

# Nonpharmacologic Therapies for Low Back Pain: A Systematic Review for an American College of Physicians Clinical Practice Guideline

Roger Chou, MD; Richard Deyo, MD, MPH; Janna Friedly, MD; Andrea Skelly, PhD, MPH; Robin Hashimoto, PhD; Melissa Weimer, DO, MCR; Rochelle Fu, PhD; Tracy Dana, MLS; Paul Kraegel, MSW; Jessica Griffin, MS; Sara Grusing, BA; and Erika D. Brodt, BS

**Background:** A 2007 American College of Physicians guideline addressed nonpharmacologic treatment options for low back pain. New evidence is now available.

**Purpose:** To systematically review the current evidence on nonpharmacologic therapies for acute or chronic nonradicular or radicular low back pain.

**Data Sources:** Ovid MEDLINE (January 2008 through February 2016), Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and reference lists.

**Study Selection:** Randomized trials of 9 nonpharmacologic options versus sham treatment, wait list, or usual care, or of 1 nonpharmacologic option versus another.

**Data Extraction:** One investigator abstracted data, and a second checked abstractions for accuracy; 2 investigators independently assessed study quality.

**Data Synthesis:** The number of trials evaluating nonpharmacologic therapies ranged from 2 (tai chi) to 121 (exercise). New evidence indicates that tai chi (strength of evidence [SOE], low) and mindfulness-based stress reduction (SOE, moderate) are effective for chronic low back pain and strengthens previous find-

ings regarding the effectiveness of yoga (SOE, moderate). Evidence continues to support the effectiveness of exercise, psychological therapies, multidisciplinary rehabilitation, spinal manipulation, massage, and acupuncture for chronic low back pain (SOE, low to moderate). Limited evidence shows that acupuncture is modestly effective for acute low back pain (SOE, low). The magnitude of pain benefits was small to moderate and generally short term; effects on function generally were smaller than effects on pain.

**Limitation:** Qualitatively synthesized new trials with prior meta-analyses, restricted to English-language studies; heterogeneity in treatment techniques; and inability to exclude placebo effects.

**Conclusion:** Several nonpharmacologic therapies for primarily chronic low back pain are associated with small to moderate, usually short-term effects on pain; findings include new evidence on mind-body interventions.

**Primary Funding Source:** Agency for Healthcare Research and Quality. (PROSPERO: CRD42014014735)

*Ann Intern Med.* 2017;166:493-505. doi:10.7326/M16-2459

Annals.org

For author affiliations, see end of text.

This article was published at Annals.org on 14 February 2017.

Low back pain is very common and is associated with more global disability than any other condition (1). Several nonpharmacologic, noninvasive therapies are available for low back pain, including exercise, complementary and alternative therapies (such as spinal manipulation, acupuncture, massage, and mind-body interventions), psychological therapies (such as cognitive behavioral and operant therapy), physical techniques (such as traction, ultrasound, transcutaneous electrical nerve stimulation, low-level laser therapy, superficial heat or cold, and back supports), and multidisciplinary rehabilitation.

A 2007 guideline (2) and an associated systematic review (3) from the American College of Physicians (ACP) and American Pain Society (APS) recommended spinal manipulation as a treatment option for acute low back pain and several nonpharmacologic therapies for subacute or chronic low back pain. New evidence is now available. The purpose of this article is to review the current evidence on the benefits and harms of nonpharmacologic therapies for low back pain. The ACP will use this review to develop an updated clinical practice guideline.

## METHODS

Detailed methods for this review, including the analytic framework, additional nonpharmacologic thera-

pies (physical techniques), medications (addressed in a separate article) (4), search strategies, inclusion criteria, data extraction and quality-rating methods, and additional outcomes (such as quality of life, global improvement, and patient satisfaction) are available in the full report (5). The protocol was developed by using a standardized process (6) with input from experts and the public and is registered in the PROSPERO database (7). This article addresses the following question: What are the comparative benefits and harms of nonpharmacologic, noninvasive therapies for acute or chronic nonradicular or radicular low back pain or for symptomatic spinal stenosis?

## Data Sources and Search

A research librarian searched several electronic databases, including Ovid MEDLINE (January 2007 through April 2015) and the Cochrane Central Register of Controlled Trials and Cochrane Database of System-

### See also:

Related articles . . . . . 480, 514

Editorial comment . . . . . 533

Web-Only  
Supplement

**Table 1.** Definitions for Magnitude of Effects, Based on Mean Between-Group Differences

Slight/Small	Moderate	Large/Substantial
<b>Pain</b>		
5-10 points on a 0- to 100-point VAS or the equivalent	>10-20 points on a 0- to 100-point VAS or the equivalent	>20 points on a 0- to 100-point VAS or the equivalent
0.5-1.0 points on a 0- to 10-point numerical rating scale or the equivalent	>1-2 points on a 0- to 10-point numerical rating scale or the equivalent	>2 points on a 0- to 10-point numerical rating scale or the equivalent
<b>Function</b>		
5-10 points on the ODI	>10-20 points on the ODI	>20 points on the ODI
1-2 points on the RDQ	>2-5 points on the RDQ	>5 points on the RDQ
<b>Pain or function</b>		
0.2-0.5 SMD	>0.5-0.8 SMD	>0.8 SMD

ODI = Oswestry Disability Index; RDQ = Roland Morris Disability Questionnaire; SMD = standardized mean difference; VAS = visual analogue scale.

atic Reviews (through April 2015). We used the previous ACP/APS review to identify earlier studies (8). Searches were updated through November 2016. We also reviewed reference lists and searched ClinicalTrials.gov.

### Study Selection

Two investigators independently reviewed abstracts and full-text articles against prespecified eligibility criteria. The population was adults with acute (<4 weeks), subacute (4 to 12 weeks), or chronic ( $\geq 12$  weeks) nonradicular or radicular low back pain. Excluded conditions were low back pain due to cancer, infection, inflammatory arthropathy, high-velocity trauma, or fracture; low back pain during pregnancy; and the presence of severe or progressive neurologic deficits. We included randomized trials of exercise, spinal manipulation, acupuncture, massage, mind-body interventions (yoga, tai chi, mindfulness-based stress reduction), psychological therapies, or multidisciplinary rehabilitation versus sham (functionally inert) treatment, wait list, or usual care (usually defined as care provided at the discretion of the clinician), as well as comparisons between 1 therapy and another. Outcomes were long-term ( $\geq 1$  year) or short-term ( $\leq 6$  months) pain, function, return to work, and harms.

Given the large number of interventions, we included systematic reviews of randomized trials (6, 9). For each intervention, we selected the most recent, relevant, and comprehensive systematic review that was of the highest quality on the basis of a validated assessment tool (9, 10). If more than 1 good-quality systematic review was available, we preferentially selected updates of reviews used in the ACP/APS review. We supplemented systematic reviews with additional randomized trials. We did not include systematic reviews identified in update searches but checked reference lists for additional studies. We excluded non-English-language articles and abstract-only publications.

### Data Extraction and Quality Assessment

One investigator extracted study data, and a second verified the accuracy of the extractions. For systematic reviews, we abstracted details about review methods and results (Supplement Table 1, available at Annals.org). For randomized trials not included in a sys-

tematic review, we abstracted details regarding the study, population, and treatment characteristics, as well as the results (Supplement Table 2, available at Annals.org).

Two investigators independently assessed the quality of each study as good, fair, or poor by using criteria developed by the U.S. Preventive Services Task Force (11) (for randomized trials [Supplement Table 3, available at Annals.org]) and AMSTAR (A Measurement Tool to Assess Systematic Reviews; for systematic reviews [Supplement Table 4, available at Annals.org]) (9).

For primary studies included in systematic reviews, we relied on the quality ratings as performed in the reviews. We used the overall grade (for example, good, fair, or poor; or high or low) as determined in the systematic review.

We classified the magnitude of effects for pain and function by using the same system used in the ACP/APS review (Table 1) (2, 12). We also reported risk estimates based on the proportion of patients achieving successful pain or function outcomes (such as >30% or >50% improvement).

### Data Synthesis and Analysis

We synthesized data qualitatively for each intervention, stratified according to the duration of symptoms (acute, subacute, or chronic) and presence or absence of radicular symptoms. We reported meta-analysis results from systematic reviews. If statistical heterogeneity was present, we examined the degree of inconsistency and evaluated subgroup and sensitivity analyses. We did not conduct an updated meta-analysis; rather, we qualitatively examined whether the results of new studies were consistent with pooled or qualitative findings from previous systematic reviews. Qualitative assessments were based on whether the findings from the new studies were in the same direction as those of the previous systematic reviews and whether the magnitude of effects was similar; if previous meta-analyses were available, we assessed whether the estimates and CIs from the new studies were encompassed in the CIs of previous pooled estimates. We assessed the strength of evidence (SOE) for each body of evidence

as high, moderate, low, or insufficient on the basis of aggregate study quality, precision, consistency, and directness (6).

### Role of the Funding Source

This project was funded by the Agency for Healthcare Research and Quality (AHRQ), U.S. Department of Health and Human Services. Staff members of AHRQ assisted in developing the scope and key questions. The AHRQ had no role in study selection, quality assessment, or synthesis.

## RESULTS

The search and selection of articles are summarized in the literature flow diagram (Figure). Database searches resulted in 2847 potentially relevant articles. After dual review of abstracts and titles, we selected 814 articles for full-text dual review; 114 publications met our inclusion criteria. Details for the systematic reviews included are shown in Supplement Table 1, and details for additional trials included are shown in Sup-

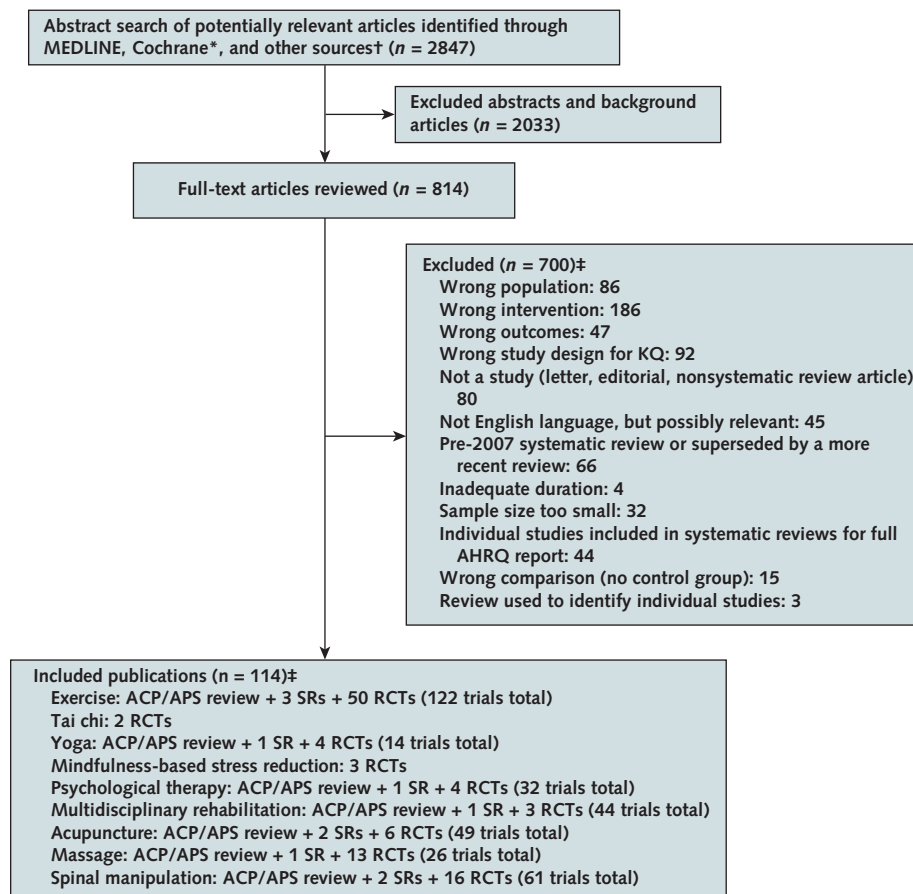
plement Table 2; quality ratings are shown in Supplement Table 3 (systematic reviews) and Supplement Table 4 (trials).

### Exercise

We found 122 trials that evaluated exercise. Three systematic reviews included 71 unique trials (total sample sizes ranged from 1993 to 4138) (13–15), and we identified 51 additional trials (sample sizes,  $\geq 100$  in 18 trials [16–34] and  $< 100$  in 33). One systematic review focused on exercise for chronic low back pain (37 trials) (14), 1 evaluated the effects of exercise on work disability in patients with subacute or chronic low back pain (23 trials) (15), and 1 examined the effects of motor control exercise (MCE) (16 trials) (13). One review classified 41% of trials as low risk of bias, and another classified 62% as high quality; among the additional trials with 100 or more patients, we rated 4 good, 7 fair, and 7 poor quality.

For acute (3 trials) or subacute (5 trials) low back pain, the ACP/APS review previously found no differ-

Figure. Literature search and selection.



ACP = American College of Physicians; AHRQ = Agency for Healthcare Research and Quality; APS = American Pain Society; KQ = key question; RCT = randomized, controlled trial; SR = systematic review.

\* Cochrane databases include the Cochrane Register of Controlled Trials and the Cochrane Database of Systematic Reviews.

† Other sources include prior reports, reference lists of relevant articles, systematic reviews, and others.

‡ Publications may be included or excluded for several interventions.

ence between exercise therapy and no exercise on pain. Three additional trials of exercise versus no exercise or usual care reported inconsistent effects on pain and function (21, 31, 32).

For chronic low back pain, the ACP/APS review found that exercise was associated with greater pain relief than no exercise (19 trials: weighted mean difference [WMD], 10 on a 0- to 100-point scale [95% CI, 1.31 to 19.09]); the effects on function were small and not statistically significant (17 trials: WMD, 3.00 on a 0- to 100-point scale [CI, -0.53 to 6.48]). In a more recent systematic review that used more restrictive criteria, exercise therapy was associated with less pain intensity (3 trials: WMD, -9.23 [CI, -16.02 to -2.43]) and better function (3 randomized, controlled trials: WMD, -12.35 on a 0- to 100-point scale [CI, -23.0 to -1.69]) versus usual care at treatment end; the effects were smaller at long-term follow-up (mean difference, -4.94 [CI, -10.45 to 0.58] for pain and -3.17 [CI, -5.96 to -0.38] for function) (14). Another systematic review found that compared with minimal intervention, MCE decreased pain intensity (2 trials: WMD, -12.48 on a 0- to 100-point scale [CI, -19.04 to -5.93] short term and 13.32 [CI, -19.75 to -6.90] long term) and improved function (3 trials: WMD, -9.00 on a 0- to 100-point scale [CI, -15.28 to -2.73] short term; 2 trials: WMD, -6.64 [CI, -11.72 to -1.57] long term) (13). Still another systematic review found an association between exercise and a lower likelihood of work disability at long-term follow-up (about 12 months) (10 comparisons in 8 trials: odds ratio, 0.66 [CI, 0.48 to 0.92]), with no statistically significant effects in the shorter term (15). Among trials of exercise versus no exercise or usual care not included in the systematic reviews, 15 of 22 found exercise to be more effective for pain and 12 of 17 found exercise to be more effective for function.

For radicular low back pain, 3 trials ( $n = 181$  to 348) found exercise to be more effective than usual care or no exercise for pain or function, but the effects were small (16, 17, 25).

A systematic review found that compared with general exercise, MCE was associated with less pain intensity in the short term (6 trials: WMD, -7.80 on a 0- to 100-point scale [CI, -10.95 to -4.65]) and intermediate term (3 trials: WMD, -6.06 [CI, -10.94 to -1.18]); however, the differences were smaller and no longer statistically significant in the long term (4 trials: WMD, -3.10 [CI, -7.03 to 0.83]) (13). In addition, MCE was associated with better short-term (6 trials: WMD, -4.65 on a 0- to 100-point scale [CI, -6.20 to -3.11]) and long-term (3 trials: WMD, -4.72 [CI, -8.81 to -0.63]) function. Three subsequent trials generally were consistent with the systematic review in finding MCE slightly more effective than general exercise for pain or function (30, 33, 34). For comparisons involving other types of exercise techniques, no clear differences were observed in more than 20 head-to-head trials of acute or chronic back pain.

## Tai Chi

Two fair-quality trials ( $n = 160$  and 320) (35, 36) found that tai chi reduced pain versus wait list or no tai chi (mean differences, 0.9 and 1.3, respectively, on a 0- to 10-point scale); 1 trial (35) also found greater improvement in function (mean difference, 2.6 on the Roland Morris Disability Questionnaire [RDQ] [CI, 1.1 to 3.7]).

## Yoga

Fourteen trials evaluated yoga for chronic low back pain. Ten trials ( $n = 1056$ ; range, 12 to 313) were in a systematic review (37), and we identified 4 additional trials ( $n = 375$ ; range, 60 to 159) (38, 39). Eight trials in the systematic review were rated as low risk of bias; we rated 2 other trials as fair and 2 as good quality.

One trial found that compared with usual care, Iyengar yoga was associated with lower pain scores (24 vs. 37 on a visual analogue scale [VAS] of 0 to 100;  $P < 0.001$ ) and better function (18 vs. 21 on the 0- to 100-point Oswestry Disability Index;  $P < 0.01$ ) at 24 weeks (40). Five trials generally found yoga to be associated with lower pain intensity and better function versus exercise, although the effects were small and differences were not always statistically significant (38, 41-44). Compared with education, yoga was associated with lower short-term pain intensity (5 trials: standardized mean difference [SMD], -0.45 [CI, -0.63 to -0.26;  $I^2 = 0\%$ ]), but the effects were smaller and not statistically significant at longer-term follow-up; yoga also was associated with better function at short-term (5 trials: SMD, 0.45 [CI, -0.65 to -0.25;  $I^2 = 8\%$ ]) and long-term (4 trials: SMD, 0.39 [CI, -0.66 to -0.11;  $I^2 = 40\%$ ) follow-up (37).

## Mindfulness-Based Stress Reduction

Three trials ( $n = 40$ , 282, and 342) evaluated mindfulness-based stress reduction (8 weekly group sessions) for chronic low back pain (45-47). Two trials were rated as good quality (45, 47) and 1 as poor quality. In 1 trial, participants in a mindfulness-based stress reduction program had greater improvement in short-term back pain (difference, -0.64 point on a 0- to 10-point numeric rating scale) and function (difference, -1.37 on the RDQ) at 26 weeks than those receiving usual care (45). They also were more likely to have pain reduction of 30% or more (relative risk, 1.64 [CI, 1.15 to 2.34]) and better function (relative risk, 1.37 [CI, 1.06 to 1.77]). The effects on pain (difference, -0.85 point) but not function remained at 52 weeks. No differences were observed between mindfulness-based stress reduction and cognitive behavioral therapy. Another good-quality trial found that compared with an education intervention, mindfulness-based stress reduction led to a greater increase in function at 8 weeks (difference, -1.1 on the RDQ [CI, -2.1 to -0.01]) but no statistically significant effects on average pain intensity (46); no differences were seen in average pain intensity or function at 6 months. The third trial, a small ( $n = 40$ ) pilot study, also found mindfulness-based stress reduction to be superior to an education intervention for pain

**Table 2.** Nonpharmacologic Treatments Versus Sham, No Treatment, or Usual Care for Chronic Low Back Pain

Intervention	Pain			Function		
	Magnitude of Effect	Evidence	SOE	Magnitude of Effect	Evidence	SOE
Exercise vs. usual care	Small	1 SR (19 RCTs) + 1 SR	Moderate	Small	1 SR (17 RCTs) + 1 SR	Moderate
MCEs vs. minimal intervention	Moderate (short to long term)	1 SR (2 RCTs)	Low	Small (short to long term)	1 SR (3 RCTs)	Low
Tai chi vs. wait list or no tai chi	Moderate	2 RCTs	Low	Small	1 RCT	Low
Yoga vs. usual care	Moderate	1 RCT	Low	Moderate	1 RCT	Low
Yoga vs. education	Small (short term) and no effect (longer term)	5 RCTs (short term) + 4 RCTs (longer term)	Low	Small (short term) and no effect (longer term)	5 RCTs (short term) + 4 RCTs (longer term)	Low
Mindfulness-based stress reduction vs. usual care or education	Small	3 RCTs	Moderate	Small	3 RCTs	Moderate
Progressive relaxation vs. wait-list control	Moderate	1 SR (3 RCTs)	Low	Moderate	1 SR (3 RCTs)	Low
Electromyography biofeedback vs. wait list or placebo	Moderate	1 SR (3 RCTs)	Low	No effect	1 SR (3 RCTs)	Low
Operant therapy vs. wait-list control	Small	1 SR (3 RCTs)	Low	No effect	1 SR (2 RCTs)	Low
Cognitive-behavioral therapy vs. wait-list control	Moderate	1 SR (5 RCTs)	Low	No effect	1 SR (4 RCTs)	Low
Multidisciplinary rehabilitation vs. no multidisciplinary rehabilitation	Moderate	1 SR (3 RCTs)	Low	Small	1 SR (3 RCTs)	Low
Multidisciplinary rehabilitation vs. usual care	Moderate (short term), small (long term), and favors rehabilitation	1 SR (9 RCTs) (short term) + 1 SR (7 RCTs) (long term)	Moderate	Small (short and long term)	1 SR (9 RCTs) (short term) + 1 SR (7 RCTs) (long term)	Moderate
Acupuncture vs. sham acupuncture	Moderate	1 SR (4 RCTs) + 5 RCTs	Low	No effect	1 SR (4 RCTs) + 5 RCTs	Low
Acupuncture vs. no acupuncture	Moderate	1 SR (4 RCTs)	Moderate	Moderate	1 SR (3 RCTs)	Moderate
Spinal manipulation vs. sham manipulation	No effect	1 SR (3 RCTs) + 1 RCT	Low	Unable to estimate	1 RCT	-
Spinal manipulation vs. inert treatment	Small	7 RCTs	Low	-	-	-
Massage vs. usual care	No effect	1 RCT	Low	Unable to estimate	2 RCTs	Insufficient

MCE = motor control exercise; RCT = randomized, controlled trial; SOE = strength of evidence; SR = systematic review.

and function, although the researchers reported baseline differences in these measures (47).

### Psychological Therapies

Thirty-two trials evaluated psychological therapies for chronic low back pain. Of these studies, 28 were included in a systematic review ( $n = 3090$ ; range, 18 to 409) (48), and we identified 4 additional trials ( $n = 976$ ; range, 54 to 701) (49–53). The review classified 13 trials as low risk of bias; we rated all the others as fair quality.

The systematic review found that compared with wait-list control or no psychological therapy, progressive relaxation (3 trials: mean difference,  $-19.77$  on a 0- to 100-point VAS [CI,  $-34$  to  $-5.20$ ]), electromyography biofeedback (3 trials: SMD,  $-0.80$  [CI,  $-1.32$  to  $-0.28$ ]), operant therapy (3 trials: SMD,  $-0.43$  [CI,  $-0.75$  to  $-0.11$ ]), and cognitive behavioral therapy (5 trials: SMD,  $-0.60$  [CI,  $-0.97$  to  $-0.22$ ]) resulted in lower posttreatment pain intensity (48). Only progressive relaxation was associated with beneficial effects on function (3 trials: SMD,  $-0.88$  [CI,  $-1.36$  to  $-0.39$ ]). No clear differences in pain intensity were seen between psychological therapies and exercise therapy (2 trials) or in pain or function between psychological therapies plus physiotherapy and physiotherapy alone (6 trials) (48). Ten trials found no clear differences among several psychological therapies (48).

### Multidisciplinary Rehabilitation

Multidisciplinary rehabilitation was evaluated in 44 trials. Of these studies, 41 ( $n = 6858$ ; range, 20 to 542) were included in a systematic review (54), and we identified 3 others ( $n = 20, 20,$  and  $70$ ) (55–57). The systematic review classified 13 trials as low risk of bias; we rated 2 others as good quality and 1 as fair quality.

The systematic review found that patients with chronic low back pain who received multidisciplinary rehabilitation had lower short-term pain intensity than those who received usual care (9 trials: SMD,  $-0.55$  [CI,  $-0.83$  to  $-0.28$ ]), no multidisciplinary rehabilitation (3 trials: SMD,  $-0.73$  [CI,  $-1.22$  to  $-0.24$ ]), or nonmultidisciplinary physical therapy (12 trials: SMD,  $-0.30$  [CI,  $-0.54$  to  $-0.06$ ]) (54). On a numerical rating scale of 0 to 10 points, the differences were approximately 1.4 to 1.7 points versus usual care or no multidisciplinary rehabilitation and approximately 0.6 point versus nonmultidisciplinary physical therapy. Multidisciplinary rehabilitation also was associated with less short-term disability (9 trials: SMD,  $-0.41$  [CI,  $-0.62$  to  $-0.19$ ;  $I^2 = 58%$ ]; 3 trials: SMD,  $-0.49$  [CI,  $-0.76$  to  $-0.22$ ]; and 13 trials: SMD,  $-0.39$  [CI,  $-0.68$  to  $-0.10$ ], respectively). On the RDQ, the differences were approximately 2.5 to 2.9 points versus usual care or no multidisciplinary rehabilitation and approximately 1.2 points versus non-

**Table 3.** Nonpharmacologic Treatments Versus Sham, No Treatment, or Usual Care for Acute Low Back Pain

Intervention	Pain			Function		
	Magnitude of Effect	Evidence	SOE	Magnitude of Effect	Evidence	SOE
Exercise vs. usual care	No effect	1 SR (3 RCTs) + 3 RCTs	Low	No effect	1 SR (3 RCTs) + 3 RCTs	Low
Acupuncture vs. sham	Small	2 RCTs	Low	No effect	5 RCTs	Low
Spinal manipulation vs. sham	Unable to estimate	1 RCT	Insufficient	Small	1 SR (2 RCTs)	Low
Spinal manipulation vs. inert treatment	No effect	1 SR (3 RCTs)	Low	No effect	1 SR (2 RCTs)	Low

RCT = randomized, controlled trial; SOE = strength of evidence; SR = systematic review.

multidisciplinary physical therapy. Multidisciplinary rehabilitation also was associated with less long-term pain intensity and disability than usual care (7 trials: SMD,  $-0.21$  [CI,  $-0.37$  to  $-0.04$ ], and 6 trials: SMD,  $-0.23$  [CI,  $-0.40$  to  $-0.06$ ], respectively) and nonmultidisciplinary physical therapy (9 trials: SMD,  $-0.51$  [CI,  $-1.04$  to  $0.01$ ], and 10 trials: SMD,  $-0.68$  [CI,  $-1.19$  to  $-0.16$ ], respectively) and with greater likelihood of return to work compared with nonmultidisciplinary rehabilitation (8 trials: odds ratio,  $1.87$  [CI,  $1.39$  to  $2.53$ ]), with no difference versus usual care (7 trials: odds ratio,  $1.04$  [CI,  $0.73$  to  $1.47$ ]). Two trials in patients with subacute low back pain reported findings consistent with those in patients with chronic symptoms (55, 56).

### Acupuncture

Acupuncture was evaluated in 49 trials. Of these studies, 11 ( $n = 1163$ ; range, 40 to 300) were in a systematic review of acupuncture for acute or subacute low back pain (58) and 32 ( $n = 5931$ ; range, 16 to 2831) in a systematic review of acupuncture for chronic low back pain (59), and we identified 6 additional trials ( $n = 864$ ; range, 80 to 275) (60–64). The systematic reviews categorized 22% and 45% of trials as low risk of bias; we rated 3 additional trials as good, 2 as fair, and 1 as poor quality.

For acute low back pain, a systematic review found that acupuncture decreased pain intensity more than sham acupuncture with nonpenetrating needles (2 trials: mean difference,  $9.38$  on a 0-to 100-point VAS [CI,  $1.76$  to  $17.0$ ]) (58). Two other trials reported inconsistent effects on pain intensity (61, 65). Acupuncture had no clear effects on function (5 trials) (58, 61, 62). Compared with nonsteroidal anti-inflammatory drugs, acupuncture was associated with a slightly greater likelihood of overall improvement at the end of treatment (5 trials: relative risk,  $1.11$  [CI,  $1.06$  to  $1.16$ ]).

For chronic low back pain, the systematic review found that acupuncture was associated with lower pain intensity (4 trials: SMD,  $-0.72$  [CI,  $-0.94$  to  $-0.49$ ]) and better function (3 trials: SMD,  $-0.94$  [CI,  $-1.41$  to  $-0.47$ ]) immediately after the intervention compared with no acupuncture (59). Mean effects on pain ranged from 7 to 24 points on a 0- to 100-point scale; for function, 1 trial reported an 8-point difference on a 0- to 100-point scale and 2 trials reported differences of 0.8 and 3.4 points on the RDQ. In the long term, 2 trials showed small or no clear differences. Acupuncture also

decreased pain intensity more than sham acupuncture immediately after the intervention (4 trials: WMD,  $-16.76$  [CI,  $-33.3$  to  $-0.19$ ]) and through 12 weeks (3 trials: WMD,  $-9.55$  [CI,  $-16.5$  to  $-2.58$ ]), with no differences in function. Five trials that could not be pooled or were not included in the review reported results consistent with these findings (60, 66–69). The systematic review found that compared with medications (nonsteroidal anti-inflammatory drugs, muscle relaxants, or analgesics), acupuncture resulted in greater pain relief (3 trials: WMD,  $-10.56$  on a 0- to 100-point scale [CI,  $-20.34$  to  $-0.78$ ]) and better function (3 trials: SMD,  $-0.36$  [CI,  $-0.67$  to  $-0.04$ ]) immediately after the intervention.

### Massage

Massage was evaluated in 26 trials, 13 of which ( $n = 1596$ ; range, 39 to 262) were included in a systematic review (70); we identified another 13 trials ( $n = 1633$ ; range, 15 to 579) (29, 71–82). The systematic review classified 6 trials as low risk of bias, and we rated 3 additional trials (29, 71, 72) as good quality.

For chronic low back pain, 1 trial found that structural or relaxation massage had small effects on the RDQ (mean, 2.0 to 2.9 points) versus usual care at 10 to 12 weeks, with smaller effects at 52 weeks (71); however, another trial found no RDQ effects from massage (Swedish massage, soft tissue release, and stretching) versus usual care (29). Three trials found no clear difference in pain or function between foot reflexology and usual care or sham (light foot) massage (79, 81, 83).

Compared with several noninvasive interventions (manipulation, exercise, relaxation therapy, acupuncture, physiotherapy, transcutaneous electrical nerve stimulation), massage had better effects on short-term pain in 8 of 9 trials (mean differences,  $-0.6$  to  $-0.94$  points on a 0- to 10-point scale) and short-term function in 4 of 5 trials (70, 82). Comparisons of various massage techniques were heterogeneous, and estimates were imprecise (71–74, 80, 84, 85).

### Spinal Manipulation

Spinal manipulation was evaluated in 61 trials. Of these studies, 19 ( $n = 2674$ ; range, 36 to 323) were included in a systematic review of manipulation for acute low back pain (86) and 26 ( $n = 6070$ ; range, 29 to 1334) in a systematic review of manipulation for chronic low back pain (87), and we identified an additional 16

trials ( $n = 2382$ ; range, 40 to 400) (18, 88-102). The reviews classified 15 trials as low risk of bias, and we rated 1 additional trial (102) as good quality.

For acute low back pain, 2 trials found that spinal manipulation had greater effects on function than sham manipulation (these differences were statistically significant in 1 trial); 1 trial found no statistically significant effects on pain (97, 103). The systematic review found no differences in pain relief at 1 week between spinal manipulation and treatments considered inactive (an educational booklet, detuned ultrasound, detuned or actual short-wave diathermy, antiedema gel, or bed rest) (3 trials: WMD, 0.14 on a 0- to 10-point scale [CI, -0.69 to 0.96]), although 1 trial found an association between manipulation and greater pain relief at 3 months (mean difference, -1.20 [CI, 2.11 to -0.29]); no differences in function were seen at 1 week (2 trials) or 3 months (1 trial) (86). In addition, no differences were observed in pain relief between patients receiving spinal manipulation and those receiving interventions considered active (primarily exercise, physical therapy, and back school) at 1 week (3 trials: WMD, 0.06 on a 0- to 10-point scale [CI, -0.53 to 0.65]) through 1 year (1 trial: mean difference, 0.40 [CI, -0.08 to 0.88]), nor were any effects on function noted. A subsequent trial reported similar findings (96).

For chronic low back pain, a systematic review showed that spinal manipulation had small, statistically nonsignificant effects on pain at 1 month compared with sham manipulation (3 trials: WMD, -3.24 [CI, -13.62 to 7.15 on a 0- to 100-point scale]); 1 trial reported similar results for function (SMD, -0.45 [CI, -0.97 to 0.06]) (87). A trial not included in the systematic review reported results that generally were consistent with it (94). Compared with other active interventions, manipulation was associated with better short-term pain relief at 1 month (10 comparisons from 6 trials: WMD, -2.76 on a 0- to 100-point scale [CI, -5.19 to -0.32]) and 6 months (7 comparisons from 4 trials: WMD, -3.07 [CI, -5.42 to -0.71]), although the magnitude of effects was below the small or slight threshold. No effect was observed at 12 months (3 trials: WMD, -0.76 [CI, -3.19 to 1.66]). Manipulation resulted in greater improvement in function than other active interventions at 1 month (10 comparisons from 6 trials: SMD, -0.17 [CI, -0.29 to -0.06]); the effects were smaller and no longer statistically significant at 6 and 12 months. Three trials not included in the systematic reviews reported consistent findings with it (18, 90, 93).

For radicular low back pain, 1 good-quality trial found that spinal manipulation plus home exercise and advice resulted in greater improvement in leg and back

pain at 12 weeks than home exercise and advice alone (mean difference, about 1 point on a 0- to 10-point scale); the effects were smaller (0.3 to 0.7 points) and not statistically significant at 52 weeks (99).

**Harms**

Across interventions, no serious harms were noted, although the reporting of harms was suboptimal. Typical harms reported were temporary increases in low back pain or other local effects (such as pain or bleeding from insertion of acupuncture needles).

**DISCUSSION**

Some evidence supports the effectiveness of several nonpharmacologic therapies for chronic low back pain (Table 2 and Supplement Table 5, available at Annals.org), and limited evidence shows that acupuncture is effective for acute low back pain (Table 3 and Supplement Table 6, available at Annals.org). These benefits generally were seen for short-term pain (usually <3 months and often immediately after the intervention) and of small (5 to 10 points on a 100-point VAS) to moderate (10 to 20 points) magnitude, on the basis of the ACP/APS categories (104). Function was reported less consistently than pain, and effects typically were smaller or not observed. Exercise and multidisciplinary rehabilitation were associated with an increased likelihood of return to work. As described in the full report (5), evidence on other outcomes (such as quality of life, mood, analgesic use, and health care use) was sparse. Evidence on the effectiveness of nonpharmacologic therapies for radiculopathy was very limited (Table 4). Few clear differences were seen between various nonpharmacologic therapies in head-to-head trials, but evidence for most comparisons was limited.

This report updates and expands on the earlier ACP/APS review (105) with additional interventions and newer evidence. We found evidence that mind-body interventions not previously addressed—tai chi (SOE, low) and mindfulness-based stress reduction (SOE, moderate) (45-47)—are effective for chronic low back pain; the new evidence also strengthens previous conclusions regarding yoga effectiveness (SOE, moderate). For interventions recommended as treatment options in the 2007 ACP/APS guideline (2), our findings were generally consistent with the prior review. Specifically, exercise therapy, psychological therapies, multidisciplinary rehabilitation, spinal manipulation, massage, and acupuncture are supported with some evidence of effectiveness for chronic low back pain (SOE, low to moderate). Unlike our previous report, which stated

**Table 4.** Nonpharmacologic Treatments for Radicular Low Back Pain

Intervention	Pain			Function		
	Magnitude of Effect	Evidence	SOE	Magnitude of Effect	Evidence	SOE
Exercise vs. usual care	Small and favors exercise	3 RCTs	Low	Small and favors exercise	3 RCTs	Low

RCT = randomized, controlled trial; SOE = strength of evidence.

that higher-intensity multidisciplinary rehabilitation seemed to be more effective than lower-intensity programs, a stratified analysis based on currently available evidence (54) did not find a clear intensity effect. Our findings generally are consistent with recent systematic reviews not included in our evidence synthesis (106–117). Although harms were not well-reported, serious adverse events were not described.

As detailed in the full report, we found little evidence to support the use of most passive physical therapies (such as interferential therapy, short-wave diathermy, traction, ultrasound, lumbar supports, taping, and electrical muscle stimulation) for low back pain (5). Exceptions were superficial heat, which was more effective than a nonheated control for acute or subacute low back pain (SOE, moderate), and low-level laser therapy, which was more effective than sham laser for pain (SOE, low) (118–120).

We categorized the magnitude of effects for pain and function by using the thresholds in the ACP/APS review. Effects classified as small (for example, 5 to 10 points on a 0- to 100-point scale for pain or function) are below some proposed minimum thresholds for clinically important differences (such as 15 points on a 0- to 100-point VAS for pain, 2 points on a 0- to 10-point numerical rating scale for pain or function, 5 points on the RDQ, and 10 points on the Oswestry Disability Index) (12). Factors that may support the use of interventions associated with small effects include low risk for harms, low costs, and strong patient preferences. The magnitude of effects may vary depending on baseline severity (121); most trials enrolled patients with at least moderate pain (for example, rated as >5 on a 0- to 10-point numeric rating scale).

Our findings have implications for clinical practice. Current guidelines do not include mindfulness-based stress reduction, which was as effective as cognitive behavioral therapy for chronic low back pain (45). Recent guidelines recommend nonopioid over opioid therapy for chronic pain; yet access to and reimbursement for certain nonpharmacologic therapies remain limited (122, 123). For acute low back pain, most patients improve with or without therapy. Therefore, strategies that target effective therapies to patients at higher risk for chronicity may be most efficient (124).

Our review had limitations. Because of the large number of interventions, reviewing all of the primary literature was not feasible. We included higher-quality, recent systematic reviews that were most relevant to the review scope (125), supplemented with additional primary trials. We did not update meta-analyses reported in systematic reviews, but we qualitatively evaluated the consistency of results from new trials against pooled estimates. We excluded non-English-language articles and did not search for abstract-only publications. We were limited in our ability to assess for publication bias because of the small numbers of trials for most comparisons, methodological limitations, and study heterogeneity. We did not address some nonpharmacologic interventions, including education (126, 127), advice to remain active (126, 128), mattresses,

and shoe insoles (129), or compare nonpharmacologic therapies with surgical or interventional procedures.

Limitations also existed in the evidence base. Effects on pain and function typically were reported as mean differences at or shortly after intervention, making it difficult to determine whether benefits were sustained. Few studies reported the likelihood of clinically significant improvements (130). For each intervention, trials were heterogeneous regarding the techniques used, the number of treatment sessions, and the duration or intensity of sessions. For example, acupuncture trials varied in needling sites; the length, number, and duration of acupuncture sessions; and the type of sham treatment (for example, nonpenetrating needles at the acupuncture site vs. penetrating needles at the nonacupuncture site) (58, 59). For many nonpharmacologic interventions, effectively blinding patients or care providers to treatments is difficult, so some observed effects might have been the result of nonspecific effects related to needling, massage, manipulation, or other treatment administration aspects (such as attentional or placebo effects) (131, 132).

In conclusion, several nonpharmacologic therapies for low back pain were associated with small to moderate, primarily short-term effects on pain. Effects on function generally were smaller than those on pain, and most evidence was for chronic low back pain. New evidence supports the effectiveness of mind-body interventions. More research is needed to identify effective nonpharmacologic treatments for radicular and acute low back pain and to understand the incremental benefits of combining interventions, as well as which treatment combinations and sequences are most effective.

From Oregon Health and Science University, Portland, Oregon, and University of Washington, Seattle, and Spectrum Research, Tacoma, Washington.

**Disclaimer:** The authors of this manuscript are responsible for its content. A representative from the Agency for Healthcare Research and Quality (AHRQ) served as a Contracting Officer's Technical Representative and provided technical assistance during the conduct of the full evidence report and provided comments on draft versions of the full evidence report. The AHRQ did not directly participate in the literature search, determination of study eligibility criteria, data analysis or interpretation, or preparation, review, or approval of the manuscript for publication. Statements in the report should not be construed as endorsement by AHRQ or the U.S. Department of Health and Human Services. The AHRQ retains a license to display, reproduce, and distribute the data and the report from which this manuscript was derived under the terms of the agency's contract with the author.

**Grant Support:** By contract HHS2902012000141 from AHRQ, U.S. Department of Health and Human Services.

**Disclosures:** Dr. Chou reports grants from AHRQ and funds for manuscript preparation from ACP during the conduct of this study. Dr. Deyo reports grants from AHRQ during the conduct of the study; grants from the National Institutes of Health (NIH), AHRQ, Centers for Disease Control and Preven-



tion, and Patient-Centered Outcomes Research Institute (PCORI) outside the submitted work; personal fees from UpToDate and other support from Kaiser Permanente outside the submitted work; and a financial gift from NuVasive as part of a lifetime achievement award from the International Society for Study of the Lumbar Spine. Dr. Friedly reports grants from AHRQ during the conduct of the study and grants from PCORI and NIH outside the submitted work. Dr. Skelly reports grants from AHRQ during the conduct of the study and other support from the Washington State Health Technology Assessment (HTA) Program and AOSpine North America outside the submitted work. Dr. Hashimoto reports grants from AHRQ during the conduct of the study, other support from the Washington State HTA Program, and personal fees from Amgen, which were received after the submitted work was prepared. Dr. Weimer, Ms. Dana, Ms. Grusing, and Ms. Brodt report grants from AHRQ during the conduct of the study. Authors not named here have disclosed no conflicts of interest. Disclosures can be viewed at [www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M16-2459](http://www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M16-2459).

**Reproducible Research Statement:** *Study protocol:* Available at [www.crd.york.ac.uk/PROSPERO/display\\_record.asp?ID=CRD42014014735](http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014014735). *Statistical code:* Not applicable. *Data set:* See the **Supplement** (available at [Annals.org](http://Annals.org)) and full report at [www.effectivehealthcare.ahrq.gov/search-for-guides-reviews-and-reports/?pageaction=displayproduct&productID=2178](http://www.effectivehealthcare.ahrq.gov/search-for-guides-reviews-and-reports/?pageaction=displayproduct&productID=2178).

**Requests for Single Reprints:** Roger Chou, MD, 3181 Southwest Sam Jackson Park Road, Mail Code: BICC, Portland, OR 97239; e-mail, [chour@ohsu.edu](mailto:chour@ohsu.edu).

Current author addresses and author contributions are available at [Annals.org](http://Annals.org).

## References

- Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis*. 2014;73:968-74. [PMID: 24665116] doi:10.1136/annrheumdis-2013-204428
- Chou R, Qaseem A, Snow V, Casey D, Cross JT Jr, Shekelle P, et al; Clinical Efficacy Assessment Subcommittee of the American College of Physicians. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. 2007;147:478-91. [PMID: 17909209]
- Chou R, Huffman LH; American Pain Society. Medications for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Ann Intern Med*. 2007;147:505-14. [PMID: 17909211]
- Chou R, Deyo R, Friedly J, Skelly A, Weimer M, Fu R, et al. Systemic pharmacologic therapies for low back pain: a systematic review for an American College of Physicians clinical practice guideline. *Ann Intern Med*. 2017;166:480-92. doi:10.7326/M16-2458
- Chou R, Deyo R, Friedly J, Skelly A, Hashimoto R, Weimer M, et al. Noninvasive Treatments for Low Back Pain. Comparative Effectiveness Review no. 169. (Prepared by the Pacific Northwest Evidence-based Practice Center under contract no. 290-2012-00014-I.) AHRQ publication no. 16-EHC004-EF. Rockville: Agency for Healthcare Research and Quality; 2016.
- Agency for Healthcare Research and Quality. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. AHRQ publication no. 10(12)-EHC063-EF. Rockville: Agency for Healthcare Research and Quality; 2014.
- Noninvasive treatments for low back pain. PROSPERO: CRD42014014735. Accessed at [www.crd.york.ac.uk/PROSPERO/display\\_record.asp?ID=CRD42014014735](http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014014735) on 21 June 2016.
- Chou R, Huffman L, eds; American Pain Society; American Academy of Pain Medicine. Guideline for the Use of Chronic Opioid Therapy in Chronic Noncancer Pain. Evidence Review. Chicago: American Pain Society; 2009.
- Shea BJ, Hamel C, Wells GA, Bouter LM, Kristjansson E, Grimshaw J, et al. AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *J Clin Epidemiol*. 2009;62:1013-20. [PMID: 19230606] doi:10.1016/j.jclinepi.2008.10.009
- Agency for Healthcare Research and Quality. Integrating bodies of evidence: existing systematic reviews and primary studies. In: Agency for Healthcare Research and Quality; U.S. Department of Health and Human Services, eds. Draft Methods Guidance. Rockville: Agency for Healthcare Research and Quality; 2015:1-13.
- U.S. Preventive Services Task Force. U.S. Preventive Services Task Force Procedure Manual. AHRQ publication no. 08-05118-EF. Rockville: Agency for Healthcare Research and Quality; 2015.
- Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korf M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)*. 2008;33:90-4. [PMID: 18165753] doi:10.1097/BRS.0b013e31815e3a10
- Byström MG, Rasmussen-Barr E, Grooten WJ. Motor control exercises reduces pain and disability in chronic and recurrent low back pain: a meta-analysis. *Spine (Phila Pa 1976)*. 2013;38:E350-8. [PMID: 23492976] doi:10.1097/BRS.0b013e31828435fb
- van Middelkoop M, Rubinstein SM, Verhagen AP, Ostelo RW, Koes BW, van Tulder MW. Exercise therapy for chronic nonspecific low-back pain. *Best Pract Res Clin Rheumatol*. 2010;24:193-204. [PMID: 20227641] doi:10.1016/j.berh.2010.01.002
- Oesch P, Kool J, Hagen KB, Bachmann S. Effectiveness of exercise on work disability in patients with non-acute non-specific low back pain: systematic review and meta-analysis of randomised controlled trials. *J Rehabil Med*. 2010;42:193-205. [PMID: 20411212] doi:10.2340/16501977-0524
- Albaladejo C, Kovacs FM, Royuela A, del Pino R, Zamora J; Spanish Back Pain Research Network. The efficacy of a short education program and a short physiotherapy program for treating low back pain in primary care: a cluster randomized trial. *Spine (Phila Pa 1976)*. 2010;35:483-96. [PMID: 20147875] doi:10.1097/BRS.0b013e3181b9c9a7
- Albert HB, Manniche C. The efficacy of systematic active conservative treatment for patients with severe sciatica: a single-blind, randomized, clinical, controlled trial. *Spine (Phila Pa 1976)*. 2012;37:531-42. [PMID: 21494193] doi:10.1097/BRS.0b013e31821ace7f
- Bronfort G, Maiers MJ, Evans RL, Schulz CA, Bracha Y, Svendsen KH, et al. Supervised exercise, spinal manipulation, and home exercise for chronic low back pain: a randomized clinical trial. *Spine J*. 2011;11:585-98. [PMID: 21622028] doi:10.1016/j.spinee.2011.01.036
- Garcia AN, Costa Lda C, da Silva TM, Gondo FL, Cyrillo FN, Costa RA, et al. Effectiveness of back school versus McKenzie exercises in patients with chronic nonspecific low back pain: a randomized controlled trial. *Phys Ther*. 2013;93:729-47. [PMID: 23431213] doi:10.2522/ptj.20120414
- George SZ, Zeppieri G Jr, Cere AL, Cere MR, Borut MS, Hodges MJ, et al. A randomized trial of behavioral physical therapy interventions for acute and sub-acute low back pain (NCT00373867). *Pain*. 2008;140:145-57. [PMID: 18786762] doi:10.1016/j.pain.2008.07.029
- Hagen EM, Ødelien KH, Lie SA, Eriksen HR. Adding a physical exercise programme to brief intervention for low back pain patients did not increase return to work. *Scand J Public Health*. 2010;38:731-8. [PMID: 20817653] doi:10.1177/1403494810382472
- Hartvigsen J, Morsø L, Bendix T, Manniche C. Supervised and non-supervised Nordic walking in the treatment of chronic low back

- pain: a single blind randomized clinical trial. *BMC Musculoskelet Disord.* 2010;11:30. [PMID: 20146793] doi:10.1186/1471-2474-11-30
23. Helmhout PH, Harts CC, Viechtbauer W, Staal JB, de Bie RA. Isolated lumbar extensor strengthening versus regular physical therapy in an army working population with nonacute low back pain: a randomized controlled trial. *Arch Phys Med Rehabil.* 2008;89:1675-85. [PMID: 18675396] doi:10.1016/j.apmr.2007.12.050
24. Henchoz Y, de Goumoëns P, So AK, Paillex R. Functional multidisciplinary rehabilitation versus outpatient physiotherapy for non specific low back pain: randomized controlled trial. *Swiss Med Wkly.* 2010;140:w13133. [PMID: 21181567] doi:10.4414/sm.w.2010.13133
25. Hofstee DJ, Gijtenbeek JM, Hoogland PH, van Houwelingen HC, Kloet A, Lötters F, et al. Westeinde sciatica trial: randomized controlled study of bed rest and physiotherapy for acute sciatica. *J Neurosurg.* 2002;96:45-9. [PMID: 11797655]
26. Hurley DA, Tully MA, Lonsdale C, Boreham CA, van Mechelen W, Daly L, et al. Supervised walking in comparison with fitness training for chronic back pain in physiotherapy: results of the SWIFT single-blinded randomized controlled trial (ISRCTN17592092). *Pain.* 2015;156:131-47. [PMID: 25599309] doi:10.1016/j.pain.0000000000000013
27. Jensen RK, Leboeuf-Yde C, Wedderkopp N, Sorensen JS, Manniche C. Rest versus exercise as treatment for patients with low back pain and Modic changes. A randomized controlled clinical trial. *BMC Med.* 2012;10:22. [PMID: 22376791] doi:10.1186/1741-7015-10-22
28. Kell RT, Risi AD, Barden JM. The response of persons with chronic nonspecific low back pain to three different volumes of periodized musculoskeletal rehabilitation. *J Strength Cond Res.* 2011;25:1052-64. [PMID: 20647943] doi:10.1519/JSC.0b013e3181d09df7
29. Little P, Lewith G, Webley F, Evans M, Beattie A, Middleton K, et al. Randomised controlled trial of Alexander technique lessons, exercise, and massage (ATEAM) for chronic and recurrent back pain. *Br J Sports Med.* 2008;42:965-8. [PMID: 19096019]
30. Macedo LG, Latimer J, Maher CG, Hodges PW, McAuley JH, Nicholas MK, et al. Effect of motor control exercises versus graded activity in patients with chronic nonspecific low back pain: a randomized controlled trial. *Phys Ther.* 2012;92:363-77. [PMID: 22135712] doi:10.2522/ptj.20110290
31. Machado LA, Maher CG, Herbert RD, Clare H, McAuley JH. The effectiveness of the McKenzie method in addition to first-line care for acute low back pain: a randomized controlled trial. *BMC Med.* 2010;8:10. [PMID: 20102596] doi:10.1186/1741-7015-8-10
32. Pengel LH, Refshaug KM, Maher CG, Nicholas MK, Herbert RD, McNair P. Physiotherapist-directed exercise, advice, or both for subacute low back pain: a randomized trial. *Ann Intern Med.* 2007;146:787-96. [PMID: 17548410]
33. Stankovic A, Lazovic M, Kocic M, Dimitrijevic L, Stankovic I, Zlatanovic D, et al. Lumbar stabilization exercises in addition to strengthening and stretching exercises reduce pain and increase function in patients with chronic low back pain: randomized clinical open-label study. *Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi.* 2012;58:177-83.
34. Inani SB, Selkar SP. Effect of core stabilization exercises versus conventional exercises on pain and functional status in patients with non-specific low back pain: a randomized clinical trial. *J Back Musculoskelet Rehabil.* 2013;26:37-43. [PMID: 23411647] doi:10.3233/BMR-2012-0348
35. Hall AM, Maher CG, Lam P, Ferreira M, Latimer J. Tai chi exercise for treatment of pain and disability in people with persistent low back pain: a randomized controlled trial. *Arthritis Care Res (Hoboken).* 2011;63:1576-83. [PMID: 22034119] doi:10.1002/acr.20594
36. Weifen W, Muharemu A, Chaohui C, Md LW, Lei S. Effectiveness of tai chi practice for non-specific chronic low back pain on retired athletes: a randomized controlled study. *J Musculoskelet Pain.* 2013;21:37-45.
37. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain.* 2013;29:450-60. [PMID: 23246998] doi:10.1097/AJP.0b013e31825e1492
38. Nambi GS, Inbasekaran D, Khuman R, Devi S, Shanmuganath, Jagannathan K. Changes in pain intensity and health related quality of life with lyengar yoga in nonspecific chronic low back pain: a randomized controlled study. *Int J Yoga.* 2014;7:48-53. [PMID: 25035607] doi:10.4103/0973-6131.123481
39. Saper RB, Boah AR, Keosaian J, Cerrada C, Weinberg J, Sherman KJ. Comparing once- versus twice-weekly yoga classes for chronic low back pain in predominantly low income minorities: a randomized dosing trial. *Evid Based Complement Alternat Med.* 2013;1-13.
40. Williams K, Abildso C, Steinberg L, Doyle E, Epstein B, Smith D, et al. Evaluation of the effectiveness and efficacy of lyengar yoga therapy on chronic low back pain. *Spine (Phila Pa 1976).* 2009;34:2066-76. [PMID: 19701112] doi:10.1097/BRS.0b013e3181b315cc
41. Sherman KJ, Cherkin DC, Erro J, Miglioretti DL, Deyo RA. Comparing yoga, exercise, and a self-care book for chronic low back pain: a randomized, controlled trial. *Ann Intern Med.* 2005;143:849-56. [PMID: 16365466]
42. Sherman KJ, Cherkin DC, Wellman RD, Cook AJ, Hawkes RJ, Delaney K, et al. A randomized trial comparing yoga, stretching, and a self-care book for chronic low back pain. *Arch Intern Med.* 2011;171:2019-26. [PMID: 22025101] doi:10.1001/archinternmed.2011.524
43. Tekur P, Nagarathna R, Chametcha S, Hankey A, Nagendra HR. A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: an RCT. *Complement Ther Med.* 2012;20:107-18. [PMID: 22500659] doi:10.1016/j.ctim.2011.12.009
44. Aboagye E, Karlsson ML, Hagberg J, Jensen I. Cost-effectiveness of early interventions for non-specific low back pain: a randomized controlled study investigating medical yoga, exercise therapy and self-care advice. *J Rehabil Med.* 2015;47:167-73. [PMID: 25403347] doi:10.2340/16501977-1910
45. Cherkin DC, Sherman KJ, Balderson BH, Cook AJ, Anderson ML, Hawkes RJ, et al. Effect of mindfulness-based stress reduction vs cognitive behavioral therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized clinical trial. *JAMA.* 2016;315:1240-9. [PMID: 27002445] doi:10.1001/jama.2016.2323
46. Morone NE, Greco CM, Moore CG, Rollman BL, Lane B, Morrow LA, et al. A mind-body program for older adults with chronic low back pain: a randomized clinical trial. *JAMA Intern Med.* 2016;176:329-37. [PMID: 26903081] doi:10.1001/jamainternmed.2015.8033
47. Morone NE, Rollman BL, Moore CG, Li Q, Weiner DK. A mind-body program for older adults with chronic low back pain: results of a pilot study. *Pain Med.* 2009;10:1395-407. [PMID: 20021599] doi:10.1111/j.1526-4637.2009.00746.x
48. Henschke N, Ostelo RW, van Tulder MW, Vlaeyen JW, Morley S, Assendelft WJ, et al. Behavioural treatment for chronic low-back pain. *Cochrane Database Syst Rev.* 2010:CD002014. [PMID: 20614428] doi:10.1002/14651858.CD002014.pub3
49. Khan M, Akhter S, Soomro RR, Ali SS. The effectiveness of cognitive behavioral therapy (CBT) with general exercises versus general exercises alone in the management of chronic low back pain. *Pak J Pharm Sci.* 2014;27:1113-6. [PMID: 25016276]
50. Lamb SE, Hansen Z, Lall R, Castelnuevo E, Withers EJ, Nichols V, et al; Back Skills Training Trial investigators. Group cognitive behavioural treatment for low-back pain in primary care: a randomised controlled trial and cost-effectiveness analysis. *Lancet.* 2010;375:916-23. [PMID: 20189241] doi:10.1016/S0140-6736(09)62164-4
51. Lamb SE, Mistry D, Lall R, Hansen Z, Evans D, Withers EJ, et al; Back Skills Training Trial Group. Group cognitive behavioural interventions for low back pain in primary care: extended follow-up of the Back Skills Training Trial (ISRCTN54717854). *Pain.* 2012;153:494-501. [PMID: 22226729] doi:10.1016/j.pain.2011.11.016
52. Siemonsma PC, Stuive I, Roorda LD, Vollebregt JA, Walker MF, Lankhorst GJ, et al. Cognitive treatment of illness perceptions in patients with chronic low back pain: a randomized controlled trial. *Phys Ther.* 2013;93:435-48. [PMID: 23162040] doi:10.2522/ptj.20110150

53. Vong SK, Cheing GL, Chan F, So EM, Chan CC. Motivational enhancement therapy in addition to physical therapy improves motivational factors and treatment outcomes in people with low back pain: a randomized controlled trial. *Arch Phys Med Rehabil*. 2011;92:176-83. [PMID: 21272712] doi:10.1016/j.apmr.2010.10.016
54. Kamper SJ, Apeldoorn AT, Chiarotto A, Smeets RJ, Ostelo RW, Guzman J, et al. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain. *Cochrane Database Syst Rev*. 2014:CD000963. [PMID: 25180773] doi:10.1002/14651858.CD000963.pub3
55. Eisenberg DM, Buring JE, Hrbek AL, Davis RB, Connelly MT, Cherkn DC, et al. A model of integrative care for low-back pain. *J Altern Complement Med*. 2012;18:354-62. [PMID: 22455544] doi:10.1089/acm.2011.0408
56. Gatchel RJ, Polatin PB, Noe C, Gardea M, Pulliam C, Thompson J. Treatment- and cost-effectiveness of early intervention for acute low-back pain patients: a one-year prospective study. *J Occup Rehabil*. 2003;13:1-9. [PMID: 12611026]
57. Monticone M, Ambrosini E, Rocca B, Magni S, Brivio F, Ferrante S. A multidisciplinary rehabilitation programme improves disability, kinesiophobia and walking ability in subjects with chronic low back pain: results of a randomised controlled pilot study. *Eur Spine J*. 2014;23:2105-13. [PMID: 25064093] doi:10.1007/s00586-014-3478-5
58. Lee JH, Choi TY, Lee MS, Lee H, Shin BC, Lee H. Acupuncture for acute low back pain: a systematic review. *Clin J Pain*. 2013;29:172-85. [PMID: 23269281] doi:10.1097/AJP.0b013e31824909f9
59. Lam M, Galvin R, Curry P. Effectiveness of acupuncture for non-specific chronic low back pain: a systematic review and meta-analysis. *Spine (Phila Pa 1976)*. 2013;38:2124-38. [PMID: 24026151] doi:10.1097/01.brs.0000435025.65564.b7
60. Cho YJ, Song YK, Cha YY, Shin BC, Shin IH, Park HJ, et al. Acupuncture for chronic low back pain: a multicenter, randomized, patient-assessor blind, sham-controlled clinical trial. *Spine (Phila Pa 1976)*. 2013;38:549-57. [PMID: 23026870] doi:10.1097/BRS.0b013e318275e601
61. Hasegawa TM, Baptista AS, de Souza MC, Yoshizumi AM, Nattour J. Acupuncture for acute non-specific low back pain: a randomized, controlled, double-blind, placebo trial. *Acupunct Med*. 2014;32:109-15. [PMID: 24316509] doi:10.1136/acupmed-2013-010333
62. Vas J, Aranda JM, Modesto M, Benítez-Parejo N, Herrera A, Martínez-Barquín DM, et al. Acupuncture in patients with acute low back pain: a multicentre randomised controlled clinical trial. *Pain*. 2012;153:1883-9. [PMID: 22770838] doi:10.1016/j.pain.2012.05.033
63. Weiss J, Quante S, Xue F, Mucche R, Reuss-Borst M. Effectiveness and acceptance of acupuncture in patients with chronic low back pain: results of a prospective, randomized, controlled trial. *J Altern Complement Med*. 2013;19:935-41. [PMID: 23738680] doi:10.1089/acm.2012.0338
64. Yun M, Xiong N, Guo M, Zhang J, Liu D, Luo Y, et al. Acupuncture at the back-pain-acupoints for chronic low back pain of peacekeepers in Lebanon: a randomized controlled trial. *J Musculoskelet Pain*. 2012;20:107-15.
65. Kennedy S, Baxter GD, Kerr DP, Bradbury I, Park J, McDonough SM. Acupuncture for acute non-specific low back pain: a pilot randomised non-penetrating sham controlled trial. *Complement Ther Med*. 2008;16:139-46. [PMID: 18534326] doi:10.1016/j.ctim.2007.03.001
66. Haake M, Müller HH, Schade-Brittinger C, Basler HD, Schäfer H, Maier C, et al. German Acupuncture Trials (GERAC) for chronic low back pain: randomized, multicenter, blinded, parallel-group trial with 3 groups. *Arch Intern Med*. 2007;167:1892-8. [PMID: 17893311]
67. Leibing E, Leonhardt U, Köster G, Goerlitz A, Rosenfeldt JA, Hilgers R, et al. Acupuncture treatment of chronic low-back pain—a randomized, blinded, placebo-controlled trial with 9-month follow-up. *Pain*. 2002;96:189-96. [PMID: 11932074]
68. Sator-Katzenschlager SM, Scharbert G, Kozek-Langenecker SA, Szeles JC, Finster G, Schiesser AW, et al. The short- and long-term benefit in chronic low back pain through adjuvant electrical versus manual auricular acupuncture. *Anesth Analg*. 2004;98:1359-64. [PMID: 15105215]
69. Yeh CH, Suen LK, Shen J, Chien LC, Liang Z, Glick RM, et al. Changes in sleep with auricular point acupressure for chronic low back pain. *Behav Sleep Med*. 2016;14:279-94. [PMID: 26244591] doi:10.1080/15402002.2014.981820
70. Furlan AD, Imamura M, Dryden T, Irvin E. Massage for low-back pain. *Cochrane Database Syst Rev*. 2008:CD001929. [PMID: 18843627] doi:10.1002/14651858.CD001929.pub2
71. Cherkin DC, Sherman KJ, Kahn J, Wellman R, Cook AJ, Johnson E, et al. A comparison of the effects of 2 types of massage and usual care on chronic low back pain: a randomized, controlled trial. *Ann Intern Med*. 2011;155:1-9. [PMID: 21727288] doi:10.7326/0003-4819-155-1-201107050-00002
72. Kong LJ, Fang M, Zhan HS, Yuan WA, Tao JM, Qi GW, et al. Chinese massage combined with herbal ointment for athletes with nonspecific low back pain: a randomized controlled trial. *Evid Based Complement Alternat Med*. 2012;2012:695726. [PMID: 23258996] doi:10.1155/2012/695726
73. Romanowski M, Romanowska J, Grzeskowiak M. A comparison of the effects of deep tissue massage and therapeutic massage on chronic low back pain. *Stud Health Technol Inform*. 2012;176:411-4. [PMID: 22744541]
74. Sritoomma N, Moyle W, Cooke M, O'Dwyer S. The effectiveness of Swedish massage with aromatic ginger oil in treating chronic low back pain in older adults: a randomized controlled trial. *Complement Ther Med*. 2014;22:26-33. [PMID: 24559813] doi:10.1016/j.ctim.2013.11.002
75. Zheng Z, Wang J, Gao Q, Hou J, Ma L, Jiang C, et al. Therapeutic evaluation of lumbar tender point deep massage for chronic non-specific low back pain. *J Tradit Chin Med*. 2012;32:534-7. [PMID: 23427384]
76. Ajimsha MS, Daniel B, Chithra S. Effectiveness of myofascial release in the management of chronic low back pain in nursing professionals. *J Bodyw Mov Ther*. 2014;18:273-81. [PMID: 24725797] doi:10.1016/j.jbmt.2013.05.007
77. Borges TP, Kurebayashi LF, Silva MJ. [Occupational low back pain in nursing workers: massage versus pain]. *Rev Esc Enferm USP*. 2014;48:669-75. [PMID: 25338248]
78. Zhang Y, Tang S, Chen G, Liu Y. Chinese massage combined with core stability exercises for nonspecific low back pain: a randomized controlled trial. *Complement Ther Med*. 2015;23:1-6. [PMID: 25637146] doi:10.1016/j.ctim.2014.12.005
79. Eghbali M, Safari R, Nazari F, Abdoli S. The effects of reflexology on chronic low back pain intensity in nurses employed in hospitals affiliated with Isfahan University of Medical Sciences. *Iran J Nurs Midwifery Res*. 2012;17:239-43. [PMID: 23833620]
80. Kummerdee W. Effectiveness comparison between Thai traditional massage and Chinese acupuncture for myofascial back pain in Thai military personnel: a preliminary report. *J Med Assoc Thai*. 2009;92 Suppl 1:S117-23. [PMID: 21299184]
81. Quinn F, Hughes CM, Baxter GD. Reflexology in the management of low back pain: a pilot randomised controlled trial. *Complement Ther Med*. 2008;16:3-8. [PMID: 18346622] doi:10.1016/j.ctim.2007.05.001
82. Yoon YS, Yu KP, Lee KJ, Kwak SH, Kim JY. Development and application of a newly designed massage instrument for deep cross-friction massage in chronic non-specific low back pain. *Ann Rehabil Med*. 2012;36:55-65. [PMID: 22506236] doi:10.5535/arm.2012.36.1.55
83. Poole H, Glenn S, Murphy P. A randomised controlled study of reflexology for the management of chronic low back pain. *Eur J Pain*. 2007;11:878-87. [PMID: 17459741]
84. Franke A, Gebauer S, Franke K, Brockow T. [Acupuncture massage vs Swedish massage and individual exercise vs group exercise in low back pain sufferers—a randomized controlled clinical trial in a 2 x 2 factorial design]. *Forsch Komplementarmed Klass Naturheilkd*. 2000;7:286-93. [PMID: 11155022]

85. Chatchawan U, Thinkhamrop B, Kharmwan S, Knowles J, Eungpinichpong W. Effectiveness of traditional Thai massage versus Swedish massage among patients with back pain associated with myofascial trigger points. *J Bodyw Mov Ther.* 2005;9:298-309.
86. Rubinstein SM, Terwee CB, Assendelft WJ, de Boer MR, van Tulder MW. Spinal manipulative therapy for acute low-back pain. *Cochrane Database Syst Rev.* 2012;CD008880. [PMID: 22972127] doi:10.1002/14651858.CD008880.pub2
87. Rubinstein SM, van Middelkoop M, Assendelft WJ, de Boer MR, van Tulder MW. Spinal manipulative therapy for chronic low-back pain. *Cochrane Database Syst Rev.* 2011;CD008112. [PMID: 21328304] doi:10.1002/14651858.CD008112.pub2
88. Balthazard P, de Goumoens P, Rivier G, Demeulenaere P, Ballabeni P, Dériaz O. Manual therapy followed by specific active exercises versus a placebo followed by specific active exercises on the improvement of functional disability in patients with chronic non specific low back pain: a randomized controlled trial. *BMC Musculoskelet Disord.* 2012;13:162. [PMID: 22925609] doi:10.1186/1471-2474-13-162
89. Bicalho E, Setti JA, Macagnan J, Cano JL, Manffra EF. Immediate effects of a high-velocity spine manipulation in paraspinal muscles activity of nonspecific chronic low-back pain subjects. *Man Ther.* 2010;15:469-75. [PMID: 20447857] doi:10.1016/j.math.2010.03.012
90. Cecchi F, Molino-Lova R, Chiti M, Pasquini G, Paperini A, Conti AA, et al. Spinal manipulation compared with back school and with individually delivered physiotherapy for the treatment of chronic low back pain: a randomized trial with one-year follow-up. *Clin Rehabil.* 2010;24:26-36. [PMID: 20053720] doi:10.1177/0269215509342328
91. de Oliveira RF, Liebano RE, Costa Lda C, Rissato LL, Costa LO. Immediate effects of region-specific and non-region-specific spinal manipulative therapy in patients with chronic low back pain: a randomized controlled trial. *Phys Ther.* 2013;93:748-56. [PMID: 23431209] doi:10.2522/ptj.20120256
92. Haas M, Vavrek D, Peterson D, Polissar N, Neradilek MB. Dose-response and efficacy of spinal manipulation for care of chronic low back pain: a randomized controlled trial. *Spine J.* 2014;14:1106-16. [PMID: 24139233] doi:10.1016/j.spinee.2013.07.468
93. Petersen T, Larsen K, Nordsteen J, Olsen S, Fournier G, Jacobsen S. The McKenzie method compared with manipulation when used adjunctive to information and advice in low back pain patients presenting with centralization or peripheralization: a randomized controlled trial. *Spine (Phila Pa 1976).* 2011;36:1999-2010. [PMID: 21358492] doi:10.1097/BRS.0b013e318201ee8e
94. Senna MK, Machaly SA. Does maintained spinal manipulation therapy for chronic nonspecific low back pain result in better long-term outcome? *Spine (Phila Pa 1976).* 2011;36:1427-37. [PMID: 21245790] doi:10.1097/BRS.0b013e3181f5dfe0
95. Goertz CM, Long CR, Hondras MA, Petri R, Delgado R, Lawrence DJ, et al. Adding chiropractic manipulative therapy to standard medical care for patients with acute low back pain: results of a pragmatic randomized comparative effectiveness study. *Spine (Phila Pa 1976).* 2013;38:627-34. [PMID: 23060056] doi:10.1097/BRS.0b013e31827733e7
96. Schneider M, Haas M, Glick R, Stevens J, Landsittel D. Comparison of spinal manipulation methods and usual medical care for acute and subacute low back pain: a randomized clinical trial. *Spine (Phila Pa 1976).* 2015;40:209-17. [PMID: 25423308] doi:10.1097/BRS.0000000000000724
97. von Heymann WJ, Schloemer P, Timm J, Muehlbauer B. Spinal high-velocity low amplitude manipulation in acute nonspecific low back pain: a double-blinded randomized controlled trial in comparison with diclofenac and placebo. *Spine (Phila Pa 1976).* 2013;38:540-8. [PMID: 23026869] doi:10.1097/BRS.0b013e318275d09c
98. Paatelma M, Kilpikoski S, Simonen R, Heinonen A, Alen M, Vide-man T. Orthopaedic manual therapy, McKenzie method or advice only for low back pain in working adults: a randomized controlled trial with one year follow-up. *J Rehabil Med.* 2008;40:858-63. [PMID: 19242624] doi:10.2340/16501977-0262
99. Bronfort G, Hondras MA, Schulz CA, Evans RL, Long CR, Grimm R. Spinal manipulation and home exercise with advice for subacute and chronic back-related leg pain: a trial with adaptive allocation. *Ann Intern Med.* 2014;161:381-91. [PMID: 25222385] doi:10.7326/M14-0006
100. Bronfort G, Evans RL, Maiers M, Anderson AV. Spinal manipulation, epidural injections, and self-care for sciatica: a pilot study for a randomized clinical trial. *J Manipulative Physiol Ther.* 2004;27:503-8. [PMID: 15510093]
101. Burton AK, Tillotson KM, Cleary J. Single-blind randomised controlled trial of chemonucleolysis and manipulation in the treatment of symptomatic lumbar disc herniation. *Eur Spine J.* 2000;9:202-7. [PMID: 10905437]
102. Santilli V, Beghi E, Finucci S. Chiropractic manipulation in the treatment of acute back pain and sciatica with disc protrusion: a randomized double-blind clinical trial of active and simulated spinal manipulations. *Spine J.* 2006;6:131-7. [PMID: 16517383]
103. Hoiriis KT, Pflieger B, McDuffie FC, Cotsonis G, Elsangak O, Hinson R, et al. A randomized clinical trial comparing chiropractic adjustments to muscle relaxants for subacute low back pain. *J Manipulative Physiol Ther.* 2004;27:388-98. [PMID: 15319761]
104. Chou R, Huffman L. Guideline for the Evaluation and Management of Low Back Pain: Evidence Review. Glenview, IL: American Pain Society; 2007.
105. Chou R, Huffman LH; American Pain Society. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline. *Ann Intern Med.* 2007;147:492-504. [PMID: 17909210]
106. Machado LA, Kamper SJ, Herbert RD, Maher CG, McAuley JH. Analgesic effects of treatments for non-specific low back pain: a meta-analysis of placebo-controlled randomized trials. *Rheumatology (Oxford).* 2009;48:520-7. [PMID: 19109315] doi:10.1093/rheumatology/ken470
107. Goertz CM, Pohlman KA, Vining RD, Brantingham JW, Long CR. Patient-centered outcomes of high-velocity, low-amplitude spinal manipulation for low back pain: a systematic review. *J Electromyogr Kinesiol.* 2012;22:670-91. [PMID: 22534288] doi:10.1016/j.jelekin.2012.03.006
108. Brosseau L, Wells GA, Poitras S, Tugwell P, Casimiro L, Novikov M, et al. Ottawa Panel evidence-based clinical practice guidelines on therapeutic massage for low back pain. *J Bodyw Mov Ther.* 2012;16:424-55. [PMID: 23036876] doi:10.1016/j.jbmt.2012.04.002
109. Hutchinson AJ, Ball S, Andrews JC, Jones GG. The effectiveness of acupuncture in treating chronic non-specific low back pain: a systematic review of the literature. *J Orthop Surg Res.* 2012;7:36. [PMID: 23111099] doi:10.1186/1749-799X-7-36
110. Xu M, Yan S, Yin X, Li X, Gao S, Han R, et al. Acupuncture for chronic low back pain in long-term follow-up: a meta-analysis of 13 randomized controlled trials. *Am J Chin Med.* 2013;41:1-19. [PMID: 23336503] doi:10.1142/S0192415X13500018
111. Furlan AD, Yazdi F, Tsertsvadze A, Gross A, Van Tulder M, Santaguida L, et al. Complementary and alternative therapies for back pain II. *Evid Rep Technol Assess (Full Rep).* 2010:1-764. [PMID: 23126534]
112. Hidalgo B, Detrembleur C, Hall T, Mahaudens P, Nielens H. The efficacy of manual therapy and exercise for different stages of non-specific low back pain: an update of systematic reviews. *J Man Manip Ther.* 2014;22:59-74. [PMID: 24976749] doi:10.1179/2042618613Y.0000000001
113. Ferreira ML, Smeets RJ, Kamper SJ, Ferreira PH, Machado LA. Can we explain heterogeneity among randomized clinical trials of exercise for chronic back pain? A meta-regression analysis of randomized controlled trials. *Phys Ther.* 2010;90:1383-403. [PMID: 20671101] doi:10.2522/ptj.20090332
114. Searle A, Spink M, Ho A, Chuter V. Exercise interventions for the treatment of chronic low back pain: a systematic review and meta-analysis of randomised controlled trials. *Clin Rehabil.* 2015;29:1155-67. [PMID: 25681408] doi:10.1177/0269215515570379

115. van Geen JW, Edelaar MJ, Janssen M, van Eijk JT. The long-term effect of multidisciplinary back training: a systematic review. *Spine (Phila Pa 1976)*. 2007;32:249-55. [PMID: 17224822]
116. Macedo LG, Saragiotto BT, Yamato TP, Costa LO, Menezes Costa LC, Ostelo RW, et al. Motor control exercise for acute non-specific low back pain. *Cochrane Database Syst Rev*. 2016;2:CD012085. [PMID: 26863390] doi:10.1002/14651858.CD012085
117. Saragiotto BT, Maher CG, Yamato TP, Costa LO, Menezes Costa LC, Ostelo RW, et al. Motor control exercise for chronic non-specific low-back pain. *Cochrane Database Syst Rev*. 2016;CD012004. [PMID: 26742533] doi:10.1002/14651858.CD012004
118. Toya S, Motegi M, Inomata K, Ohshiro T. Report on a computer-randomized double blind clinical trial to determine the effectiveness of the GaAlAs (830 nm) diode laser for pain attenuation in selected pain groups. *Laser Ther*. 1994;6:143-8.
119. Soriano F, Rios R. Gallium arsenide laser treatment of chronic low back pain: a prospective, randomized and double blind study. *Laser Ther*. 1998;10:175-80.
120. Basford JR, Sheffield CG, Harmsen WS. Laser therapy: a randomized, controlled trial of the effects of low-intensity Nd:YAG laser irradiation on musculoskeletal back pain. *Arch Phys Med Rehabil*. 1999;80:647-52. [PMID: 10378490]
121. Licciardone JC, Kearns CM, Minotti DE. Outcomes of osteopathic manual treatment for chronic low back pain according to baseline pain severity: results from the OSTEOPATHIC Trial. *Man Ther*. 2013;18:533-40. [PMID: 23759340] doi:10.1016/j.math.2013.05.006
122. Cleary-Guida MB, Okvat HA, Oz MC, Ting W. A regional survey of health insurance coverage for complementary and alternative medicine: current status and future ramifications. *J Altern Complement Med*. 2001;7:269-73. [PMID: 11439848]
123. Gatchel RJ, McGeary DD, McGeary CA, Lippe B. Interdisciplinary chronic pain management: past, present, and future. *Am Psychol*. 2014;69:119-30. [PMID: 24547798] doi:10.1037/a0035514
124. Hill JC, Whitehurst DG, Lewis M, Bryan S, Dunn KM, Foster NE, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *Lancet*. 2011;378:1560-71. [PMID: 21963002] doi:10.1016/S0140-6736(11)60937-9
125. Whitlock EP, Lin JS, Chou R, Shekelle P, Robinson KA. Using existing systematic reviews in complex systematic reviews. *Ann Intern Med*. 2008;148:776-82. [PMID: 18490690]
126. Abdel Shaheed C, Maher CG, Williams KA, McLachlan AJ. Interventions available over the counter and advice for acute low back pain: systematic review and meta-analysis. *J Pain*. 2014;15:2-15. [PMID: 24373568] doi:10.1016/j.jpain.2013.09.016
127. Dupeyron A, Ribinik P, Gélis A, Genty M, Claus D, Hérisson C, et al. Education in the management of low back pain: literature review and recall of key recommendations for practice. *Ann Phys Rehabil Med*. 2011;54:319-35. [PMID: 21782541] doi:10.1016/j.rehab.2011.06.001
128. Dahm KT, Brurberg KG, Jamtvedt G, Hagen KB. Advice to rest in bed versus advice to stay active for acute low-back pain and sciatica. *Cochrane Database Syst Rev*. 2010;CD007612. [PMID: 20556780] doi:10.1002/14651858.CD007612.pub2
129. Chuter V, Spink M, Searle A, Ho A. The effectiveness of shoe insoles for the prevention and treatment of low back pain: a systematic review and meta-analysis of randomised controlled trials. *BMC Musculoskelet Disord*. 2014;15:140. [PMID: 24775807] doi:10.1186/1471-2474-15-140
130. Moore RA, Derry S, Wiffen PJ. Challenges in design and interpretation of chronic pain trials. *Br J Anaesth*. 2013;111:38-45. [PMID: 23794643] doi:10.1093/bja/aet126
131. Kalauokalani D, Cherkin DC, Sherman KJ, Koepsell TD, Deyo RA. Lessons from a trial of acupuncture and massage for low back pain: patient expectations and treatment effects. *Spine (Phila Pa 1976)*. 2001;26:1418-24. [PMID: 11458142]
132. Linde K, Witt CM, Streng A, Weidenhammer W, Wagenpfeil S, Brinkhaus B, et al. The impact of patient expectations on outcomes in four randomized controlled trials of acupuncture in patients with chronic pain. *Pain*. 2007;128:264-71. [PMID: 17257756]

**Current Author Addresses:** Drs. Chou and Fu, Ms. Dana, Ms. Griffin, and Ms. Grusing: 3181 Southwest Sam Jackson Park Road, Mail Code: BICC, Portland, OR 97239.

Dr. Deyo: 3181 Southwest Sam Jackson Park Road, Mail Code: FM, Portland, OR 97239.

Dr. Friedly: 325 Ninth Avenue, Box 359612, Seattle, WA 98104.

Drs. Skelly and Hashimoto and Ms. Brodt: 705 South 9th Street, Suite 203, Tacoma, WA 98405.

Dr. Weimer: 3181 Southwest Sam Jackson Park Road, Mail Code: L-475, Portland, OR 97239.

Mr. Kraegel: University of Washington, Department of Pharmacy, Box 357630, Seattle, WA 98195.

**Author Contributions:** Conception and design: R. Chou, J. Friedly, M. Weimer.

Analysis and interpretation of the data: R. Chou, R. Deyo, J. Friedly, A. Skelly, R. Hashimoto, M. Weimer, R. Fu, T. Dana, J. Griffin, E. Brodt.

Drafting of the article: R. Chou, A. Skelly, R. Hashimoto, M. Weimer, R. Fu, J. Griffin, S. Grusing, E. Brodt.

Critical revision for important intellectual content: R. Chou, R. Deyo, J. Friedly, M. Weimer, J. Griffin.

Final approval of the article: R. Chou, R. Deyo, J. Friedly, A. Skelly, R. Hashimoto, M. Weimer, R. Fu, T. Dana, P. Kraegel, J. Griffin, S. Grusing, E. Brodt.

Statistical expertise: R. Chou, R. Fu.

Obtaining of funding: R. Chou.

Administrative, technical, or logistic support: T. Dana, P. Kraegel, J. Griffin, S. Grusing, E. Brodt.

Collection and assembly of data: R. Chou, R. Deyo, A. Skelly, R. Hashimoto, M. Weimer, T. Dana, P. Kraegel, J. Griffin, S. Grusing, E. Brodt.