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Mediated by Self-Efficacy Status, Positive Clinician Conveyed Expectations of Treatment Effect Reduces Pain in Knee Osteoarthritis

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Abstract

Objective—A prior knee osteoarthritis (OA) trial found that provider conveyed expectations for treatment success were associated with pain improvement. We hypothesized this relationship was mediated by patient self-efficacy since expectations of improvement may enhance one's ability to control health behaviors, and therefore health. Our aim was to examine whether self-efficacy was a mediator of the relationship observed in this trial.

Methods—A secondary analysis of a three arm (traditional acupuncture, sham acupuncture, and wait list) trial for knee OA was conducted. Those in the acupuncture groups were equally randomized to acupuncturists trained to communicate a high or neutral expectation of treatment success (e.g. used language conveying high or unclear likelihood that acupuncture would reduce knee pain). A modified Arthritis Self-Efficacy Questionnaire and the Western Ontario McMasters (WOMAC) pain subscale were administered. Linear regression analyses were used to examine whether patient self-efficacy mediated the relationship between provider communication style and knee pain at 3 months.

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Results—High expectation provider communication was associated with patient self-efficacy, β coefficient of 0.14 (95%CI: 0.01, 0.28). Self-efficacy was associated with WOMAC pain, β coefficient of -9.29 (95%CI: -11.11 , -7.47), while controlling for the provider communication style. The indirect effect $a*b$ of -1.36 for high versus neutral expectation, (bootstrap 95% CI: -2.80 , -0.15 , does not include 0), supports that patient self-efficacy mediates the relationship between provider-communicated expectations of treatment effects and knee pain.

Conclusion—Our findings suggest that clinician-conveyed expectations can enhance the benefit of treatments targeting knee OA symptoms, mediated by improved patient self-efficacy.

Osteoarthritis (OA) is one of the most common and debilitating forms of arthritis, causing severe physical and psychological disabilities, especially in elderly populations (1–3). Using data from NHANES I and corresponding 2005 population estimates from the Census Bureau, it is estimated that approximately 27 million adults in the United States have clinical OA, defined on the basis of symptoms and physical exam findings, in at least one joint, and its ever-increasing prevalence suggests that its healthcare impact will continue to grow, thereby necessitating more effective methods of diagnosis and treatment (4). A mainstay for knee OA treatment include medications targeting pain relief, including acetaminophen, nonacetylated salicylate, and opioids (5–6). However, these treatments have serious attendant risks including renal insufficiency, upper GI bleeding, and acute liver injury (7). Thus, there is merit to investigating safer, non-pharmacologic interventions for knee OA.

In a randomized controlled trial (RCT) of acupuncture designed to evaluate the benefit of true (i.e., use of true acupuncture points within known relevant meridians) vs. sham (i.e., use of non-acupuncture points outside of relevant meridians) acupuncture (8), true acupuncture was not superior to sham. The study also had a factorial design to address a secondary question of whether acupuncturist communication style influenced outcomes. Using this design, equal number of participants in the true and sham arms were randomized to an acupuncturist communication style that conveyed high versus neutral expectations of treatment benefit (e.g. used language conveying high versus unclear likelihood that acupuncture would reduce knee pain). Those who were randomized to a high expectation acupuncturist's communication style exhibited greater pain improvement. These findings suggest that provider-communicated expectation of treatment benefit has a therapeutic effect in patients with knee OA (8–9). We were interested in better understanding the underlying mechanism of this relationship, and posited that there might be a mind-body relationship, mediated by patient attitudes and beliefs influencing these outcomes (10). We hypothesized that this relationship might be mediated by self-efficacy, since expectations of improvement may enhance one's ability to control health behaviors, and therefore health. Therefore, we anticipated that provider expectations of treatment effect could substantially improve a patient's self-efficacy, which ultimately might lead to improved symptoms. In support of this hypothesized relationship, we have found that in other diseases including diabetes and HIV, there is evidence that provider-patient communication influences patient self-efficacy (11–12), and there is disease specific evidence within knee OA showing that improved self-efficacy results in improved knee symptoms (13–14). Therefore the objective of this study was to test whether the effect from provider-communicated expectation of treatment benefit

on patient symptoms was mediated by improved patient self-efficacy in the aforementioned acupuncture RCT (8).

Materials and Methods

Study Design

This is a secondary analysis of a three arm (traditional acupuncture, sham acupuncture, and wait list) RCT for symptomatic knee OA (8). Participants receiving either traditional (i.e., use of true acupuncture points within known relevant meridians) or sham (i.e., use of non-acupuncture points outside of relevant meridians) acupuncture were equally randomized to a high expectation and neutral communication style. Participants with both baseline and three-month follow-up visits were included. Full description of the RCT is available (8).

In brief, six licensed acupuncturists were trained to communicate with the study participants in either a high expectation or neutral-based communication style. Those trained in the neutral communication style group conveyed uncertain, non-definitive statements to participants regarding their treatment protocol and pain-based outcome, such as “This treatment may or may not work for you,” “Different people experience different results while undergoing this treatment,” and “We are not certain if acupuncture will work for knee pain” (8·9). Those trained in the high expectation communication style conveyed positive, hopeful statements to participants, such as “I’ve had a lot of success with treating these symptoms,” “I expect this treatment to work,” and “I’m positive that this treatment will work for you” (8·9). Each participant was assigned to the same acupuncturist who communicated only using the style to which the participant was randomized during all of the twice weekly acupuncture sessions for the entire 6 weeks of the intervention (8). The acupuncturists remained blinded to the whether the participants would receive true vs. sham acupuncture until the first meeting with each participant (8). Midway into the study, acupuncturists who were initially trained to communicate using high expectations were retrained to utilize a neutral communication style, and vice versa when interacting with a new round of participants (8).

Assessment of Self Efficacy

Self-efficacy status was assessed using an modified version of the Arthritis Self-Efficacy Questionnaire (15) at baseline and 3 month follow-up visits. All self-efficacy questions (Table I) were assessed using Likert scores (ranging from 1–5, with 1 scored as “very uncertain”, and 5 scored as “very certain”), and were averaged together to provide an overall self-efficacy score, where a higher score is consistent with greater self-efficacy. The standardized Cronbach’s alpha for the modified Arthritis Self –Efficacy Questionnaire was very good at 0.88 at baseline and 0.90 at 3 months.

Assessment of Pain

Knee pain was assessed using the Western Ontario McMasters (WOMAC) pain subscale (16) at the baseline and 3 month follow-up visits. The WOMAC subscale was re-scaled to have a maximum score of 100 (highest level of pain).

Analytic Method

We used an analysis of variance (ANOVA) to test the differences in basic demographics across the 3 groups, high expectation communication style and neutral expectation communication style and wait-listed arms. To assess the relationship between self-efficacy and pain cross-sectionally, all participants who had baseline and follow-up visits in all three arms were evaluated. We performed Pearson's correlations between baseline self-efficacy and WOMAC pain, and the change in these two variables over three months.

To evaluate the role of participant self-efficacy as a mediator of the relationship between provider communication style and improved pain outcomes, first using linear regression, we tested path a (figure 1), evaluating whether the predictor variable of interest, provider communication style (where neutral style was the referent group), was associated with the mediator, 3 month assessment of self-efficacy. We then assessed path b (figure 1) evaluating the influence of 3 month assessment of self-efficacy, with the predictor variable (provider communication style) as a control variable, was associated with the outcome of WOMAC pain at 3 months. For completeness, this latter model also allowed us to calculate path c' (the direct effect) though this finding is not needed to assess for mediation (17). In both models, baseline WOMAC pain and self-efficacy were included as covariates. If both the β coefficients for paths a and b are statistically significant, this is supportive of a mediating role of patient self-efficacy in the relationship between provider communication style and WOMAC pain. We also tested for an interaction between the predictor (provider communication style) and the mediator (patient self-efficacy). We did not use the Sobel test for this mediation analysis as it is known to be a conservative test with low power (18). Instead we have tested for the significance of an indirect effect ($a*b$) by calculating a confidence interval using stratified bootstrapping wherein 5000 bootstrap samples were generated (19-20).

Correlations were conducted using the SAS statistical software, version 9.3 (SAS Institute), while linear regression models and bootstrapping were run using the MEDIANTE macro (21) in SPSS, version 22 with a $p < 0.05$ considered statistically significant in our analyses.

Results

In total, there were 485 participants, 63% female, with a mean age of 64.7 (± 9.2) years and body mass index of 32.2 (± 7.5) kg/m² (Table 2).

Self-efficacy was associated with WOMAC pain. Cross-sectionally, self-efficacy was correlated with WOMAC pain levels with a $\rho = -0.25$ ($p < 0.0001$), where those with greater self-efficacy had less pain. Similarly, longitudinal change in self-efficacy was correlated with change in WOMAC pain levels with a $\rho = -0.25$ ($p < 0.0001$), where those with an improvement in self-efficacy had a reduction in WOMAC pain.

The β coefficient was statistically significant at 0.14 (95%CI: 0.01, 0.28) for path a (figure 2) where high expectation provider communication style was associated with 3 month patient self-efficacy, where those who received a high expectation communication style from their providers had a greater score for patient self-efficacy at 3 months compared to those who

received a neutral communication style (Figure 2). Path b's β coefficient was -9.29 (95%CI: $-11.11, -7.47$) also statistically significant where self-efficacy at 3 months was significantly associated with WOMAC pain at 3 months, while controlling for the provider communication style (figure 2). In this relationship, those with a higher self-efficacy score had a lower pain at 3 months. There was no statistically significant interaction between provider communication style and patient self-efficacy at 3 months when evaluating the outcome of WOMAC pain score at 3 months. Because the indirect effect of $a*b$ was -1.36 for high expectation compared to neutral (bootstrap 95% CI: $-2.80, -0.15$), a statistically significant finding (e.g. the 95% CI does not include 0), this supports that higher patient self-efficacy mediates the relationship between provider-communicated expectations of treatment effects and knee pain at 3 months in those with knee OA in this RCT.

Discussion

In a RCT of acupuncture for symptomatic knee OA, patient arthritis self-efficacy was highly correlated with knee pain scores both cross-sectionally and longitudinally, such that higher self-efficacy was associated with lower pain severity levels, and that improvement of self-efficacy was associated with a reduction of WOMAC pain. Our study illustrates high expectation provider communication style provided over a course of 6 weeks, with 2 sessions each week, mediated by better patient self-efficacy at 3 months, resulted in a lower patient knee pain scores at 3 months. These findings underscore the importance of the mind-body relationship and potentially have important clinical implications as well as the importance of modeling pathways through which communication can contribute to improved health outcomes (22). This study shows that high-expectations of treatment effect communicated to patients can provide a treatment effect through improvements in intermediary processes such as patient self-efficacy, irrespective of whether there is inherent benefit of the recommended treatment. This is a low cost, effective intervention that can potentially raise the benefit of potentially any provider's plan to manage a patient's knee OA symptoms.

The relationship between improved self-efficacy and improved knee symptoms has been established in other studies of knee OA. In clinical trials of a support group-based Arthritis Self-Management Program (ASMP) and Self-Management Arthritis Relief Therapy education program (SMART), those who were in the treatment arm exhibited improved patient self-efficacy and decreased pain (13-14). The findings from our study corroborate the possibility that improved self-efficacy can result in reduced symptoms of OA. In fact, we posit that it may be through a mediation effect where self-efficacy is improved that treatment of depression is effective for improving symptoms in knee OA (23-28). With improvement of depression, people may experience greater self-efficacy that results in improved pain. We speculate that this mind-body relationship may also be mediated by improved patient self-efficacy; however, further studies are needed to confirm this possibility.

There may also be broader implications related to the finding that improved self-efficacy can improve musculoskeletal pain. In other diseases that are difficult to treat where pain is the primary symptom, including fibromyalgia, chronic low back pain, and headaches, the use of a provider communication style conveying high expectation of treatment efficacy may also

result in improved pain in these conditions. A number of intervention studies support the idea that improvement in self-efficacy is associated with reduction of pain in these conditions (29–31). Systematic evaluation of these possible relationships in these other diseases could provide an important additional strategy for managing symptoms in these patients with chronic pain.

A limitation to our study was the timing of the assessment of our mediator, self-efficacy. The increase of self-efficacy may cause a decrease in pain. Alternatively, a decrease in pain may have caused an increase self-efficacy. If information on self-efficacy were available at the end of 6 weeks when traditional/sham acupuncture was finished, using change of self-efficacy at 6 weeks as mediator and knee pain at 3 months as outcome might have made the time sequence of exposure, mediator, and outcome clearer. Unfortunately, self-efficacy data at the 6 week time point were not available in the wait list arm. Therefore, in our analyses, we do assume that the direction of the association is that increase in self-efficacy results in a reduction of pain. An additional limitation to our study was that it was conducted in the setting of a randomized clinical trial which is not likely reflective of the real world effect of communicated provider expectation of treatment benefit. It is likely that both patients and providers that would participate in a clinical trial of OA are different from those in the general population. A comparative effectiveness trial would be needed to address whether there would be a significant benefit of high-expectations of treatment effect communicated to patients in reducing knee OA pain in the population at large; nevertheless our study does provide a proof-of-concept that provider communication style can have an effect on patient self-efficacy, which can mediate an improvement in pain.

In conclusion, our study demonstrates that for knee OA patients undergoing acupuncture treatment in an RCT setting, provider communication style influences patient self-efficacy, which mediated their pain improvements. This study underscores the potential benefits of improved patient self-efficacy that can result from positive messages from providers. This is an inexpensive intervention that can provide an important benefit in a disease where currently few treatment options exist.

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Significance & Innovations

- High clinician expectations of efficacy conveyed to patients for a given treatment, even a treatment that is not inherently effective, has an important effect on pain reduction in knee OA. This relationship is mediated by improved patient self-efficacy.
- These findings suggest that clinician-conveyed expectations can enhance the benefit of treatments targeting symptoms of knee OA.

Figure 1.

Diagram of the proposed relationship between provider communication style (independent variable), patient self-efficacy at 3 months (mediator), and WOMAC pain at 3 months (dependent variable). **Path a** tests the relationship between provider communication style and patient self-efficacy at 3 months. **Path b** tests the relationship between self-efficacy at 3 months and WOMAC pain at 3 months. The **indirect effect of $a*b$** tests for significance of mediation by self-efficacy at 3 months in the model.

Figure 2.
Linear regression results are super-imposed on the proposed mediation diagram outlined in figure 1.

Table 1

Self-efficacy Assessment Questions

1. How certain are you that you can decrease your pain quite a bit?
2. How certain are you that you can keep arthritis pain from interfering with your sleep?
3. How certain are you that you can keep your arthritis from interfering with things you want to do?
4. How certain are you that you can regulate your activity so as to be active without aggravating your arthritis?
5. How certain are you that you can keep the fatigue caused by your disease from interfering with the things you want to do?
6. How certain are you that you can do something to help yourself feel better if you are feeling blue?
7. As compared with other people with arthritis like yours, how certain are you that you can manage pain during your daily activities?
8. How certain are you that you can deal with the frustration of arthritis?

Table 2

Participant Characteristics (n = 485)

	Total (n=485)	Groups of Participants		
		High Expectation Communication Style (n=208)	Neutral Expectation Communication Style (n=205)	Wait listed (n=72)
Baseline Age (Years) (Mean (SD))	64.7 (9.2)	65 (9.5)	64.7 (8.8)	64.1 (9.6)
Sex Female	304 (63%)	132 (63%)	130 (63%)	42 (58%)
Baseline BMI (Mean (SD))	32.2 (7.5)	32.2 (7.4)	32.1 (7.7)	32.5 (7.5)
Baseline Self Efficacy (Mean (SD))	3.5 (0.8)	3.5 (0.8)	3.5 (0.8)	3.4 (0.9)
Baseline WOMAC (Mean (SD))	44.6 (17.7)	44.1 (18.4)	45.2 (17.9)	44.1 (15.2)
3 month Self Efficacy (Mean (SD))	3.6 (0.8)	3.7 (0.8)	3.6 (0.8)	3.4 (0.7)
3 month WOMAC (Mean (SD))	31.6 (18.4)	28.5 (18.3)	31.1 (17.9)	42.2 (16.8)