

# The interrelationships among pain interference, depressive symptoms, loneliness, and employment status: a moderated mediation study

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## Abstract

**Objective:** To explore the mediating effect of loneliness on the relationship between pain interference and depressive symptoms and to determine whether this mechanism is contingent on employment status.

**Design:** Cross-sectional study.

**Subjects:** A total of 876 adult caregivers of adolescents living in extremely impoverished conditions.

**Analysis:** Mediation and moderated mediation analyses using standard path-analytic approaches.

**Results:** The mean age of the sample was 39.0 (SD = 12.8) years and 80.7% ( $n = 707$ ) identified as female. Almost half (48.9%,  $n = 425$ ) of the participants did not report any pain, while 32.5% ( $n = 285$ ) reported non-disabling pain, and 19.0% ( $n = 166$ ) reported disabling pain. The mean depressive symptoms score was 16.20 (SD = 10.6), and the mean loneliness score was 40.09 (SD = 10.5). Loneliness mediated the effect of both non-disabling and disabling pain on depressive symptoms. However, the indirect effect of pain interference on depressive symptoms through loneliness was more pronounced among participants reporting disabling pain (coefficient, 2.11; Boot 95% confidence interval (CI) (1.25–3.01)) than non-disabling pain (coefficient, 0.99; Boot 95% CI (0.25–1.76)). Moderated mediation results showed that the indirect effect of pain interference on depressive symptoms, via loneliness varied in magnitude as a function of employment status among participants reporting disabling pain but not those reporting non-disabling pain.

**Conclusion:** Loneliness provides an important link in the relationship between depressive symptoms and pain interference. Furthermore, employment status is an important factor to consider, especially among individuals reporting disabling pain with comorbid depressive symptoms.

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## Keywords

Pain, depressive symptoms, loneliness, employment, socioeconomic status

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Pain is a widespread problem experienced across the general population and contributes greatly to national rates of morbidity, mortality, and disability<sup>1</sup> including depression. Globally, one in five people suffer from moderate to severe chronic pain, and one in three are unable or less able to maintain an independent lifestyle due to pain.<sup>2</sup> Research shows that individuals in lower socioeconomic groups report more chronic pain symptoms,<sup>3</sup> experience higher pain severity and pain-related disability<sup>4</sup> including depression. Furthermore, loneliness and employment have been shown to be independently associated with pain and depression.<sup>5,6</sup> However, few studies have targeted individuals from low social economic groups and none have explored loneliness as a potential mediating factor. Utilizing a sample of adults living in impoverished neighborhoods in the Southeastern United States, this study explores the mediating effect of loneliness on the relationship between pain interference and depressive symptoms and determines whether this mechanism is contingent on employment status.

## Pain and depression

The relationship between pain and depressive symptoms is well documented.<sup>7</sup> Furthermore, research consistently indicates that comorbidity of pain with psychological disorders, such as depression, leads to poorer outcomes including significant disability, a worse prognosis<sup>8</sup> and poorer health-related quality of life.<sup>9</sup> For low-socioeconomic groups, the adverse effects of socioeconomic hardships and the accompanying stressors may exacerbate the experience of pain<sup>4</sup> leading to poorer mental health outcomes such as depression.

It is worth noting that most research on pain and depressive symptoms has focused on individuals meeting criteria for chronic pain, where the main foci include pain duration (i.e. pain persisting for

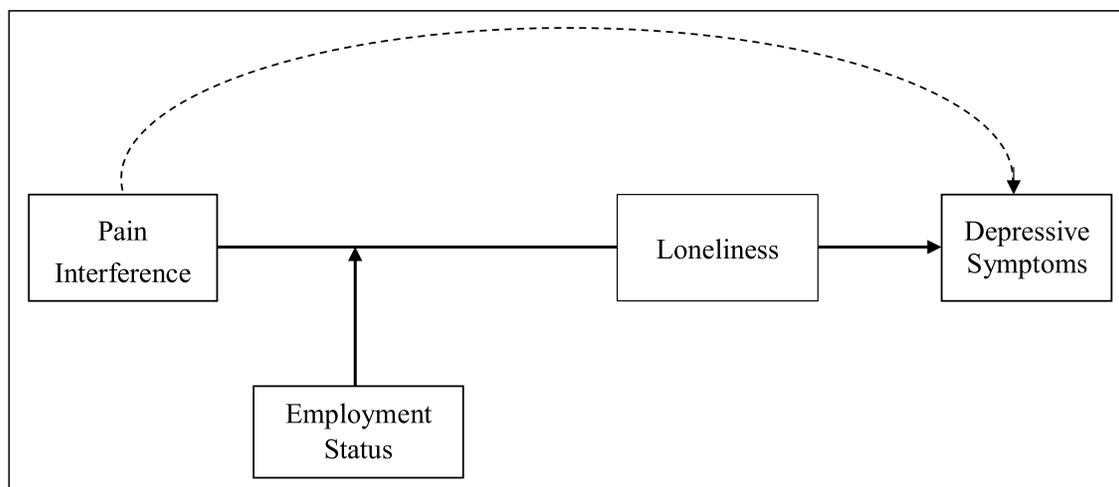
six months). However, some researchers argue that such definitions and methods of diagnosing chronic pain and understanding its deleterious effects cause pain to be under-diagnosed and under-treated.<sup>10</sup> Indeed, findings indicate that the impact of pain (e.g. the interference with daily activities and employment) is a much stronger predictor of depression than pain intensity and duration.<sup>11</sup> Furthermore, the recent definition of pain emphasizes factors other than duration of pain (e.g. interference with work and social activities) and provides avenues for improving outcomes beyond simply controlling physical pain.<sup>12</sup> This study is informed by this newer approach, defining pain inclusively, and acknowledging such factors as disability associated with pain.

## Effect of loneliness and employment

Loneliness has been associated with pain and depression independently. For instance, research suggests that lonelier people become more depressed and fatigued over time than people who feel more socially connected.<sup>13</sup> Furthermore, Oishi et al.<sup>5</sup> found that individuals who felt socially disconnected tolerated physical pain to a lesser extent than their counterparts who felt more socially connected. Employment status has also been associated with pain and loneliness. Employed individuals have higher levels of self-esteem and are more willing to accept a disabling condition.<sup>6</sup> In addition, those who are employed tend to have lower levels of loneliness.<sup>14</sup>

## Current study

While extant research has established several positive associations among pain, depressive symptoms, and loneliness, few if any, researchers have explored the potential mechanism through which



**Figure 1.** Conceptual moderated mediation model.

loneliness influences the relationship between pain and depressive symptoms. Goesling et al.<sup>15</sup> note that the association between pain and depression is complex and multiple factors, including cognitive and environmental factors, should be considered when trying to disentangle the pain–depression link. Thus, it appears that there are relationships among pain interference (which we define as pain that interferes with individuals’ normal activities such as with daily activities and employment), depression, and loneliness. That is, individuals reporting pain interference are likely to experience higher loneliness and, in turn, an increase in depressive symptoms. Furthermore, based on research indicating that low-income earners are hesitant to report pain for various reasons including fear of losing employment,<sup>16</sup> employment status could differentially affect individuals’ feelings of loneliness, especially if pain affects their ability to work optimally. Thus, this study aims to test a moderated mediated mechanism involving pain interference (i.e. disabling and non-disabling pain), depressive symptoms, feelings of loneliness, and employment status in a sample of adult caregivers of adolescents living in extremely impoverished conditions.

Specifically, this study has three aims: (1) explore the direct effect of disabling pain and non-disabling pain on depressive symptoms, (2) examine whether loneliness mediates the relationship between pain (both non-disabling and disabling)

and depressive symptoms, and (3) explore whether the mediating role of loneliness on the relationship between pain interference and depressive symptoms varies by employment status. Our conceptual model for depicting these mechanisms is shown in Figure 1.

## Method

### *Participants and recruitment procedures*

Data utilized in this study is derived from the larger Mobile Youth and Poverty Study, a 14-year longitudinal study that was conducted between 1998 and 2011, which includes multiple individual studies.<sup>17</sup> The parent study is referred to as the Mobile Youth Survey, and one of the individual studies is referred to as the Adult and Family Dynamics Study. The data for this study are derived from the latter individual study. Complete information about the recruitment and sampling procedures for the parent study are provided elsewhere.<sup>17</sup> Briefly, the Mobile Youth Survey participants were adolescents recruited from 13 of the poorest neighborhoods within the Mobile Statistical Area in Alabama. The adolescents from the original 13 neighborhoods were followed as they moved to new neighborhoods throughout the data collection period. Each new neighborhood was added to the study, and by the year 2011, the Mobile Youth Survey included

approximately 50 neighborhoods. Based on the 1990 US Census data—the most current census data at the start of the study—the median household income of the Mobile Statistical Area was US\$5290 or a 73% poverty rate.

Between the years 2001 and 2010, a complementary cross-sectional survey involving adult caregivers of the adolescents in the Mobile Youth Survey—referred to as Adult and Family Dynamics Study—was conducted. More specifically, the parents/caregivers were administered questionnaires that included demographic information, questions regarding the adults' living conditions, employment, and health status, as well as other factors. Prior to data collection, the studies were approved by the University's Institutional Review Board.

This study utilized items related to health status and demographic factors. A total of 1043 adults ( $n=180$  men and  $n=863$  women) completed the Adult and Family Dynamics Study. Of these, 84% ( $n=881$ ) responded to the health status portion of the questionnaire. Given that pain interference is the main independent variable in this study, five respondents who did not answer the question or provided a "don't know" response to the level that pain interfered with their normal work were eliminated from analysis. This study is thus based on the remaining 876 participants who responded to the health portion of the questionnaire and had complete responses to the pain interference portion of the questionnaire.

**Dependent variable.** Depressive symptoms as measured by the Center for Epidemiological Studies Depression Scale, a 20-item measure,<sup>18</sup> served as the dependent variable in this study. The scale ranges from 0 to 60, where higher scores indicate greater depressive symptoms. The instrument has been validated in a general population and clinical patient samples.<sup>19,20</sup> Specifically, internal consistency for the scale scores for both the general ( $\alpha=0.85$ ) and clinical populations ( $\alpha=0.90$ ) have been reported to be sound.<sup>18</sup> The internal reliability of the instrument's scores for this study was good ( $\alpha=0.83$ ).

**Independent variable.** Pain interference was the independent variable of interest. The variable was

measured using the question "During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?" with response options of (1) *not at all*, (2) *some*, and (3) *a lot*. For this study, these response options are trichotomized as (1) *none*, (2) *non-disabling*, and (3) *disabling*, respectively.

**Mediator variable.** Loneliness was the mediator variable. Loneliness was measured using the Revised UCLA Loneliness Scale.<sup>21</sup> The scale contains 20 statements, describing participants' relationships with and feelings toward others. The scale ranges from 0 to 60 with higher scores indicating more feelings of loneliness or social disconnectedness. Peplau and Cutrona<sup>21</sup> report a Cronbach's alpha of 0.91, indicative of high internal reliability for the instrument's scores. The internal reliability for this study was also good ( $\alpha=0.84$ ).

**Moderator variable.** Employment status was the moderator variable. Participants were asked to report whether they were employed outside of the house with the response options of no (=0) or yes (=1).

**Control variables.** Previous research indicates that various demographic and socioeconomic factors are associated with pain interference and depressive symptoms; thus, additional variables collected as part of the Adult and Family Dynamics Questionnaire study were included in the analyses to control for possible confounding. These variables included age, gender, relationship status, and public support (used as a proxy for poverty). *Age* in years was analyzed as a continuous variable; *relationship status* was dichotomized into being in a relationship (included participants who were married and those dating/engaged; =1); and not in a relationship (included those who had never been married and those in previous relationships but were currently single; =0). *Gender* was dichotomized and coded as Male (=0); Female (=1). Finally, as a measure of poverty, respondents were asked whether they *received public support*,

including unemployment insurance benefits, Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), and supplemental security income (SSI). If they indicated that they received benefits from any of these programs, public support was coded as 1; otherwise, it was coded as 0.

## Data analysis plan

Descriptive statistics were first used to describe the characteristics of the study sample. Bivariate correlations were then conducted. Next, mediation analysis was conducted using mediation for multicategorical independent variables procedures provided by Hayes and Preacher.<sup>22</sup> Whereby, the independent variable (pain interference) was first dummy coded with individuals reporting no pain serving as the reference group. The coding for the various categories of pain were as follows: (1) the *no pain* condition was coded as 0 on all conditions; (2) the *non-disabling pain* condition was coded as 1 for non-disabling pain, 0 for no pain, 0 for disabling pain; and (3) the *disabling pain* condition coded as 1 for disabling pain condition and 0 for non-disabling pain, and 0 for no pain conditions. The relative indirect effects and their corresponding 95% bias-corrected bootstrap-confidence intervals (CIs) were then estimated.

Finally, moderated mediation analyses were conducted using standard path-analytic approaches.<sup>23–27</sup> Specifically, we examined whether employment status moderated the strength of the mediated relationship between pain interference (i.e. non-disabling pain and disabling pain) with depressive symptoms via loneliness. Separate analyses were conducted for participants reporting non-disabling and disabling pain. In both models, participants reporting no pain were utilized as the reference group. Moderated mediation in both models was examined by assessing the following conditions of standard path-analytic approaches:<sup>23–27</sup> (1) overall effect of the treatment (non-disabling and disabling pain) on the outcome variable (depressive symptoms) will be significant; (2) interactions between pain interference and employment will be significantly associated with loneliness; (3) there will be a significant effect of

loneliness on depressive symptoms; (4) there will be differences in the conditional indirect effect of pain interference on depressive symptoms, via loneliness, by employment status (i.e. unemployed vs employed). That is, the conditional indirect effect of pain interference on depressive symptoms, via loneliness, differs in strength based on employment status (i.e. employed vs unemployed); (5) finally, the association between the indirect effect and the moderator as quantified by an index of moderated mediation will be non-zero and its associated bias-correlated CI will not include zero.

All the analyses were conducted in SPSS version 24.0 (SPSS Inc., Chicago, IL, USA). Mediation and moderated mediation analyses were conducted using the PROCESS Macro for SPSS provided by Hayes<sup>28</sup> with a 10,000 bootstrap estimates for the construction of 95% bias-corrected CIs. Age, gender, relationship status, and public support were simultaneously included in all the analyses as control variables.

## Results

### Descriptive statistics

Descriptive statistics and bivariate correlations are shown in Table 1. The mean age of the sample was 39.0 (SD=12.8). A majority of the participants identified as female, were in a relationship, unemployed, and received public support. Almost half (48.9%,  $n=425$ ) of the participants did not report having pain that interfered with their normal work in the past four weeks (no pain), 32.5% ( $n=285$ ) reported pain that slightly interfered with their normal work in the past four weeks (non-disabling pain), and 19.0% ( $n=166$ ) had pain that interfered a lot with their work in the past four weeks (disabling pain).

### Mediation

As shown in Table 2 and Figure 2, there was a significant positive relationship between pain interference (both non-disabling and disabling pain) and depressive symptoms both before (Table 2, Model 2; Figure 2, paths c1 and c2) and after adjusting for

**Table 1.** Descriptive statistics and bivariate correlations.

	Descriptive statistics		Bivariate correlations								
	Number (%)	Mean (SD)	1	2	3	4	5	6	7	8	
1. Depressive symptoms		16.20 (10.6)	–								
2. Pain interference			0.19**	–							
None	425 (48.5)										
Non-disabling	285 (32.5)										
Disabling	166 (19.0)										
3. Loneliness		40.09 (10.5)	0.48**	0.14**	–						
4. Employment status			–0.12**	–0.23**	–0.12**	–					
Unemployed	523 (59.7)										
Employed	353 (40.3)										
5. Age		39.03 (12.8)	–0.08*	0.25**	–0.07*	–0.26*	–				
6. Gender			0.06	0.07*	0.00	–0.15**	0.09**	–			
Male	164 (18.7)										
Female	707 (80.7)										
Information unavailable	5 (0.6)										
7. Relationship status			–0.08*	–0.05	–0.08*	0.20**	–0.27**	–0.24**	–		
Not in a relationship	424 (48.4)										
In a relationship	452 (51.6)										
8. Received economic support			0.14*	0.09**	0.04	–0.23**	0.02	0.15**	–0.10**	–	
No	169 (19.3)										
Yes	707 (80.7)										

\* $P < 0.05$ ; \*\* $P < 0.01$ .

loneliness (Table 2, Model 3; Figure 2, paths c'1 and c'2). Furthermore, both non-disabling pain and disabling pain were positively and significantly associated with loneliness (Table 2, Model 1; Figure 2, paths a1 and a2), with a stronger relationship being observed among those reporting disabling pain.

Holding pain constant, loneliness was significantly and positively associated with depressive symptoms scores (Table 2, Model 3; Figure 2 path b). Thus, all the relative direct and total effects of pain interference on depressive symptoms were positive and statistically different from zero for all comparisons (non-disabling pain versus no pain; disabling pain versus no pain).

Most pertinent to the mediation hypothesis is the estimation of the relative indirect effects of pain interference (independent variable) on depressive

symptoms (dependent variable) through loneliness (mediator variable). A significant indirect effect, as indicated by a 95% bias-corrected bootstrap-CI that doesn't include a zero, provides evidence for mediation<sup>22</sup> The mean differences in loneliness between the pain interference conditions (i.e. non-disabling–path a1 and disabling pain–path a2) relative to the no pain condition are multiplied by the effect of loneliness on depressive symptoms when pain interference is constant (path b). For instance, relative to participants reporting no pain, those reporting disabling pain scored 2.11 points ( $4.68 \times 0.45$ ) higher on the depressive symptoms measure than those who report no pain as a result of the positive effect of disabling pain on loneliness, which, in turn, resulted in higher depressive symptoms scores. The 95% bias-corrected bootstrap-CI generated using 10,000 bootstrap

**Table 2.** Regression results for the mediation relationship.

	Loneliness		Depression	
		Model 1 (mediator)	Model 2 (total effect)	Model 3 (direct effect)
Constant		44.31***	17.66***	-2.11
Non-disabling pain	a <sub>1</sub>	2.22**	3.09***	2.11**
Disabling pain	a <sub>2</sub>	4.68***	5.78***	3.70***
Loneliness				b
Age		-0.11**	-0.14***	-0.09***
Female		-0.63	0.47	0.75
Coupled		-2.31**	-2.04**	-1.01
Received economic assistance		0.41	2.96**	2.78**

Relative indirect effect of pain on depressive symptoms through loneliness		
	Point estimate	Boot 95% CI
Non-disabling Pain	0.99	0.25–1.76
Disabling Pain	2.11	1.25–3.01

\*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

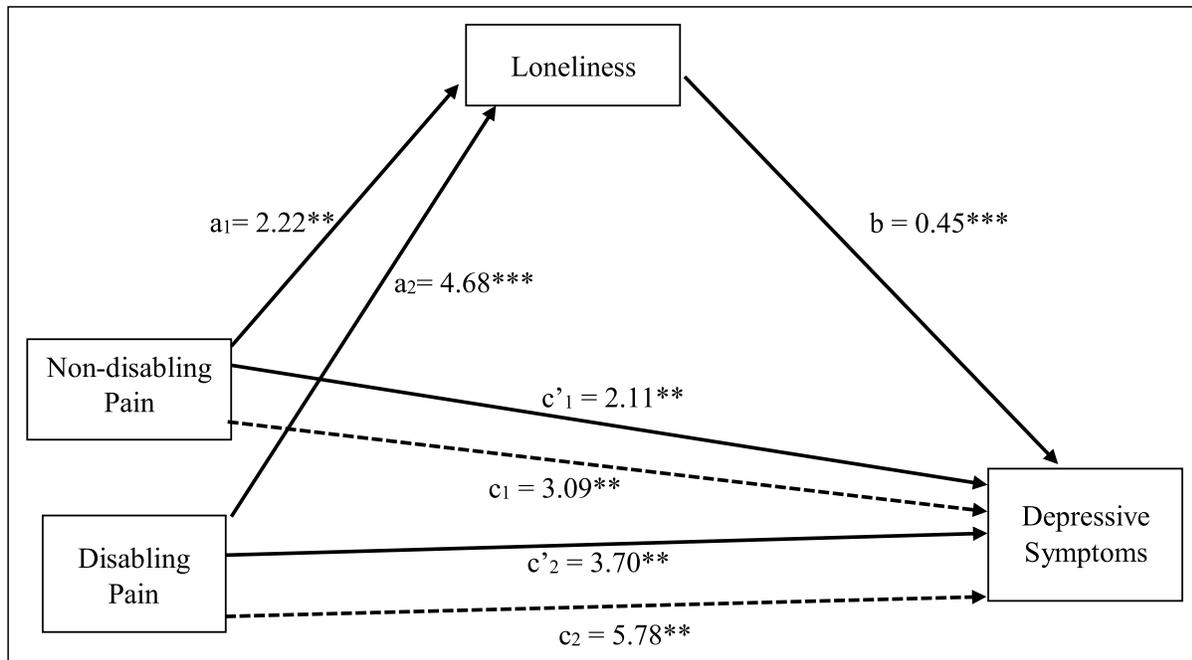
coefficient estimates for the product of these paths did not include zero, both for individuals reporting non-disabling pain and those reporting disabling pain (Table 2). Thus, the association between pain interference (both disabling and non-disabling) and depressive was mediated by loneliness.

In summary, both non-disabling pain and disabling pain conditions were significantly associated with loneliness, and loneliness was significantly associated with depressive symptoms after controlling for pain. Furthermore, the indirect effect of non-disabling pain and disabling pain on depressive symptoms through loneliness was significant. Thus, the relationship between pain interference (both non-disabling and disabling pain) and depressive symptoms was mediated by loneliness. Age and economic assistance were significant control variables in the model, with younger participants and those utilizing economic assistance scoring higher on the depressive symptoms measure.

### Moderated mediation

Moderated mediation analyses were conducted by examining the standard path-analysis conditions<sup>23–27</sup> as indicated in the data analysis plan

above. Condition 1 was verified in the previous results (See Table 2, Model 2). To test for condition 2, we evaluated whether the interaction between pain interference (i.e. non-disabling pain and disabling pain) and employment status were significantly associated with loneliness. Results showed that the interaction effect between non-disabling pain and employment on loneliness ( $\beta = 2.15$ ,  $P = 0.21$ ) was non-significant (Table 3, Model 1<sup>ND</sup>), while the effect of the interaction between disabling pain and employment on loneliness was significant ( $\beta = 5.34$ ,  $P < 0.05$ ; Table 3, Model 2<sup>D</sup>). Thus, condition 2 was fulfilled for participants reporting disabling pain but not for those reporting non-disabling pain. The finding that, holding pain interference constant, participants with higher loneliness scores reported higher depressive symptoms scores ( $\beta = 0.45$ ,  $P < 0.001$ ) provides evidence for condition 3 for both participants reporting non-disabling pain (Model 3<sup>ND</sup>) and those reporting disabling pain (Model 4<sup>D</sup>). Thus, results of the first three conditions indicate that the indirect effect of disabling pain on depressive symptoms, via the mediator (i.e. loneliness), varies in magnitude as a function of employment status (i.e. moderator). However, the indirect



**Figure 2.** Path coefficients of mediation of the relationship between pain interference and depressive symptoms via loneliness.

a<sub>1</sub> = Effect of non-disabling pain on loneliness; a<sub>2</sub> = Effect of disabling pain on loneliness; b = Effect of loneliness on depressive symptoms after adjusting for disabling and non-disabling pain; c<sub>1</sub> and c<sub>2</sub> = the effect of non-disabling pain and disabling on depressive symptoms without the mediator (i.e. total effect); c'<sub>1</sub> and c'<sub>2</sub> = the effect of non-disabling pain and disabling on depressive symptoms when loneliness is included as a mediator (i.e. direct effect). Age, gender, relationship status, and economic assistance are included in the analyses as covariates.

\*P < 0.05; \*\*P < 0.01.

**Table 3.** Moderated mediation results.

Outcome	Loneliness		Depressive symptoms	
	Model 1 <sup>ND</sup>	Model 2 <sup>D</sup>	Model 3 <sup>ND</sup>	Model 4 <sup>D</sup>
Constant	44.89	46.30***	-1.02	-0.21
Disabling pain	-	4.73***	-	3.78***
Non-disabling pain	1.89*	-	2.10***	-
Loneliness	-	-	0.45***	0.45***
Employment	-3.18***	-2.54***	-	-
Employment × pain interference	2.15	5.34*	-	-
Age	-0.11**	-0.11**	-0.08**	-0.09**
Female (Re: Male)	-0.92	-0.74	0.44	0.93*
Coupled (Re: Uncoupled)	-1.01	-1.45	-0.91	-1.21
Received economic assistance (Re: No)	0.13	-0.64	3.25**	2.33*

ND: non-disabling pain; D: disabling pain.

\*P < 0.05; \*\*P < 0.01; \*\*\*P < 0.001.

effect of non-disabling pain on depressive symptoms, via loneliness, does not vary in magnitude as a function of employment status.

To further validate the moderated mediation relationship, we examined conditions 4 and 5. As shown in Table 4, the conditional indirect effect of

**Table 4.** Conditional indirect effects of pain interference on depressive symptoms through loneliness at different levels of employment.

Employment status	Non-disabling pain		Disabling pain	
	Point estimate	95% Boot CI <sup>a</sup>	Point estimate	95% Boot CI <sup>a</sup>
Unemployed	0.40	-0.45 to 1.27	1.07	0.12 to 2.12
Employed	1.33	-0.21 to 2.52	3.40	1.77 to 5.25

<sup>a</sup>95% bias-corrected bootstrap-confidence interval using 10,000 samples.

disabling pain on depressive symptoms through loneliness was higher among participants who were employed when compared to their counterparts who were unemployed. Among participants reporting non-disabling pain, the conditional indirect effect was higher and significant (i.e. non-zero) among those employed but lower and insignificant among those who were unemployed. Thus, condition 4 was satisfied for both participants reporting disabling and non-disabling pain. Finally, the index of moderated mediation among participants reporting disabling pain had a 95% bias-correlated CI that did not include zero. However, the index of moderated mediation among participants reporting non-disabling pain had a 95% bias-correlated CI that included a zero. Thus, condition 5 was satisfied for participants reporting disabling pain but not those reporting non-disabling pain.

In summary, our moderated mediation results indicate that employment status moderated the indirect effect of disabling pain on depressive symptoms through loneliness. Whereby, among participants reporting disabling pain the indirect effect of disabling pain on depressive symptoms through loneliness was higher among those employed than those who were not employed. Conversely, the indirect effect of non-disabling pain on depressive symptoms through loneliness was not moderated by employment status.

## Discussion

Overall, the findings of this study indicate that both non-disabling pain and disabling pain are significantly associated with greater depressive symptoms, and the associations are mediated by

loneliness. Furthermore, moderated mediation analyses indicate that the indirect effect of disabling pain on depressive symptoms through loneliness is conditioned on the participants' employment status. This same finding did not hold up for non-disabling pain. These findings reiterate the importance of considering the impact of pain interference, and not the mere presence of pain, when working with clients. Furthermore, the significance of loneliness and employment highlight the necessity of taking a holistic view when working with clients presenting with comorbid pain and depressive symptoms, especially low-income individuals. Relatedly, a major strength of this study is the insight it provides into a rarely studied and high risk population. The following is a discussion of our results in light of this literature base.

The finding that pain interference, whether disabling or non-disabling, is positively associated with depressive symptoms is consistent with a growing literature base suggesting that individuals reporting pain also experience comorbid depressive symptoms.<sup>5,6</sup> This finding could be explained utilizing a cognitive behavioral theory,<sup>29</sup> whereby depressive symptoms are viewed as a response to the consequences of living in pain. Thus, some participants, could have been overly focused on their pain and resulting disability leading to an increase in worry and anxiety, which then presented as depressive symptoms. Another explanation, that is, relevant to this study, is that by living in impoverished neighborhoods, there were fewer resources for medical and psychological care available.<sup>30</sup> Thus, those presenting with pain could have received inadequate care, which when combined with the high levels of stress often observed in socioeconomic status (SES) populations<sup>31</sup> could have led to increased risk for

pain, as well as negative psychological consequences including depression.

Furthermore, our findings show that the association between pain interference and depressive symptoms was stronger among participants reporting disabling pain than those reporting non-disabling pain. This finding is consistent with previous research indicating that interference of pain with activities, not just the mere presence of pain, may be one of the major factors associated with depression.<sup>8,32</sup> This finding has important implications for practice. That is, in addition to evaluating pain intensity, clinicians and other rehabilitation professionals should also assess the effect of pain in daily life activities and address these issues in prevention, intervention, and treatment plans.

The association between pain interference and depressive symptoms was mediated by loneliness in both participants reporting non-disabling and disabling pain. The mediating role of loneliness on the relationship between pain interference and depressive symptoms could be attributed to activity limitation leading to feelings of social disconnectedness. Individuals reporting pain interference, especially disabling pain, could have reduced their involvement in social activities leading to feelings of loss of interconnectedness and hence higher loneliness scores. This, in turn, led to emotional distress, which was expressed as depressive symptoms. This finding may suggest that interventions aimed at decreasing loneliness may simultaneously reduce pain and depressive symptoms. Thus, a more integrative approach to the treatment of pain that addresses all facets of pain should be promoted in lieu of—or in addition to—the existing treatments for pain and depression, which tend to focus on alleviating specific symptoms.<sup>33</sup>

The moderated mediated analysis tested the extent to which the relationship between pain interference (i.e. disabling pain and non-disabling pain) and depressive symptoms was mediated via loneliness, while also depending on employment status. Results indicate that the indirect effect of disabling pain on depressive symptoms through loneliness was dependent on participants' employment status. That is, disabling pain seemed to lead to an increase in loneliness to a higher extent

among the employed participants, compared to their unemployed counterparts, which then translated to increased depressive symptomatology. This result is consistent with Jackson et al.'s<sup>34</sup> finding that individuals experiencing pain and are employed are more likely to report more emotional distress than those who were unemployed or employed and reporting no pain. A possible explanation for this finding is that disabling pain could have made it more difficult for some employed participants to perform employment related tasks, which led to frustrations making them to withdraw from coworkers. This led to an increase in feelings of loneliness and consequently an increase in depressive symptoms. Another possible explanation for this finding is that some of the employed participants reporting disabling pain may have perceived pain as threatening to their employment, leading them to respond with pain-related fear avoidance, which resulted in decreased functioning.<sup>35,36</sup> The decrease in functioning may have led to an increase in feelings of loneliness leading to poor mood and subsequent increase in depressive symptoms. Given findings from previous research indicating that worker's, especially low-income earners, are hesitant to report pain for various reasons including fear of losing employment,<sup>16</sup> it is important for health professionals and vocational rehabilitation counselors to educate individuals presenting with disabling pain on potential negative effects of continuing to work while experiencing disabling pain. Furthermore, it is important for such workers to understand the options they have including a right to request for accommodations such as changes work schedules or work assignments when necessary.

Conversely, the indirect effect of non-disabling pain on depressive symptoms through loneliness was not dependent on the individual's employment status. This finding may be due to the minimal pain (i.e. non-disabling pain) experienced in the work place and thus employment status was not relevant for these individuals.

Considering the confounding factors, our findings showed that receiving public support was positively and significantly related to reporting pain interference (See Table 1). Furthermore, after

adjusting for the other variables, the individuals receiving public support (representative of those living in poverty) were significantly more likely to meet the CES-D criteria for depressive symptoms (See Table 2, Model 3). A possible explanation for this finding is that the adverse effects of socioeconomic hardships and the accompanying stressors could have magnified the experience of pain and the related consequences leading to an increase in depressive symptoms. This finding points to the need for professionals to take a holistic view of their clients, instead of just the problems and symptoms with which clients present.

Our findings indicate that age was positively and significantly associated with pain interference were consistent with past studies.<sup>37,38</sup> However, logistic regression analyses showed that age was negatively associated with depressive symptoms even after adjustments were made for the other variables. Further research is needed on these findings, specifically to characterize the effect of age on depressive symptoms. It is worth noting that past studies have provided mixed findings regarding the association between age and depressive symptoms. While some researchers report that there is a linear relationship between age and depressive symptoms,<sup>39</sup> others argue that the relationship is nonlinear, with the depressive symptoms decreasing between the early 20s and the mid-50s and then increasing through late life.<sup>40</sup>

The findings of this study should be considered with the following limitations in mind. First, the cross-sectional design does not allow for establishing a causal relationship between pain interference, loneliness, and depressive symptoms. However, our findings, in conjunction with past literature, provide a possible mechanism through which these factors may be associated. Second, these analyses are based on participants with complete data, leaving a possibility of non-representativeness of those with incomplete data in the Adult and Family Dynamics study sample. Third, while participants in the Adult and Family Dynamics study were recruited randomly, as is the case in many social science research studies, resources were not available to recruit all caregivers of the original Mobile

Youth and Poverty Study. Thus, it is possible that those who participated in the Adult and Family Dynamics study may be not representative of all the caregivers in the Mobile Youth Study or of the population of caregivers living in the highly impoverished neighborhoods identified in the Mobile Youth Study. The generalizability of the results to populations beyond highly impoverished adult caregivers of adolescents is also quite limited. Fourth, the measures utilized in this study are based on self-report and may therefore be biased. Finally, we used receipt of public assistance benefits as a measure of poverty.

## Implications

The finding that loneliness serves as an important link between pain interference and depressive symptoms suggests that rehabilitation professionals and other practitioners should assess for levels of loneliness, especially among individuals presenting with comorbid pain and depressive symptoms. Furthermore, clinicians and other rehabilitation professionals should be aware that interventions aimed at decreasing loneliness may have an added benefit of simultaneously reducing pain and depressive symptoms. Group interventions and other activities or support have shown promise in reducing loneliness.<sup>41</sup> For example, Hawkley and Cacioppo<sup>42</sup> posited that interventions targeting maladaptive social cognition, such as cognitive behavioral therapy, could be more effective when working with individuals presenting with loneliness. Other interventions, which may be beneficial, include one-on-one counseling and home visits.<sup>43</sup> It is, however, worth noting that most of the interventions for loneliness have targeted older individuals, thus more research targeting the general population is needed.

The finding that being employed was associated with worse outcomes for individuals reporting disabling pain, highlights the necessity for professionals working with individuals presenting with pain to focus on issues related to employment including the possible negative health consequences of continuing to work with pain. Furthermore, employers and employees should investigate available remedies

for individuals presenting with pain including counseling and various work place accommodations such as modifications of work setting and changes to work schedule, which have been found to be beneficial to both employers and employees.<sup>44</sup> Importantly, the findings from this study reiterate the need for professionals working with individuals experiencing disabling pain and presenting with depressive symptoms to take a holistic view of the individuals, whereby the biological, psychological, and social dimensions of the individual are equally considered.

### Clinical messages

- The association between pain interference and depressive symptoms was stronger among participants reporting disabling pain compared to those reporting non-disabling pain, which suggests that the impact of pain interference (e.g. disabling pain that interferes with daily activities and employment) may be more significantly associated with depression.
- Loneliness is an important link in the association between pain interference and depressive symptoms.

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