Authors:

Rachel Müller, PhD
Alexandra L. Terrill, PhD
Mark P. Jensen, PhD
Ivan R. Molton, PhD
Craig Ravesloot, PhD
Catherine Ipsen, PhD

Affiliations:

From the Department of Rehabilitation Medicine, University of Washington, Seattle (RM, ALT, MPJ, IRM); Swiss Paraplegic Research, Nottwil, Switzerland (RM); and Rural Institute on Disabilities, University of Montana, Missoula (CR, CI).

Correspondence:

All correspondence and requests for reprints should be addressed to: Rachel Müller, PhD, Swiss Paraplegic Research, Guido A. Zäch Strasse 4, 6207 Nottwil, Switzerland.

Disclosures:

Data collection was conducted at the Rural Institute on Disabilities, University of Montana, Missoula.
The contents of this article were developed under grants from the National Institute for Disability and Rehabilitation Research, Department of Education (grant number H133G110077 awarded to Craig Ravesloot and Catherine Ipsen and grant number H133B080024 awarded to Mark Jensen and Ivan Molton) and the Swiss National Science Foundation (grant number PBSKP1_143548 awarded to Rachel Müller). However, those do not necessarily represent the policy of the Department of Education, and readers should not assume endorsement by the Federal Government.
No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.
Financial disclosure statements have been obtained, and no conflicts of interest have been reported by the authors or by any individuals in control of the content of this article.

0894-9115/15/9412-1041
American Journal of Physical Medicine & Rehabilitation

DOI: 10.1097/PHM.0000000000000294

ORIGINAL RESEARCH ARTICLE

Happiness, Pain Intensity, Pain Interference, and Distress in Individuals with Physical Disabilities

ABSTRACT

Müller R, Terrill AL, Jensen MP, Molton IR, Ravesloot C, Ipsen C: Happiness, pain intensity, pain interference, and distress in individuals with physical disabilities. Am J Phys Med Rehabil 2015;94:1041–1051.

Objectives: The aim of this study was to examine how the construct of happiness is related to pain intensity, pain interference, and distress in individuals with physical disabilities.

Design: This study involves cross-sectional analyses of 471 individuals with a variety of health conditions reporting at least mild pain.

Results: The first hypothesis that happiness mediates the relationship between pain intensity and two outcomes, pain interference and distress, was not supported. The second hypothesis was supported by a good fitting model ($\chi^2_{10} = 12.83$, $P = 0.23$, root-mean-square error of approximation = 0.025) and indicated that pain intensity significantly mediated the effect of happiness on pain interference (indirect effect: $\beta = -0.13$, $P < 0.001$) and on distress (indirect effect: $\beta = 0.10$, $P = 0.01$). Happiness showed a significant direct effect on pain intensity ($\beta = -0.20$, $P < 0.001$). A third model exploring the happiness components meaning, pleasure, and engagement fitted well ($\chi^2_4 = 9.65$, $P = 0.05$, root-mean-square error of approximation = 0.055). Pain intensity acted as a significant mediator but only mediated the effect of meaning on pain interference (indirect effect: $\beta = -0.07$, $P = 0.05$) and on distress (indirect effect via pain interference: $\beta = -0.04$, $P = 0.05$). Only meaning ($\beta = -0.10$, $P = 0.05$), but neither pleasure nor engagement, had a significant direct effect on pain intensity.

Conclusions: Participants who reported greater happiness reported lower pain interference and distress through happiness' effects on pain intensity. Experiencing meaning and purpose in life seems to be most closely (and negatively) associated with pain intensity, pain interference, and distress. Findings from this study can lay the groundwork for intervention studies to better understand how to more effectively decrease pain intensity, pain interference, and distress.

Key Words: Happiness, Chronic Pain, Pain Interference, Distress, Disability

Pain is a highly prevalent problem that can have a negative impact on a person's physical, psychologic, and social functioning. Between 26% and 31% of adults in the United States experience chronic moderate-to-severe pain.[1] Among those with disabling health conditions, between 56% and 71% have ongoing pain.[2,3] Moreover, individuals living with chronic pain commonly report symptoms of depression (29%–86%)[4] and anxiety (20%–40%),[5] limitations in daily activity, job loss, social isolation, and elevated suicidal ideation.[6–8]

Contemporary treatment of chronic pain is informed by a biopsychosocial model that supports the use of appropriate pharmacologic, psychologic, and social interventions. Pharmacologic interventions continue to be the most common treatment options provided to individuals experiencing pain. Unfortunately, even the most potent medications only reduce pain by 30%–40% in fewer than 50% of individuals with chronic pain,[9] and disability-related pain is usually refractory to analgesics and other biomedical interventions.[10–13] Moreover, many pharmacologic treatments are accompanied by significant negative side effects including constipation, sedation, dizziness, and nausea.[14,15]

The most common psychologic pain treatment provided to individuals with chronic pain is cognitive-behavioral therapy, which addresses maladaptive pain-related thoughts and behavioral patterns that are hypothesized to maintain poor adjustment to chronic pain. Cognitive-behavioral therapy has been found to have a positive influence on short-term psychologic and pain outcomes in individuals with physical disabilities.[16–18]

Rather than targeting maladaptive thoughts and behavioral patterns (i.e., deficits and vulnerabilities), other psychologic treatments focus on increasing happiness by creating and enhancing psychosocial strengths and resources such as meaning, pleasure, and engagement.[19] *Meaning* refers to belonging to and serving something larger than the self (e.g., family and community). *Pleasure* is the hedonic notion of experiencing positive emotions about the past (e.g., pride), present (e.g., immediate pleasure), or future (e.g., optimism), and *engagement* occupies or directs attention when undertaking an activity (e.g., reading a book or drawing).[20]

Strength- and resource-based psychologic approaches have been effectively applied to improving happiness in the general population and have also been shown to benefit individuals with symptoms of depression[21] and anxiety disorders.[22] However, research examining the importance of psychosocial strengths and recourses in adjustment to chronic pain is limited. In one study, meaning (measured as part of sense of coherence) was found to mediate the relationship between psychosocial resources (i.e., optimism, self-esteem, self-efficacy, and social support) and chronic pain in elderly individuals.[23] Motivation to pursue pleasurable experiences was found to be reduced when pain is present[24] and flow experiences (i.e., a state of complete engagement and absorption in an activity) may have the potential to modulate pain experiences.[25] In individuals with physical disabilities, meaning/purpose in life was found to mediate the effects of perceived loss of physical resources and locus of control on psychologic well-being and adjustment to disability.[26,27]

Thus, despite preliminary findings and theory, the hypothesized influence of happiness on key pain-related outcomes has not yet been tested. A well-designed study to test this hypothesis is an important next step in developing the model further. The purpose of the current study is to address this knowledge gap regarding the associations between psychosocial strengths and resources and outcomes in individuals with pain by examining the associations between happiness, pain intensity, pain interference, and distress. The findings of this study will provide information to the empirical foundation for the development of intervention studies to reduce pain interference and distress in individuals with physical disabilities and chronic pain. Two hypotheses were tested: (1) happiness mediates the effects of pain intensity on both pain interference and distress, and (2) pain intensity mediates the effect of happiness on pain interference and distress. In addition to testing these specific hypotheses, the associations between happiness components (meaning, pleasure, and engagement) and pain intensity, pain interference, and distress were explored.

METHODS

Study Design, Participants, and Procedures

This article reports on data from a population-based survey study of individuals with different functional disabilities living in a small US western city. The survey data represent baseline assessment for a planned and ongoing longitudinal study. The project was approved by the institutional review board of the local university.

With the support of US Data Corporation, a random list of 10,000 households was drawn for five zip codes (all within the city limits of a small western US city). A recruitment letter and precoded anonymous return postcard were sent to each of the households.

The recruitment letter asked individuals to self-identify into the study, if the recipient or someone in the household was willing to complete surveys about their experiences with pain, was at least 18 yrs old, and could answer "yes" to at least one of the following five disability-screener questions used in the American Community Survey[28]: (1) Do you have serious difficulty walking or climbing stairs? (2) Do you have difficulty dressing or bathing? (3) Do you have difficulty doing errands alone, such as visiting a doctor's office or shopping because of a physical condition? (4) Are you deaf or do you have serious difficulty hearing? and (5) Are you blind or do you have difficulty seeing even when wearing glasses? The American Community Survey by the US Census Bureau is an ongoing statistical survey sent to 3 million households per year with the aim of providing communities the current information they need to plan investments and services. US Census data for the study location indicated that 13.4% of the population had a disabling health condition using these measures. With 2.2 people per household, the eligible study population was estimated to be 2,948 individuals.

Recruitment letters were mailed twice, 2 wks apart. In addition to the screening questions, letters included information about small monetary stipends for completing the surveys. Stipends of $5 were sent with the first survey, and subsequent surveys were mailed with $10 stipends. Participants could earn a total of $35 for completing all four surveys.

Individuals who met inclusion criteria and were willing to participate in the study completed and returned a postcard to receive the first survey (baseline) and informed consent form. Individuals who did not return a survey were sent a reminder letter within 2 wks, a replacement survey packet at 4 wks, and then a final replacement packet enclosed in a priority envelope at 6 wks. The current analyses used data from the first (baseline) survey.

Postcards were returned by 601 participants, and 564 participants completed the informed consent and baseline survey. Based on estimates of the eligible population, this represented a 19% response rate. For this study, only persons reporting at least mild pain in the week before completing the survey were included in the analyses (n = 471).

Measurements

Characteristic pain intensity was assessed using recommended items of the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials.[29] Specifically, the respondents were asked to rate their current, average, worst, least, and overall pain over the past week on a 0–10 scale, where 0 is "no pain" and 10 is "pain as bad as you can imagine." Overall pain was assessed with a four-point anchored scale: none, mild, moderate, and severe. These five items were combined into a sum score representing characteristic pain.[29,30] Reliability of the measure based on Cronbach alpha in the sample was excellent (α = 0.91).

Pain interference was measured using the Pain Interference Short Form 8a from the Patient-Reported Outcomes Measurement Information System,[31] which assesses pain impact in key areas of functioning, including daily and social activities. One item retrieved from the International Spinal Cord Injury Pain Basic Data Set[32] was added to address pain interference with sleep.[33] Cronbach alpha of the composite scale made up of these items in the present sample was excellent (α = 0.96).

Distress was assessed using aggregated items from the Behavior Risk Factor Surveillance System (BRFSS)[34] of the Centers for Disease Control and Prevention and the Secondary Conditions Surveillance Instrument (SCSI)[35] based on findings from confirmatory factor analyses conducted for this study. Three BRFSS questions ask about the number of days out of 30 the individual experienced mental issues. The first of these items asks about the experience of "stress, depression and problems with emotions." The second item asks about "feeling worried, tense and anxious," and the third asks about "getting enough sleep." Three SCSI items for depression, anxiety, and sleep problems assess interference with activity and independence on a 0–3 scale, where 0 is "not experienced during the past month" and 3 is "significant/chronic problem." Cronbach alpha of the scales based on the selected items was adequate (BRFSS, α = 0.80; SCSI, α = 0.76).

Happiness was measured using six items taken from the original Orientations to Happiness Scale (OTH).[36] In this 18-item measure, respondents rate statements such as "My life has a lasting meaning," "For me, the good life is the pleasurable life," and "I am always very absorbed in what I do" on a five-point Likert scale from "very much unlike me" to "very much like me." The OTH consists of three happiness domains (meaning, pleasure, and engagement), has demonstrated adequate reliability and validity in other samples,[36–39] and has been found to predict life satisfaction in the general population.[36] To select a smaller subset of six items for the present study (in order minimize assessment burden), factor loadings from other published work were consulted[36] to identify two items from each subscale (meaning, pleasure, and engagement) that

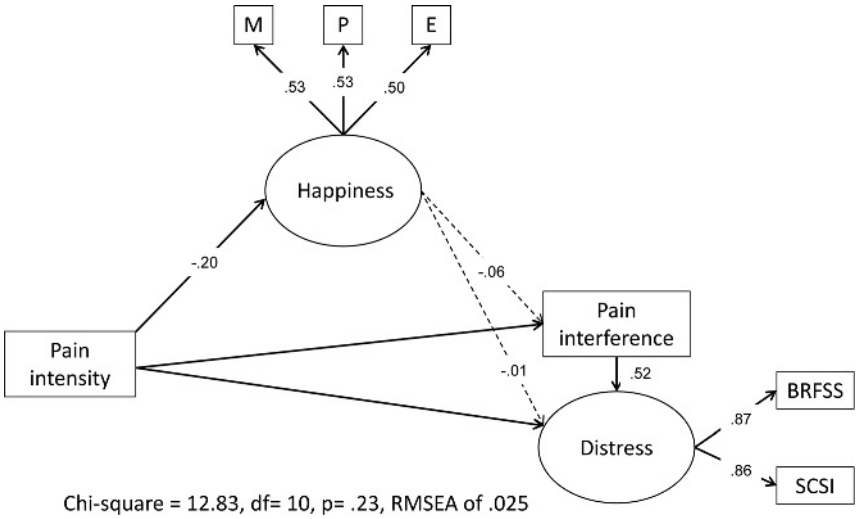

FIGURE 1 *Model 1, including happiness as one latent variable mediating the relationship between pain intensity and the two outcomes distress and pain interference. M, meaning; P, pleasure; E, engagement; BRFSS involved three selected items referring to the amount of days experiencing mental issues; SCSI involved three selected items referring to mental conditions that interfere with activity and independence. Square, observed construct; oval, latent construct; bold line, significant path; dotted line, nonsignificant path.*

demonstrated the most validity with respect to their associations with the parent scales. A principal component analysis using a varimax rotation was then performed in SPSS version 19.0 (SPSS Inc, Chicago, IL) to determine whether the six selected items of the OTH measured the latent variable happiness. The results confirmed a three-factor solution, labeled meaning, pleasure, and engagement, with 80% explained variance. In addition, because the happiness factors were associated with one another, it is possible to combine all items into a single composite score of overall happiness; this score evidenced adequate internal consistency in this sample ($\alpha = 0.72$). Subsequent analyses used both the individual happiness domain and composite scales.

Data Analyses

After computing descriptive statistics of demographic data to describe the sample, Pearson correlation coefficients were computed to examine the associations between characteristic pain intensity, pain interference, distress, and happiness. To identify potential confounding effects of the most frequently reported health conditions on study outcomes, the authors ran partial correlations of all

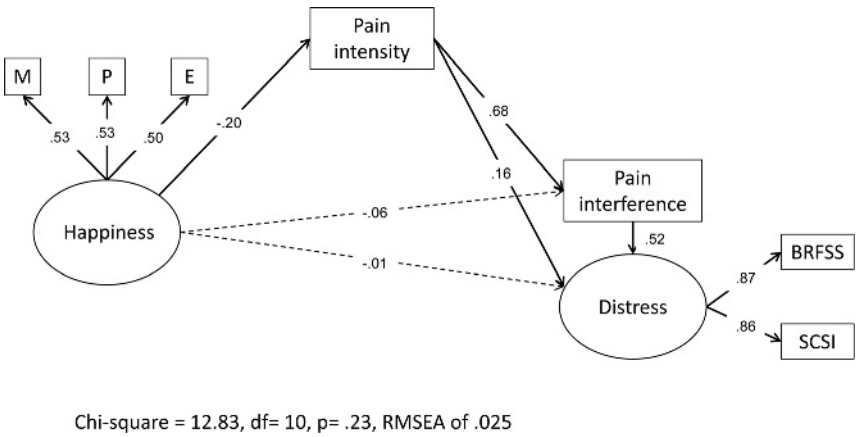

FIGURE 2 *Model 2, including pain intensity as a mediator between happiness and pain interference and distress. M, meaning; P, pleasure; E, engagement; BRFSS involved three selected items referring to the amount of days experiencing mental issues; SCSI involved three selected items referring to mental conditions that interfere with activity and independence. Square, observed construct; oval, latent construct; bold line, significant path; dotted line, nonsignificant path.*

TABLE 1 Descriptive characteristics of participants included in the analyses ($n = 471$)

		Participants
Age, mean (SD), yrs		61.45 (16.11)
	Missing, *n* (%)	2 (0.4)
Sex, *n* (%)	Male	194 (41.2)
	Female	277 (58.8)
Ethnicity, *n* (%)	White	453 (96.2)
	American Indian/Alaska Native	20 (4.2)
	Asian	3 (0.6)
	Black/African American	2 (0.4)
	Native Hawaiian/other Pacific Islander	1 (0.2)
	Hispanic/Latino	6 (1.3)
	Other	8 (1.7)
Health conditions, *n* (%)	Arthritis or rheumatism	289 (61.4)
	Fracture or bone or joint injury	111 (23.6)
	Migraine headaches	82 (17.4)
	Diabetes	78 (16.6)
	Fibromyalgia	72 (15.3)
	Asthma	61 (13.0)
	Cancer	25 (5.3)
	Spinal cord injury	23 (4.9)
	Stroke problem	18 (3.8)
	Traumatic brain injury	19 (4.0)
	Multiple sclerosis	11 (2.3)
	Paralysis	12 (2.5)
	Epilepsy	11 (2.3)
	Amputation	8 (1.7)
	Cerebral palsy	4 (0.8)
	Muscular dystrophy	0 (0.0)
	Other health conditions	133 (28.2)
	Missing	3 (0.6)
Health problems, *n* (%)	Back or neck problems	316 (67.1)
	Eye or vision problems	230 (48.8)
	Weight problem	207 (43.9)
	Hypertension or high blood pressure	190 (40.3)
	Depression, anxiety, emotional problem	188 (39.9)
	Hearing problems	155 (32.9)
	Gastrointestinal problems	119 (25.3)
	Lung or breathing problems	110 (23.4)
	Heart problem	94 (20.0)
	Circulation problems	84 (17.8)
	Tendonitis	48 (10.2)
	Intellectual disability/mental retardation	17 (3.6)
	Missing	3 (0.6)
Overall level of pain, *n* (%)	Severe	56 (11.9)
	Moderate	246 (52.2)
	Mild	169 (35.9)

variables controlling for reported health conditions and examined differences in correlation coefficients. In case mean difference between the correlation coefficients was less than 0.05, a confounding effect was considered negligible.

Two models were specified to test the two study hypotheses. Model 1 included happiness as one latent variable mediating the relationship between pain intensity and the two outcomes distress and pain interference (Fig. 1). Model 2 included pain intensity mediating the relationship between happiness and the two outcomes distress and pain interference (Fig. 2). A third model was specified to explore the associations between happiness components (of meaning, pleasure, and engagement) and pain intensity, pain interference, and distress and incorporated meaning, pleasure, and engagement separately as observed variables (i.e., sum scores of each subscales). All three models included a path from pain interference to distress.

The hypothesized models were tested, and the relative importance of the three happiness domains was examined applying structural equation modeling. Structural equation modeling incorporates the two statistical techniques factor analysis and path analysis. In factor analysis, intercorrelations among measured

TABLE 2 Descriptive characteristics of pain intensity, pain interference, distress, and happiness ($n = 471$)

	Range	Mean (SD)	Missing, *n* (%)
Characteristic pain intensity	1–44	20.94 (9.03)	5 (1.0)
Current pain intensity	0–10	4.42 (2.52)	3 (0.6)
Average pain intensity	0–10	4.66 (2.37)	0 (0.0)
Worst pain intensity	0–10	6.45 (2.79)	1 (0.2)
Least pain intensity	0–10	2.65 (2.15)	1 (0.2)
Pain interference	9–45	27.05 (9.91)	23 (5.2)
Distress			
BRFSS	0–90	35.40 (25.50)	17 (3.6)
SCSI	0–9	4.02 (2.61)	12 (2.5)
Happiness (total)	6–30	20.58 (4.73)	40 (8.5)
Meaning	2–10	7.47 (2.33)	23 (5.2)
Pleasure	2–10	6.70 (2.28)	26 (5.5)
Engagement	2–10	6.40 (1.98)	22 (4.2)

Missing, *n* (%) refers to missing total scores, except current, average, worst, and least pain intensity. Little's MCAR [Missing Completely at Random] test was nonsignificant ($P > 0.05$), indicating that data were missing completely at random for characteristic pain intensity, pain interference, distress, and happiness.

BRFSS involved three selected items referring to the amount of days experiencing mental issues; SCSI involved three selected items referring to mental conditions that interfere with activity and independence.

variables are analyzed to confirm an unobserved latent construct (measurement model, e.g., for distress). The path analysis depicts the relationship among the latent constructs (structural model, e.g., relationship between happiness and pain intensity). For structural equation modeling analyses, the authors used the free statistics environment "R"[40] and its "lavaan" package (version 3.0.1[41]). For both models, distress was measured by two item parcels, which are sum scores of the selected items of the BRFSS and SCSI. Item parcels incorporate measurement errors into the model, which can reduce bias of the parameter estimates.[42]

Full information maximum likelihood estimation was used to account for partially missing values. For data missing at random, full information maximum likelihood estimates are unbiased and more efficient than other methods such as listwise deletion, pairwise deletion, and similar response pattern imputation.[43] Model fit was evaluated with a χ^2 test. A nonsignificant χ^2 ($P \geq 0.05$) indicates that the hypothesized model can explain the empirically observed relationships in the data. In addition, root-mean-square error of approximation (RMSEA) was used to assess model fit because it takes sample size and model complexity into account. An RMSEA less than 0.06 indicates good model fit.[44] The models report standardized path coefficients (β). Values greater than 0.50 indicate a large effect, values around 0.30 denote a medium effect, and values around 0.10 indicate a small effect.[45] Mediation was assessed by testing the significance of indirect effects, which are the effects of pain intensity via happiness on the outcomes pain interference and distress (hypothesis 1) and the effects of happiness via pain intensity on the outcomes pain interference and distress (hypothesis 2).

RESULTS

Descriptive Statistics of the Study Sample

As shown in Table 1, 59% of the sample was female. Participants were mostly non-Hispanic white (96%) with a mean age of 61.5 yrs. Most frequent health conditions were arthritis or rheumatism (61%), fracture or bone or joint injury (24%), and migraine (17%). Most frequently reported health problems were back or neck problems (67%), eye or vision problems (49%), and weight problems (44%). Slightly more than half of the participants (52%) experienced moderate pain, and 12% experienced severe pain as an average in the week before the assessment. Table 2 lists the score range, mean, and the number of missing values for characteristic pain intensity, pain interference, distress, and happiness. The correlations between the study variables are reported in Table 3. The impact of the most frequent reported health conditions (i.e., arthritis or rheumatism, fracture or bone or joint injury, migraine, diabetes, and fibromyalgia) in the partial correlation on study outcomes was negligible in all cases (mean difference < 0.05).

Hypothesis 1: Happiness Mediates the Effects of Pain Intensity on Pain Interference and Distress

Model 1 tested hypothesis 1 (Fig. 1) that happiness mediates the relationship between pain intensity and the two outcomes pain interference and

distress. The model fit showed a nonsignificant χ^2_{10} of 12.83, $P = 0.23$, and an RMSEA of 0.025, but happiness did not significantly mediate the effect of pain intensity on pain interference (indirect effect: $\beta = 0.01$, $P = 0.25$) or distress (indirect effect: $\beta = 0.01$, $P = 0.51$). Pain interference showed a significant direct effect on distress ($\beta = 0.52$, $P = 0.05$).

Hypothesis 2: Pain Intensity Mediates the Effect of Happiness on Pain Interference and Distress

Model 2 tested hypothesis 2 (Fig. 2) that pain intensity mediates the effect of happiness on pain interference and distress. Good model fit with a nonsignificant χ^2_{10} of 12.83, $P = 0.23$, and an RMSEA of 0.025 was found. Pain intensity significantly mediated the effect of happiness on pain interference (indirect effect: $\beta = -0.13$, $P < 0.001$) and on distress (indirect effect: $\beta = 0.10$, $P = 0.01$). Happiness showed a significant direct effect on pain intensity ($\beta = -0.20$, $P < 0.001$) and, identical to model 1, pain interference showed a significant direct effect on distress ($\beta = 0.52$, $P = 0.05$).

Exploration of the Associations Between Happiness Components (of Meaning, Pleasure, and Engagement) and Pain Intensity, Pain Interference, and Distress

The associations between different components of happiness (meaning, pleasure, and engagement) and the study criterion measures assessing pain intensity, pain interference, and distress were explored in model 3 (Fig. 3). The third model fit well, with a nonsignificant χ^2_4 of 9.65, $P = 0.05$, and an RMSEA of 0.055. Again, pain intensity acted as a significant mediator. However, pain intensity only mediated the effect of meaning on pain interference (indirect effect: $\beta = -0.07$, $P = 0.05$) and on distress (indirect effect via pain interference: $\beta = -0.04$, $P = 0.05$). Only meaning ($\beta = -0.10$, $P = 0.05$), but not pleasure or engagement, had a significant direct effect on pain intensity.

DISCUSSION

This study examined how global happiness and three happiness domains (meaning, pleasure, and engagement) are related to pain intensity, pain interference, and distress. Although the findings did not support the first study hypothesis (that happiness mediates the association between pain intensity and pain interference, and between pain intensity and distress), results from the second model showed that pain intensity mediated the effect of happiness on pain interference and distress. Those individuals who

TABLE 3 Pearson correlation between pain intensity, pain interference, distress, and happiness ($n = 471$)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Characteristic pain intensity	1.000											
2. Current pain intensity	0.922[a]	1.000										
3. Average pain intensity	0.940[a]	0.836[a]	1.000									
4. Worst pain intensity	0.879[a]	0.737[a]	0.805[a]	1.000								
5. Least pain intensity	0.822[a]	0.722[a]	0.731[a]	0.553[a]	1.000							
6. Pain interference	0.688[a]	0.584[a]	0.643[a]	0.646[a]	0.521[a]	1.000						
7. BRFSS (distress)	0.473[a]	0.450[a]	0.438[a]	0.404[a]	0.398[a]	0.538[a]	1.000					
8. SCSI (distress)	0.431[a]	0.403[a]	0.388[a]	0.361[a]	0.383[a]	0.547[a]	0.743[a]	1.000				
9. Happiness (total)	−0.136[a]	−0.091	−0.120[b]	−0.119[b]	−0.152[a]	−0.144[a]	−0.110[b]	−0.017	1.000			
10. Meaning	−0.125[a]	−0.085	−0.127[a]	−0.104[b]	−0.143[a]	−0.117[b]	−0.128[a]	−0.028	0.738[a]	1.000		
11. Pleasure	−0.109[b]	−0.092	−0.087	−0.086	−0.112[b]	−0.130[a]	−0.101[b]	−0.065	0.727[a]	0.275[a]	1.000	
12. Engagement	−0.065	−0.029	−0.051	−0.064	−0.083	−0.050	−0.019	0.021	0.692[a]	0.269[a]	0.274[a]	1.000

BRFSS involved three selected items referring to the amount of days experiencing mental issues; SCSI involved three selected items referring to mental conditions that interfere with activity and independence.
[a]Correlation is significant at the 0.01 level (two tailed).
[b]Correlation is significant at the 0.05 level (two tailed).

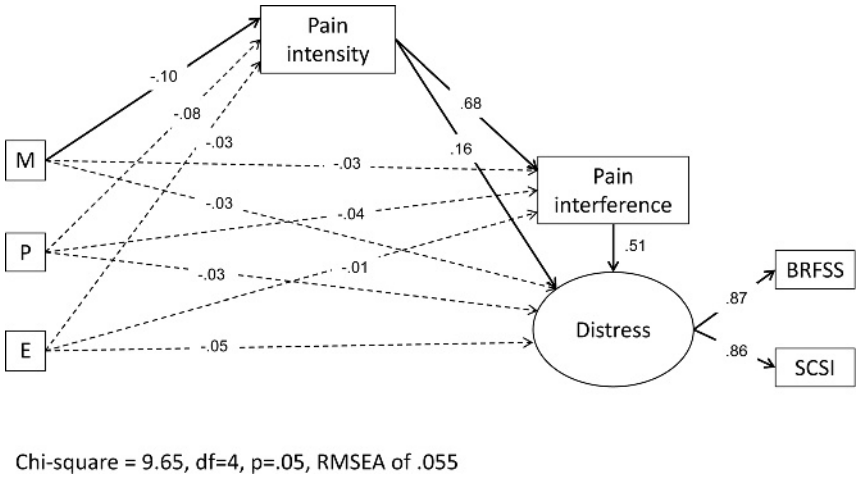

FIGURE 3 *Model 3, including the different happiness approaches meaning, pleasure, and engagement and their relationship to pain intensity and the outcomes pain interference and distress. M, meaning; P, pleasure; E, engagement; BRFSS involved three selected items referring to the amount of days experiencing mental issues; SCSI involved three selected items referring to mental conditions that interfere with activity and independence. Square, observed construct; oval, latent construct; bold line, significant path; dotted line, nonsignificant path.*

reported greater happiness reported lower pain interference and distress through happiness' effects on pain intensity. Interestingly, of the three happiness subscales, the one assessing meaning seems to be most closely associated with pain intensity, pain interference, and distress (model 3). This suggests that to the extent that endorsing greater meaning in one's life contributes to less distress and pain interference, the effects are attributable to the potential impact of meaning on reduced pain intensity.

Although the findings of this study do not provide causal conclusions, they shed light on some potential avenues for interventions. The findings indicate that increasing happiness may be a viable treatment target in psychotherapeutic pain interventions for chronic pain. To the extent that such a treatment reduces pain intensity, it is not assumed that this is attributable to its direct effects on nociception (i.e., encoding and processing painful stimuli); rather, it produces a shift in the processes related to pain evaluation and distraction.[46] Happiness may decrease the awareness of pain, which in turn could lead to decreases in pain interference and distress. A next step could be to test the effects of a psychosocial strength- and resource-based intervention to see whether the intervention alters pain intensity and whether this impact on pain is mediated by the intervention. If so, this could provide an important new intervention to help patients with pain—one that directly improves positive mood and pain intensity and indirectly (via pain intensity) reduces pain interference and distress.

The results showed that meaning, in particular, was the most potent happiness domain associated with key pain-related outcomes. Other studies examining meaning and its relation to pain show inconsistent results. For example, Lillefjell and Jakobsen[47] reported weak and nonsignificant correlation between the meaning dimension of the Orientation to Life Test and pain intensity. Another study with healthy women showed that meaning (measured with the purpose in life scale from the Scales of Psychological Well-Being) was significantly associated with enhanced habituation to hot and cold painful stimuli.[48] Differences in the effects of different meaning subdomains, that is, cosmic and ultimate (i.e., spiritual) *vs*. terrestrial (i.e., personal purpose in life, secular foundation),[49] could potentially account for differences in study findings. Future studies comparing the association of different types of meaning to pain can further inform the development of interventions. In individuals with physical disabilities, research indicates that meaning or purpose in life plays a key role in determining psychologic well-being[27] and adjustment to disability.[26]

Creating a meaningful life typically involves belonging to or being part of something greater than the self. This may be accomplished through one's work, contributing to society (e.g., through volunteering), or working toward a meaningful goal. The literature indicates that providing support to others[50] and striving for something personally important[51,52] are both related to enhanced happiness in the general population. A number of psychologic interventions incorporated in pain therapy could facilitate this

process. For example, Acceptance and Commitment Therapy interventions that include nonjudgmental acknowledgement of thoughts and emotions can be applied to strengthen personally meaningful goals. Cognitive behavioral therapy could combine cognitive restructuring (e.g., decreasing the frequency of thoughts such as "No one needs me" and "The future looks dark" and increasing the frequency of thoughts such as "I have a purpose in life" and "I have personally meaningful goals that can be achieved") and behavioral therapy (e.g., social skills training to feel more comfortable in doing volunteer work) to increasing happiness and meaning. Both of these interventions have been found to positively influence mental health and pain outcomes also in individuals with physical disabilities.[16–18,53] In addition, participation in religious practices could also present potential pathways for increasing meaning for individuals who value such activities. Research findings suggest that religious and spiritual beliefs and practices in persons with chronic pain are associated with coping efforts (prayer) and increased happiness.[54]

The authors' final discussion point refers to the weak association between happiness and distress found in this study. A fair amount of research has examined the extent to which these two domains go hand in hand, that is, whether individuals who benefit in terms of happiness also show reduction in distress (i.e., they represent two ends of a single continuum) or whether individuals may evidence improvements in one dimension but not on the other (i.e., they represent two related but distinct dimensions). Research supports the latter case, indicating that individuals with fewer psychologic problems do not necessarily have better positive mental health.[55]

Limitations

This study is subject to several important limitations. First, the study used a cross-sectional design. Thus, although the structural models suggest paths from one variable to the others, causality cannot be inferred. Analyses of longitudinal data can provide more robust findings about the associations between happiness, pain intensity, pain interference, and distress and will be the goal of future research. Second, the response rate of the present study was low (19%), and there is an overwhelming proportion of non-Hispanic whites in the sample, which limits generalizability of the study results as these associations can be culturally sensitive. Furthermore, the mean age of the sample (61.5 yrs) is higher than that in some other similar studies, including those of individuals with physical disabilities. Thus, it is not known whether the findings can be generalized to a younger group of individuals with physical disabilities. These issues indicate that replication of the study in additional samples is warranted. Third, participants were reimbursed for the time they spent responding to the surveys, and it is possible that this may contribute to selection bias. However, financial reimbursement has been found to have positive effects on the willingness to participate in research[56] as well as study performance.[57] Moreover, because this study used only small monetary stipends ($5 for the current and a total of $35 for completing all future surveys), the authors believe that potential selection bias was minimal. Fourth, it is possible that level of happiness might have affected some subjects' willingness to participate in the study. Happy individuals well adapted to their pain might be less likely to participate in research addressed by the current study. It is also possible that very unhappy individuals with high levels of depressive symptoms and difficulties in adjusting to pain might have lower motivation to participate in the current study. Fifth, reliability of measuring happiness can be questioned as internal consistency of the OTH in this study was merely acceptable. Using the whole 18-item OTH could potentially improve reliability, as good Cronbach alphas of 0.82 for meaning, 0.82 for pleasure, and 0.72 for engagement were found in a previous study.[36] Finally, structural equation models are, to some extent, data driven and exploratory in nature. The final model should therefore be cross-validated to confirm reliability.

CONCLUSIONS

Research about the importance of psychosocial strengths and resources in adjustment to chronic pain is still in its infancy. Identifying specific targets for intervention is a valuable step in the development and implementation of effective strength- and resource-based interventions for chronic pain. Findings from this study provide important new data that could help to lay the groundwork for intervention studies to better understand how lowering pain intensity, pain interference, and distress can be achieved.

REFERENCES

1. Johannes CB, Le TK, Zhou X, et al: The prevalence of chronic pain in United States adults: Results of an Internet-based survey. *J Pain* 2010;11:1230–9
2. Kinne S, Patrick DL, Doyle DL: Prevalence of secondary conditions among people with disabilities. *Am J Public Health* 2004;94:443–5

3. Seekins T, Clay JA, Ravesloot C: Descriptive study of secondary conditions reported by a population of adults with physical disabilities served by three independent living centers in a rural state. *J Rehabil* 1994;60:47–51

4. Poole H, White S, Blake C, et al: Depression in chronic pain patients: Prevalence and measurement. *Pain Pract* 2009;9:173–80

5. Twillman RK: Mental disorders in chronic pain patients. *J Pain Palliat Care Pharmacother* 2007;21:13–9

6. Ehde DM, Osborne TL, Jensen MP: Chronic pain in persons with multiple sclerosis. *Phys Med Rehabil Clin N Am* 2005;16:503–12

7. Jensen MP, Abresch RT, Carter GT, et al: Chronic pain in persons with neuromuscular disease. *Arch Phys Med Rehabil* 2005;86:1155–63

8. Modirian E, Pirouzi P, Soroush M, et al: Chronic pain after spinal cord injury: Results of a long-term study. *Pain Med* 2010;11:1037–43

9. Turk DC: Clinical effectiveness and cost-effectiveness of treatments for patients with chronic pain. *Clin J Pain* 2002;18:355–65

10. Pollmann W, Feneberg W: Current management of pain associated with multiple sclerosis. *CNS Drugs* 2008;22:291–324

11. Wasner G: Central pain syndromes. *Curr Pain Headache Rep* 2010;14:489–96

12. Solaro C, Messmer Uccelli M: Pharmacological management of pain in patients with multiple sclerosis. *Drugs* 2010;70:1245–54

13. Baastrup C, Finnerup NB: Pharmacological management of neuropathic pain following spinal cord injury. *CNS Drugs* 2008;22:455–75

14. Porreca F, Ossipov MH: Nausea and vomiting side effects with opioid analgesics during treatment of chronic pain: Mechanisms, implications, and management options. *Pain Med* 2009;10:654–62

15. Stone P, Minton O: European Palliative Care Research collaborative pain guidelines. Central side-effects management: What is the evidence to support best practice in the management of sedation, cognitive impairment and myoclonus? *Palliat Med* 2011;25: 431–41

16. Ehde DM, Jensen MP: Feasibility of a cognitive restructuring intervention for treatment of chronic pain in persons with disabilities. *Rehabil Psychol* 2004; 49:254–8

17. Dorstyn D, Mathias J, Denson L: Efficacy of cognitive behavior therapy for the management of psychological outcomes following spinal cord injury: A meta-analysis. *J Health Psychol* 2011;16:374–91

18. Mehta S, Orenczuk S, Hansen KT, et al: An evidence-based review of the effectiveness of cognitive behavioral therapy for psychosocial issues post-spinal cord injury. *Rehabil Psychol* 2011;56:15–25

19. Seligman ME, Csikszentmihalyi M: Positive psychology. An introduction. *Am Psychol* 2000;55:5–14

20. Seligman MP, Steen TA, Park N, et al: Positive psychology progress. *Am Psychol* 2005;60:410–21

21. Sin NL, Lyubomirsky S: Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *J Clin Psychol* 2009;65:467–87

22. Fava GA, Ruini C, Rafanelli C, et al: Well-being therapy of generalized anxiety disorder. *Psychother Psychosom* 2005;74:26–30

23. Wiesmann U, Dezutter J, Hannich HJ: Sense of coherence and pain experience in older age. *Int Psychogeriatr* 2014;26:123–33

24. Leknes S, Tracey I: A common neurobiology for pain and pleasure. *Nat Rev Neurosci* 2008;9:314–20

25. Robinson K, Kennedy N, Harmon D: The flow experiences of people with chronic pain. *Occup Participation Health* 2012;32:104–12

26. Thompson NJ, Coker J, Krause JS, et al: Purpose in life as a mediator of adjustment after spinal cord injury. *Rehabil Psychol* 2003;48:100–8

27. deRoon-Cassini TA, de St. Aubin E, Valvano A, et al: Psychological well-being after spinal cord injury: Perception of loss and meaning making. *Rehabil Psychol* 2009;54:306–14

28. U.S. Census Bureau, design and methodology of the American Community Survey. 2006. Available at: https://www.census.gov/history/pdf/ACSHistory.pdf. Accessed December 1, 2014

29. Dworkin RH, Turk DC, Farrar JT, et al: Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain* 2005;113:9–19

30. Freynhagen R, Baron R, Gockel U, et al: painDETECT: A new screening questionnaire to identify neuropathic components in patients with back pain. *Curr Med Res Opin* 2006;22:1911–20

31. Instrument development and validation scientific standards—Version 2.0. 2013. Available at: http://www.nihpromis.org/science/publications?AspxAutoDetectCookieSupport=1. Accessed October 14, 2013

32. Widerstrom-Noga E, Biering-Sorensen F, Bryce T, et al: The international spinal cord injury pain basic data set. *Spinal Cord* 2008;46:818–23

33. Jensen MP, Widerstrom-Noga E, Richards JS, et al: Reliability and validity of the International Spinal Cord Injury Basic Pain Data Set items as self-report measures. *Spinal Cord* 2010;48:230–8

34. Behavioral Risk Factor Surveillance System operational and user's guide—Version 3.0. 2005. Available at: http://www.cdc.gov/brfss/pdf/userguide.pdf. Accessed October 14, 2013

35. Seekins T, Smith N, McCleary T, et al: Secondary disability prevention: Involving consumers in the development of a public health surveillance instrument. *J Disabil Policy Stud* 1990;1:21–35

36. Peterson C, Park N, Seligman E: Orientations to happiness and life satisfaction: The full life versus the empty life. *J Happiness Stud* 2005;6:25–41

37. Chen GH: Validating the Orientations to Happiness Scale in a Chinese sample of university students. *Soc Indic Res* 2010;99:431–42

38. Chen LH, Tsai YM, Chen MY: Psychometric analysis of the Orientations to Happiness questionnaire in Taiwanese undergraduate students. *Soc Indic Res* 2010;98:239–49

39. Henderson LW, Knight T, Richardson B: The hedonic and eudaimonic validity of the Orientations to Happiness Scale. *Soc Indic Res* 2013;115:1087–99

40. R Core Team: R: A language and environment for statistical computing. 2012. Available at: http://www.R-project.org/

41. Rosseel Y: lavaan: An R package for structural equation modeling. *J Stat Softw* 2012;48:1–36

42. Coffman DL, MacCallum RC: Using parcels to convert path analysis models into latent variable models. *Multivar Behav Res* 2005;40:235–59

43. Enders CK, Bandalos DL: The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Struct Equ Model* 2001;8:430–57

44. Hu L, Bentler PM: Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Model* 1999;6:1–55

45. Cohen J: A power primer. *Psychol Bull* 1992;112:155–9

46. Valet M, Sprenger T, Boecker H, et al: Distraction modulates connectivity of the cingulo-frontal cortex and the midbrain during pain—An fMRI analysis. *Pain* 2004;109:399–408

47. Lillefjell M, Jakobsen K: Sense of coherence as a predictor of work reentry following multidisciplinary rehabilitation for individuals with chronic musculoskeletal pain. *J Occup Health Psychol* 2007;12:222–31

48. Smith BW, Tooley EM, Montague EQ, et al: The role of resilience and purpose in life in habituation to heat and cold pain. *J Pain* 2009;10:493–500

49. Yalom I: *Existential Psychotherapy*. New York, NY, Basic Books, 1980

50. Piliavin JA: Doing well by doing good: Benefits for the benefactor. In: Keyes CLM, Haidt J (eds): *Flourishing: Positive Psychology and the Life Well-Lived*. Washington, DC, American Psychological Association, 2003, pp. 227–47

51. Sheldon KM: The self-concordance model of healthy goal-striving: When personal goals correctly represent the person. In: Deci EL, Ryan RM (eds): *Handbook of Self-determination Research*. Rochester, NY, University of Rochester Press, 2002, pp. 65–86

52. Sheldon KM, Elliot AJ: Goal striving, need satisfaction, and longitudinal well-being: The self-concordance model. *J Pers Soc Psychol* 1999;76:482–97

53. Veehof MM, Oskam MJ, Schreurs KM, et al: Acceptance-based interventions for the treatment of chronic pain: A systematic review and meta-analysis. *Pain* 2011;152:533–42

54. Glover-Graf NM, Marini I, Baker J, Buck T: Religious and spiritual beliefs and practices of persons with chronic pain. *Rehabil Couns Bull* 2007;51:21–33

55. Westerhof GJ, Keyes CL: Mental illness and mental health: The two continua model across the lifespan. *J Adult Dev* 2010;17:110–9

56. Bentley JP, Thacker PG: The influence of risk and monetary payment on the research participation decision making process. *J Med Ethics* 2004;30:293–8

57. Brase GL: How different types of participant payments alter task performance. *Judgm Decis Making* 2009;4:419–28