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ORIGINAL RESEARCH

Loneliness and Pain Catastrophizing Among Individuals with Chronic Pain: The Mediating Role of Depression

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Purpose: Loneliness increased during the COVID-19 pandemic and social distancing guidelines, potentially exacerbating negative cognitions about pain. The present study investigated the longitudinal relationship between loneliness, assessed during the early weeks of the pandemic, and pain catastrophizing, assessed after living in the pandemic for approximately 1 year, among chronic pain patients. We also examined whether severity of depressive symptoms mediated this association.

Methods: This prospective longitudinal study recruited individuals with chronic pain (N=93) from Massachusetts using an online convenience sampling method via the platform Rally. Participants completed an initial survey early after the onset of social distancing (4/28/20–6/17/20; Time 1) and a follow-up survey 1 year later (5/21/21–6/7/21; Time 2). Participants completed validated assessments of loneliness (T1), pain catastrophizing (T2), and depression (T2). Spearman correlations and Mann–Whitney *U*-tests were used to explore associations among psychosocial, pain, and participant characteristics. A mediation analysis was conducted to test whether the association between loneliness and pain catastrophizing was mediated by depression.

Results: Participants had a mean age of 40.6 years and were majority female (80%) and White (82%). Greater loneliness was associated with subsequent higher pain catastrophizing (b=1.23, 95% CI [0.03, 2.44]). Mediation analysis showed a significant indirect effect (b=0.57, 95% CI [0.10, 1.18) of loneliness (T1) on catastrophizing (T2) through depression (T2) while accounting for several important covariates. The direct effect of loneliness on catastrophizing was no longer significant when depression was included in the model (b=0.66, 95% CI [−0.54, 1.87]).

Conclusion: Findings suggest that greater loneliness during the pandemic was associated with higher pain catastrophizing 1 year later, and severity of depression after living in the pandemic mediated this association. As loneliness, depression, and catastrophizing can all be modified with behavioral interventions, understanding the temporal associations among these variables is important for the employment of future empirically supported treatments.

Keywords: loneliness, pain catastrophizing, depression, chronic pain, COVID-19

Introduction

The COVID-19 pandemic and social distancing guidelines had widespread physical and mental health consequences among adults in the U.S.,[1–3] with studies also showing increased levels of loneliness.[4–6] Individuals with chronic pain may have been particularly at risk of social and physical isolation as a result of social distancing guidelines, which could consequently exacerbate pain.[7] Indeed, one study showed that patients with chronic pain reported higher levels of loneliness, pain severity, pain catastrophizing, and depression compared to healthy adults.[8] Despite the fact that many states have now relaxed social distancing guidelines, a lasting impact of prolonged isolation persists, making it critical to understand the long-term impact in the current recovery and to also help plan for potential future waves of social distancing.

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The biopsychosocial model of pain acknowledges the contribution of social and psychological factors to the pain experience.[9] Pain catastrophizing (ruminating about, magnification of, and feelings of helplessness in the face of pain) is a psychological factor associated with greater pain intensity and interference.[10,11] Because pain catastrophizing is a modifiable risk factor,[12] it is important to explore what is associated with increased catastrophizing to inform behavioral interventions for reducing pain. Pre-pandemic, one study showed that loneliness predicted greater pain-related catastrophic thoughts.[13] Due to social distancing guidelines during the pandemic, it is plausible that loneliness among individuals with chronic pain may longitudinally be associated with higher catastrophizing, although this has yet to be demonstrated.

Further, it is unknown what may explain the association between loneliness and catastrophizing, but one such factor may be depression. Loneliness is related to worse overall mental health,[14] as well as increased depression during the pandemic.[5,15,16] Theoretically, while loneliness refers to an individual's feelings about their social relationships, and depression refers to how an individual feels more generally, loneliness and depression are separate constructs that may be importantly linked.[17] Several longitudinal studies, conducted pre-pandemic, showed that loneliness predicted increased depressive symptomology, but this has yet to be tested within the context of heightened social isolation, which occurred as a result of the social distancing guidelines.[18,19] Chronic pain is often comorbid with depression,[20,21] and among individuals with chronic pain, depression is associated with greater pain catastrophizing.[22–24] Importantly, depression and catastrophizing are considered conceptually distinct constructs, as depression refers to a more general mood disorder.[25] Therefore, depression may link loneliness and pain catastrophizing, potentially mediating their association. Identifying depression as a link between loneliness and pain catastrophizing has important clinical implications, including early identification of at-risk patients to facilitate behavioral interventions and address depressive symptomology. Early treatment of depressive symptoms may simultaneously prevent worsened pain catastrophizing among chronic pain patients during times of increased isolation.

This prospective cohort study investigated the longitudinal relationship between loneliness experienced by individuals with chronic pain, assessed during the early weeks of the COVID-19 pandemic, and pain catastrophizing assessed after living in the pandemic for approximately 1 year. Further, we examined whether severity of depressive symptoms, after living in the pandemic for 1 year, mediated the association between loneliness and pain catastrophizing.

Materials and Methods

Participants and Procedure

This study recruited adults with chronic pain from Massachusetts and was approved by the Partners Human Research Committee/Institutional Review Board. Due to the conditions of the COVID-19 pandemic (eg, social distancing restrictions), we used an online survey to recruit a convenience sample. Participants were recruited using an online platform (Rally) that connects the public to research studies that they may be eligible to participate in. We also contacted participants from our previous pain cohorts (eg, mastectomy, total knee replacement, fibromyalgia, back pain) via email. Eligibility criteria included being at least 18 years of age, a Massachusetts resident, English speaking, and having self-reported persistent pain for ≥3 months. The survey was only open to residents of MA to try and control for discrepancies between ongoing state-ordered social distancing mandates at the time of the survey. After confirming that each participant met our eligibility criteria, they were emailed a separate link to REDCap, which is a secure data entry system, to participate in the survey. All participants provided electronic informed consent before participating in the study.

The first survey (Time 1; T1) was sent out to participants during the early weeks of the pandemic, from April 28-June 17, 2020. A total of 150 participants completed the survey at T1 (Figure 1). All participants were asked whether they were willing to be contacted for future studies, and 147 indicated that they were. All 147 participants who were willing to be contacted for future studies were invited to participate in a follow-up survey (Time 2; T2), which was completed approximately 1 year later from May 21 to June 7, 2021. The second survey (T2) was sent out to participants when social distancing mandates were beginning to be lifted after more people were vaccinated (see Figure 1). Ninety-four participants (63% response rate) completed the follow-up survey. One participant did not complete the UCLA loneliness scale (T1) and was excluded from analyses. For each survey participants completed, they were compensated with a $20 Amazon electronic gift code. Surveys took approximately 30–45 minutes to complete.

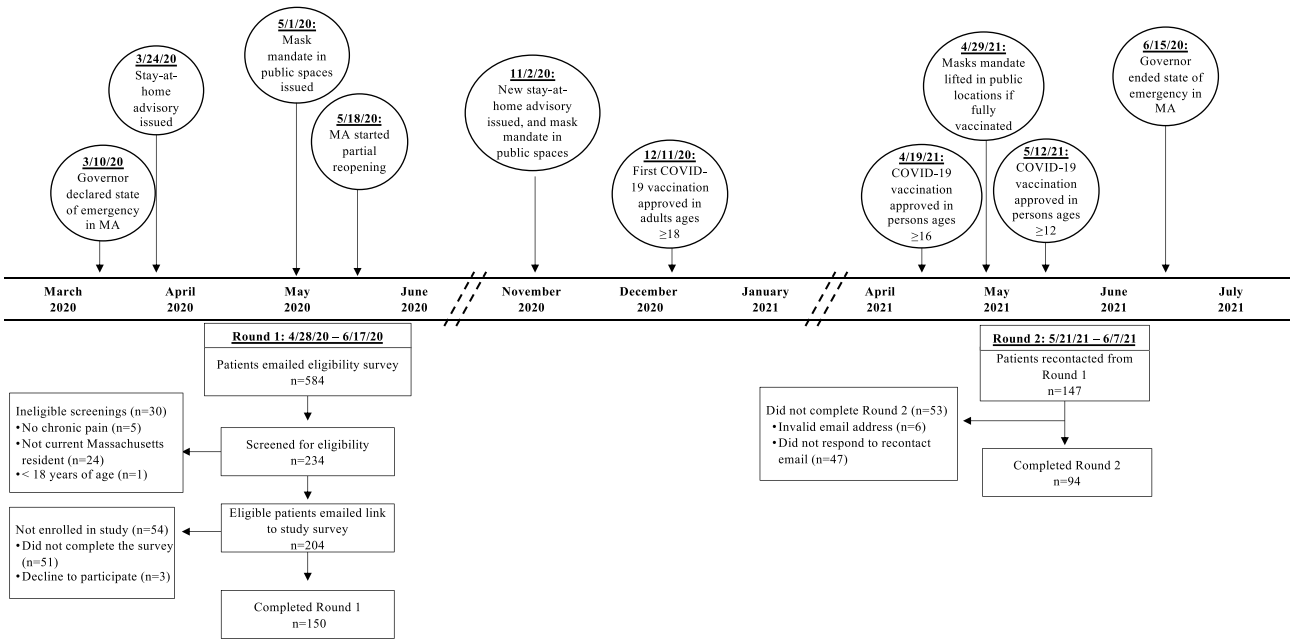

Figure 1 Study timeline in relation to the COVID-19 pandemic in Massachusetts. The timeline includes key dates relevant to social distancing mandates in Massachusetts around the time of survey administrations.

Measures

Loneliness

During the early weeks of the pandemic (T1), the 3-item UCLA Loneliness Scale Version 3[26] was used to assess loneliness. Items (eg, "How often do you feel that you lack companionship?") were rated on a scale from 1 (*hardly ever*) to 3 (*often*) and summed for a total score (α=0.76). Scores range from 3 to 9, and higher scores indicate greater feelings of loneliness. This scale has shown convergent and discriminant validity and demonstrated adequate internal reliability (α=0.72) in prior work.[26] In prior research, scores ≥6 have been used as a cut-off point for significant loneliness.[27,28]

Pain Catastrophizing

The 13-item Pain Catastrophizing Scale[29] was used to assess negative, maladaptive cognitions associated with pain at T1 and T2. Items (eg, "I worry all the time about whether the pain will end") were rated on a scale from 0 (*not at all*) to 4 (*all the time*). Total scores were computed separately for T1 and T2 by summing all items, with a total possible score of 52 (αs=0.96–0.97). Higher scores reflect greater pain catastrophizing. The PCS has shown acceptable internal reliability (α=0.87) and concurrent and discriminant validity in pain and control populations.[29,30] In prior research, a PCS score ≥ 16 has been used to represent clinically relevant levels of catastrophizing.[31,32]

Depression

The 8-item depression short form from the Patient Reported Outcome Measurement Information System (PROMIS)[33] was used to measure depressive symptoms at T2. All items (eg, "I felt unhappy"; "I felt worthless") were rated on a scale from 1 (*never*) to 5 (*always*), and items were summed for a total score (α=0.96). Scores range from 8 to 40, and higher scores indicate greater severity of depression. The PROMIS depression short form has shown acceptable internal reliability (α=0.95) and construct validity in prior work.[33] Per the standard scoring, scores ranging from 8 to 16 are considered to be "None to slight" depressive symptoms; 17 to 22 are considered to be "Mild" depressive symptoms; 23 to 32 are considered to be "Moderate" depressive symptoms; and scores ≥33 are considered to be "Severe" depressive symptoms.

Potential Covariates

At T1, participants answered several questions related to their chronic pain. These variables were explored as potential covariates to examine the unique effect of loneliness on pain catastrophizing. Additionally, these pain variables were

chosen because prior research has shown that they are related to pain catastrophizing,[10,34,35] as well as to loneliness.[36,37] One item from the Brief Pain Inventory[38] (BPI) assessed participants' pain severity (ie, "Rate your pain on average") on a scale from 0 (*no pain*) to 10 (*worst pain imaginable*). Seven items from the BPI assessed how much pain interfered with participants' daily activities (eg, "How has your pain interfered with your walking ability?") on a scale from 0 (*my pain did not interfere*) to 10 (*my pain completely interfered*). The seven items were summed for a total pain interference score (range: 0–70, α=0.91). The BPI has shown high internal reliability (αs= 0.89–0.92) and construct validity in chronic pain samples.[38,39] Participants were also asked "Do you typically take any medications for your pain?". Response options were "yes" or "no". If participants selected "yes", then they were asked about their use of over-the-counter medications (eg, Ibuprofen), opioids (eg, Morphine), non-opioids (eg, Gabapentin), and marijuana. Participants also reported their age, education, race, income, and marital status.

Analytic Approach

Non-parametric tests were used to report basic descriptive statistics and explore associations between loneliness, pain catastrophizing, depression, and potential covariates (Table 1). Spearman correlations were conducted to explore the

Table 1 Associations Among Participant Characteristics (T1) and Pain Catastrophizing (T2)

	Mean±SD or %	Pain Catastrophizing
Pain catastrophizing (range: 0–52)	18.86±14.08	–
Loneliness (range: 3–9)	6.25±1.90	0.34*
Depression (range: 8–40)	17.37±8.33	0.63**
Pain intensity (range: 0–10)	5.16±1.72	0.31*
Pain interference (range: 0–70)	31.93±16.45	0.42**
Baseline catastrophizing (T1) (range: 0–52)	18.18±14.43	0.70**
Age	40.58±15.96	−0.21
Income	–	−0.18
Use of pain medication		
Yes	69.9%	$20.90\pm13.74_{a}$
No	30.1%	$14.12\pm13.98_{b}$
Race		
White non-Hispanic	81.7%	$18.49\pm13.21_{a}$
Non-White and/or Hispanic	18.3%	$20.53\pm17.88_{a}$
Education		
Bachelor's degree or higher	83.9%	$19.05\pm14.13_{a}$
Less than bachelor's degree	16.1%	$17.87\pm14.29_{a}$
Marital status		
Married/in partnership	35.5%	$17.45\pm12.86_{a}$
Not married	64.5%	$19.63\pm14.76_{a}$

Notes: N=93. Spearman correlations for continuous variables, *p<0.01, **p<0.001. Mann–Whitney *U*-tests for categorical variables. For each categorical variable, means having different subscripts ($_{a \text{ and } b}$) indicates that the groups were significantly different from each other (p<0.05), whereas means having identical subscripts indicates that they are not significantly different. For example, two means having the subscript of "$_{a}$" indicates that those means were not significantly different, whereas two means with subscripts "$_{a}$" and "$_{b}$" indicates that the means were significantly different from each other.

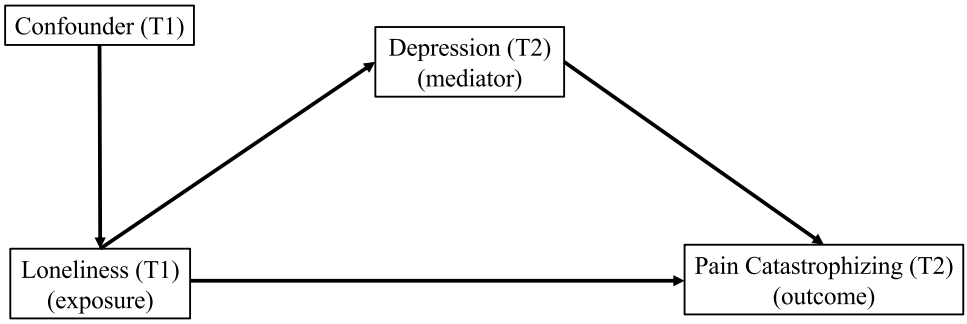

Figure 2 Causal mediation model testing the total exposure–outcome effect.

association of pain catastrophizing with continuous variables and Mann–Whitney *U*-tests were used to explore the association of pain catastrophizing with categorical variables. Mediation analysis was conducted using the PROCESS macro for SPSS. PROCESS is a regression path analysis modeling tool used to estimate direct and indirect effects of mediator models.[40] The mediation model used 5000 bootstrapped samples to test the total exposure–outcome effect, and that the association between loneliness (T1) and pain catastrophizing (T2) was mediated by severity of depression (T2) (Figure 2). Participant characteristics that were significantly related to pain catastrophizing (dependent variable) were included in the model as covariates. A post-hoc power analysis indicated that a sample of 68 participants was necessary to detect a medium-sized effect (f^2=0.15) of a predictor in a multiple linear regression (eg, mediation analysis), assuming power is 0.80 and α = 0.05.[41]

Results

Sample Characteristics

Overall, this sample of participants (n=93) with chronic pain had a mean age of 40.6 years (*SD* = 16.0) and was majority female (80%), White (82%), and self-reported having a college degree or higher (84%). The majority of participants also reported being married/in a partnership (36%). Participants self-reported the nature of their chronic pain with approximately 59% reporting back pain, 24% fibromyalgia, 7% postsurgical pain, and 63% of the participants indicated other sources (eg, arthritis, knee pain) of chronic pain. On average, participants reported a pain severity score of 5.2 (*SD* = 1.7) and pain interference score of 31.9 (*SD* = 16.5). Use of any pain medication was common (70%), with approximately 58% taking over the counter medication, 15% taking opioids, and 22% using marijuana.

Based on prior research using the UCLA Loneliness Scale Version 3 with a cut-off point of ≥6,[27,28] the prevalence of loneliness, assessed during the early weeks of the pandemic (T1), was 66%. Using a cut-off point of scores ≥16 on the PCS,[31,32] 52% of the sample reported high levels of pain catastrophizing after living in the pandemic for 1 year (T2). Based on established cut-off categories for depression,[33] after living in the pandemic for 1 year (T2), 56% of the sample reported "none to slight" depressive symptoms, 17% reported "mild" depressive symptoms, 24% reported "moderate" depressive symptoms, and 3% reported "severe" depressive symptoms.

Chi-square and Mann–Whitney *U*-tests revealed that participants who did not complete the follow-up survey at T2 did not significantly (n=56, 37%) differ from those who did complete the follow-up survey based on any demographic characteristics (ie, age, gender, race, education, income, or marital status), or on T1 scores of loneliness, depression, and pain catastrophizing (*ps*>0.05).

Variables Associated with Pain Catastrophizing After 1 Pandemic Year

Spearman correlations and Mann–Whitney *U*-tests were conducted to assess associations among pain catastrophizing, loneliness, depression, and potential covariates (Table 1), with a focus on the relation of variables to pain catastrophizing. Loneliness was significantly correlated with pain catastrophizing, such that greater feelings of loneliness were associated with higher levels of pain catastrophizing. Depression was also significantly correlated with pain catastrophizing, such that greater severity of depression was associated with higher levels of pain catastrophizing. Pain catastrophizing was

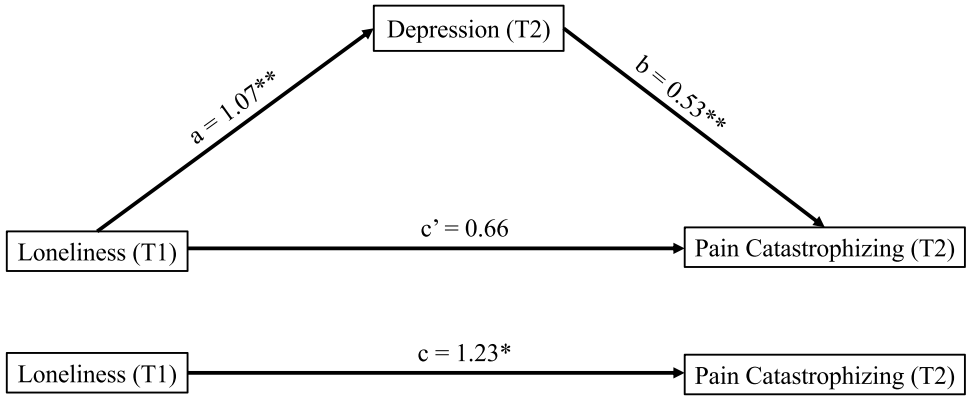

Figure 3 The mediating effect of depression after living in the pandemic for 1 year (T2) on the association between loneliness during the early weeks of the pandemic (T1) and pain catastrophizing after living in the pandemic for 1 year (T2), controlling for T1 pain intensity, pain interference, pain medication use, and baseline catastrophizing. *p<0.05, **p<0.01.

associated with greater pain severity, greater pain interference, and use of pain medications. Participants' demographic characteristics were not significantly associated with pain catastrophizing.

Mediation Analysis

A mediation analysis tested whether the association between loneliness (T1) and pain catastrophizing (T2) was mediated by depression (T2). Loneliness was entered as the predictor variable (x variable), depression was entered as a mediator (m variable), and pain catastrophizing was entered as the outcome variable (y variable) (Figure 3). Pain severity and interference, and use of pain medications at T1 were included as covariates. Additionally, T1 catastrophizing was included as a covariate to adjust for how catastrophizing may have changed over time.

The model predicting T2 pain catastrophizing was significant, $F(6, 85)=18.19$, $p<0.001$, $R^2=0.562$. The direct effect of loneliness on pain catastrophizing, while controlling for covariates, was significant (b=1.23, 95% CI [0.03, 2.44]). Loneliness was also significantly associated with greater severity of depression (b=1.07, 95% CI [0.34, 1.80]), and depression was significantly associated with higher levels of pain catastrophizing (b=0.53, 95% CI [0.19, 0.87]). There was a significant indirect effect of loneliness on pain catastrophizing through depression (b=0.57, 95% CI [0.10, 1.18]), and the direct effect of loneliness on pain catastrophizing was no longer significant when depression was included in the model (b=0.66, 95% CI [−0.54, 1.87]). This finding suggests that loneliness during the early weeks of the pandemic was associated with higher levels of pain catastrophizing after living in the pandemic for 1 year, and greater severity of depression after living in the pandemic for 1 year mediated this relationship. We also conducted the mediation model without covariates, to test whether the associations and mediational pattern and significance may be altered by the inclusion of our control variables. When covariates were not included in the mediation model, the pattern and significance of findings remained the same.

Discussion

The recent period of mandated social distancing allowed a unique opportunity to examine the longer-term impact of social isolation among individuals with chronic pain. The present longitudinal study showed that greater feelings of loneliness during the early weeks of the pandemic were associated with subsequent higher levels of pain catastrophizing 1 year later. Further, the association between loneliness and pain catastrophizing was mediated by greater severity of depression.

Participants in this sample reported a mean score on the UCLA loneliness measure that was above the cut-off point for significant loneliness, and also somewhat higher than loneliness reported in other samples of individuals with chronic medical conditions (eg cardiovascular, autoimmune, metabolic) during the pandemic.[4] This suggests that these individuals with chronic pain may have experienced heightened levels of loneliness and emphasizes the importance of understanding the long-term effects of social distancing among those with chronic pain. Our sample also exhibited

relatively high levels of depression after living in the pandemic for 1 year, with approximately 26% of the sample reporting moderate-to-severe depressive symptoms. This finding is in line with other research conducted during the pandemic.[42,43] The mean score of pain catastrophizing after living in the pandemic for 1 year in the present study was higher than pain catastrophizing reported in some samples of individuals with chronic pain pre-pandemic,[44] but lower than pain catastrophizing scores among other chronic pain samples pre- and during the pandemic.[8,31] Importantly, we did not assess pre-pandemic levels of loneliness, depression, or pain catastrophizing, and therefore we are unable to attribute scores on these variables to the COVID-19 pandemic.

The prospective, longitudinal design of our study showed that loneliness was associated with higher pain catastrophizing 1 year later. This finding expands upon prior work[13] by demonstrating this association during a time of heightened social isolation, over a longer timeframe, and while accounting for participants' pain experiences and medication use. The present study also gives insight into this association by showing that depression may serve as a mediator, such that feeling lonely may contribute to depressed mood (hopelessness, helplessness), leading to more catastrophic cognitions about pain. Notably, an alternative mediation model tested whether depression during the early weeks of the pandemic contributed to greater feelings of loneliness 1 year later, contributing to more catastrophizing (Supplemental Material). This alternative model showed that loneliness did not serve as a significant mediator, providing further support for the temporal ordering of loneliness preceding depressive symptomology.[18,19]

Our findings provide potentially important clinical implications, suggesting that loneliness may influence catastrophic pain-related thoughts through depression, providing a viable point of intervention in the management of pain symptoms. Importantly, depression can be modified with behavioral interventions, such as cognitive behavioral therapy.[45–47] Interventions targeting depressive symptomology among chronic pain patients may reduce catastrophizing pain-related thinking and may be particularly essential during times of heightened social isolation, such as the COVID-19 pandemic (eg, self-quarantining). Because prior work suggests that reducing catastrophic pain-related cognitions improves pain management,[45] targeting depressive symptoms may be one strategy by which pain catastrophizing decreases and pain management improves. Future studies may benefit from investigating the temporal associations among loneliness, depression, and catastrophizing over the course of empirically supported treatments in patients with chronic pain.

Our findings should be interpreted within the context of certain limitations. First, due to the method of convenience sampling required to obtain responses expediently during the timeframe after onset of social distancing, the sample was demographically skewed, with the majority of participants identifying as female, White, and with more formal education. Thus, the generalizability of the findings may be limited. For example, some research has shown that females report more frequent pain-related catastrophic thoughts than men,[48] whereas other studies indicate no sex differences.[49] It is important that future studies recruit a more demographically diverse sample from different geographic locations to further understand associations among these variables, as well as to replicate our findings to test generalizability. Second, due to the conditions of the pandemic and the online sampling strategy used, we compensated participants with an Amazon electronic gift code which may have impacted participants' decision to complete our follow-up survey at T2 (63% response rate). Although Amazon gift codes are commonly used as an incentive to participate in online surveys, some research suggests that providing participants with cash may lead to a higher response rate.[50] Third, our analysis was fundamentally based on associations between variables, and did not randomize participants to certain conditions, which limits the ability to draw causal associations. However, we demonstrated the temporal ordering of the independent variable (loneliness) and mediator (depression) by assessing the mediator at T2 instead of T1, which is a common approach when only having access to two time points of data.[51,52]

Conclusion

The present study demonstrated how loneliness during the early weeks of social distancing was associated with greater pain catastrophizing after living in the pandemic for approximately 1 year. Further, this association was mediated by severity of depression after living in the pandemic for 1 year. By studying the association between depression and pain catastrophizing within the context of a historically steep increase in isolation, this study afforded an opportunity to detect the relation more sensitively between isolation and negative cognitions about pain. Further, studying these associations and the mediational role

of depression in this sample of patients with chronic pain is clinically important, in that it provides novel insights into how we may prioritize the employment of behavioral interventions to help individuals.

Ethics Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Partners Human Research Committee (PHRC)/Institutional Review Board (IRB).

Consent to Participate

All participants provided electronic informed consent before participating in the study.

Data Sharing Statement

The data used to support the findings of this study are available from the corresponding author upon request.

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Disclosure

There were no relevant conflicts of interests for any of the authors.

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