

Chronic Pain and Social Pain: Loneliness, Healthcare Utilization, and Associated  
Characteristics in a Cross-Section of Patients Receiving Opioids for Chronic Pain

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**Abstract**

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**Introduction:** Loneliness is detrimental to several domains of health and quality of life, and is sometimes linked to higher healthcare utilization (HCU). Individuals prescribed opioids for chronic pain experience loneliness more frequently than the general population. Patients with chronic pain utilize more health services than the general population. Discovering characteristics associated with loneliness in this patient population could help prioritize the delivery of appropriate interventions and reduce unnecessary healthcare utilization.

**Methods:** This is an analysis of cross-sectional survey data collected as part of the screening process for a clinical trial testing a social navigation intervention. The population was patients being prescribed long-term opioids for chronic pain. Characteristics associated with loneliness were identified via  $\chi^2$  tests and logistic regression. Associations between loneliness and number of primary care visits, emergency room visits, and behavioral healthcare visits were measured using negative binomial regression. Regression models were adjusted for predictors of health service use selected from the Andersen Model of Health Service Utilization.

**Results:** The sample size was n=278. Characteristics associated with loneliness were social isolation( OR=1.33, 95%CI=1.18-1.51), pain severity, (OR=1.04, 95% CI=1.01-1.07), and living

alone (OR=1.21, 95% CI=1.06-1.39). Being aged 65+ was associated with lower odds of loneliness (OR=0.768, 95% CI=0.650-0.908). Loneliness was not associated with increased primary care or ER visits. Loneliness appeared to have a moderate association with increased behavioral health visits (IRR=1.99,  $p=0.030$ ), but this result was not significant under a Benjamini-Hochberg correction.

**Conclusion:** Given the prevalence of loneliness and chronic pain, there is a need for more research. Future researchers should consider revisiting this topic using longitudinal study designs with larger sample sizes.

## **1. Introduction**

### **Loneliness, pain, and health**

Loneliness appears to be on the rise both in the U.S. and globally, as a result of social and demographic trends<sup>1</sup>, and 34% of U.S. adults report being lonely<sup>2</sup>. There is an expanding literature exploring loneliness as a public health problem<sup>3–5</sup>. Large studies have suggested a connection between loneliness, and a variety of physical and mental health conditions occurring across the lifespan<sup>5–7</sup>. Physical ailments associated with loneliness include heart disease<sup>8,9</sup>, stroke<sup>8</sup>, dementia<sup>10</sup>, and diabetes<sup>11</sup>. Loneliness is also associated with a 29% increased odds for early mortality<sup>12</sup>. With some conditions, there appears to be a reciprocal relationship between loneliness and the associated condition, with loneliness exacerbating the health problem, and the health problem in turn exacerbating loneliness<sup>13</sup>. The impact of loneliness on mental well-being may be even greater than its impact on physical health. Chronic loneliness is associated with increased risk of depression and anxiety<sup>14</sup>. Cross-lagged study designs have shown the mutual reinforcement of depression and loneliness<sup>15</sup>.

While loneliness and social isolation are closely tied concepts, they have important conceptual distinctions and are not interchangeable. Loneliness refers to the subjective sense that one does not have the quality or quantity of personal relationships that one desires<sup>16</sup>. Social isolation, on the other hand, refers to deficiencies in an individual's social network, and reflects a lack of connections, or a lack of high-quality connections in which material assistance and emotional support can be exchanged<sup>17</sup>. Loneliness has been referred to as a "social pain", a sense like hunger or thirst, driving us to seek or renew social connections<sup>18</sup>. As such, transient loneliness is a healthy drive towards social behavior<sup>19</sup>. It becomes a problem when an individual's social network is weak, or if cognitive distortion keeps an individual feeling lonely despite a robust community. Unfortunately, while loneliness is changeable, for some it persists for years or decades<sup>20</sup>.

Social isolation and loneliness have also been linked to chronic pain<sup>21</sup>. Chronic pain is defined as experiencing pain most of the days for over 3 months<sup>22,23</sup>. The CDC estimates that 20.6% of U.S. adults, or approximately 51 million people, in the United States experience chronic pain<sup>24</sup>. In the 2019 National Health Interview Study, 3.7% of respondents reported having used prescribed opioids to treat chronic pain in the last three months<sup>25</sup>. Functional limitations from pain leading can lead to social isolation and loneliness, by interfering with the ability to work, maintain relationships, or engage in social organizations<sup>26,27</sup>. There is evidence of a mutually-reinforcing relationship between pain and loneliness: some studies have found that loneliness can increase the perception of pain<sup>28</sup>, and longitudinal data from the UK Biobank suggests that individuals who are lonely are more likely to develop pain down the road than those who are not lonely<sup>29</sup>. While this is thought to be mediated by inflammation<sup>30</sup>, loneliness may also impact pain through its impact on mental health and cognitive behavior. In some studies, forms of psychological distress like depression and anxiety have been found to have a significant impact on long-term pain outcomes, such as physical disability and care costs<sup>31</sup>. Issues associated with loneliness may also increase the risk of opioid misuse. Recent work has pointed to feelings of loneliness as a risk factor for misusing opioids<sup>32</sup>. This might mean that patients who are receiving opioids for chronic pain are at increased risk of opioid misuse.

In addition to experiencing these additional risks, patients experiencing chronic pain represent some of the highest utilizers of the healthcare system. Patients experiencing chronic pain visit physicians 24% to 113% more often than patients who do not experience chronic pain<sup>33</sup>. This disease burden is estimated to be responsible for up to \$300 billion in costs to the healthcare system in the U.S., in addition to deleterious effects on quality of life<sup>34</sup>. As such, if loneliness is an important determinant of utilization in patients experiencing chronic pain, then finding effective loneliness interventions for this patient population could potentially improve patient quality of life while also reducing burden to the healthcare system.

## **Personal characteristics associated with loneliness**

The most significant factors associated with loneliness in adults are relationship status—being single versus married—and living alone<sup>35</sup>. Most demographic factors like race, gender, and age, do not have a clear relationship with loneliness<sup>35</sup>. Data on whether males or females are lonelier have not found significant differences. While females are more likely to report feelings of loneliness, most studies do not find significant differences between male and female scores on loneliness scales like the UCLA Version 3<sup>35</sup>. There is some evidence of interaction between gender and marital status in their impact on loneliness, with marriage being more protective against loneliness for males than for females, especially in older adulthood<sup>35</sup>.

There is some evidence that loneliness follows a 'U-shaped' trend through the lifespan<sup>35</sup>. Youth and emerging adults are likely to experience loneliness, at a prevalence of up to 71%<sup>36</sup>, which drops off in middle adulthood, and then loneliness rises again in older adulthood, with a potential prevalence of 50%<sup>36</sup>. The relationship between advanced age and loneliness may be mediated by a variety of other factors, such as health status, functional limitations, and bereavement<sup>4</sup>.

There is a possibility that the stress of existing with a minoritized identity puts some groups at higher risk of loneliness. Members of the LGBTQ community are likely to experience familial rejection, limiting the strength of family relationships and putting additional strain on supportive friendships<sup>37</sup>. In a national survey, 56% of members of the LGBTQ community reported loneliness<sup>37</sup>, compared to the general population prevalence of 34%<sup>2</sup>. Minority stress theory also suggests that people of sexual minority status, and potentially other minoritized identities, may experience mental health problems and subjective isolation due to this minoritized status<sup>38</sup>. Race on its own does not appear to have a significant impact on loneliness<sup>35</sup>, but being a member of a racial minority in many countries appears to influence feelings of social connection, especially if combined with immigrant status and speaking a non-dominant language<sup>35</sup>.

## **Loneliness and healthcare utilization**

Along with its connection to a variety of physical and mental health problems, loneliness has also been linked to increased healthcare utilization in some studies<sup>5,39</sup>. A meta-analysis conducted in 2021 found that loneliness had a small but persistent association with increased primary care visits across 23 studies, and this effect was stronger in samples with larger proportions of females<sup>40</sup>. The effect of loneliness on both primary care and physician visits in the population-based samples appears to be primarily mediated by health status<sup>41,42</sup>

Important topics in the study of emergency room (ER) utilization are non-urgent visits and frequent utilizers—patients who seek treatment in the ER when it is not therapeutically appropriate<sup>43</sup>. In some studies, feelings of social disconnection have been connected to higher use of ER services in non-urgent scenarios. A longitudinal study found that older adults experiencing chronic loneliness were more likely to visit the emergency room, even though they were not more prone to hospitalization; the study authors posit that these patients may perceive the physician-patient relationship as a supportive social relationship, and that this might explain the motivation to visit the emergency room more frequently than non-lonely patients<sup>5</sup>. One study of older adults found that those who were both lonely and socially isolated had higher medical costs and visited the ER more frequently, than those who were lonely but not isolated, isolated but not lonely, or neither isolated nor lonely<sup>44</sup>.

There are significant inconsistencies and gaps in the literature on loneliness and healthcare utilization. There is inconsistent measurement of loneliness in this literature, with some studies using instruments such as the UCLA 3, which assesses multiple domains of loneliness<sup>45</sup>, with others using single-item measures of loneliness frequency<sup>46</sup>, and with other researchers conflating social support/social network quality with loneliness<sup>47</sup>. Obtaining clear answers on the effect of loneliness are hindered by this lack of standardization of measures<sup>48</sup>. This is problematic because while loneliness may be caused by lack of social support in some cases, social support is sometimes considered an enabling factor in healthcare utilization<sup>47</sup>.



There are also important gaps in this literature. Most research on loneliness and healthcare utilization focuses on older adults<sup>36,40</sup>, with relatively few studies including young and middle-aged adults. Despite the impact of loneliness on mental health, there is little research on the impact loneliness has on behavioral health visits. Similarly, despite existing research on loneliness as a determinant of healthcare utilization in specific patient groups like COPD patients<sup>49</sup> and cancer patients<sup>39</sup>, we were unable to find research measuring the impact of loneliness on healthcare utilization in patients prescribed opioids for chronic pain. This study is an attempt to begin filling this gap.

### **Conceptual model of loneliness, associated characteristics, and health service utilization**

We applied Andersen's Behavioral Model of Health Service Utilization to guide selection of patient characteristics to adjust for when measuring the association of loneliness and healthcare utilization<sup>50</sup>. Andersen's Model was selected because it is the most widespread model of health service utilization, creating easy comparability of factors with other studies<sup>51</sup>. It also does not focus on the determinants surrounding any particular population or health problems, instead having wide applicability to populations, determinants, health conditions, and types of service delivery<sup>51</sup>.

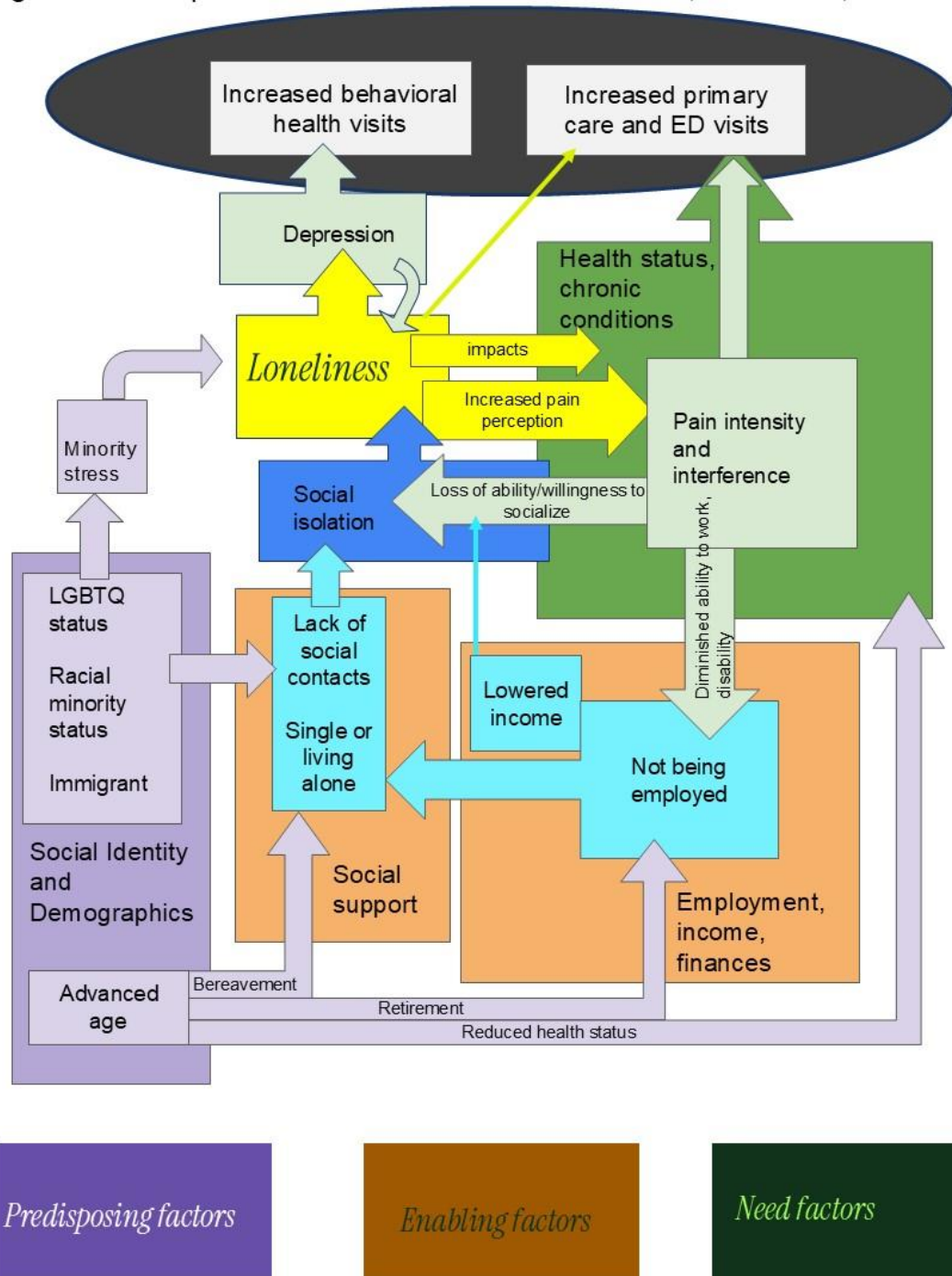
According to Andersen's model, personal determinants of healthcare utilization can be divided into three categories, which are predisposing factors, enabling factors, and need factors<sup>50</sup>. Predisposing factors are personal characteristics that may lead individuals to seek healthcare more frequently. Demographic factors such as age, sex, education, and race have been found to be predisposing factors in a variety of studies<sup>52</sup>. The second category, enabling factors, are characteristics that make it easier logistically for an individual to access health services when needed. Income and social support have been pointed to as enabling factors<sup>53</sup> in some cases. Finally, need, i.e., that people will seek healthcare when there is a medical need for them to do so<sup>54</sup>. It is assumed that in an equitable social and health system, need factors will be the primary determinant of health service utilization<sup>50</sup>. Chronic and acute health conditions,

including pain, represent need factors, and are expected to have the largest impact on the number of primary care and ER visits.

This conceptual model presents patient characteristics both as they relate to loneliness, as well as how they might contribute to healthcare utilization. Given its association with increased pain perception, and mental health conditions, addressing loneliness can help promote recovery and resilience in patients experiencing chronic pain, and may even have the potential to reduce mortality and opioid misuse. Learning more about what characteristics are associated with loneliness in this patient population may provide insight on how to create and implement loneliness interventions. By analyzing the association between loneliness and different forms of health service utilization, we may shed light on how to address loneliness in patients experiencing chronic pain, potentially improving long-term pain outcomes and reducing the need for health service visits.

We hypothesized that clinical and social factors, such as pain intensity/interference and social isolation, are more proximate to loneliness, and therefore have a stronger association with loneliness, compared with demographic factors such as race or sexual orientation, which are more distal correlates<sup>35</sup>. Nonetheless, if these characteristics do have a strong association with loneliness, there may be important implications for the structure and setting of interventions.

Figure 1: Conceptual Model of Personal Characteristics, Loneliness, and HCU



## **2. Methods**

### **Research population and setting**

The population for this study is adults receiving opioid medications for chronic pain from their primary care providers. The study sample is the total respondents to a screening survey for a randomized controlled trial; this trial tests the comparative effectiveness of a social navigation intervention compared with cognitive behavioral therapy and treatment-as-usual for improving loneliness. This parent study is described further in our protocol paper (see Tong et al., 2024)<sup>55</sup> referred to as the Decreasing Loneliness to Optimize Pain (D-LOOP) study.

### **Data collection and management**

Data were collected from electronic health records (EHR) of primary care clinics from two health systems located in Seattle, WA. Patients with records indicating pain treatment and those who were receiving opioids in primary care were probabilistically sampled and invited via email to complete the screening survey for a study on social connection and pain. All measures are self-reported by participants participating in the screening survey for the D-LOOP study.<sup>55</sup> Participants were excluded if they were under 18 years old, not prescribed opioids long-term, had upcoming surgeries, were being treated for cancer pain, had significant cognitive impairment, or were not proficient in English. Screening consent and data collection were conducted using REDCap<sup>56</sup>. Participants were compensated \$25 for screening survey completion. Data collection began in August 2024 and was ongoing at the time data analysis began for this study.

### **Measures**

#### **Psychometric measures:**

##### **Pain, Enjoyment of Life, and General Activity (PEG) Scale**

The PEG scale is a 3-factor scale meant as a measure of limitations from chronic pain. Its typical use is to track longitudinal changes in limitations caused by pain. Each item is scored on

a scale of 0 (no pain interference in life) to 10 (very high limitation) with the overall score as a mean of the three items, on a 0 to 10 scale<sup>57</sup>.

### **UCLA-3 3 Item Scale**

The UCLA version 3 3-Item Scale is an adaptation of the UCLA Version 3 20-item scale, developed as a tool to assess loneliness in telephone surveys<sup>58</sup>. The UCLA 3-Item scale correlates significantly with the 20-item measure, and has high measurement invariance and test-retest reliability across different population groups<sup>58,59</sup>. It is scored on a scale of 3 (no loneliness) to 9 (high loneliness), with different studies using values from 4 to 7 as cutoffs for screening an individual as lonely. In this study, the UCLA 3-item score will be dichotomized into a binary variable (0=not lonely, 1 = lonely) with scores 6 and above treated as lonely and 5 and below as not lonely. This measure was dichotomized a score of 6 or above as the cutoff for loneliness to ensure comparability with similar studies<sup>39</sup> and because of its clinical significance<sup>60</sup>.

### **Lubben Social Network Scale 6 (LSNS-6)**

The Lubben Social Network Scale was originally developed as a 12-item scale, for the purpose of measuring social isolation in older adults<sup>61</sup>. Since its initial development, it has been found to have high validity in both older adults and other groups<sup>61</sup>. This study uses the abbreviated 6-item version (LSNS-6). The LSNS-6 has two factors: family network quality, and friend network quality. Each of these factors incorporates 3 questions determining number and quality of social contacts, and is scored from 6 to 30, with a score of 12 or lower indicating high risk of social isolation<sup>62</sup>. The LSNS-6 score was dichotomized to a binary variable with participants scoring 12 or lower being coded as socially isolated.

## **Demographic measures**

### **Age**

Age was recorded as a categorical variable with participants selecting one of the following bins: (1) under 18, (2) 18-29, (3) 30-44, (4) 45-65, and (5) 65+. Participants answering (1) under age 18 were excluded.

### **Sex assigned at birth**

Participants selected one of the following options: (1) Male, (2) Female, (3) Intersex.

### **Gender identity**

Participants selected one of the following options: (1) Man, (2) Woman (3) Non-binary (4) Prefer to self-describe [enter text], or (5) Prefer not to answer.

This variable was only included to characterize the sample.

### **Race/ethnicity**

Participants selected any of the following options that they identify with, and were able to select multiple options: (1) American Indian/Alaskan Native, (2) Asian American (3) Black/African American (4) Latino/a/x or Hispanic (5) Middle Eastern or North African (6) Native Hawaiian/Other Pacific Islander (7) White (8) Prefer to self-describe [insert text].

### **Sexual orientation**

Participants selected one of the following options: (1) Straight or heterosexual (2) Gay or lesbian (3) Bisexual, pansexual or queer (4) Asexual (5) I am not sure (6) Prefer to self-describe [insert text] (7) Prefer not to answer.

### **Relationship status**

Participants selected one of the following options: (1) Single, (2) Married, (3) Separated , (4) Divorced, (5) Widowed (6) In a relationship, or (7) Prefer not to answer. Since this was a categorical demographic variable with less than 10% on some responses, this variable was dichotomized, with answers (2) and (6) grouped together as “In a relationship”, and (1), (3), (4),

and (5) grouped as “Single”. Respondents answering (7) were excluded from analysis of relationship status versus loneliness.

### **Employment Status**

Participants selected their employment status from the following categories: (1) Full-time employed, (2) part-time employed, (3) contract/temporary, (4) voluntarily unemployed, (5) involuntarily unemployed, (6) unable to work due to disability, (7) retired, and (8) Prefer not to answer.

### **People living in home**

Participants reported how many individuals lived in their home, including themselves, with response options of 1 through 15.

### **Education**

Participants selected their highest level of education from the following categories: (1) 8th grade or less, (2) some high school, (3) high school graduate or GED, (4) some college but did not complete degree, (5) 2 year degree, (6) 4 year degree, (7) more than 4 year degree, or (8) prefer not to answer.

### **Household income**

Participants selected one of the following options: (1) <\$35,000 (2) \$35,000 to \$49,999 (3) \$50,000 to \$75,000 (4) \$75,000 to \$100,000 (5) More than \$100,000 (6) Don't know (7) Prefer not to answer.

### **Health service use**

Participants are asked about their use of primary care, the emergency room, and behavioral healthcare within the last year. For each form of healthcare, participants could respond with options (0) no, (1) yes, (2) I don't know, and (3) prefer not to answer. If the response was (0) no, then the number of visits to that form of care in the past year was coded as 0. If the response was (1) yes, respondents were asked to report as a count variable how many times they had visited primary that form of care in the past year. Respondents who answered (2) don't know or

(3) prefer not to answer for any of these three forms of healthcare, were excluded from analysis of utilization for that form of healthcare.

## **Analysis**

### **Data management**

Under the approval of UW's Human Subjects Division, anonymized survey data was exported in an Excel format from REDCap on April 17th, 2025. Unless otherwise specified, analysis was conducted in base R<sup>63</sup>. Data was imported into the Rstudio programming environment using 'readr'<sup>64</sup>, and cleaned using the 'tidyverse' R package<sup>65</sup>. Summary statistics were generated, and histogram plots of primary care, ER, and behavioral health visits were generated using ggplot2<sup>66</sup>.

### **Research question 1: Which characteristics of survey respondents are associated with loneliness?**

Categorical variables were dichotomized when any individual response option received less than 10% of the total responses. As such, race was dichotomized into 'White' and 'People of Color'. Sexual orientation was dichotomized into 'heterosexual' and 'non-heterosexual'. Intersex individuals were removed from analyses that included sex due to low base rate. Relationship status was dichotomized into 'in a relationship' for those who were married or in a relationship and 'single' for others. Education was dichotomized into '2 year degree or less' and '4 year degree or more', and employment status was dichotomized into 'employed' and 'unemployed/disabled/retired'. Number of members of the household was dichotomized into 'living alone' and 'living with at least one other', as living alone has been identified as a risk factor for loneliness<sup>67,68</sup>. Chi-square tests of independence were conducted for each of these variables to determine whether loneliness varied between dichotomized demographics.

Logistic regression with dichotomized UCLA 3-item score as the binary outcome variable was conducted to determine if there is an association between PEG score and loneliness.

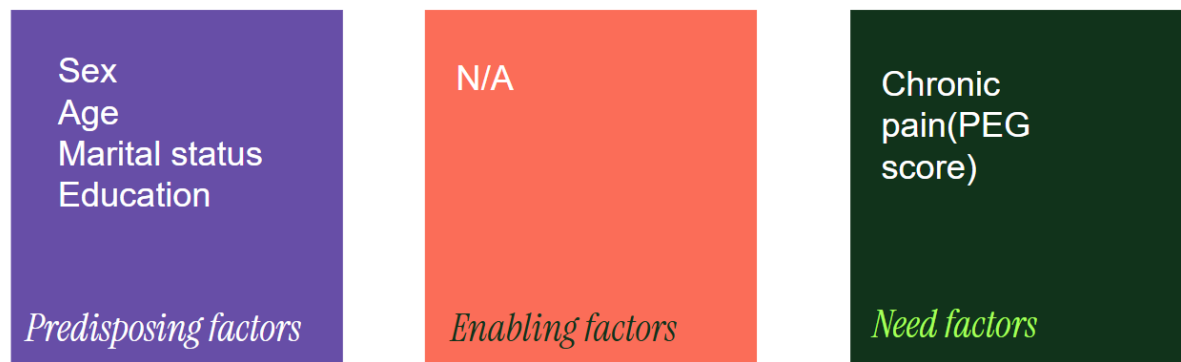


After identifying variables statistically significantly associated with loneliness under a Benjamini-Hochberg correction<sup>69</sup>, a multivariable logistic model was constructed using these variables. Odds ratios and 95% confidence intervals were computed for these characteristics. Listwise deletion was used to handle missing data.

## **Research question 2: Is loneliness associated with increased healthcare utilization?**

For each type of healthcare utilization: primary care visits, emergency department visits, and behavioral health visits, two models were created. The first was an unadjusted model measuring the relationship between loneliness and the number of healthcare visits. The second was a model adjusted controlled for covariates selected from the literature on the Andersen model of healthcare. The variables most commonly connected to utilization in the literature on the Andersen model are the predisposing factors of age, sex, marital status, and education, the enabling factors of income, health insurance, and geographic proximity, and the need factors of chronic and acute health conditions<sup>70</sup>. Because of our small sample size, we kept the total number of covariates at ten or below, and since enabling factors are considered less important in patients with chronic conditions, the “enabling factors” construct was excluded from our models<sup>70</sup>. The final list of covariates was sex, age, education, and PEG score, along with loneliness as our variable of interest.

Figure 2: Covariates Selected from the Andersen Model



A negative binomial regression was run for each model using the 'MASS' R library<sup>71</sup>, and coefficients and p-values were computed for each variable. The coefficients were exponentiated to obtain the Incident Rate Ratio (IRR) for each variable in each model. A Benjamini-Hochberg correction with  $\alpha=0.05$  was run on the p-value of loneliness within the adjusted models for primary care, emergency room, and behavioral health visits. The null hypothesis that loneliness had no relationship with healthcare visits was rejected if the p-value for loneliness was significant under the correction.

### **3. Results**

#### **Sample characteristics**

The sample consisted of 278 respondents. The sample was 69.8% female, with 29.9% reporting male sex and one participant reporting being intersex. Twelve participants reported a gender identity diverging from their gender assigned at birth, including one transmasculine person and 9 female participants reporting nonbinary identities. Only 32.4% of the sample reported being a member of the labor force—employed or unemployed; 35.3% reported being unable to work due to a disability, and 29.9% reported being retired. A complete breakdown of self-reported participant characteristics is available in Table 1.

In total, 55% of the sample scored 6 or more on the UCLA 3 3-item scale, marking them as lonely.

Table 1: Descriptive Summary, Sample Characteristics

| Characteristic                 | n   | %     |
|--------------------------------|-----|-------|
| Total sample                   | 278 |       |
| Assigned sex                   |     |       |
| Male                           | 83  | 29.9% |
| Female                         | 194 | 69.8% |
| Intersex                       | 1   | 0.3%  |
| Gender identity                |     |       |
| Man                            | 84  | 30.2% |
| Woman                          | 183 | 65.8% |
| Nonbinary                      | 9   | 3.2%  |
| Self described                 | 2   | 0.7%  |
| Sexual orientation             |     |       |
| Straight or heterosexual       | 215 | 77.3% |
| Gay or lesbian                 | 15  | 5.4%  |
| Bisexual, pan, or queer        | 30  | 10.8% |
| Asexual                        | 5   | 1.8%  |
| Other/self-describe/refused    | 13  | 4.7%  |
| Ethnicity/race*                |     |       |
| American Indian/Alaskan Native | 23  | 8.3%  |

|                                                                                                                   |     |       |
|-------------------------------------------------------------------------------------------------------------------|-----|-------|
| Asian American                                                                                                    | 9   | 3.2%  |
| Black/African American                                                                                            | 23  | 8.3%  |
| Latino/a/x or Hispanic                                                                                            | 9   | 3.2%  |
| Middle Eastern or North African                                                                                   | 2   | 0.7%  |
| Native Hawaiian/Other Pacific Islander                                                                            | 2   | 0.7%  |
| White                                                                                                             | 227 | 81.7% |
| Self-described                                                                                                    | 13  | 4.7%  |
| Prefer not to answer                                                                                              | 6   | 2.6%  |
| <i>*Participants could choose multiple options for race, so totals may add up to more than 100%/more than 278</i> |     |       |
| Age                                                                                                               |     |       |
| Under 18                                                                                                          | 0   | 0%    |
| 18-29                                                                                                             | 11  | 4.0%  |
| 30-44                                                                                                             | 60  | 21.6% |
| 45-65                                                                                                             | 121 | 43.5% |
| 65+                                                                                                               | 86  | 30.9% |
| Relationship status                                                                                               |     |       |
| Single                                                                                                            | 65  | 23.4% |
| Married                                                                                                           | 106 | 38.1% |
| Divorced                                                                                                          | 4   | 1.4%  |

|                                 |     |       |
|---------------------------------|-----|-------|
| Separated                       | 38  | 13.7% |
| Widowed                         | 19  | 6.8%  |
| In a relationship               | 42  | 15.1% |
| No answer                       | 4   | 1.4%  |
| Education                       |     |       |
| 8th grade or less               | 0   | 0.0%  |
| Some high school                | 10  | 3.6%  |
| High school diploma or GED      | 21  | 7.6%  |
| Some college, did not complete  | 71  | 25.5% |
| 2-year degree                   | 45  | 16.2% |
| 4-year degree                   | 48  | 17.3% |
| More than 4 year degree         | 81  | 29.1% |
| No answer                       | 2   | 0.7%  |
| Income                          |     |       |
| Less than \$35,000              | 105 | 37.8% |
| \$35,000 to \$49,999            | 31  | 11.1% |
| \$50,000 to \$75,000            | 27  | 9.7%  |
| \$75,000 to \$100,000           | 24  | 8.6%  |
| More than \$100,000             | 68  | 24.5% |
| Don't know/prefer not to answer | 23  | 8.3%  |

|                                                           |      |       |
|-----------------------------------------------------------|------|-------|
| Employment                                                |      |       |
| Full-time                                                 | 40   | 14.4% |
| Part-time                                                 | 24   | 8.6%  |
| Contract                                                  | 3    | 1.1%  |
| Voluntarily unemployed                                    | 9    | 3.2%  |
| Involuntarily unemployed                                  | 14   | 5.0%  |
| Disabled                                                  | 98   | 35.3% |
| Retired                                                   | 83   | 29.9% |
| No answer                                                 | 7    | 2.5%  |
| Loneliness                                                |      |       |
| Lonely                                                    | 153  | 55.0% |
| Not lonely                                                | 125  | 45.0% |
| Social isolation                                          |      |       |
| Isolated                                                  | 130  | 46.8% |
| Not isolated                                              | 139  | 50.0% |
| Did not complete LSNS-6 scale                             | 9    | 3.24% |
| Pain, enjoyment of life, and general activity (PEG) scale |      |       |
| Mean (SD)                                                 | 5.95 | 2.18  |
| Did not complete PEG scale                                | 1    | 0.3%  |

Healthcare utilization is summarized in Table 2. In this sample, 91.4% of individuals reported at least one primary care visit, 49.6% reported at least one ER visit, and 41.4% reported at least one behavioral health visit. All of these distributions were right-skewed, and the count values for ER visits and behavioral health visits were both over-dispersed, with the standard deviation exceeding the mean.

| Table 2: Healthcare Utilization Summary |     |        |
|-----------------------------------------|-----|--------|
| Type of healthcare                      | n   | %      |
| Primary care                            |     |        |
| None                                    | 7   | 2.52%  |
| At least one visit                      | 254 | 91.4%  |
| Don't know                              | 16  | 5.76%  |
| No answer                               | 1   | 0.360% |
| Emergency room                          |     |        |
| None                                    | 116 | 41.7%  |
| At least one visit                      | 138 | 49.6%  |
| Don't know                              | 20  | 7.19%  |
| No answer                               | 3   | 1.08%  |
| Behavioral health                       |     |        |
| None                                    | 139 | 50.0%  |
| At least one visit                      | 116 | 41.4%  |

|                                               |      |                    |
|-----------------------------------------------|------|--------------------|
| Don't know                                    | 20   | 7.19%              |
| No answer                                     | 3    | 1.08%              |
| Distribution of healthcare utilization        |      |                    |
| Type of healthcare                            | Mean | Standard Deviation |
| Primary care visits ( <i>n</i> =261)          | 4.52 | 3.66               |
| Emergency room visits ( <i>n</i> =254)        | 1.58 | 2.63               |
| Behavioral Healthcare visits ( <i>n</i> =255) | 5.86 | 11.3               |



Figure 3: Number of Primary Care Visits in the Past Year (n=261)

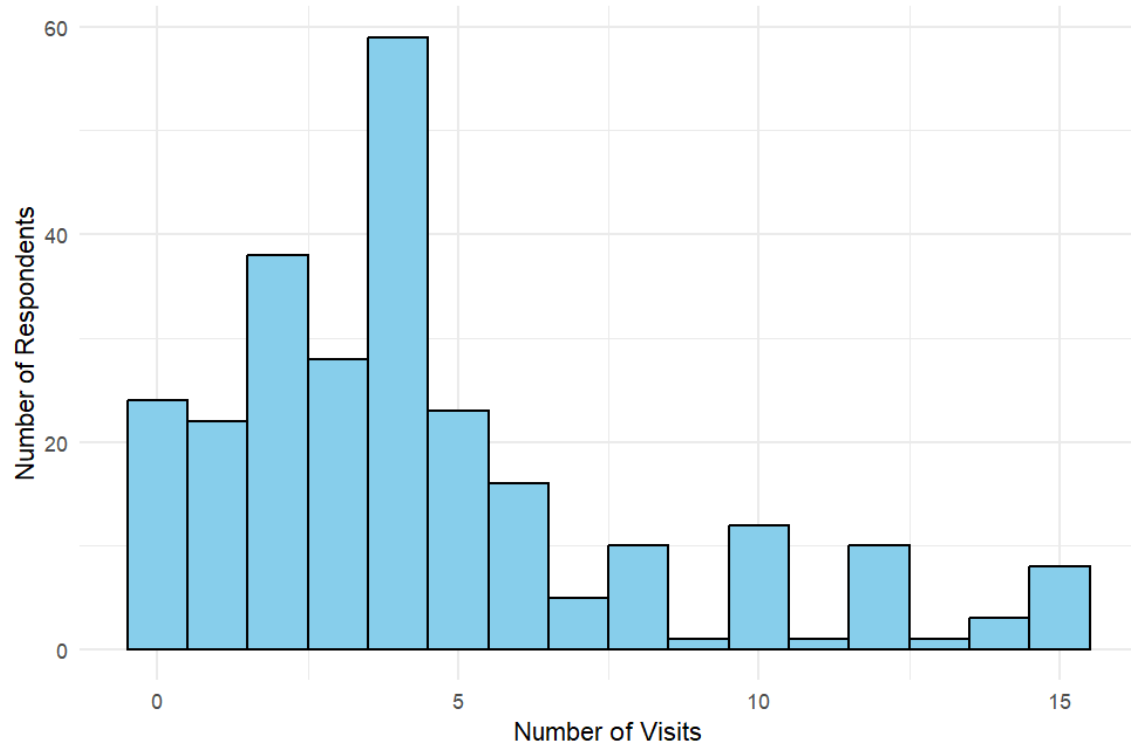


Figure 4: Number of Emergency Room Visits in the Past Year (n=254)

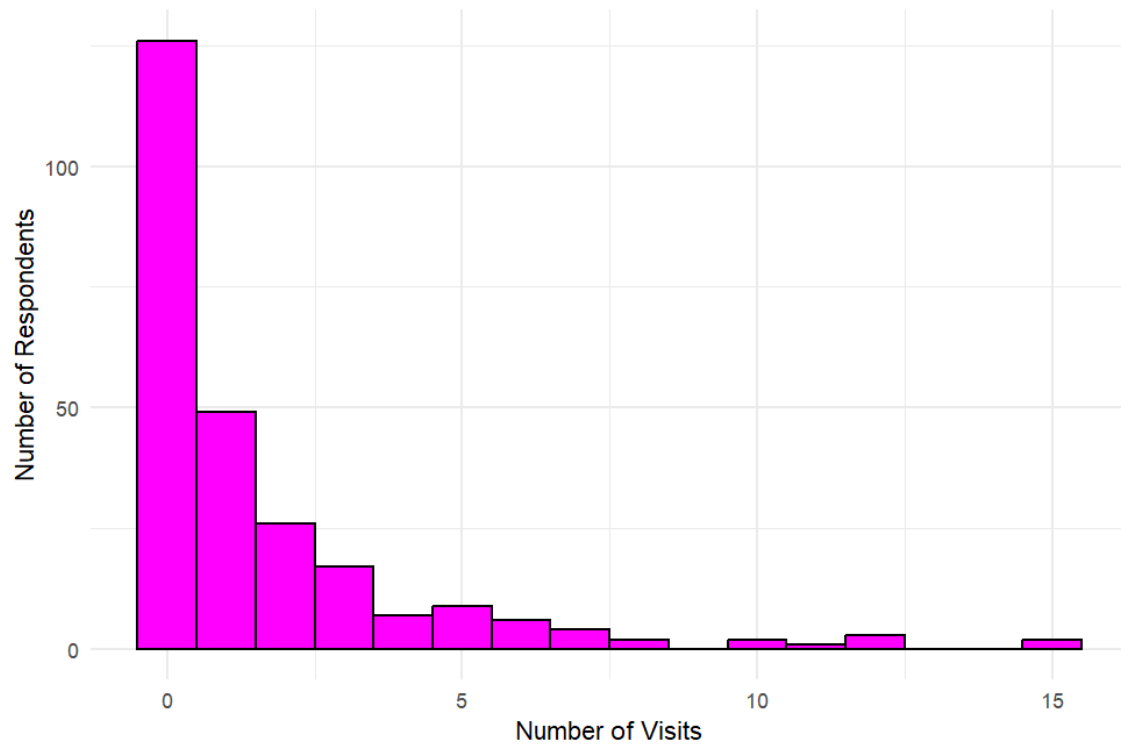
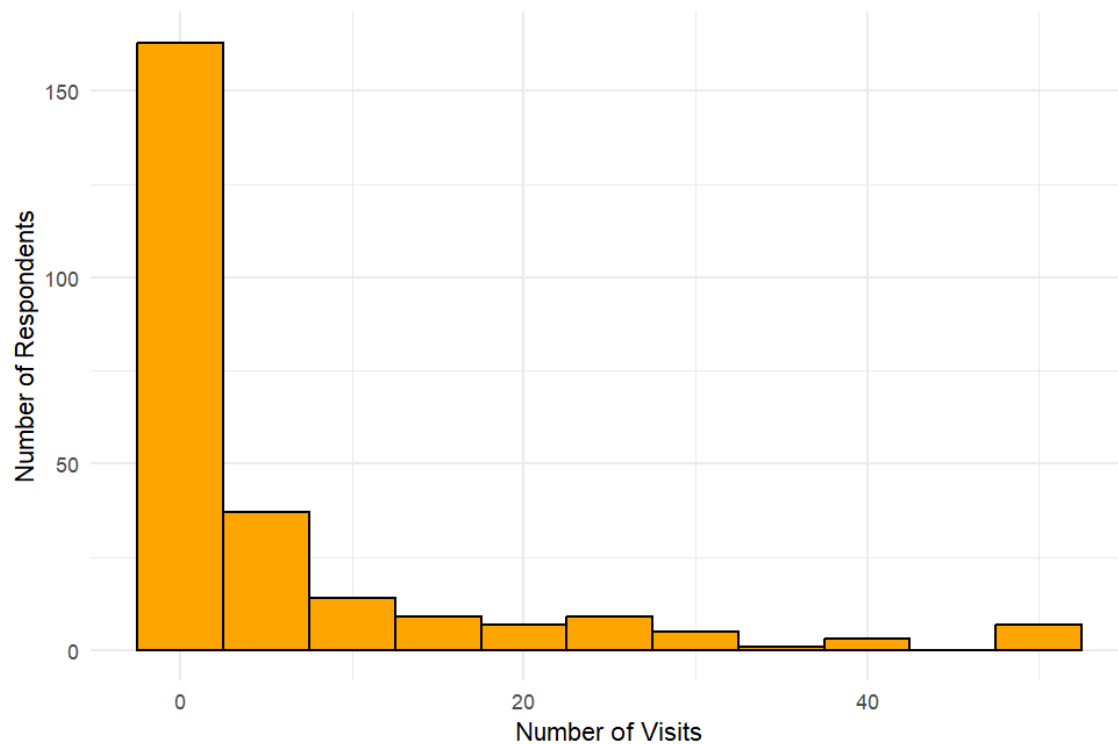


Figure 5: Number of Behavioral Health Visits in the Past Year (n=255)



### Correlates of loneliness

Under the Benjamini-Hochberg correction, there was no significant association between loneliness and sex, race/ethnicity, sexual orientation, education level, relationship status, or employment status. There was a significant association between loneliness and income, age, PEG score, and social isolation (Table 3). In a logistic model that included these characteristics as variables, there were significant associations between higher loneliness and social isolation (OR=1.33, 95%CI=1.18:1.51), PEG score, (OR=1.04, 95% CI=1.01:1.07), and living alone (OR=1.21, 95% CI=1.06:1.39). Being aged 65+ was associated with lower odds of loneliness (OR=0.768, 95% CI=0.650:0.908). See Table 4.

| Table 3: Characteristics Association with Loneliness |                |            |          |
|------------------------------------------------------|----------------|------------|----------|
| Characteristic                                       | Not lonely (n) | Lonely (n) | p-value  |
| Male                                                 | 45             | 38         | p=.063   |
| Female                                               | 80             | 115        |          |
| Straight /heterosexual                               | 102            | 113        | p=.079   |
| Gay/lesbian/bi/pan/a gender/self-report              | 19             | 38         |          |
| White                                                | 103            | 124        | p=.439   |
| Other                                                | 17             | 28         |          |
| 18-29                                                | 4              | 7          | p<.001   |
| 30-44                                                | 15             | 45         |          |
| 45-65                                                | 51             | 70         |          |
| 65+                                                  | 55             | 31         |          |
| Married or in a relationship                         | 75             | 73         | p=.049 † |

|                                             |    |     |         |
|---------------------------------------------|----|-----|---------|
| Single, divorced, widowed or separated      | 48 | 78  |         |
| Employed                                    | 27 | 40  | p=.411  |
| Unemployed, retired or disabled             | 96 | 108 |         |
| Less than 2-year degree                     | 41 | 61  | p=.239  |
| 2-year degree or more                       | 84 | 90  |         |
| Lives alone                                 | 28 | 58  | p=.017  |
| Lives with at least 1 other                 | 84 | 87  |         |
| Less than \$35,000                          | 35 | 70  | p<.01   |
| \$35,000 to \$49,999                        | 10 | 21  |         |
| 50,000 to 74,999                            | 15 | 12  |         |
| 75,000 to 100,000                           | 16 | 8   |         |
| More than \$100,000                         | 38 | 30  |         |
| Not isolated                                | 85 | 54  | p<.001  |
| Isolated                                    | 35 | 95  |         |
| Odds per each additional point on PEG scale |    |     | p<0.001 |

†No longer significant under Benjamini-Hochberg correction.

| Table 4–Odds Ratios for Loneliness |             |                         |
|------------------------------------|-------------|-------------------------|
| Variable                           | Odds Ratio  | 95% Confidence Interval |
| Income                             |             |                         |
| Income <\$35,000                   | 1.04        | 0.845-1.29              |
| Income \$35,000 to \$49,999        | 1.19        | 0.908-1.51              |
| Income \$50,000 to \$74,999        | <i>Ref.</i> | <i>N/A</i>              |
| Income \$75,000 to 100,000         | 0.933       | 0.719-1.20              |
| Income More than \$100,000         | 1.03        | 0.828-1.27              |
| Living alone                       | 1.21        | 1.06-1.39               |
| Age                                |             |                         |
| Age 18-29                          | 1.02        | 0.714-1.38              |
| Age 30-44                          | <i>Ref.</i> | <i>N/A</i>              |
| Age 45-64                          | 0.858       | 0.744-1.01              |
| Age 65+                            | 0.768       | 0.650-0.908             |
| Social isolation                   | 1.33        | 1.18-1.51               |

|                                           |      |           |
|-------------------------------------------|------|-----------|
| PEG score (per additional point on scale) | 1.04 | 1.01-1.07 |
|-------------------------------------------|------|-----------|

### Health care utilization

Loneliness was significant at  $p < 0.05$  in all unadjusted models, but this significance disappeared in the adjusted models for all forms of healthcare except behavioral health. After adjustment, loneliness was associated with an IRR of 1.09 for primary care visits (Table 5), 1.28 for ER visits (Table 6), and 1.99 for behavioral health visits (Table 7). Under the adjusted model, loneliness had a p-value of  $p = 0.0300$ , which was not significant under the Benjamini-Hochberg correction, so the null hypothesis was not rejected.

| Table 5—Regression Models of Primary Care Utilization ( $n=259$ ) |                  |            |                |                |
|-------------------------------------------------------------------|------------------|------------|----------------|----------------|
|                                                                   | Unadjusted model |            | Adjusted model |                |
| Variable                                                          | IRR              | p-value    | IRR            | p-value        |
| Intercept                                                         | 4.00             | $p < .001$ | 3.28           | $p < .001$ *** |
| Lonely (0 = no, 1 = yes)                                          | 1.23             | $p = .040$ | 1.09           | $p = .397$     |
| PEG score (continuous)                                            | N/A              |            | 1.06           | $p = .014$     |
| 4 year degree (0=no, 1=yes)                                       |                  |            | 1.04           | $p = .737$     |

|                                                  |  |             |             |
|--------------------------------------------------|--|-------------|-------------|
|                                                  |  |             |             |
| Age 18-29<br>(0=no, 1=yes)                       |  | 1.39        | p=.162      |
| Age 30-44<br>(0=no, 1=yes)                       |  | <i>Ref.</i> | <i>Ref.</i> |
| Age 45-64<br>(0=no, 1=yes)                       |  | 0.867       | p=.250      |
| Age 65+<br>(0=no, 1=yes)                         |  | 0.778       | p=.079      |
| Sex<br>(0=male, 1 = female)                      |  | 0.978       | p=.834      |
| Marital status<br>(0 = non-married, 1 = married) |  | 1.01        | p=.919      |

Table 6—Regression Models of Emergency Room Utilization ( $n=252$ )

|                             | Unadjusted model |         | Adjusted model |             |
|-----------------------------|------------------|---------|----------------|-------------|
| Variable                    | IRR              | p-value | IRR            | p-value     |
| Intercept                   | 1.17             | p=.334  | 0.795          | p=.630      |
| Lonely (0 = no, 1 = yes)    | 1.65             | p=.016  | 1.28           | p=.241      |
| PEG score (continuous)      | N/A              |         | 1.15           | p<0.01      |
| 4-year degree (0=no, 1=yes) |                  |         | 1.18           | p=.440      |
| Age 18-29 (0=no, 1=yes)     |                  |         | 1.97           | p=.157      |
| Age 30-44 (0=no, 1=yes)     |                  |         | <i>Ref.</i>    | <i>Ref.</i> |
| Age 45-64 (0=no, 1=yes)     |                  |         | 0.726          | p=.201      |
| Age 65+ (0=no, 1=yes)       |                  |         | 0.527          | p=.029      |
| Sex (0=male, 1 = female)    |                  |         | 0.675          | p=.071      |
| Marital status              |                  |         | 1.206          | p=.378      |



|                                    |  |  |  |
|------------------------------------|--|--|--|
| (0 =<br>unmarried, 1<br>= married) |  |  |  |
|------------------------------------|--|--|--|

| Table 7–Regression Models of Behavioral Healthcare Utilization (n=252) |                  |         |                |             |
|------------------------------------------------------------------------|------------------|---------|----------------|-------------|
|                                                                        | Unadjusted model |         | Adjusted model |             |
| Variable                                                               | IRR              | p-value | IRR            | p-value     |
| Intercept                                                              | 3.24             | p<.001  | 3.88           | p=.052      |
| Lonely (0 =<br>no, 1 = yes)                                            | 2.54             | p<.01   | 1.99           | p=0.030†    |
| PEG score<br>(continuous)                                              | N/A              |         | 1.09           | p=.256      |
| 4 year degree<br>(0=no, 1=yes)                                         |                  |         | 1.10           | p=.769      |
| Age 18-29<br>(0=no, 1=yes)                                             |                  |         | 1.36           | p=.697      |
| Age 30-44<br>(0=no, 1=yes)                                             |                  |         | <i>Ref.</i>    | <i>Ref.</i> |
| Age 45-64<br>(0=no, 1=yes)                                             |                  |         | 0.365          | p<.01       |

|                                            |  |       |        |
|--------------------------------------------|--|-------|--------|
| Age 65+<br>(0=no, 1=yes)                   |  | 0.328 | p=.010 |
| Sex<br>(0=male, 1 = female)                |  | 1.052 | p=.878 |
| Marital status<br>(0=unmarried, 1=married) |  | 0.949 | p=.870 |

†No longer significant under Benjamini-Hochberg correction.

#### 4. Discussion

In this study, we aimed to identify patient characteristics most associated with loneliness, and fitted negative binomial models to learn whether loneliness was associated with increased number of primary care, emergency room, and behavioral health visits within the past year. We found that after adjusting for aside from social isolation itself, most of the significant characteristics associated with higher loneliness incidence were not demographic characteristics like race, gender, sexual orientation, employment, income, or education. The significant correlates with loneliness were social isolation, living alone, and a higher PEG score. Being aged 65 or older was associated with lower rates of loneliness.

These results largely correspond to evidence from the general population, and to the predictions from our conceptual model, where we expected the most proximal associations with loneliness would be related to social isolation and pain intensity/interference. However, an unexpected result was that relationship status—being married or in a relationship—was not significantly associated with loneliness, despite being a primary determinant of loneliness in most studies<sup>35</sup>. This may indicate that this study was underpowered to find this result, that the dichotomization scheme used was inappropriate, or that the impact was more distal relative to factors like living alone versus with others.

There were several unexpected associations with age in this study, which contradict what our conceptual model predicted. First, the relationship between age and loneliness in this study was unexpected. As noted in the introduction, loneliness is generally thought to follow a “U-shaped” pattern with those in middle adulthood experiencing less loneliness than either young adults or older adults<sup>35</sup>. Most loneliness research focuses on older adults<sup>4</sup>, and loneliness in advanced age is part of our social narrative, with many people expecting to be lonely in older adulthood<sup>72</sup>. This study found that older adults were less lonely than the reference age group, adults age 30-44. This may be an example of Simpson’s paradox, whereby trends within the overall population are reversed when analysis is limited to a subgroup<sup>73</sup>. A potential explanation for this is the homogenization of social networks after chronic pain onset, with middle aged adults less likely to have same-aged peers in their network with chronic pain, leading to loneliness and isolation<sup>74</sup>.

The small association between primary care and ER visits, and loneliness, is similar to results of previous work<sup>40,48</sup>. These small effect sizes, and their lack of statistical significance, suggest that for patients taking opioids for chronic pain, there is little association between loneliness and healthcare utilization that is not mediated by pain. In the adjusted model of behavioral health utilization, loneliness also did not meet the significance threshold to reject the null hypothesis under our Benjamini-Hochberg correction. However, loneliness had the largest effect size of any variable in this model, and was closer to the significance cutoff as a predictor of behavioral health visits than it was in the adjusted models for primary care and emergency room visits. Loneliness is highly correlated with depression<sup>2</sup>, which is a common need-based reason to seek behavioral healthcare<sup>75</sup>; as such, depression might be acting as a latent variable here.

### **Strengths and Limitations**

This is, to our knowledge, the first study to analyze loneliness and its association with primary care, emergency room, and behavioral health utilization. Despite its contribution on an

exploratory basis, it has several important limitations. Most notably, this is a cross-sectional study, where loneliness in the present is reported by participants at the same time as healthcare visits over the past year, alongside the other measures like the LSNS-6 and the PEG scale. This means that it is impossible to draw causal conclusions about the relationship between any of these factors, including loneliness, from this study. Since the survey was conducted in English only and did not ask about immigrant status, we were unable to measure loneliness impacts from being an immigrant or speaking a non-dominant language. This study also had a relatively small sample size of less than 300. This limited our ability to include adjustment variables, and may have made our analysis underpowered to find associations between loneliness and healthcare utilization that have small effect sizes. Additionally, the data used did not include measures for overall health status, or for mental health measures, which means these factors may be acting as latent variables within the dataset. Finally, our data for ER and behavioral health visits but zero-weighted and over-dispersed, which would have made a zero-inflated negative binomial regression potentially more of an appropriate regression model, but our sample size was too small to support this regression.

There is also a significant risk of selection bias in the recruitment process, which may have affected our results. First, the study population were recruited by being invited to take part in a study on the topic of loneliness and its relationship to pain; those who were confident that they are not lonely may not have opted for the screening survey, inflating the prevalence of loneliness in the sample. Second, since this survey was distributed via email, and the associated intervention for the D-LOOP study was a videoconference-based intervention, potential respondents who had limited digital access or digital literacy may have either not received study invitations, or may have self-selected out of the study. The study was also only available in English, and did not ask about immigrant status; as such, loneliness impacts from speaking a non-dominant language or being an immigrant could not be measured. Finally, the sample size of this study was less than 300, which may have meant our analysis was

underpowered to replicate some of the results found in other loneliness research, or to find associations between loneliness and Healthcare utilization that have small effect sizes.

### **Implications for Future Work**

Current evidence-based interventions for loneliness include social skills training, small-group cognitive behavioral therapy, structured group activities, and peer-support groups<sup>36</sup>. Evidence for other interventions, such as social prescribing, is still emerging<sup>4</sup>. Since there is a strong association between pain intensity/interference and loneliness, it may be appropriate to routinely conduct loneliness screenings with patients receiving opioids for chronic pain who have significant pain interference. Most loneliness interventions were developed for older adults<sup>36</sup>, and may need adaptation to be appropriate for other age groups. The surprisingly lower odds of loneliness in adults 65+ relative to adults aged 30-44 may indicate a need for interventions targeting middle-aged adults.

An important consideration for researchers in this field is the reciprocal relationship between chronic health problems like pain, and loneliness. Chronic illness pain and associated reduction in function can lead to social isolation and loneliness, and that loneliness can increase perception of pain and reduced health, leading to a greater need for healthcare. As such, chronic illness and pain are both confounders and mediators of the relationship between loneliness and healthcare utilization. Longitudinal data is necessary to tease out effects on healthcare utilization caused by loneliness that are mediated by pain or other variables.

This study did not find sufficient evidence to suggest that loneliness is significantly associated with increased primary care or emergency room visits, and while there appeared to be a stronger association between mental healthcare utilization and loneliness, more evidence is needed. Most of the literature on the connection of loneliness and healthcare utilization is also based on cross-sectional studies, and other authors have already called for more longitudinal studies in the study of healthcare utilization and loneliness, so as to more effectively test causal

hypotheses<sup>48</sup>. Future researchers should consider prospective longitudinal studies, with loneliness assessed at study onset. Given the impact of loneliness on depression as well as the neglected mental health needs of individuals with chronic pain<sup>76</sup>, learning more about loneliness and behavioral health services in this population, including how to integrate loneliness interventions into behavioral health, should be a high priority. Future researchers assessing loneliness and use of behavioral health should include measures for depression so that loneliness does not act as a proxy variable for depression.

## **5. Conclusion**

In this study we measured characteristics associated with loneliness in a cross-sectional sample of patients receiving opioids for chronic pain. Most characteristics associated with loneliness were already expected from the literature: living alone, social isolation, and pain interference. In this sample, older adults age 65+We also looked for an association between loneliness and increased primary care, ER, and behavioral health visits, while adjusting for other determinants of health service use. No significant associations were found. This study is limited by its cross-sectional design and small sample size. More research is needed to learn about loneliness and health service utilization in patients receiving opioids for chronic pain.

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