interpreting the current results so that appropriate comparisons can be made. San Antonio is the second largest city in Texas with a population of 1.41 million people, while the larger San Antonio metropolitan area is approximately 2.38 million people. Unless otherwise cited, the following demographics are based on the wider San Antonio metropolitan area and taken from

the 2015 US Census. [23] The median age of San Antonio residents is 34.4 years with 62% of the population between the ages of 18 and 64 years. Thirty-four percent of the population is White, 55% is Hispanic or Latino, 6% is Black, 2% is Asian, and 2% is mixed race. Eighty-four percent of adults have at least a high school diploma and 26.6% have a bachelor's degree or higher.

San Antonio is located in Bexar County. As the population of the city comprises 77% of the county population, one may assume that descriptive statistics of Bexar County should reflect both the city and likely the whole metropolitan area of Bexar County. A 2013 report entitled "Bexar County Community Health Assessment" evaluated the mental health status of Bexar County residents using self-reported information from the 2012 Behavioral Risk Factor Surveillance System (BRFSS) and the 2013 Youth Risk Behavior Surveillance System (YRBSS). [24] Information from this report will be used as context for interpreting descriptive statistic performed in the current study. One of the overarching conclusions of this report is that mental health in Bexar County should be viewed as a critical and growing issue and that more resources need to be redirected to ensure mental health challenges are being met. According to this report, "County leaders and residents view mental health as a critical issue in Bexar County. Economic stress on adults and academic and social pressures on youth have taxed the limited mental health system."

From this report, 23% of Bexar County adults reported experiencing five or more days of poor mental health status (stress, depression, or emotional problems) within the last month. This number was slightly higher than the Texas population as a whole (20.4%) or the US as a whole. Women were more likely than men to report poor mental health (25% vs 20%, respectively) and Whites were more likely than

Hispanics to report poor mental health (28% vs 20%, respectively). Over twice as many people with less than a high school education reported having poor mental health compared to individuals who were at least high school graduates (38% vs 16%, respectively). Mental health disorders accounted for the highest proportion of hospitalization in the county at approximately 6 per 1,000 individuals. The rate of hospitalization for mental health disorders was lowest among Hispanics (8 per 1,000 individuals) compared to Blacks (14 per 1,000 individuals) or Whites (13 per 1,000 individuals).

Reported mental health issues were particularly high among youths (also referred to as students in this report) in Bexar County. Approximately 30% of youths said they felt sad or hopeless. These numbers are similar to Texas as a whole but slightly higher than 2011 figures for the entire US (28.5%). Rates were much higher among female youth (37%) than male youth (22%) and among Hispanic youth (30%) compared to White youth (23%).

Methods

Literature review

PubMed, Web of Science, and PsycINFO were used for all literature searches. Searches were done using the following key words in the title or abstract either individually or with either the "AND" or "OR" function: PHQ-9, patient health questionnaire 9, depression, pain, mental health or psychiatric urgent care. As this search returned > 20,000 articles, the search was further refined using PHQ-9 as a title word only. Pain and depression were also searched using only the "AND" function in the title only and non-clinical studies were excluded through filtering via the clinical trial function. These searches returned approximately 350 articles which

were then assessed by reading each abstract for content. For searches related to more specific topics (e.g. pain and suicide), a similar tactic was used.

San Antonio census data was taken from the US Census Bureau [23] and DataUSA [25] websites. The DataUSA website utilizes US Census bureau data to create visuals of city level census data. Information on San Antonio mental health statistics was taken from a 2013 report entitled Bexar County Community Health Assessment [26]. This report was compiled by the Health Collaborative of Bexar County, which is a group of citizens, community organizations, and businesses.

Dataset

This thesis was approved by the Emory University Institutional Review Board. Patient level data was taken from Sigma Mental Health Urgent Care (SMHUC) of San Antonio, Texas between March 27, 2015 and August 12, 2017. Appropriate HIPAA identifiers were purged from the dataset before receipt and patient names replaced with a random patient ID number. For certain variables (e.g. occupation) where a proper name could potentially identify a patient, the proper name was replaced with the term "other." As the dataset does not included longitudinal data, only the information at intake could be assessed. In the rare case of duplicates (12 total), only the initial intake assessment was used. Where age was less than 10 or greater than 85, these individuals were also removed from the dataset. This resulted in 28 patients being removed from the dataset. The final number of individuals in the dataset was 1366.

The variables included in the dataset are as follows:

Variable	Explanation of variable
Patient ID	Unique number for each individual
Occupation	Occupation of individual patient. This variable was grouped into occupational categories as the amount of individual occupations was greater > 100. For descriptive statistics, the occupational categories are as follows: • Student • Health care/medicine/counseling • Sales/marketing/customer service • Unemployed/disabled • Retired • Teaching/education • Skilled trades • Restaurant industry/food service • Entertainments/arts • Banking/accounting • IT/data management • Law/law enforcement • Other • Not provided
Race and ethnicity	Patient self-identified racial or ethnic group. Choices were: • White • Hispanic or Latino • Mixed race • Black or African American • Asian • American Indian or Alaska Native • Native Hawaiian or Other Pacific Islander
Age	Patient age
PHQ-9 Score	Score from the patient health questionnaire 9. More information on the PHQ-9 assessment is provided below.
Functional difficulty	Answer to the question, “How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?” Categories include: • Not difficult at all • Somewhat difficult • Very difficult • Extremely difficult
Pain value	Answer to the question, “What has your average pain level been over the last five days?” This is a based on a scale of 1-10 with 0 being no pain at all and 10 being excruciating pain. It should be noted that individuals were allowed to choose “More than 10,” which results in 11 on the continuous scale.
Physical activity value	Answer to the question, “Over the last five days, how many hours on average have you been physically active and out of bed each day?”

Sleep value	Answer to the question, "On average, how many hours per night are you sleeping, uninterrupted?"
Harm behavior	Answer to the question, "Are you currently having thoughts of harming yourself or someone else?" Choices are: • No • Yes – myself • Yes – someone else • Yes – both
Suicidal attempt history	Answer to the question, "Do you have a history of suicidal attempts?"
Currently under the influence	Answer to the question, "Are you currently under the influence of any of the following?" Choices are: • None • Psychotropic medication • Alcohol • Street drugs • Combination of the above
Frequency of substance use	Answer to the question, "How often do you use drugs or alcohol?" Choices are: • Never • Monthly or less • 2 to 4 times a month • 2 to 3 times a week • 4 or more times a week • No response
Frequency of non-prescribed mediations	Answer to the question, "How often do you use medications (or dosages) which are not prescribed to you?" Choices are: • Never • Monthly or less • 2 to 4 times a month • 2 to 3 times a week • 4 or more times a week • No response
Current prescription	Answer to the question, "Are you currently prescribed medications?"

Data collection

Data was collected using *remindtrac*™, a health technology tool that allows healthcare professionals to conduct clinical assessments, monitor medication therapy management in real-time and encourage patient participation and feedback. [27] The *remindtrac* platform allows behavioral health providers and other

health care professionals to deploy paperless clinical assessments, directly in the hands of patients via a mobile device (tablet) at the physician's office or remotely, directly on the patient's mobile device. This pre-visit interaction, when the patient is answering the assessment questions directly into the mobile device, allows for a more honest, "judgment free" answer, permitting the health care professional to have more patient relevant conversation topics that can be addressed during the office visit, therefore impacting patient outcomes and effectively promoting continuum of care.

Depression measurement using PHQ-9

The patient health questionnaire 9, or PHQ-9 for short, is a diagnostic tool for mental health disorders that is commonly used by mental health care professionals. [28, 29] The PHQ-9 is a shortened form of the Primary Care Evaluation of Mental Disorders (PRIME-MD), a diagnostic tool for mental health disorders. [30] The benefit of the PHQ-9 as a diagnostic instrument is that it is half the length of many other depression measures while having comparable sensitivity and specificity across many different populations. [31, 32] The PHQ-9 is composed of nine questions as shown in Table 1 below. Scores for each individual column are then summed to create a total PHQ-9 score.

Table 1. The PHQ-9 questions and scoring system

Over the last 2 weeks, how often have you been bothered by any of the following problems?

	A	B	C	D
	Not at all	Several days	More than half the days	Nearly every day
Little interest or pleasure in doing things	0	1	2	3
Feeling down, depressed, or hopeless	0	1	2	3
Trouble falling or staying asleep, or sleeping too much	0	1	2	3
Feeling tired or having little energy	0	1	2	3
Poor appetite or overeating	0	1	2	3
Feeling bad about yourself – or that you are a failure or have let yourself or your family down	0	1	2	3
Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
Moving or speaking so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3
Total				

Total PHQ-9 score = sum of column totals from A, B, C, and D

Total PHQ-9 score can be further categorized as minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), and severe (20-27) depression.

Statistical Analysis

Descriptive statistics were performed using either JMP v11 or SAS v9.4 (SAS, Institute, North Carolina, USA). Data was first analyzed in its entirety and reported

at the level of mean, standard deviation, median, range, minimum, and maximum for continuous variables. Categorical variables were reported as number and percentage of the total population (Table 2). Because it was observed that almost 20% of the SMHUC population identified as students and the Bexar County health assessment report stratified adolescents and young adults based on "student," data was then analyzed on the basis of occupation using two categories – student and other occupation (Table 3). Lastly, descriptive statistics were analyzed on the basis of no to mild pain versus moderate to severe pain with pain categorized as described in Table 4. This also removed the obstacle of using the pain value of "11" which could be any number greater than 10 as discussed in the table above. Statistical differences between groups were determined using independent 2-tailed *t* test for continuous variables and the chi-square likelihood ratio test for categorical variables. For the chi-squared test, if greater than 20% of cells had a frequency of less than 5, certain categorical subgroups were combined to avoid this.

For logistic regression analysis, certain variables were recoded as follows.

Variable	**Recode**
Occupational category	• Student • All other • No response
Race and ethnicity	• White • Hispanic or Latino • Other
Age	• < 18 years • 18 to < 30 years • 30 to < 45 years • 45 to < 60 years • 60+ years

Pain value	• No to mild pain (0 – 4 on the linear pain scale) • Moderate to severe pain (>4 on the linear pain scale) These categories are based on pain classification index used by the University of Wisconsin School of Medicine and Public Health (http://projects.hsl.wisc.edu/GME/PainManagement/session2.4.html)
Harm behavior	• No • Yes
Currently under the influence	• No • Yes
Frequency of substance use	• Never • Monthly or less • More than once per month
Frequency of non-prescribed mediations	• Never • Monthly or less • More than once per month

Although both the dependent and independent variables were originally continuous measures, linear regression analysis was not used. After a precursory analysis, it was determined that the linear regression assumptions of normality and homoscedasticity were likely violated for pain score, and logarithmic transformation did not correct this problem. Thus, logistic regression analysis using a meaningful clinical cutoff for the outcome, pain, was used. The exposure variable, PHQ-9 score, was kept as a continuous measure. Control variables to include in the initial model were chosen based on biological plausibility and previous literature reports on the association of pain with various measures. The reasoning for including or excluding a variable from the model is shown in the table below:

Variable	Included or excluded in initial model?	Explanation/comments
PHQ-9 score	Included	Exposure variable
Occupational category	Included	Biological plausibility/literature evidence – caution should be taken as there may be some overlap with age category
Age category	Included	Biological plausibility/literature evidence
Race/ethnicity	Included	Biological plausibility/literature evidence
Functional difficulty	Excluded	This information is also captured in the PHQ-9 score
Physical activity value	Excluded	This information is also captured in the PHQ-9 score
Sleep value	Excluded	This information is also captured in the PHQ-9 score
Harm behavior	Excluded	This information is also captured in the PHQ-9 score
Suicidal attempt history	Excluded	This information is also captured in the PHQ-9 score
Currently under the influence	Excluded	This information is captured in "frequency of substance abuse"
Frequency of substance use	Included	Biological plausibility/literature evidence
Frequency of non-prescribed mediations	Included	Biological plausibility/literature evidence
Current prescription	Included	Biological plausibility/literature evidence

Initial logistic regression analysis containing 1) only the exposure variable, 2) exposure plus control variables, and 3) exposure, control, and interaction variables was performed. A "chunk test" was performed comparing the full model with all interaction terms to a reduced model with the interaction terms removed. The results ($p = 0.77$) indicated that all interaction terms could be removed from the model.

An assessment for confounding by control variables was then performed to investigate whether inclusion/exclusion of control variables resulted in a meaningful (> 10% change) in the estimated odds ratio (OR). The goodness-of-fit statistic was estimated using the Hosmer-Lemeshow method in SAS, and the receiver operating characteristic (ROC) curve and predicted pain classification was generated in JMP using logistic regression diagnostics. Outcomes from the confounding assessment are presented in the Results section.

Results

Descriptive statistics

Descriptive statistics of the SMHUC population are presented in Tables 2-4. In total, 1,366 individuals were included in the cohort, and Table 2 describes the population as a whole. The mean and median age of this study population was 32.8 and 29 years, respectively, with a range of 10 – 85 years of age. The study population was predominantly white (62.1%) and Hispanic or Latino (24%) with all other races comprising 13.9% of the population, and students comprising 17.3% of the SMHUC population. The mean and median PHQ-9 score was 14.9 and 16, respectively, suggesting that the average individual in this population suffered from moderate to moderately severe depression. In terms of PHQ-9 difficulty category, approximately 60% of the study population indicated that their symptoms made it either very or extremely difficult to do their work, take care of things at home, or get along with other people. The mean and median pain value for this population was 3.5 and 3, respectively, which suggests that this population as whole experienced mild pain symptoms as based on the University of Wisconsin pain classification index (see Methods). It should be noted that 478 individuals (35%) had no pain symptoms

at all (pain value = 0). The mean amount of time that the study population was physically active and out of bed each day was 7.9 hours, and the mean value for time spent in uninterrupted sleep each evening was 5.1 hours.

Questions around harmful and potentially injurious behaviors were also investigated in the SMHUC population. The majority of the population, 76.6%, indicated having no thoughts of harming themselves or someone else, while 22.7% of the population indicated thoughts of harming themselves and/or someone else. Approximately 20% of the study population has previously attempted suicide. Although the majority of the study population indicated that they were not currently under the influence, 19.9% indicated that they were currently under the influence of psychotropic medication, alcohol, street drugs, or a combination of these. The frequency of alcohol and drug use was also assessed. Approximately 41% of the study population never used either, whereas 16% used monthly or less, 15.4% used 2 to 4 times a month, and 27.1% used 2 to 3 times a week or more. The majority of the study population, 84.5%, never used non-prescribed medications and 58.9% of the population had a current prescription, although information on the types of medication prescribed was unavailable.

With the exception of occupational category, non-responses were minimal. For occupation, approximately one-third of the study population did not provide a response. The reasons for this are unknown. However, for all other categories, non-response was between 0% and 2.2%.

Because students comprised a large percentage of the SMHUC population, student attributes were compared to other members of the SMHUC population in which an occupation other than student was known. The results from this

stratification are shown in Table 3. The mean age of students was 18.2 years compared to 39.0 years for individuals in the other category. Students had a significantly lower mean PHQ-9 score of 13.1 compared to 15.2 for others. Students also had a significantly lower mean pain value of 2.9 compared to others at 3.6. The mean amount of time that students were physically active and out of bed each day was 7.8 hours compared to 8.3 hours for others, and the mean value for time spent in uninterrupted sleep each evening was 6.1 hours for students compared to 4.7 hours for others. Both of these differences were statistically significant.

There was no difference between suicide attempt history between students and others, but students (34.3%) were twice as likely to harm themselves or someone else compared to others (17.6%). Students (12.7%) were less likely to be under the influence of psychotropic medication, alcohol, street drugs or a combination of these compared to others (23.2%), and a larger proportion of students (58.5%) indicated that they never abused drugs or alcohol compared to others (32.7%). Lastly, students (51.3%) were less likely to have a current prescription compared to others (63.8%).

Table 4 describes the SMHUC population stratified by pain category of either no to mild pain or moderate to severe pain. There was no difference in the mean age or occupational category between these two groups, but a larger percentage of Hispanic or Latino individuals was represented in the moderate to severe pain group (28.2%) compared to the no to mild pain group (21.3%). The opposite was true for White individuals where 65.5% of the no to mild pain group was comprised of Whites compared to 56.7% of the moderate to severe pain group. Individuals with no to mild pain had a significantly lower mean PHQ-9 score of 13.1 compared to 17.8

for individuals with moderate to severe pain, and 72.2% of individuals with moderate to severe pain indicated that it was either extremely or very difficult to do their work, take care of things at home, or get along with other people compared to 51.8% of individuals with no to mild pain. The mean amount of time that individuals with no or mild pain were physically active and out of bed each day was 8.0 hours compared to 7.7 hours for individuals with moderate to severe pain, and these individuals also spent significantly less time in uninterrupted sleep each evening at 4.6 hours compared to 5.4 hours for individuals with no to mild pain.

There was no significant difference between the two groups in terms of whether individuals were currently under the influence or the frequency of alcohol or drug abuse. However, individuals with moderate to severe pain (30.8%) indicated that they were more likely to harm themselves and/or someone else compared to individuals with no to mild pain (17.3%). A significantly larger percentage of individuals with moderate to severe pain (27.4%) had previously attempted suicide compared to individuals with no to mild pain (15.7%). Current medication prescriptions were significantly lower in patients with moderate to severe pain (56.0%) compared to individuals with no to mild pain (60.7%).

Association between pain and PHQ-9 score

Logistic regression was used to investigate the relationship between pain and PHQ-9 score as described more fully in the Methods section. Pain score was categorized using a clinically meaningful cutoff to differentiate into two groups, those individuals with no to mild pain and those with moderate to severe pain. As shown in Table 5 and Figure 1, there was a significant relationship between pain and PHQ-9 score in that for every unit increase in the PHQ-9 score, the odds that an

individual will suffer from moderate to severe pain increases 11.1%. As shown in Table 5, there was very little difference in OR and corresponding confidence interval (CI) between the unadjusted and adjusted models. In the adjusted analysis, only one control variable, race/ethnicity, showed a statistically significant relationship with pain category (p = 0.0172), with Hispanic or Latino individuals having greater odds of moderate to severe pain (OR = 1.47, 95% CI = 1.11, 1.94) compared to White individuals. Using goodness-of-fit diagnostics, a significant *p*-value (0.006) was observed for the unadjusted model but not for the fully adjusted model (p = 0.1432, Table 5). Partially adjusted models were also investigated, but they did not change the OR value or increase precision of the model (data not shown). The adjusted model was able to correctly classify 65.6% of individuals and the receiver operating characteristic (ROC) curve is illustrated in Figure 2. The area under the curve (AUC) value of 0.703 suggests a fair discrimination for the adjusted model.

Discussion

Descriptive statics can offer a comprehensive understanding of the SMHUC population. In the current analysis descriptive statistics were used to understand the SMHUC population as a whole, stratified by student versus non-student, and stratified by pain category. The complete SMHUC population can be compared demographically to San Antonio and Bexar County, although caution must be used as the SMHUC population is seeking emergency mental health care while care seeking behavior in the county population is not known. The SMHUC population had a mean age of 32.8 years which is similar to the mean age of 34.4 [23] for the San Antonio metropolitan area. However, racial demographics of the SMHUC population at 62% White, 24% Hispanic or Latino, and 2.9% Black do not reflect that of the wider San

Antonio community at 34% White, 55% Hispanic or Latino and 6% Black. [23] This may be due to the fact that individuals who identify as White are more likely than Hispanic or Latino individuals to report poor mental health in Bexar County, TX, [26] but it could also imply that SMHUC resources are not reaching populations of color. The mean PHQ-9 score in the SMHUC population suggests moderate to moderately severe depression in this population. Unfortunately no PHQ-9 information from other San Antonio populations or mental health urgent care centers could be found to use as a reasonable comparator. A similar issue was encountered when interpreting the pain value. The mean pain value of 3.5 suggests that the SMHUC population as a whole suffers from only mild pain symptoms. As pain has never been studied in a non-veteran urgent care mental health population, an expectation of pain levels in this population was unknown. As indicated in the results section, a large proportion of this population (35%) had no pain symptoms at all (pain value = 0) which greatly skewed the population towards the lower end of the pain scale and presented challenges for regression analysis. In terms of substance use as defined by either alcohol or drugs, the SMHUC population does not appear to differ substantially from the wider Bexar County population [26], however direct comparisons could be problematic due to way questions were posed. For instance, in the SMHUC population “drugs” were not defined whereas in the Bexar County report, frequency of use questions were asked concerning alcohol, marijuana and cocaine separately. Even with this caveat, there appear to be no gross differences in the SMHUC and Bexar County populations in terms of alcohol and drug use frequency.

Of some concern in the SMHUC population is the lack of sleep and the potential for harm behavior. Individuals in this population report getting on average 5.1 hours of uninterrupted sleep each night which is well below the national average of 6.8 hours and the recommended amount of 7 to 9 hours each evening. [33] Like pain, the relationship between sleep and depression is complex; depression may cause sleep problems and sleep problems can contribute to depression. [34] Sleep problems are also associated with more severe depression and anxiety which suggest that addressing sleep issues could be one way to help combat depression in the SMHUC population. [35, 36] Approximately 25% of individuals in the SMHUC population indicated having thoughts of harming themselves, someone else, or both. Given this statistic, particular attention may need to be paid to these individuals with potentially more robust intervention measures.

Because a considerable proportion of the SMHUC population (17.3%) self-identified as students, the population was also stratified into students and non-students (those who reported an occupation other than student). Another reason for stratifying based on 'student' and not age group was to compare to the recent Bexar County mental health statistics which also stratified based on student and not age group. While the mean age of non-students was 39.0 years, it was 18.2 years for students and suggests that the majority of students treated at SMHUC were in high-school or college. The age demographics also suggest that stratifying by student can be used as a surrogate for stratifying by adult versus adolescence/young adult. Approximately 19% of students in this population indicated a previous suicide attempt. Although this value did not differ significantly from non-students, it is much higher than the 8.6% of Bexar County and 10.8% of Texas students who had

previously attempted suicide, although this higher prevalence may be expected in a clinical population seeking care. [26] This in combination with the high rate of harm behavior (34.3%) compared to analogous populations (12 – 20%) [37, 38] and the SMHUC adult population suggests that the SMHUC student population could be at greater risk of suicide and physical violence than either their SMHUC non-student counterparts or the general student population in Texas.

Compared to non-students, students had significantly lower mean PHQ-9 and pain scores. It should be noted that the PHQ-9 has been validated in adolescents [39] and thus appropriate for use in the SMHUC student population. No information could be found concerning validation of the exact pain scale used here for adolescents, but validation has been shown for similar numerical rating scales for pain in adolescent populations. [40] From the PHQ-9 scores, students in the SMHUC population appear to suffer from moderate depression and non-students from moderately severe depression. Whether this significant yet subtle difference in the PHQ-9 score (2.1 units) is clinically meaningful would have to be addressed by a mental health care specialist. Based on the mean pain scores, both students and non-students generally present with no to mild pain. On average, students slept 1.4 more hours each evening, which again emphasizes the lack of sleep that the SMHUC adult population is experiencing at an average of only 4.7 hours each evening. However, students in the SMHUC population can in general be considered sleep deprived given that 8 or more hours of sleep are recommended for people between the ages of 12 – 21 and 7 or more hours of sleep are recommended for people age 22 and above. [41]

Stratifying the SMHUC population by pain category (no to mild pain versus moderate to severe pain) can give some initial insights into the characteristics of

individuals in the moderate to severe pain category. These individuals had a significantly higher mean PHQ-9 score (17.8 versus 13.1) compared to individuals in the no to mild pain category and were 1.5 times more likely to find daily activities very or extremely difficult. Individuals in the moderate to severe pain category were also more likely to sleep fewer hours each evening, twice as likely to consider harming themselves or someone else, and twice as likely to have previously attempted suicide compared to individuals in the no to mild pain category. Interestingly, individuals in the moderate to severe pain category were less likely to have any current prescription. These characteristic of SMHUC moderate to severe pain population are generally consistent with recent reviews on pain and its relationship with other characteristics. [2, 14, 42, 43] However, a systematic review of pain and self-harm suggests that individuals who self-harm have an elevated pain tolerance and may actually feel pain to a lesser extent. [44] Whether this is a cause of or a consequence of the behavior is currently unclear.

Many studies have looked at the relationship between pain and depression using a standard pain scale, as used in this study, and the PHQ-9. However, the majority of these studies have looked at depression in terms of pain caused by chronic physical ailments such as fibromyalgia, cancer, HIV, migraine, and orthopedic surgeries. [45-50] Data as to whether individuals in the SMHUC population were suffering from a chronic physical ailment was not collected and thus could not be considered for our analysis. Several studies have looked at the effects of depression on pain outcomes by screening individuals for depression and pain before and after surgery or treatment. Three studies investigated the effects of clinically meaningful depression (as measured by the PHQ-9) on post-operative pain outcomes. All three studies

indicated that preoperative depression was associated with more severe post-surgery pain, slower recovery, and in one case increased medical visits. [51-53] A recent study investigated the differences in migraine pain between individuals with depression symptoms (PHQ-9 > 5) and those without. In this study, individuals suffering from symptoms of depression had significantly more headaches per month and experienced greater pain and sensitization. [54] The results from these studies suggest that depression can cause increased, longer lasting or worsening pain. One report in a Japanese population investigating the relationship between depression and pain in individuals considered otherwise physically healthy found that individuals with depression who reported physical pain had higher PHQ-9 depression scores (14.3 vs 11.1, $p>0.001$). [55] The results obtained in the current analysis are in line with those previously published, although direct comparisons with previously published reports are somewhat tenuous due to differences in in study type (cross-sectional vs longitudinal), choice of model (logistic vs linear), and variable selection. However, the current analysis using the SMHUC population clearly indicates that the odds of having moderate to severe pain are higher with increased PHQ-9 score. Table 6 demonstrates the probability of moderate to severe pain at different PHQ-9 scores for a white, non-student between the ages of 30-45 year who never uses drugs, alcohol, or non-prescription medications and does not have a current prescription. In the SMHUC population, all individuals with minimal, mild, or moderate depression (PHQ-9 < 15) have a rather low probability of moderate to severe pain. It is only in the cases of moderately severe to severe depression (PHQ-9 = 15-27) that the probability of moderate to severe pain may be a concern and

should be monitored more closely, as individuals with moderate to severe chronic pain may be more inclined to self-medicate with drugs or alcohol. [56]

There were several limitations to this analysis. A major limitation is that this is a cross-sectional study and thus not valid for examining a cause and effect relationship. As longitudinal data was not available, it was not possible to evaluate the relationship between PHQ-9 and pain over time and evaluate interventions such as anti-depressants or psychotherapy. Given the nature of mental health urgent care in providing short-term treatment, a longitudinal analysis may not be feasible with this population unless a study is prospectively designed this way. A second limitation to this analysis is that information was not collected about variables known to be important in pain perception and reporting. For instance, information on gender was not available for this analysis, and it has been shown that gender influences pain perception and reporting. [57] Information concerning recently diagnosed acute or chronic illness or injury was also not collected in this population, and previous studies have shown that this can significantly affect pain and PHQ-9 score and alter the relationship between the two variables. [46, 58, 59] Logistic regression analysis was chosen for this analysis as linear regression was deemed inappropriate. This made it difficult to directly compare to previous studies investigating the effects of depression on pain as most of these studies used linear regression. However, it should be noted that the lack of information on model choice justifications, assumptions, and diagnostics in previous studies indicates that these results need to be viewed with caution. Lastly, the pain scale used in this analysis does not necessarily delineate between emotional and physical pain, which could impact future treatment or intervention strategies. However, a recent study

suggests that our brains make little distinction between the physical and emotional pain [60] and that analgesics, such as acetaminophen, could relieve emotional pain. [61]

In conclusion, our results describe the San Antonio SMHUC population with a focus on 1) demographic information for the SMHUC population, 2) summary statistics around key measures and indicators important in treating the SMHUC population, and 3) elucidating the probability of SMHUC patients to suffer from moderate to severe pain symptoms based on their PHQ-9 score and other explanatory variables. It is the hope of the author that this information can be used to better serve the SMHUC population and wider San Antonio community.

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Table 2. Descriptive statistics of the entire SMHUC study population used in this analysis.

Characteristic		
Total population	1366	
Age (years)		
Mean (SD)	32.8 (15.7)	
Median (range)	29 (75)	
Minimum	10	
Maximum	85	
Race	**N**	**%**
White	848	62.1
Hispanic or Latino	328	24.0
Mixed Race	78	5.7
Black or African American	40	2.9
Asian	29	2.1
American Indian or Alaska Native	14	1.0
Native Hawaiian or Other Pacific Islander	1	0.1
Not provided	28	2.0
Occupation	**N**	**%**
Student	236	17.3
Other	161	11.8
Health care/medicine/counseling	78	5.7
Sales/marketing/customer service	75	5.5
Unemployed/disabled	69	5.1
Homemaker/self-employed	66	4.8
Retired	57	4.2
Teaching/education	48	3.5
Skilled trades	37	2.7
Restaurant industry/food service	31	2.3
Entertainment arts	24	1.8
Banking/accounting	24	1.8
IT/data management	21	1.5
Law/law enforcement	19	1.4
Not provided	420	30.7

PHQ-9 score		
Mean (SD)	14.9 (7.1)	
Median (range)	16 (27)	
Minimum	0	
Maximum	27	
Functional difficulty	**N**	**%**
Extremely difficult	472	34.6
Very difficult	346	25.3
Somewhat difficult	400	29.3
Not difficult at all	137	10.0
No response	11	0.8
Pain value		
Mean (SD)	3.5 (3.5)	
Median (range)	3 (11)	
Minimum	0	
Maximum	11	
Physical activity value		
Mean (SD)	7.9 (3.5)	
Median (range)	10 (11)	
Minimum	0	
Maximum	11	
Sleep value		
Mean (SD)	5.1 (2.5)	
Median (range)	5 (11)	
Minimum	0	
Maximum	11	
Harm behavior	**N**	**%**
None	1046	76.6
Yes – myself	240	17.6
Yes – someone else	20	1.5
Yes – both	49	3.6
No response	11	0.8
Previous suicide attempt	**N**	**%**
No	1079	79.0
Yes	277	20.3
No response	10	0.7

Currently under the influence	**N**	**%**
None	1093	80.0
Psychotropic medication	204	14.9
Alcohol	25	1.8
Street Drugs	14	1.0
Combination of the above	30	2.2
Frequency of substance use	**N**	**%**
Never	554	40.6
Monthly or less	218	16.0
2 to 4 times a month	211	15.4
2 to 3 times a week	202	14.8
4 or more times a week	168	12.3
No response	13	1.0
Frequency of non-prescribed medications	**N**	**%**
Never	1154	84.5
Monthly or less	83	6.1
2 to 4 times a month	40	2.9
2 to 3 times a week	23	1.7
4 or more times a week	55	4.1
No response	11	0.8
Current prescription?	**N**	**%**
Yes	804	58.9
No	549	40.2
No response	13	1.0

Table 3. Descriptive statistics of the SMHUC study population used in this analysis stratified by student or non-student. Individuals who did not respond to the question on occupation were excluded from this analysis.

Characteristic	**N (%)**		***p*-value[a]**
	Non-student	Student	
Total population	710 (75.1)	236 (24.9)	
Age			
Mean (SD)	39.0 (15.1)	18.2 (5.1)	<0.0001
Race			
Asian	15 (2.1)	6 (2.5)	0.66
Black or African American	19 (2.7)	6 (2.5)	
Hispanic or Latino	162 (22.8)	62 (26.2)	
Mixed Race	33 (4.6)	15 (6.4)	
Not Provided/Other	28 (3.9)	5 (2.1)	
White	453 (63.8)	142 (60.2)	
PHQ-9 score			
Mean (SD)	15.2 (7.1)	13.1 (6.4)	<0.0001
Functional difficulty			
Extremely difficult	265 (37.3)	50 (21.2)	<0.0001
Very difficult	172 (24.2)	69 (29.2)	
Somewhat difficult	202 (28.5)	88 (37.3)	
Not difficult at all	68 (9.6)	29 (12.3)	
No response	3 (0.4)	0 (0)	
Pain value			
Mean (SD)	3.6 (3.5)	2.9 (3.1)	<0.0001
Physical activity score			
Mean (SD)	8.3 (3.3)	7.8 (3.5)	<0.0001
Sleep value			
Mean (SD)	4.7 (2.5)	6.1 (2.3)	<0.0001
Harm behavior			
No	585 (82.4)	155 (65.7)	<0.0001
Yes – myself, someone else or both	125 (17.6)	81 (34.3)	
Previous suicide attempt			
No	588 (82.8)	191 (80.9)	0.44
Yes	122 (17.2)	45 (19.1)	
Currently under the influence			
No	545 (76.8)	206 (87.3)	0.0003
Yes - psychotropic medication, alcohol, street drugs or combination	165 (23.2)	30 (12.7)	

Frequency of substance use			
Never	232 (32.7)	138 (58.5)	<0.0001
Monthly or less	131 (18.5)	29 (12.3)	
2 to 4 times a month	112 (15.8)	36 (15.3)	
2 to 3 times a week	124 (17.5)	18 (7.3)	
4 or more times a week	106 (14.9)	15 (6.4)	
No response	5 (0.7)	0 (0)	
Frequency of non-prescribed medications			
Never	607 (85.5)	211 (89.4)	0.29
Monthly or less	38 (5.4)	10 (4.2)	
More than once per month	65 (9.2)	15 (6.4)	
Current prescription?			
Yes	453 (63.8)	121 (51.3)	0.0007
No	253 (35.6)	115 (48.7)	
No response	4 (0.6)	0 (0)	

[a]$\alpha = 0.05$, independent 2-tailed *t* test for continuous variables, chi-square test

likelihood ratio for categorical variables

Table 4. Descriptive statistics of the SMHUC study population used in this analysis stratified by pain category. No to mild pain represents 0 – 4 on the linear pain scale and moderate to severe pain represents > 4 on the linear pain scale. These categories are based on pain classification index used by the University of Wisconsin School of Medicine and Public Health.

Characteristic	**N (%)**		***p*-value[a]**
	No to mild pain	Moderate to severe pain	
Total population	830 (60.8)	536 (39.2)	
Age			
Mean (SD)	32.7 (16.3)	32.6 (14.6)	0.62
Race			
Asian	19 (2.3)	10 (1.9)	0.04
Black or African American	23 (2.8)	17 (3.2)	
Hispanic or Latino	177 (21.3)	151 (28.2)	
Mixed Race	40 (4.8)	38 (7.1)	
Not Provided/Other	27 (3.3)	16 (3.0)	
White	544 (65.5)	304 (56.7)	
Occupational category			
Student	157 (18.9)	79 (14.7)	0.099
All other	429 (51.7)	281 (52.4)	
No response	244 (29.4)	176 (32.8)	
PHQ-9 score			
Mean (SD)	13.1 (7.1)	17.8 (5.9)	<0.0001
Functional difficulty			
Extremely difficult	229 (27.6)	243 (45.3)	<0.0001
Very difficult	202 (24.3)	144 (26.9)	
Somewhat difficult	270 (32.5)	130 (24.2)	
Not difficult at all	118 (14.2)	19 (3.5)	
No response	11 (1.3)	0	
Physical activity score			
Mean (SD)	8.0 (3.5)	7.7 (3.5)	0.0048
Sleep value			
Mean (SD)	5.4 (2.6)	4.6 (2.4)	<0.0001
Harm behavior			
No	675 (81.3)	371 (69.2)	<0.0001
Yes – myself, someone else or both	144 (17.3)	165 (30.8)	
No response	11 (1.3)	0 (0)	

Previous suicide attempt			
No	690 (83.1)	389 (72.6)	<0.0001
Yes	130 (15.7)	147 (27.4)	
No response	10 (1.2)	0 (0)	
Currently under the influence			
No	676 (81.5)	417 (77.8)	0.101
Yes - psychotropic medication, alcohol, street drugs or combination	154 (18.5)	119 (22.2)	
Frequency of substance use			
Never	343 (41.3)	211 (39.4)	0.094
Monthly or less	126 (15.2)	92 (17.2)	
2 to 4 times a month	132 (15.9)	79 (14.7)	
2 to 3 times a week	115 (13.9)	87 (16.2)	
4 or more times a week	102 (12.3)	66 (12.3)	
No response	12 (1.5)	1 (0.2)	
Frequency of non-prescribed medications			
Never	711 (85.7)	443 (82.7)	0.028
Monthly or less	46 (5.5)	37 (6.9)	
More than once per month	63 (7.6)	55 (10.3)	
No response	10 (1.2)	1 (0.2)	
Current prescription?			
Yes	504 (60.7)	300 (56.0)	0.004
No	314 (37.8)	235 (43.8)	
No response	12 (1.5)	1 (0.2)	

[a]$\alpha = 0.05$, independent 2-tailed *t* test for continuous variables, chi-square test

likelihood ratio for categorical variables

Table 5. Association between PHQ-9 score and pain category using logistic regression.

Model	**Exposure variables**	**OR for moderate to severe pain**	**95% CI**	**Hosmer-Lemeshow GOF *p*-value***
Unadjusted	PHQ-9 score	1.112	1.093, 1.133	0.006
Adjusted	PHQ-9 score, occupational category, age category, race/ethnicity, frequency of substance use, frequency of non-prescribed medications, has a current prescription	1.111	1.092, 1.133	0.1432

*$\alpha = 0.05$

Table 6. Probability table for PHQ-9 score and moderate to severe pain for a White non-student between the ages of 30 to 45 who never uses drugs, alcohol, or non-prescribed medications and does not have a current prescription.

PHQ-9 score	Probability of moderate to severe pain
0	0.114
5	0.179
10	0.273
15	0.387
20	0.516
25	0.646

Figure 1. Graphical representation of the logistic regression fits for the association between pain category and PHQ-9 score.

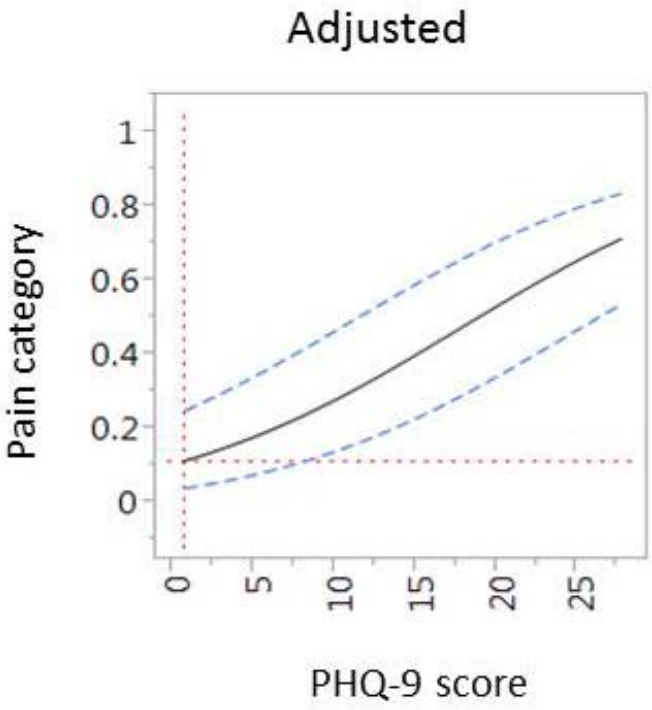

Figure 2. ROC curve illustrating the sensitivity and specificity of the adjusted logistic regression model used in the analysis. AUC = 0.703