Published in final edited form as:

Rehabil Psychol. 2011 February ; 56(1): 52–57. doi:10.1037/a0022683.

Positive Affect and Pain Ratings in Persons with Stroke

Ivonne-M. Berges, PhD^{1,3}, Gary Seale, PhD^{3,4}, and Glenn V. Ostir, PhD^{1,2}

¹ Sealy Center on Aging, University of Texas Medical Branch, Galveston, Texas

² Division of Geriatrics, Department of Internal Medicine, University of Texas Medical Branch, Galveston, Texas

³ Division of Rehabilitation Sciences, University of Texas Medical Branch, Galveston, Texas

⁴ Transitional Learning Center at Galveston, Texas

Abstract

OBJECTIVE—To examine the association between positive affect at discharge from inpatient medical rehabilitation and pain ratings three months post-discharge in persons with stroke aged 50 or older.

DESIGN—A longitudinal study using information from the Stroke Recovery in Underserved Population (SRUP) data base. A 4-item positive affect scale and an 11-point visual analog pain scale were collected at discharge and at 3 months post-discharge.

PARTICIPANTS—The study included 917 adults aged 50 and older with first-time stroke admitted to one of eleven inpatient medical rehabilitation facilities across the United States.

RESULTS—The mean age of the sample was 71 years, 51.0% were women, and 51.6% were married. One third of the sample reported pain and the mean positive affect score was 9.2 (range 0–12). Cumulative logit models showed higher positive affect scores at discharge were significantly associated with lower pain ratings (OR: 0.87, 95% CI 0.81, 0.92) at 3 month follow-up after adjusting for discharge pain ratings, negative affect, and demographic and clinical characteristics.

CONCLUSION—High positive affect at discharge from inpatient medical rehabilitation was associated with lower pain ratings three months post discharge after controlling for pain and negative affect at discharge and clinical and demographic characteristics. The identification of links between positive affect and pain may contribute to a better understanding of functional recovery processes post stroke and the planning of therapeutic programs directed at the positive psychological strengths in elderly persons with stroke.

Correspondence concerning this article should be addressed to Ivonne-M. Berges, University of Texas Medical Branch, 301 University Boulevard, Route 0177, Galveston, Texas 77555 imberges@utmb.edu.

Author Contributions

I-M. Berges – Conducted analysis and interpretation of data. Drafted and revised manuscript, and approved final version.

G. Seale – Revised manuscript and approved final version.

G. Ostir – Acquired data, developed concept and design, and approved final version.

Publisher's Disclaimer: The following manuscript is the final accepted manuscript. It has not been subjected to the final copyediting, fact-checking, and proofreading required for formal publication. It is not the definitive, publisher-authenticated version. The American Psychological Association and its Council of Editors disclaim any responsibility or liabilities for errors or omissions of this manuscript version, any version derived from this manuscript by NIH, or other third parties. The published version is available at www.apa.org/pubs/journals/rep

Keywords

Positive affect; pain; cerebrovascular accident; stroke

Stroke is the third leading cause of death and the leading cause of long-term disability in the United States. Approximately 5.7 million Americans currently live with the effects of stroke (American Heart Association, 2007) and of those, an estimated 33% will experience moderate to severe pain in the first few months after first time stroke (Jönsson, Lindgren, Norrving & Lindgren, 2006). Individuals who report pain post-stroke typically have poorer recovery trajectories, experience higher health care costs, report low satisfaction with personal and working life, and report decreased overall quality of life (Helgason & Wolf, 1997).

Studies examining pain and emotion indicate an intimate relationship between the two constructs (Mollet & Harrison, 2006; Wiech & Tracey, 2009), where the presence of negative affect such as feelings of sadness, worthlessness and depression are known to co-occur with pain (Delgado, 2004). A study by Gureje and colleagues found a 4-fold increase in psychological distress, such as depression and anxiety among pain sufferers in primary care compared to those reporting no pain (Gureje, Von Korff, Simon, & Gater, 1998). Dohrenwend and colleagues further reported elevated rates of depressive symptoms among individuals diagnosed with myofascial facial pain, concluding that myofascial pain preceded the onset of depressive symptoms (Dohrenwend, Raphael, Marbach, & Gallagher, 1999). To date, less is known the role positive affect may play in the experience of pain after an acute event such as stroke.

Positive affect, conceptualized as feelings of happiness, joy, contentment, and or enthusiasm, (Ostir, Cohen-Mansfield, Leveille, Volpato, & Guralnik, 2003; Pressman & Cohen, 2005; Steptoe, O'Donnell, Marmot, & Wardle, 2008) has been associated with a reduced risk for cardiovascular diseases (Ostir, Markides, Peek, & Goodwin, 2001; Ostir, Peek, Markides, & Goodwin, 2001), lower blood pressure (Ostir, Berges, Markides, & Ottenbacher, 2006), better functional outcomes after an acute medical event (Ostir, Berges, Ottenbacher, Clow, & Ottenbacher, 2008), and greater survival (Ostir, Markides, Black, & Goodwin, 2000). Studies have also shown positive affect to reduce the risk of new onset disability and frailty in older minority populations (Fisher, Snih, Ostir, & Goodwin, 2004; Ostir, Ottenbacher, & Markides, 2004). Following inpatient medical rehabilitation for stroke, recent studies have shown positive affect to be associated with improved functional status 3 months post-discharge (Ostir et al., 2008; Seale, Berges, Ottenbacher, & Ostir, 2010). Not known is whether positive affect plays a role in the experience of pain post-stroke.

Several theories provide a framework for examining a possible association between positive affect and pain after stroke. From the stress and coping theory (Lazarus & Folkman, 1984), positive appraisals under stressful health challenges are known to be associated with increased motivation to initiate and sustain treatment and are also known to facilitate positive coping and personal sense of control (Johnston, Morrison, Macwalter, & Partridge, 1999; Ryff & Singer, 1996). Another perspective, the “broaden and build” hypothesis proposes that high levels of positive affect may reverse or act as a buffer against potentially deleterious consequences of stress (Fredrickson, 2003; Fredrickson & Levenson, 1998). Under the platform of both of these theories, positive coping processes are those that provide comfort and hope and a sense of meaning and purpose to life. Following stroke persons reporting high positive affect might be more likely to adopt a proactive approach toward

managing pain allowing them to achieve therapeutic goals and regain their functional abilities essential for independent living and quality of life.

The goal of the present study was to assess the association between positive affect and pain ratings in adults aged 50 and older following first time stroke. Information was collected at two time points including discharge from inpatient medical rehabilitation and 3-months post-discharge. We hypothesized that high positive affect at discharge would be associated with lower pain ratings at follow-up. Given the impact emotional factors and pain have on functioning, studying these two constructs within the context of an inpatient medical rehabilitation stroke population may provide new insights into factors associated with rehabilitation post-stroke. The identification of links between positive affect and factors associated with recovery post-stroke may also contribute to the understanding of positive emotional factors associated with recovery and could lead to the development of programs directed at increasing positive psychological strengths in persons with stroke.

METHODS

Source of Data

Data came from the Stroke Recovery in Underserved Populations (SRUP) database, a prospective observational cohort study of persons with stroke (ICD-9 codes 436 – 439) who received inpatient medical rehabilitation services in 2005–2006. A total of 20 facilities were invited to participate and were sent information describing the goals of the study. Of these, 16 agreed to participate in the study. Five facilities located in the Gulf coast region affected by hurricanes that occurred in 2005 were subsequently removed from the study. The 11 remaining facilities were located across diverse regions of the country including: California, Florida, Iowa, Illinois, Kentucky, New Jersey, New York (2), Texas (2), and Washington DC. Operating bed sizes ranged from 12 to 155 (median bed size = 78). All eleven facilities were accredited by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), and all but one facility was accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF).

Data Collection

Sociodemographic characteristics and clinical measures were collected by trained clinical nurse researchers blinded to research questions and hypotheses of the study at 2 time points: before 72 hours of discharge from inpatient medical rehabilitation facility and 3-months post discharge. Discharge interviews were completed at the inpatient medical rehabilitation facility. Follow-up information was collected by trained nurse researchers by telephone interview. The Interrater reliability and stability of the follow-up information collected using phone interviews has been previously established (Heinemann, Linacre, Wright, Hamilton, & Granger, 1993; Smith et al., 1996). In-hospital and follow-up interviews were conducted in Spanish or English based on the preference of the person being interviewed.

Study Population

Persons eligible for inclusion were admitted to an inpatient medical rehabilitation facility with a diagnosis of a first-time stroke and aged 50 years or older of either gender. Potential study participants were screened for cognitive appropriateness by nursing staff via standard protocol with regard to their ability to respond to basic orientation questions about person, place, and time. A total of 1,219 non-proxy and cognitively appropriate participants (626 women, 593 men; 945 non-Hispanic whites, 200 non-Hispanic blacks, and 74 Hispanics) were interviewed and consented. Of these, we excluded individuals who were younger than 50 years of age ($n = 119$), had missing data on gender, marital status or age at baseline ($n =$

20), and those who had missing data on the pain measure ($n = 19$), were unable to locate ($n = 115$) or had died ($n = 29$) at the 3 month follow-up.

The current study included 917 adults with stroke who had complete information on positive affect and pain ratings at discharge and at the 3-month follow-up (464 women, 453 men; 716 non-Hispanic whites, 146 non-Hispanic blacks, and 55 Hispanics). To evaluate the potential bias of those with incomplete information or lost to follow-up, we tested for significant differences across the sociodemographic and clinical measures of interest. After reviewing these measures we did not find any significant differences between those included and those excluded. Consent was obtained in-person at the time of the discharge interview. Central and local ethical committee approval was sought and obtained.

Outcome Measures

Pain—Participants were asked at discharge and at a 3-month follow-up interview to rate their current level of pain. Responses were coded using an established 11-point scale rating ranging from no pain (score, 0) to worst possible pain (score, 10). This single-item measure of pain intensity is widely used in clinical studies, and has shown good reliability and validity when compared to other alternative forms of pain measurement (Huskisson, 1974). For analytical purposes, the pain measure was examined as a continuous variable where higher scores indicated higher pain ratings.

Positive affect—The factor structure of the 20-item Center for Epidemiologic Studies-Depression Scale (CES-D) includes a four-item positive affect scale extracted from the original 20-item scale (Miller, Markides, & Black, 1997; Radloff, 1977; Roberts, 1980; Sheehan, Fifield, Reisine, & Tennen, 1995). The four positive items included: “I felt that I was just as good as other people”, “I felt hopeful about the future”, “I was happy”, and “I enjoyed life” (Radloff, 1977). Responses to items were scored on a four-point scale (0 to 3) and ranged from 0 (rarely or none of the time) to 3 (most of the time). Summing the responses from the 4-items created a positive affect summary score ranging from 0 to 12 with higher scores indicating higher positive affect. In the current study, the four positive affect items showed high internal consistency ($\alpha = .80$), and a weak correlation with the 16 negative affect items on the CES-D ($r = -.26$) ($\alpha = 0.90$). The positive affect summary score was used as a continuous measure.

Covariates

Sociodemographic and clinical measures were included as covariates in the statistical models described below. Sociodemographic measures included age ≥ 50 (continuous), gender, marital status, (married vs. unmarried), ethnicity (non-Hispanic white, non-Hispanic black and Hispanic) and years of school (continuous).

Clinical measures included pain ratings at discharge (0 – 10, continuous), number of comorbidities (0 – 5, continuous, including diagnosis of heart attack, diabetes, arthritis, kidney disease or cancer), length of hospital stay (days from inpatient admission to discharge), stroke type (ischemic, hemorrhagic or other), functional status, and therapy after discharge (any therapy vs. none). Functional status was assessed by the Functional Independence Measure (FIM instrument), a standardized measure including 18 items covering six domains: self-care, sphincter control, transfer, locomotion, communication, and social cognition. All 18 items are scored into one of seven levels of function, ranging from complete dependence (level 1) to complete independence (level 7). Total FIM ratings have a potential range of 18 to 126, with higher scores indicating greater functional independence. The reliability, validity, and responsiveness of the FIM instrument have been widely investigated (Hamilton, Laughlin, Fiedler, & Granger, 1994; Ottenbacher, Hsu, Granger, &

Fiedler, 1996; Stineman et al., 1996). The reliability (intraclass correlation coefficient) of the total FIM and of its domains has consistently been found to be > 0.85 (Hamilton et al., 1994; Ottenbacher et al., 1996).

Statistical analysis

Descriptive statistics were reported as means and standard deviations for continuous measures and as percentages for categorical measures. Chi-square and t-test statistics were used to examine associations between positive affect, sociodemographic characteristics and clinical measures, and pain.

To examine associations between sociodemographic characteristics, clinical measures, positive affect at discharge and pain ratings at follow-up, three cumulative logit models were computed. Model fit was tested through Pearson goodness-of-fit statistics. In these models, each reported odds ratio (OR) and 95% confidence interval (CI) are interpreted as the effect of positive affect on the odds of being in a higher pain rating category rather than in a lower pain rating category. The first model tested the effect of positive affect at discharge on pain ratings at three month follow-up controlling for pain ratings at discharge. The second model included sociodemographic characteristics (age, sex, marital status, race/ethnicity, and years of education). The third model added clinical measures (type of stroke, length of hospital stay (LOS), comorbidities, therapy, and total FIM rating).

For all models, testing was 2-sided using an alpha of < 0.05 . Model assumptions for the three cumulative logit models were tested and met. All analyses were performed using SAS software, version 9.3 (SAS Institute, Cary, NC).

Results

The study included 917 participants with complete information at discharge and at the 3-month follow-up. The mean age of the sample was 71.0 years; about half were women (51.0%) and the majority was non-Hispanic white (78.0%). One third of the participants (31.0%) reported pain. Table 1 shows bivariate associations between selected baseline sociodemographic and clinical characteristics and pain ratings (pain vs. no pain). Among those reporting pain ($n = 284$), the mean age was 71.2 years, 59.5% were women, and 58.8% were married. Results of chi-square analyses showed gender was significantly associated with pain rating ($p < 0.01$). In a multivariate analysis, we tested the interaction effect between positive affect and gender on pain ratings finding no significant results.

Figure 1 shows the trajectory of mean pain ratings from discharge to 3 months post-discharge for those participants in the top and bottom quartile of the positive affect score. Mean pain ratings decreased from discharge to the 3 month follow up among participants in both groups. Post hoc analysis showed no significant differences between the groups ($P = 0.07$).

To examine the association between positive affect at discharge and pain rating at 3 month follow-up, we tested three cumulative logit models (Table 2). The cumulative logit model predicts the probability of being in a higher pain category rather than in a lower pain category. In model 1, each 1-point increase in positive affect score was significantly associated with a 14% decreased odds of being in a higher pain category (OR: 0.86, 95% CI 0.81, 0.91). In model 2, after adjusting for sociodemographic characteristics, similar results were observed (OR: 0.86, 95% CI 0.81, 0.91). With the addition of clinical measures (model 3), each 1-point increase in positive affect score was significantly associated with a 13% decreased odds of being in a higher pain category (OR: 0.87, 95% CI 0.81, 0.92). Other covariates associated with pain ratings were gender (OR: 0.48, 95% CI 0.32, 0.74) and

functional status (OR: 0.98, 95% CI 0.98, 0.99). Negative affect at discharge was not associated with pain ratings at follow-up (OR: 1.01, 95% CI 0.96, 1.07).

DISCUSSION

This study investigated the association between positive affect at discharge from inpatient medical rehabilitation and pain ratings 3-months post-discharge in persons with stroke aged 50 and older. Our findings indicate that high positive affect at discharge was significantly associated with lower pain ratings at a 3-month post-discharge, after adjusting for negative affect and pain ratings at discharge.

The significant inverse relationship between higher positive affect score at discharge and lower pain ratings 3-months post discharge adds to the accumulating evidence of mind-body connections, and specifically, that high positive affect is linked to physical and functional processes of recovery. More importantly, these findings indicate that positive affect may play a key role in the recovery process and are relevant to inpatient medical rehabilitation and its goal to improve the quality of life of persons with stroke.

Previous studies that investigated connections between positive affect and pain show an inverse relationship between positive affect and pain over time (Jönsson et al., 2006; Zautra, Johnson, & Davis, 2005). In a study of women with osteoarthritis and fibromalgia pain, Zautra and colleagues found those who reported higher positive affect also reported less pain in weekly assessments over a three month period (Zautra et al., 2005). Strand and colleagues (Strand, Zautra, Thorensen, & Ödegård, 2009) reported that stress-related pain in individuals with rheumatoid arthritis was significantly reduced in those who reported high positive affect. In both studies, positive affect was considered a source of resilience in the face of the stressful experience of pain.

The sudden stress that follows an acute medical event, such as a stroke, comes with many uncertainties and expectations about the recovery process and the potential negative effect on quality of life. Individuals with a positive attitude may be more likely to realistically appraise their current situation. Additionally, those with high levels of positive affect might make a conscious decision to maintain optimism and focus on functional and cognitive gains rather than the current limitations in activities of daily living brought on by the stroke. A positive attitude may also motivate the use of positive coping skills (Zautra, Smith, Affleck, & Tennen, 2001) which in turn can ameliorate negative perceptions. Use of adaptive coping skills, sense of personal control, and focusing on positive gains may combine to facilitate active engagement in the recovery process with a proactive approach to personal goal setting and overcoming challenges (Johnston et al., 1999).

In line with the present findings, it is important to understand possible mechanisms by which positive affect may contribute to positive outcomes post stroke. First, it is possible that positive affect is associated with healthier lifestyles and behaviors (Steptoe, Wardle, & Marmot, 2005). Individuals with high positive affect tend to be physically active (Clark & Watson, 1988) and enjoy good social ties and support (Watson, 1988). Physical activity is known for its positive effect on cardiovascular health, immune functioning, muscle strength, and mental health. It is well-established that social ties and support are strongly linked to good physical and cognitive function, lower risk of institutionalization, faster recovery after an illness, and less risk of mortality (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Fredrickson's (Fredrickson, 2003) broaden-and-build theory posits that individuals with high levels of positive affect are able to draw on personal resources, which in turn, may buffer against the effects of negative affect and thus increase the chances of a successful recovery. Additionally, positive affect also has been associated with adherence to medical

treatments which, in turn, may speed recovery and reduce severity of illness (Pressman & Cohen, 2005). In all, these patterns of behaviors are conducive to better health, better quality of life, and greater life satisfaction. Second, the association between positive affect and health might be mediated through psychobiological processes which may serve as pathways by which psychological factors stimulate biological systems such as the autonomic, immune, neuroendocrine, and inflammatory (Steptoe et al., 2005). As such, positive affect may be able to indirectly exert a homeostatic balance in the body's internal environment creating positive feedback among the various biological systems.

In the present study, we cannot assume a causal association between positive affect and pain. There is always the possibility that an unmeasured factor could be related to pain ratings at the follow-up assessment. In addition, because positive affect was not measured at admission to the rehabilitation facility, it was not possible to examine change in positive affect during the hospital stay as well as change in pain levels. It would be interesting to see if increases or decreases in positive affect during rehabilitation are related to increases or decreases in pain ratings. From these data, we were also not able to assess the association between positive affect and severity, type (e.g. local, central post-stroke), or location of the pain (e.g. upper / lower limbs).

Despite these limitations, the present study demonstrates that high positive affect at discharge from inpatient medical rehabilitation is associated with lower pain ratings three months post-discharge. Future studies should continue to investigate the psychobiological pathways by which psychological factors such as positive affect may influence the experience of pain in persons with stroke.

CONCLUSION

This study assessed the association between positive affect at discharge from inpatient medical rehabilitation facility and pain ratings 3-months later in persons with stroke aged 50 and older. The study demonstrates that high positive affect at discharge from inpatient medical rehabilitation is associated with lower pain ratings three months post-discharge.

Acknowledgments

Funding sources: This research was supported by the National Center for Medical Rehabilitation Research for I-M. Berges (grant no. R03-HDO05821-01), and the National Institutes of Health and the National Institute of Aging for G. Ostir (grants no. R01-AG024806 and 01-HD046682).

Role of Sponsor: The funding sources had no role in the design, methods, subject recruitment, data collection, analysis or preparation of the manuscript.

References

- American Heart Association. Heart Disease and Stroke Statistics-2007 Update. Dallas, Texas: American Heart Association; 2007.
- Clark LA, Watson D. Mood and the mundane: relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology*. 1988; 54:296–308. [PubMed: 3346815]
- Delgado PL. Common pathways of depression and pain. *Journal of Clinical Psychiatry*. 2004; 65:16–19. [PubMed: 15315473]
- Dohrenwend BP, Raphael KG, Marbach JJ, Gallagher RM. Why is depression comorbid with chronic myofascial pain? A family study test of alternative hypotheses. *Pain*. 1999; 83:183–192. [PubMed: 10534589]
- Fisher MN, Snih SA, Ostir GV, Goodwin JS. Positive affect and disability among older Mexican Americans with arthritis. *Arthritis and Rheumatism*. 2004; 51:34–39. [PubMed: 14872453]

- Fredrickson BL. The value of positive emotions - The emerging science of positive psychology in coming to understand why it's good to feel good. *American Scientist*. 2003; 91:330–335.
- Fredrickson BL, Levenson RW. Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition and Emotion*. 1998; 12:191–220.
- Gureje O, Von Korff M, Simon GE, Gater R. Persistent pain and well-being: a World Health Organization Study in Primary Care. *Journal of the American Medical Association*. 1998; 280:147–151. [PubMed: 9669787]
- Hamilton BB, Laughlin JA, Fiedler RC, Granger CV. Interrater reliability of the 7-level functional independence measure (FIM). *Scandinavian Journal of Rehabilitation Medicine*. 1994; 26:115–119. [PubMed: 7801060]
- Heinemann AW, Linacre JM, Wright BD, Hamilton BB, Granger C. Relationships between impairment and physical disability as measured by the functional independence measure. *Archives of Physical Medicine and Rehabilitation*. 1993; 74:566–573. [PubMed: 8503745]
- Helgason CM, Wolf PA. American Heart Association Prevention Conference IV: prevention and rehabilitation of stroke: executive summary. *Circulation*. 1997; 96:701–707. [PubMed: 9244247]
- Huskisson EC. Measurement of pain. *Lancet*. 1974; 2:1127–1131. [PubMed: 4139420]
- Johnston M, Morrison V, Macwalter R, Partridge C. Perceived control, coping and recovery from disability following a stroke. *Psychology and Health*. 1999; 14:181–192.
- Jönsson AC, Lindgren I, Norrving B, Lindgren A. Prevalence and intensity of pain after stroke: a population based study focusing on patient's perspectives. *Journal of Neurology and Neurosurgery Psychiatry*. 2006; 77:590–595.
- Lazarus, RS.; Folkman, S. Stress, appraisal, and coping. New York: Springer Pub. Co; 1984.
- Miller TQ, Markides KS, Black SA. The factor structure of the CES-D in two surveys of elderly Mexican Americans. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*. 1997; 52B:S259–S269.
- Mollet GA, Harrison DW. Emotion and pain: A functional cerebral systems integration. *Neuropsychological Review*. 2006; 16:99–121.
- Ostir GV, Berges IM, Markides KP, Ottenbacher KJ. Hypertension in older adults and the role of positive emotions. *Psychosomatic Medicine*. 2006; 68:727–733. [PubMed: 17012526]
- Ostir GV, Berges IM, Ottenbacher ME, Clow A, Ottenbacher KJ. Associations between positive emotion and recovery of functional status following stroke. *Psychosomatic Medicine*. 2008; 70:404–409. [PubMed: 18434490]
- Ostir GV, Cohen-Mansfield J, Leveille S, Volpato S, Guralnik JM. The association of positive and negative affect and exercise self-efficacy in older adults. *Journal of Aging and Physical Activity*. 2003; 11:265–274.
- Ostir GV, Markides KS, Black SA, Goodwin JS. Emotional well-being predicts subsequent functional independence and survival. *Journal of the American Geriatrics Society*. 2000; 48:473–478. [PubMed: 10811538]
- Ostir GV, Markides KS, Peek MK, Goodwin JS. The association between emotional well-being and the incidence of stroke in older adults. *Psychosomatic Medicine*. 2001; 63:210–215. [PubMed: 11292267]
- Ostir GV, Ottenbacher KJ, Markides KS. Onset of frailty in older adults and the protective role of positive affect. *Psychology and Aging*. 2004; 19:402–408. [PubMed: 15382991]
- Ostir GV, Peek MK, Markides KP, Goodwin JS. The association of emotional well-being on future risk of myocardial infarction in older adults. *Primary Psychiatry*. 2001; 8:34–38.
- Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. *Archives of Physical Medicine and Rehabilitation*. 1996; 77:1226–1232. [PubMed: 8976303]
- Pressman SD, Cohen S. Does positive affect influence health? *Psychological Bulletin*. 2005; 131:925–971. [PubMed: 16351329]
- Radloff LS. The CES-D Scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1:385–401.

- Roberts RE. Reliability of the CES-D Scale in different ethnic contexts. *Psychiatry Research*. 1980; 2:125–134. [PubMed: 6932058]
- Ryff CD, Singer B. Psychological well-being: meaning, measurement, and implications for psychotherapy research. *Psychotherapy and Psychosomatics*. 1996; 65:14–23. [PubMed: 8838692]
- Seale GS, Berges IM, Ottenbacher KJ, Ostir GV. Change in positive emotion and recovery of functional status following stroke. *Rehabilitation Psychology*. 2010; 55:33–39. [PubMed: 20175632]
- Sheehan TJ, Fifield J, Reisine S, Tennen H. The measurement structure of the Center for Epidemiologic Studies Depression Scale. *Journal of Personality Assessment*. 1995; 64:507–521. [PubMed: 7760258]
- Smith PM, Illig SB, Fiedler RC, Hamilton BB, Ottenbacher KJ, Fielder RC. Intermodal agreement of follow-up telephone functional assessment using the Functional Independence Measure in patients with stroke. *Archives of Physical Medicine and Rehabilitation*. 1996; 77:431–435. [PubMed: 8629917]
- Steptoe A, O'Donnell K, Marmot M, Wardle J. Positive affect, psychological well-being, and good sleep. *Journal of Psychosomatic Research*. 2008; 64:409–415. [PubMed: 18374740]
- Steptoe A, Wardle J, Marmot M. Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. *Proceedings of the National Academy of Sciences of the United States of America*. 2005; 102:6508–6512. [PubMed: 15840727]
- Stineman MG, Shea JA, Jette A, Tassoni CJ, Ottenbacher KJ, Fiedler R, et al. The Functional Independence Measure: tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. *Archives of Physical Medicine and Rehabilitation*. 1996; 77:1101–1108. [PubMed: 8931518]
- Strand EB, Zautra AJ, Thorensen M, Ödegård S. Positive affect as a factor of resilience in the pain-negative affect relationship in patients with rheumatoid arthritis. *Journal of Psychosomatic Research*. 2009; 60:477–484. [PubMed: 16650588]
- Uchino BN, Cacioppo JT, Kiecolt-Glaser JK. The relationship between social support and physiological processes: a review with emphasis on underlying mechanisms and implications for health. *Psychological Bulletin*. 1996; 119:488–531. [PubMed: 8668748]
- Watson D. Intraindividual and interindividual analyses of positive and negative affect: their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology*. 1988; 54:1020–1030. [PubMed: 3397861]
- Wiech K, Tracey I. The influence of negative emotions on pain: Behavioral effects and neural mechanisms. *Neuroimage*. 2009; 47:987–994. [PubMed: 19481610]
- Zautra AJ, Johnson LM, Davis MC. Positive Affect as a Source of Resilience for Women in Chronic Pain. *Journal of Consulting and Clinical Psychology*. 2005; 73:212–220. [PubMed: 15796628]
- Zautra AJ, Smith B, Affleck G, Tennen H. Examination of chronic pain and affect relationship: application of a dynamic model of affect. *Journal of Clinical Psychology*. 2001; 69:786–795.

Figure 1.
Mean pain ratings from discharge to 3 months post-discharge by positive affect score (N= 917).

Table 1

Bivariate associations between selected sociodemographic and clinical characteristics of the sample and pain. Descriptive statistics, t-tests and chi-square (N=917)

Variable	Pain (n = 284)	No Pain (n = 633)	df	t
Age M (SD)	71.2 (10.5)	71.7 (10.2)	915	0.66
Education M (SD)	12.0 (3.0)	12.4 (3.0)	881	1.70
Positive Affect M (SD)	8.6 (3.4)	9.5 (2.8)	915	4.15 [†]
Negative Affect M (SD)	9.2 (8.9)	8.8 (9.1)	915	-5.38 [†]
	Pain	No pain	df	X ²
	(n = 284)	(n = 633)		
Gender n %				
Men	115 (40.5)	338 (53.4)	1	13.05 [†]
women	169 (59.5)	295 (46.6)		
Married n (%)				
Yes	167 (58.8)	334 (52.8)	1	2.8
No	117 (41.2)	299 (47.2)		
Race n (%)				
White	219 (77.1)	497 (78.5)	1	0.22
Non-white	65 (22.9)	136 (21.5)		
Co-morbidities n (%)				
Yes	219 (77.1)	466 (73.6)	4	5.36
No	65 (22.9)	167 (26.4)		
Type of Stroke n (%)				
Ischemic	473 (74.9)	211 (74.3)	2	4.20
Hemorrhagic	105 (16.6)	38 (13.4)		
Other	54 (8.5)	35 (12.3)		

[†] $p < .001$.

* $p < .05$.

** $p < 0.1$.

Table 2

Cumulative logit models assessing the association between positive affect and pain after stroke (N = 917)

	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Variable			
Positive Affect (continuous)	0.86 (0.81, 0.91)	0.86 (0.81, 0.91)	0.87 (0.81, 0.92)
Pain (Discharge)	1.21 (1.03, 1.42)	1.20 (1.01, 1.43)	1.15 (0.96, 1.37)
Age (continuous)		0.99 (0.97, 1.01)	0.98 (0.96, 1.00)
Men (vs. women)		0.53 (0.35, 0.81)	0.48 (0.32, 0.75)
Married (vs. unmarried)		1.51 (0.99, 2.28)	1.35 (0.88, 2.06)
White (vs. non-white)		1.43 (0.97, 2.10)	1.52 (1.03, 2.24)
Education (continuous)		0.96 (0.90, 1.02)	0.98 (0.92, 1.04)
Ischemic stroke (vs. other)			1.27 (0.85, 1.89)
Length of Stay (continuous)			1.01 (0.99, 1.03)
Comorbidities (continuous)			1.26 (0.99, 1.60)
Total FIM (continuous)			0.98 (0.97, 0.99)
Therapy (Follow-up)			0.49 (0.26, 0.94)
Negative Affect			1.01 (0.96, 1.07)