

Exploring the relationships among social support, patient activation, and pain-related outcomes

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Abstract

Objective: Social support has been linked to more effective pain adaptation. The relationship between social support and other relevant constructs is less well-understood. Chief among these is patient activation, which has robust links to effective self-management, yet has not been well-studied in chronic pain. We sought to better understand these relationships in an effort to inform future intervention strategies for patients with chronic pain.

Methods: Using baseline data from a clinical trial with patients with chronic pain (N=213), we analyzed the relationships among perceived social support and patient activation, depression, anxiety, general health perceptions, pain centrality, pain catastrophizing, and pain intensity and interference. Multiple linear regression was used to examine the effect of social support on outcomes. Patient activation was explored as a mediator of the effect of social support on outcomes.

Results: Social support was significantly associated with all outcomes except pain. Social support explained the greatest variance in patient activation (squared semi-partial correlation = .081), followed by depression (.073) and general health perceptions (.072). Patient activation was not found to be a significant mediator of the effect of social support on pain-related outcomes.

Conclusions: Findings provide insight into the roles of patient activation and social support in chronic pain management. Although patient activation did not mediate the relationship between social support and outcomes, this study is an important step toward gaining a more complete understanding of constructs thought to be related to pain self-management and points to the need to advance theory in this area to guide

future research. Such work is needed to optimize interventions for patients with chronic pain.

Key Words: chronic pain, social support, pain self-management, patient-centered outcomes, patient activation

Introduction

Chronic pain is prevalent and costly; pain reduces quality of life and is associated with deleterious psychological outcomes.(1) Social support, defined as feeling cared for, valued, and having a sense of belonging,(2) has long been believed to play a role in chronic pain management. Social support has been linked to positive emotional states and more effective pain adaptation, which may in turn predict lower pain and more effective psychological functioning.(3) Conversely, lack of support, including social isolation, conflict, or distress, is thought to exacerbate pain and potentially facilitate development of chronic pain.(4-6)

The positive effects of social support are due, in part, to supportive communication behaviors. Indeed, social relationships are thought to enhance one's ability to cope with pain.(3) More specifically, social support in the form of supportive communication appears to play a key role in facilitating pain self-management ("the ability to manage the symptoms, treatment, physical and psychosocial consequences, and life-style changes inherent in living with a chronic condition"(7)). In qualitative studies, patients have identified behaviors such as receiving encouraging and motivating messages, being held accountable to self-management goals and activities,

and having someone to listen and show concern as key facilitators of successful pain self-management.(8-10) This function of social support is particularly important for chronic pain because self-management is a critical part of chronic pain treatment, yet consistently engaging in pain self-management can be challenging.(1)

While the literature on social support and pain management is well-established (3, 11), emerging research also points to the integral role of patient activation in chronic pain. Patient activation refers to having the knowledge, confidence, and ability to self-manage. It has been found to play an important role in the management of numerous chronic conditions and has been found to be associated with productive self-management behaviors and better quality of life. (12) (13-17) Moreover, patient activation has been shown to have important associations with outcomes beyond the individual patient. Of particular relevance to the broader healthcare system, patient activation has been associated with lower service utilization, lower rates of hospital readmission, lower healthcare costs, and better experiences with care and care coordination.(14, 18, 19) Gaining a better understanding of the role of patient activation in chronic pain – a particularly high-burden, high-cost condition (1) – could highlight new avenues of intervention that have impact for the patient and broader society. Notably, evidence suggests that patient activation is modifiable through intervention.(20-23)

Despite the integral role that patient activation plays in self-management, it has received little attention in chronic pain care, particularly in the U.S. Studies conducted in New Zealand, Japan, Korea, and China found higher patient activation to be associated with positive pain and pain-related outcomes, such as better pain control strategies, lower pain intensity, better mood, and better quality sleep.(20, 24-26) Given the

documented role of social support in chronic pain management and the emerging evidence of patient activation as a facilitator of self-management, particularly in pain, gaining a more nuanced understanding of their respective roles would inform pain care. For example, given that social support has been found to serve functions such as holding patients accountable for their pain self-management activities (8-10), a plausible hypothesis is that social support serves to facilitate patient activation, which then leads to improved pain outcomes.

The purpose of the current study was to advance our understanding of the relationship between social support and patient activation and their respective relationships to pain and pain-related outcomes. In particular, we sought to ascertain whether social support might encourage patients to be more active participants in their pain management, which would then lead to better outcomes. Based on the literature, we hypothesized that higher social support would be associated with higher patient activation, and that higher social support would be associated with lower patient-reported pain, lower depression and anxiety, lower pain centrality and catastrophizing, and higher perceptions of general health. We also hypothesized that patient activation would mediate the relationship between social support and these outcomes.

Methods

We analyzed baseline data from a 2-arm randomized controlled trial of peer-supported pain self-management conducted with patients with chronic musculoskeletal pain (ECLIPSE—Evaluation of a Peer Coach-Led Intervention to Improve Pain Symptoms). Patients were all veterans recruited from primary care clinics at a large VA

medical center. Patients met the following eligibility criteria: 1) musculoskeletal pain in the low back, cervical spine, or extremities (hip, knee, or shoulder) for ≥ 3 months; 2) at least moderate pain severity, defined by pain ≥ 5 on a 0 (no pain) to 10 (worst pain imaginable) scale; and 3) willingness to engage in phone or in-person contact on a regular basis with another patient. Patients were excluded if the electronic medical record indicated 1) psychiatric hospitalization in the last 6 months, 2) current substance dependence, 3) severe medical conditions precluding participation (e.g., New York Heart Association Class III or IV heart failure), 4) if the eligibility screener given to prospective participants revealed active suicidal ideation, severe hearing or speech impairment, or pending surgery for a musculoskeletal condition (e.g., back surgery), or 5) current participation in another pain study. Additional details on the ECLIPSE study, design, and main trial findings are published elsewhere.(27, 28)

Measures

Demographic variables were assessed at baseline with a questionnaire administered to patients.

Social support was assessed with the Multidimensional Scale of Perceived Social Support. The MSPSS includes 12, 7-point Likert scale items with answers ranging from very strongly disagree to very strongly agree. Questions include “There is a special person around when I am in need” and “I get the emotional help and support I need from my family.” The test-retest reliability and internal consistency for the MSPSS are high, ranging from $\alpha=.84-.95$ across a variety of studies.(29, 30)

Patient activation, having the knowledge, skills, and confidence to manage one’s health, was measured with the 13-item Patient Activation Measure (PAM) Short

Form.(13) The PAM has been demonstrated to be reliable and valid across a variety of studies.(13, 31-33)

Depression was measured with the PHQ-8, a widely used measure of depression,(34) and anxiety was measured with the GAD-7, a brief measure of generalized anxiety disorder.(35)

Patient perception of general health was taken from the last question of the RAND SF-36, which was developed as part of the Medical Outcomes Study.(36)

Pain centrality was measured with the Centrality of Pain Scale, a 10-item scale that assesses how much pain dominates or “takes over” a patient’s life. The scale shows high internal consistency and has demonstrated construct validity.(37)

Pain catastrophizing was measured with the Pain Catastrophizing Scale, a 13-item measure that assesses rumination, magnification, and helplessness cognitions about pain. Validation studies for the Pain Catastrophizing Scale have found strong evidence of criterion-related, concurrent, and discriminant validity.(38)

Pain was measured with the Brief Pain Inventory (BPI) total score, which is the average of two scores: pain intensity and pain interference. The BPI was developed to assess pain severity and its impact on functioning and has been validated in primary care studies.(39, 40) The pain intensity score is an average of 4 ratings of 0 (no pain) to 10 (pain as bad as you can imagine) for current, least, worst, and average pain in the past week. The BPI pain interference score averages seven ratings, 0 (does not interfere) to 10 (interferes completely), of interference with general activity, mood, walking ability, normal work, relations with other people, sleep, and enjoyment of life.

Analysis

Baseline data for patients was used to assess the associations between outcome measures of pain and social support. Descriptive statistics (N, Mean, SD, Median, Minimum and Maximum) were provided for continuous measures of age, pain, coping, mood, activation, and social support. Categorical measures (marital status, race, education, employment, and income) were summarized by frequency and percent. Bivariate scatterplots with loess smoothers were examined to assess the linearity and curvature of associations. Pearson correlation coefficients and 95% confidence intervals were obtained to assess the strength and direction of the linear associations.

To assess potential confounding of demographic characteristics and social support, we first regressed social support on demographic characteristics. Characteristics that were significant at the 0.25 level in the linear regression models were then included in all multivariable models of pain outcomes regressed on social support. Multiple linear regression was used to examine the effect of social support on pain outcomes while adjusting for demographic characteristics. Residual plots were examined for assessment of normality and for homogeneity of variance. A Šidák adjusted p-value is reported for the test corresponding to the parameter estimate for Perceived Social Support from each of the 9 regression models to keep familywise error at 0.05. To assess the contribution of perceived social support on the amount of total variance explained by the multiple regression model, the squared semi-partial correlation, which is the difference in R^2 for the full model and the R^2 for the multivariable model that excludes social support, is reported.

To test the hypothesis that patient activation mediates the effect of social support on pain-related outcomes, mediation models were conducted for each pain-related outcome that was significantly correlated with patient activation. We estimated the path effects and indirect effect of the hypothesized mediator (patient activation) on each pain-related outcome, adjusting for social support. Additionally, the same mediation models were estimated controlling for the demographic characteristics of education, partner status, employment, and income. Mediation analyses were conducted with SAS Proc CAUSALMED in SAS V9.4 (Cary, NC).^(41, 42) Unstandardized coefficients, standard errors, and p-values are presented for path effects. The unstandardized coefficient and bias-corrected 95% bootstrap confidence interval with 1000 bootstrap replications is presented for the indirect effect. The percentage of the total effect mediated is also reported.

Results

A total of 213 patients (18.8% female), all veterans, were included in the analysis (Table 1). Over half of participants (61.5%) were White, and most had at least a 2-year college or technical degree. Just over half (51.9%) were married or had a partner, and 40.6% were employed. In terms of income, 47.4% described themselves as “comfortable,” 34.3% as having “just enough to make ends meet,” and 17.8% as “not having enough to make ends meet.”

Because bivariate scatterplots indicated a plausible linear relationship, we report Pearson correlation coefficients. The Pearson correlation coefficients were in the expected direction for all outcomes and were modest, ranging from -0.39 to 0.30.

Perceived social support was positively correlated with patient activation (PAM) and SF-36 general health and negatively correlated with pain measures (BPI Total, BPI Intensity, BPI Interference, Centrality of Pain, Pain Catastrophizing), anxiety (GAD-7), and depression (PHQ-8). Table 2 shows correlations among all variables.

From the linear regression models of perceived social support as explained by each demographic variable, age and race were not significantly associated with perceived social support. However, education, having a partner, being employed, and being comfortable with income were associated with higher social support (with p-values < 0.25) and were retained for inclusion in the multiple regression models for outcomes of interest.

From the multiple regression models, the estimated coefficient of perceived social support, the model R^2 , the squared semi-partial correlation, and the p-value from the test of the perceived social support association being zero for are reported in Table 3. After adjusting for demographic characteristics of education, partner status, employment, and income, and further adjusting for multiple comparisons with a Šidák correction, perceived social support was not significantly associated with total BPI or the intensity or interference subscales; thus this hypothesis was not supported. However, our other hypotheses were supported. Social support was statistically significantly associated with patient activation, depression, anxiety, general health perceptions, pain centrality, and pain catastrophizing (Table 3). In terms of the unique variance explained by social support (squared semi-partial correlation), social support explained the greatest variance in patient activation (0.081), followed by depression (0.073) and general health perceptions (0.072). See Figure 1.

Of the pain-related outcomes, pain centrality, pain catastrophizing, anxiety (GAD-7), depression (PHQ-8), and general health perceptions were significantly associated with patient activation based on the Pearson correlation (See Table 2). As a result, five mediation models were fit. The indirect effect was not statistically significant in any of the models. Thus, contrary to our hypothesis, no evidence was found to support patient activation as a significant mediator of the effect of social support on these pain-related outcomes. The percent of the total effect of social support that was mediated by patient activation ranged from 5.4% for the outcome of depression (PHQ-8) to 14.7% for pain centrality. After adjusting for demographic characteristics, the percent of the total effect of social support mediated by patient activation was further reduced. See Table 4.

Discussion

Social support was positively associated with higher patient activation, fewer depression and anxiety symptoms, better perceived overall health, and lower pain centrality and catastrophizing, but not with pain intensity or interference. Our hypothesis that patient activation mediates the effect of social support on pain-related outcomes was not supported.

These findings add to our understanding of the role of social support in chronic pain by providing a more nuanced view of its association with specific pain-related outcomes and perceptions of overall health. Of particular note is the relationship between social support and patient activation. Although patient activation is widely recognized as integral to effective self-management, few studies have examined its relationship with outcomes for patients with chronic pain. This is a critical omission,

because, not only is being highly activated essential for effective self-management, lower health service utilization, better medication adherence, and better quality of life,(13-17) but low activation is associated with depression, anxiety, and poorer physical health.(14, 15, 18, 43)

Given the literature linking patient activation to effective self-management, as well as the theoretical link between patient activation and social support (which was confirmed in the current study), we hypothesized that social support would be related to better pain-related outcomes in part because social support leads to increased patient activation, thereby facilitating better outcomes. However, this mediation effect was not found to be significant, suggesting that social support works through other mechanisms and that patient activation might play less of a mediating role in pain outcomes than originally thought. However, it is important to acknowledge recent work conducted outside of the U.S. that found higher patient activation to be associated with positive outcomes such as lower pain intensity, more effective pain management strategies, and improved mood (20, 24-26). Collectively, these findings raise important questions regarding whether these differences are due to cultural variations, differences in methodology, or other factors. These questions, along with the observed relationship in the current study between patient activation and social support and the robust literature on the association of patient activation with positive health outcomes (including emerging work in chronic pain), indicate a need for future theoretical and empirical work to further explore these relationships. Understanding inconsistent findings regarding patient activation and pain, as well as elucidating the mechanisms through which social support is related to pain and pain-related outcomes, are essential to advance our

understanding and our ability to intervene to improve outcomes for patients suffering from chronic pain.

In addition to patient activation, higher levels of social support were associated with lower depression and anxiety, better perceptions of overall health, and lower pain centrality and catastrophizing. These associations with positive outcomes are largely consistent with literature on the role of social support in a variety of acute and chronic conditions. For example, social support has been found to be positively associated with recovery from illness and injury, including coronary heart disease(44) and spinal cord injury.(45) Similarly, a systematic review indicated that support from family was correlated with better symptom control, self-management, and disease-related quality of life for patients with chronic diseases that require ongoing self-management, including diabetes, heart disease, arthritis, and chronic lung disease.(46) In pain, higher levels of social support have been found to be associated with reduced symptoms of depression and anxiety.(47-49)

Given the aforementioned literature, it is surprising that little prior work has examined the relationship between social support and more general health perceptions in patients with pain. The current results suggest a positive association between these two variables, which may be explained by a number of reasons. Positive perceptions of one's health may be a reflection of supportive relationships and positive social interactions that include affirming messages, thereby helping to foster and/or reinforce perceptions of being healthy. Social support may also be more behavioral in nature. Indeed, "active" support groups are common among individuals with chronic health conditions,(50-52) including chronic pain,(53-55) and frequently involve participation in

healthy activities, such as walking or attending an exercise class, with other people. In these ways, social support may help to facilitate the positive health perceptions we saw in this study. Similar mechanisms may also apply to the relationship between social support and pain centrality – that is, affirming messages and/or behavioral activation may buffer against the tendency to view one’s life and oneself solely through the lens of chronic pain. In this way, social support may serve to re-focus a person’s attention away from the experience of pain to social interactions and activities with others that are not associated with pain, thereby reducing the degree to which pain dominates a person’s life.

The relationship between social support and pain catastrophizing is potentially less straightforward. We found that higher levels of social support were associated with less catastrophizing, which is consistent with some prior work (56) and makes intuitive sense: Feeling valued and cared for by others can potentially reduce negative thoughts and facilitate reappraisal of pain as less threatening.(11) However, another view, based on the communal coping model, holds that pain catastrophizing and associated pain behaviors may elicit support from others, thereby reinforcing these maladaptive cognitions and behaviors.(11, 57) This perspective is consistent with studies showing that support can have negative and/or inconsistent effects. For example, overly responsive or solicitous reactions to individuals with pain have been shown to compromise self-sufficiency and reinforce maladaptive pain behaviors.(57-59) Although frequently well-intended, these “supportive” reactions may foster dependency and interfere with one’s ability to cope with and adapt to pain.(58-62) Although our study found that social support was associated with lower catastrophizing, these findings point

to the importance of carefully targeted interventions that facilitate productive social support and monitor for negative effects.

The lack of association between social support and pain was somewhat unexpected, especially given the relationships with other outcomes, as well as previous findings on the link between social factors and pain.(11) One possible explanation may be the nature of the sample. To be eligible to participate in the intervention, patients were required to report a pain intensity ≥ 5 at baseline. As a result, participants had at least moderate pain severity, thereby limiting the variability to be explained by social support. It is possible that without this *a priori* restriction in range, we would have seen an association. In addition, it is important to bear in mind that the experience of chronic pain involves more than just pain intensity and interference – it is a complex relationship among biological, cognitive, emotional, and social factors.(1, 63) Stress, anxiety, depression, and maladaptive thoughts are all potential components of the experience of chronic pain; social support, in turn, has been shown to have a mitigating effect on these components.(11, 47-49) Patients themselves have recognized that reducing pain per se is not always the most important factor in improving their overall ability to live with and adjust to their pain.(64, 65)

This study's findings extend the literature by providing a more nuanced understanding of the relationship between social support and a broader range of outcomes that patients have identified as important for chronic pain. Moreover, this study explored patient activation as a potential mediator of the relationship between social support and pain outcomes. Although this hypothesized mediation effect was not significant, the current study points to the need to advance our understanding of how

these constructs are related—both through future empirical examination and theory development that can serve to guide future research. Gaining such understanding is essential not just to help elucidate these relationships, but to facilitate development of novel, appropriately targeted interventions that help patients manage their chronic pain.

In addition to advancing our understanding of social support and patient activation, this study adds to our understanding of the role of social support in how people think about their pain. Higher social support was associated with lower catastrophizing and pain centrality, suggesting that patients with pain who have more supportive relationships are better equipped to cope with and adjust to their pain. Moreover, emotional functioning and quality of life are highly valued clinical outcomes for pain.⁽⁶⁶⁾ In particular, depression and anxiety commonly co-occur with chronic pain and can have additive effects that complicate treatment and outcomes.⁽⁶⁷⁻⁶⁹⁾ Understanding that these outcomes are positively related to social support underscores the need to consider interventions targeting social support for people with chronic pain. Such efforts, regardless of their direct impact on pain itself, are likely to facilitate better pain self-management through higher patient activation, improved psychosocial outcomes and feelings of wellbeing, and better pain coping.

This study also corroborates and extends prior work examining patients' perceptions of support as they seek to manage their pain. Patients have identified the importance of having another person to motivate them in their self-management activities, someone to listen, and someone with whom they can discuss common interests unrelated to pain as valuable to their pain management.^(8-10, 70) Gaining a more complete understanding of social support and how it is related to a broader range

of outcomes—particularly to patient perceptions of having the knowledge, skills, and confidence to manage one’s health (i.e., patient activation)—provides a stronger evidence-based foundation from which to ascertain and prioritize social support needs for patients with chronic pain.

This study is limited in that it was conducted at one medical center with patients who were all veterans and mostly men. Consequently, findings might not generalize to patients in other settings. In addition, all data were taken from baseline assessments prior to an intervention. As a result, data reflect associations that do not readily lend themselves to causal inferences. Finally, the measure used to assess social support, the Multidimensional Scale of Perceived Social Support, assesses social support generally and does not provide data on the specific source(s) of support. More granular analyses of these sources of support in future work will facilitate further targeting of interventions designed to enhance social support for patients with chronic pain.

Conclusions

This study’s findings integrate with and extend prior work on the role of social support in pain self-management and provide insight into the role of patient activation in chronic pain management. Although patient activation did not mediate the relationship between social support and outcomes, this study is an important step toward gaining a more complete understanding of constructs thought to be related to pain self-management and points to the need to advance theory in this area to guide future research. Such work is needed to optimize interventions for patients with chronic pain, ultimately leading to better pain care and outcomes.

References

1. Institute of Medicine. Relieving pain in America: a blueprint for transforming prevention, care, education, and research. Washington, DC: National Academies Press; 2011.
2. Cobb S. Social support as a moderator of life stress. *Psychosomatic Medicine*. 1976;38(5):300-14.
3. Sturgeon JA, Zautra AJ. Social pain and physical pain: shared paths to resilience. *Pain Management*. 2016;6(63-74).
4. Wolf LD, Davis MC, Yeung Ew, Tennen HA. The within-day relation between lonely episodes and subsequent clinical pain in individuals with fibromyalgia: mediating role of pain cognitions. *Journal of Psychosomatic Research*. 2015;79(3):202-6.
5. Riva P, Wesselmann ED, Wirth JH, Carter-Sowell AR, Williams KD. When pain does not heal: the common antecedents and consequences of chronic social and physical pain. *Basic and Applied Social Psychology*. 2014;36(4):329-46.
6. Eisenberger NI, Jarcho JM, Lieberman, M.D., Naliboff BD. An experimental study of shared sensitivity to physical pain and social rejection. *Pain*. 2006;126(1-3):132-8.
7. Barlow J, Wright C, Sheasby J, Turner A, Hainsworth J. Self-management approaches for people with chronic conditions: a review. *Patient Education and Counseling*. 2010;48(2):177-87.
8. Bair MJ, Matthias MS, Nyland KA, Huffman M, Stubbs DL, Kroenke K, et al. Barriers and facilitators to chronic pain self-management: a qualitative study among primary care patients with comorbid musculoskeletal pain and depression. *Pain Medicine*. 2009;10:1280-90.
9. Matthias MS, Bair MJ, Nyland KA, Huffman M, Stubbs DL, Damush TM, et al. Self-management support and communication from nurse care managers compared to primary care physicians: a focus group study of patients with chronic musculoskeletal pain. *Pain Management Nursing*. 2010;11(1):26-34.
10. Matthias MS, Miech EJ, Myers LJ, Sargent C, Bair MJ. An expanded view of self-management: patients' experiences with self-management education and support in an intervention for chronic musculoskeletal pain. *Pain Medicine*. 2012;13:1018-28.
11. Che X, Cash R, Ng SK, Fitzgerald P, Fitzgibbon BM. A systematic review of the processes underlying the main and the buffering effect of social support on the experience of pain. *Clinical Journal of Pain*. 2018;34(11):1061-76.
12. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. *JAMA: The Journal of the American Medical Association*. 2002;288(14):1775-9.
13. Hibbard JH, Eldon RM, Jean S, Martin T. Development and testing of a short form of the patient activation measure. *Health Services Research*. 2005;40(6):1918-30.
14. Hibbard JH, Greene J. What the evidence shows about patient activation: better health outcomes and care experiences; fewer data on costs. *Health Affairs*. 2013;32(2):207-14.
15. Hibbard JH, Mahoney ER, Stock R, Tusler M. Do increases in patient activation result in improved self-management behaviors? *Health Services Research*. 2007;42(4):1443-63.

16. Heller A, Elliott MN, Haviland AM, Klein DJ, Kanouse DE. Patient activation status as a predictor of patient experience among Medicare beneficiaries. *Medical Care*. 2009;47(8):850-7.
17. Munson GW, Wallston KA, Dittus RS, Speroff T, Roumie CL. Activation and perceived expectancies: correlations with health outcomes among veterans with inflammatory bowel disease. *Journal of General Internal Medicine*. 2009;24(7):809-15.
18. Greene J, Hibbard JH. Why does patient activation matter? An examination of the relationships between patient activation and health-related outcomes. *JGIM: Journal of General Internal Medicine*. 2012;27(5):520-6.
19. Greene J, Hibbard JH, Sacks R, Overton V, Parrotta CD. When patient activation levels change, health outcomes and costs change, too. *Health Affairs*. 2015;34(3):431-7.
20. Ahn YH, Ham OK. Evaluation of the Interaction Model of Client Health Behavior-based multifaceted intervention on patient activation and osteoarthritis symptoms. *Japan Journal of Nursing Science*. 2019;17(2):17:e12306.
21. Alegria M, Sribney W, Perez D, Laderman M, Keefe K. The role of patient activation in patient-provider communication and quality of care for US and foreign born Latino patients. *Journal of General Internal Medicine*. 2009;29(Suppl 3):534-41.
22. Deen D, Wei-Hsin L, Rothstein D, Santana L, Gold MR. Asking questions: the effect of a brief intervention in community health centers on patient activation. *Patient Education and Counseling*. 2011;84(257-60).
23. Parchman ML, Zeber JE, Palmer RF. Participatory decision-making, patient activation, medication adherence, and intermediate clinical outcomes in type 2 diabetes: a STARNet study. *Annals of Family Medicine*. 2010;8(5):410-17.
24. Budge C, Taylor M, Mar M, Hansen C, Fai F. Chronic pain: good management of practical pain control strategies is associated with being older, more health activated and having better mental health. *Journal of Primary Health Care*. 2020;12(3):225-34.
25. Yao F, Zheng M, Wang X, Ji S, Li S, Xu G, et al. Patient activation level and its associated factors in adults with chronic pain: a cross-sectional survey. *Medicine (Baltimore)*. 2021;100(19).
26. Ahn YH, Kim BJ, Ham OK, Kim SH. Factors associated with patient activation for self-management among community residents with osteoarthritis in Korea. *Journal of Korean Academic Community Health Nursing*. 2015;26:303-11.
27. Matthias MS, Daggy J, Adams J, Menen T, McCalley S, Kukla M, et al. Evaluation of a peer coach-led intervention to improve pain symptoms (ECLIPSE): rationale, study design, methods, and sample characteristics. *Contemporary Clinical Trials*. 2019;81:71-9.
28. Matthias MS, Bair MJ, Ofner S, Heisler M, Kukla M, McGuire AB, et al. Peer support for self-management of chronic pain: the Evaluation of a peer Coach-Led Intervention to improve Pain Symptoms (ECLIPSE) trial. *Journal of General Internal Medicine*. 2020;35(12):3525-33.
29. Cecil H, Stanley MA, Carrion PG, Swann A. Psychometric properties of the MSPSS and NOS in psychiatric outpatients. *Journal of Clinical Psychology*. 1995;51:593-602.
30. Osman A, Lamis DA, Freedenthal S, Gutierrez PM, McNaughton-Cassill M. The Multidimensional Scale of Perceived Social Support: analyses of internal reliability,

- measurement invariance, and correlates across gender. *Journal of Personality Assessment*. 2014;96(1):103-12.
31. Mosen DMP, Schmittiel JP, Hibbard JP, Sobel DM, Remmers CM, Bellows JP. Is patient activation associated with outcomes of care for adults with chronic conditions? *Journal of Ambulatory Care Management Disease Management*. 2007;30(1):21-9.
 32. Salyers MP, Matthias MS, Spann CL, Lydick JM, Rollins AL, Frankel RM. The role of patient activation in psychiatric visits. *Psychiatric Services*. 2009;60(11):1535-9.
 33. Chinman M, Oberman RS, Hanusa BH, Cohen AN, Salyers MP, Twamley EW, et al. A cluster randomized trial of adding peer specialists to intensive case management teams in the Veterans Health Administration. *Journal of Behavioral Health Services and Research*. 2015;42(1):109-21.
 34. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. *Journal of Affective Disorders*. 2009;114:163-73.
 35. Spitzer RL, Kroenke K, Williams JB. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*. 2006;166:1092-7.
 36. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Medical Care*. 1993;31:247-63.
 37. Nicolaidis C, Chianello T, Gerrity M. Development and preliminary psychometric testing of the centrality of pain scale. *Pain Medicine*. 2011;12:612-7.
 38. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. *Psychological Assessment*. 1995;7(4):524-32.
 39. Kroenke K, Bair MJ, Damush TM, Wu J, Hoke S, Sutherland J, et al. Optimized antidepressant therapy and pain self-management in primary care patients with depression and musculoskeletal pain: a randomized controlled trial. *JAMA*. 2009;301(20):2099-110.
 40. Cleeland CS, Ryan KM. Pain assessment: global use of the Brief Pain Inventory. *Annals of the Academy of Medicine Singapore*. 1994;23:129-38.
 41. Valeri L, Vanderweele TJ. Mediation analysis allowing for exposure-mediator interactions and causal interpretation: theoretical assumptions and implementation with SAS and SPSS macros. *Psychol Methods*. 2013;18(2):137-50.
 42. VanderWeele TJ. A unification of mediation and interaction: a 4-way decomposition. *Epidemiology (Cambridge, Mass)*. 2014;25(5):749-61.
 43. Hibbard JH, Cunningham PJ. How engaged are consumers in their health and health care, and why does it matter? *Research Brief*. 2008;8:1-9.
 44. Barth J, Schneider S, von Kanel R. Lack of social support in the etiology and the prognosis of coronary heart disease: a systematic review and meta-analysis. *Psychosomatic Medicine*. 2010;72(3):229-38.
 45. Muller R, Peter C, Cieza A, Geyh S. The role of social support and social skills in people with spinal cord injury--a systematic review of the literature. *Spinal Cord*. 2011;50(2):94-106.
 46. Rosland AM, Heisler M, Piette JD. The impact of family behaviors and communication patterns on chronic illness outcomes: a systematic review. *Journal of Behavioral Medicine*. 2012;35(2):221-39.

47. Cano A, Gillis M, Heinz W, Geisser M, Foran H. Marital functioning, chronic pain, and psychological distress. *Pain*. 2004;107:99-106.
48. Brown GK, Wallston KA, Nicassio PM. Social support and depression in rheumatoid arthritis: a one-year prospective study. *Journal of Applied Social Psychology*. 1989;19(14):1164-81.
49. Lee JE, Kahana B, Kahana E. Social support and cognitive functioning as resources for elderly persons with chronic arthritis pain. *Aging and Mental Health*. 2016;20(4):370-79.
50. Beauchamp MR, Ruissen GR, Dunlop W, Estabrooks PA, Harden SM, Wolf SA, et al. Group-based physical activity for older adults (GOAL) randomized controlled trial: exercise adherence outcomes. *Health Psychology*. 2018;37(5):451-61.
51. Burkow TM, Vognild LK, Johnsen E, Bratvold A, Risberg MJ. Promoting exercise training and physical activity in daily life: a feasibility study of a virtual group intervention for behaviour change in COPD. *BMC Medical Informed Decision Making*. 2018;18(1):136.
52. Jansen CP, Nerz C, Kramer F, Labudek S, Klenk J, Dams J, et al. Comparison of a group-delivered and individually delivered lifestyle-integrated functional exercise program in older persons: a randomized noninferiority trial. *BMC Geriatrics*. 2018;18(1):267.
53. Von Korff M, Moore JE, Lorig K, Cherkin DC, Saunders K, Gonzalez VM, et al. A randomized trial of a lay person-led self-management group intervention for back pain patients in primary care. *Spine*. 1998;23(23):2608-15.
54. Ersek M, Turner JA, McCurry SM, Gibbons L, Kraybill BM. Efficacy of a self-management group intervention for elderly persons with chronic pain. *Clinical Journal of Pain*. 2003;19(3):156-67.
55. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. *Cochrane Database of Systematic Reviews*. 2017;4(4):CD011279.
56. Holtzman S, DeLongis A. One day at a time: the impact of daily satisfaction with spouse responses on pain, negative affect and catastrophizing among individuals with rheumatoid arthritis. *Pain*. 2007;131:202-13.
57. Turk DC, Kerns RD, Rosenberg R. Effects of marital interaction on chronic pain and disability: examining the down side of social support. *Rehabilitation Psychology*. 1992;37(4):259-74.
58. Romano JM, Turner JA, Jensen MP, Friedman LS, Bulcroft RA, Hops H, et al. Chronic pain patient-spouse behavioral interactions predict patient disability. *Pain*. 1995;63(3):353-60.
59. Boothby JL, Thorn BE, Overduin LY, Ward LC. Catastrophizing and perceived partner responses to pain. *Pain*. 2004;109(3):500-6.
60. Franks HM, Cronan TA, Oliver K. Social support in women with fibromyalgia: is quality more important than quantity? *Journal of Community Psychology*. 2004;32(4):425-38.
61. Hamilton NA, Karoly P, Zautra AJ. Health goal cognition and adjustment in women with fibromyalgia. *Journal of Behavioral Medicine*. 2005;28(5):455-66.
62. Stone AL, Wilson AC. Transmission of risk from parents with chronic pain to offspring: an integrative conceptual model. *Pain*. 2016;157(12):2628-39.

63. Raja SN, Carr DB, Cohen M, Finnerup NB, Flor H, Gibson S, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *Pain*. 2020.
64. Matthias MS, Miech EJ, Myers LJ, Sargent C, Bair MJ. "There's more to this pain than just pain": how patients' understanding of pain evolved during a randomized controlled trial for chronic pain. *The Journal of Pain*. 2012;13:571-8.
65. Matthias MS, Evans E, Porter B, McCalley S, Kroenke K. Patients' experiences with telecare for chronic pain and mood symptoms: a qualitative study. *Pain Medicine*. 2020;21(10), 2137-45.
66. Dworkin RH, Turk DC, Wyrwich KW, Beaton D, Cleeland CS, Farrar JT, et al. Interpreting the Clinical Importance of Treatment Outcomes in Chronic Pain Clinical Trials: IMMPACT Recommendations. *The Journal of Pain*. 2008;9(2):105-21.
67. Lowe B, Spitzer RL, Williams JB, Mussell M, Schellberg D, Kroenke K. Depression, anxiety and somatization in primary care: syndrome overlap and functional impairment. *General Hospital Psychiatry*. 2008;30:191-99.
68. Bair MJ, Poleshuck EL, Wu J, Krebs EE, Damush TM, Kroenke K. Anxiety but not social stressors predict 12-month depression and pain outcomes. *Clinical Journal of Pain*. 2013;2:95-101.
69. Von Korff M, Jensen MP, Karoly P. Assessing global pain severity by self-report in clinical and health services research. *Spine*. 2000;25(24):3140-51.
70. Matthias MS, Kukla M, McGuire A, Bair MJ. How do patients with chronic pain benefit from a peer-supported pain self-management intervention? A qualitative study. *Pain Medicine*. 2016;17(12):2247-55.