New Directions for Physical Rehabilitation of Musculoskeletal Pain Conditions
Review

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Psychologically informed physical therapy for musculoskeletal pain: current approaches, implications, and future directions from recent randomized trials

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Abstract

Psychologically informed physical therapy (PIPT) blends psychological strategies within a physical therapist's treatment approach for the prevention and management of chronic musculoskeletal pain. Several randomized trials have been conducted examining the efficacy of PIPT compared to standard physical therapy on important patient-reported outcomes of disability, physical function, and pain. In this review, we examine recent trials published since 2012 to describe current PIPT methods, discuss implications from findings, and offer future directions. Twenty-two studies, representing 18 trials, were identified. The studied PIPT interventions included (1) graded activity or graded exposure (n = 6), (2) cognitive-behavioral-based physical therapy (n = 9), (3) acceptance and commitment-based physical therapy (n = 1), and (4) internet-based psychological programs with physical therapy (n = 2). Consistent with prior reviews, graded activity is not superior to other forms of physical activity or exercise. In a few recent studies, cognitive-behavioral-based physical therapy had short-term efficacy when compared to a program of standardized exercise. There is a need to further examine approaches integrating alternative strategies including acceptance-based therapies (ie, acceptance and commitment therapy or mindfulness) or internet-based cognitive-behavioral programs within physical therapy. Although PIPT remains a promising care model, more convincing evidence is needed to support widespread adoption, especially in light of training demands and implementation challenges.

Keywords: Cognitive-behavioral therapy, Musculoskeletal pain, Physiotherapy, Psychological adaptation, Rehabilitation

1. Introduction

Musculoskeletal pain remains one of the leading health complaints prompting individuals to seek medical care. Not only is musculoskeletal pain highly prevalent in both developed and developing societies,[20,62] the effects can dramatically impact quality of life. Estimates suggest that 10.6 million adults within the United States have high-impact pain conditions that result in substantial disability.[70] Musculoskeletal conditions such as low back pain, neck pain, and lower-extremity osteoarthritis are listed among the top diseases contributing to years lived with disability.[20,79] The costs associated with managing chronic pain exceeds costs for conditions such as heart disease and cancer.[27]

The problem of musculoskeletal pain is complex and there is wide recognition that the optimal management approach uses a biopsychosocial model of care.[28] Psychological factors are considered

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important risk factors for disability and pain outcomes.[4] Psychologically based treatments that target maladaptive cognitions, emotions, or behavior with physical rehabilitation through multidisciplinary team approaches are more effective than physical treatment alone.[41] However, substantial barriers including access and cost may prevent some patients from receiving this type of care.[67] To address these barriers, recent efforts have focused on training nonpsychologist practitioners to integrate psychological strategies within primary care for prevention and management of chronic pain.[9,14,57]

Psychologically informed physical therapy (PIPT) is an approach initially advocated by Main and George in a 2011 *Physical Therapy* article.[56] Psychologically informed physical therapy represents a multimodal rehabilitation approach for pain that incorporates behavioral strategies from the mental health realm into physical therapist practice. This integrated form of pain management by a physical therapist is a marked shift in how therapy is commonly delivered. Although most physical therapists would accept the central principles of PIPT and recognize the importance of mitigating psychosocial risk,[21] there may be challenges in delivering PIPT in everyday practice. As an initial step towards PIPT implementation, efficacy of this approach should be clearly established.

To date, there have been several systematic reviews around the topic of PIPT.[1,17,33,75,90] These prior reviews have summarized studies focused on different pain conditions (ie, postoperative pain, general musculoskeletal pain, and low back pain) and using a range of PIPT delivery modes (ie, in-person, group-based, and remotely delivered) and control groups (ie, no/minimal treatment, attention control, education, and usual care). Most of the prior studies reviewed have included a PIPT intervention based on cognitive-behavioral approaches. Two meta-analyses by Silva Guerrero et al.[75] and Wilson and Cramp[90] demonstrate that PIPT has a small, but significant, effect on improving physical function, disability, and pain compared to standard physical therapy. In the meta-analysis by Wilson and Cramp,[90] the authors included interventions where the psychological component could be delivered by either a psychologist or physical therapist. This may limit applicability of the review findings to PIPT if adhering to the description by Main and George.

The primary aim and scope of this narrative review was to build upon existing reviews and examine evidence since the publication of Main and George[56] on PIPT vs standard physical therapy approaches for musculoskeletal pain. We modeled our approach similar to the high-quality review by Silva Guerrero et al.[75] by focusing on studies that compare interventions that include psychological strategies delivered by physical therapists to standard physical therapy. Summarizing studies that compare PIPT to standard physical therapy would help establish the transformative value of PIPT. Important advancements to the review by Silva Guerrero et al.[75] involve the inclusion of more recent studies after 2016 and greater description of the individual studies and interventions. Specifically, we aimed to categorize the types of psychological interventions used, report on aspects of dosage and training, and discuss clinical implications and future directions. Our hope is that this review describing recent PIPT methods and data will inspire continued efforts to optimize pain rehabilitation.

2. Methods

The recent peer-reviewed literature was screened by the first author for randomized trials published after 2012 examining the efficacy or effectiveness of PIPT. A P-I-C-O-S strategy was used to guide the literature search.[64] We aimed to review studies that (1) examined adult patients with musculoskeletal pain (Population), (2) included a PIPT intervention delivered by a physical therapist (Intervention), (3) compared PIPT to standard physical therapy (eg, individual in-person exercise, manual therapy, or usual physical therapy care) (Comparator), (4) measured disability, physical function, or pain as an outcome (Outcome), and (5) used a randomized controlled trial design (Study design). Psychologically informed physical therapy search terms combined "psychotherapy," "psychologically informed," "psychological based," "cognitive behavioral," "acceptance and commitment," "mindfulness," and "psychological strategies" with "rehabilitation," "physical therapy," and "physiotherapy." For the purpose of this review of summarizing behavioral change interventions, studies investigating education interventions for pain as the primary treatment component were not considered for inclusion. PubMed, CINAHL, and PsycINFO databases were searched (see Appendix Tables 1–3 for search results, available at http://links.lww.com/PR9/A79). Database results and reference lists from prior systematic reviews and studies were screened. Two independent raters (R.A.C. and H.M.) graded relevant studies using the PEDro scale for randomized trial quality.[18,55] We summarized PIPT intervention methods and outcome findings.

3. Results

A total of 943 unique articles from the literature search were screened, with 73 article full-texts being evaluated. Of these, 22 studies representing 18 randomized trials on PIPT were included in this review (see Appendix Table 4 for exclusions, available at http://links.lww.com/PR9/A79). The majority of trials were graded as having good to excellent methodological quality (PEDro scores >6/10) (**Table 1**), except for studies by Bello

Table 1

Methodological quality of studies.

Study	1*	2	3	4	5	6	7	8	9	10	11	PEDro score†
Ariza-Mateos et al.[3]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Bello et al.[8]	Y	Y	Y	N	N	N	Y	N	Y	Y	Y	6
Bennell et al.[12]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Bennell et al.[10]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Godfrey et al.[32]	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Hunt et al.[40]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Khan et al.[43]	Y	Y	Y	Y	N	N	N	Y	N	Y	Y	6
Lee et al.[44]	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Ludvigsson et al.[49]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Macedo et al.[50]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Magalhaes et al.[54]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Monticone et al.[61]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Petrozzi et al.[69]	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	9
Reid et al.[72]	Y	Y	N	Y	N	N	Y	N	N	Y	Y	5
Sterling et al.[76]	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Thompson et al.[77]	Y	Y	Y	Y	N	N	N	N	N	Y	Y	5
van Erp et al.[81]	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Vibe Fersum et al.[82]	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	6

* Item 1 is not included in total score.

† PEDro scores of 7/10 or greater are considered good to excellent methodological quality.

N, no (item not met); Y, yes (item met).

PEDro items: 1, eligibility criteria were specified; 2, subjects were randomly allocated to groups; 3, allocation was concealed; 4, groups were similar at baseline regarding the most important prognostic indicators; 5, blinding of all subjects; 6, blinding of all therapists who administered therapy; 7, blinding of all assessors who measured at least one outcome; 8, measures of at least one key outcome were obtained from more than 85% of subjects initially allocated to groups; 9, all subjects for whom outcome measures were available received the treatment or control condition as allocated, or where this was not the case, data for at least one key outcome were analyzed by "intention to treat"; 10, results of between-group statistical comparisons are reported for at least one key outcome; 11, study provides both point measures and measures of variability for at least one key outcome.

et al.,[8] Khan et al.,[43] Reid et al.,[72] Thompson et al.,[77] and Vibe Fersum et al.[82] Lower-quality scores in these studies were due to weaknesses in concealed allocation, similarity in groups at baseline, masking of outcome assessment, follow-up rates, or intent-to-treat analysis. As expected, most studies were unable to mask participants or therapists.

The conditions studied included chronic low back pain (n = 8), chronic neck pain (n = 2), chronic knee osteoarthritis (n = 2), chronic whiplash-associated disorder (n = 1), chronic hip osteoarthritis (n = 1), chronic pelvic pain (n = 1), acute whiplash-associated disorder (n = 1), acute or subacute low back pain (n = 1), and mixed musculoskeletal pain (n = 1). No studies involving patients undergoing surgery for musculoskeletal pain met our eligibility criteria. Across all studies, the sample size ranged from 20 to 588 patients and the average age of patients ranged from 37.3 to 73.0 years. Follow-up outcome durations ranged from immediate postintervention assessment to 3 years. We categorized PIPT interventions based on the primary psychological strategy: (1) graded activity or graded exposure, (2) cognitive-behavioral-based physical therapy, (3) acceptance and commitment-based physical therapy, and (4) internet-based psychological programs.

3.1. Graded activity or graded exposure

Graded activity and graded exposure are behavioral strategies informed by an operant conditioning paradigm, which emphasizes the reinforcement of target behaviors through learned consequences. These interventions are derived from the Fear-Avoidance Model of Musculoskeletal Pain, which identifies primary cognitive and affective processes that influence the perception and maintenance of pain.[45,86] Specifically, *pain-related fear* (viewing pain as threatening) and *pain catastrophizing* (the tendency for patients to exaggerate, focus on, or magnify the threat or seriousness of pain) interact to determine how a patient responds behaviorally to pain, either through avoidance or activity engagement.[71] For those who avoid pain or pain-related stimuli, the absence of pain reinforces the avoidant behavior. When used as a primary coping mechanism, fear-avoidance can lead to hypervigilance, disuse, and increased disability.[23,30]

Graded activity and exposure directly address avoidance by supporting a patient through repeated engagement in specific (sometimes feared) physical activities or tasks in a paced, collaborative, and goal-directed manner. These behavioral techniques can be easily embedded within a physical therapy episode of care.[29] For graded activity, target activities (or exercises) are selected based on a patient's report of difficulty, chief complaints, or relevance to the pain condition. After establishing a baseline tolerance level, specific activities are performed on a time- or intensity-contingent basis (eg, quota) rather than on a patient's pain response. Positive reinforcement is provided when quotas are reached. The primary goals of graded activity are to increase the patient's tolerance to specific activities that are meaningful to daily functioning and to promote healthy behaviors. Through approaching increased activity, patients also learn to "confront" previously avoided behaviors, thus breaking the reinforcing cycle of fear-avoidance-pain.[86]

Five trials examined graded activity against a standard physical therapy group (**Table 2**). Results from 4 trials by Bello et al.,[8] Khan et al.,[43] Macedo et al.,[50] and Magalhaes et al.[52,54] among patients with chronic low back pain suggest that a course of graded activity does not result in significantly greater short-term (<6 months) or long-term (>1 year) improvements in disability, physical function, or pain compared to other forms of supervised exercise. Likewise, for patients with chronic whiplash-associated disorder, Ludvigsson et al.[48,49,66] showed no difference in outcomes up to 2 years after a 12-week graded activity program or 12 weeks of progressive neck strengthening. In these trials, varying levels of additional pain strategies such as oral or booklet pain education and basic coping skills training were provided within the graded activity intervention group. Therapists delivering the intervention received varying levels of graded activity training from "brief" sessions to 2-day and 4-day workshops. The prescribed dosage (eg, frequency and duration) of the intervention and control groups was matched in all trials.

Graded exposure specifically targets activities or tasks that a patient is fearful of due to perceived risks of harm or the pain-related fear that contributes to avoidant behavior.[84,85] Patients work with a physical therapist to initially rate their level of fear toward these activities. Patients work in treatment to progressively approach or "confront" feared stimuli in a hierarchical model. Graded exposure proceeds with activities that elicit the least amount of fear and after task mastery, progresses towards those that are most feared. Progression within graded exposure occurs based on changes in fear after exposure, where patients learn that fears may be exaggerated,[30] or a sense of mastery and increased self-efficacy to approach previously avoided tasks. There are 2 mechanisms underlying graded exposure: (1) behavioral mechanism based on habituation to feared stimulus and positive reinforcement for successful completion, and (2) cognitive mechanism based on disconfirmation of fear-based predictions leading to cognitive restructuring. In a trial by Ariza-Mateos et al.[3] among patients with chronic pelvic pain, graded exposure added to manual therapy resulted in greater short-term improvement in disability and pain compared to a manual therapy alone (**Table 2**). An introductory session of pain education was included as part of the graded exposure intervention. Therapist training was not described; however, the provider who delivered graded exposure was experienced with the approach. In terms of dosage, patients received graded exposure as an additional weekly 45-minute session of therapy over the 6-week period in addition to the manual therapy sessions.

3.2. Cognitive-behavioral-based physical therapy

Cognitive-behavioral therapy (CBT) is a widely known and effective psychological intervention for chronic pain.[89] The premise of CBT is that cognitive and behavioral factors, including a person's thoughts, beliefs, and actions, play a key role in the development or maintenance of chronic pain.[78] Cognitive-behavioral therapy provides patients with a repertoire of techniques to improve self-management of pain, enhance patient confidence in their ability to manage pain, and increase perceived control over pain.[5] Cognitive-behavioral therapy techniques aim to identify and decrease maladaptive behaviors, bolster positive coping, address dysfunctional thoughts and beliefs influencing pain, and increase confidence in pain self-management. Although specific techniques vary from clinician-to-clinician, components typically include elements of education, skill training (ie, goal setting, activity pacing, relaxation techniques [eg, deep breathing] or distraction, and problem solving), and skill application and maintenance in the patient's daily life.[24]

Nine trials examined a cognitive-behavioral-based physical therapy approach (**Table 3**). There was a range of CBT components across the physical therapy interventions, with most including education, goal setting, problem solving, and pain-coping skills. In all trials, physical therapists were trained to deliver the psychological-based intervention—mostly through workshop format and some offering ongoing supervision or feedback from a

Table 2

Summary of recent graded activity or exposure studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
Ariza-Mateos et al.[3]	49 female patients with chronic pelvic pain Mean age: 41.9 years	*Graded exposure therapy and manual therapy* included manual therapy, pain education, and activity-based treatment focused on the patient's 5 most fearful tasks. Patients were exposed to tasks based on least to most fearful. Progressions were based on within-session changes in fear. Patients performed graded exposure for a single 45-minute session each week for 6 weeks. Patients in this group also received manual therapy similar to control group.	*Manual therapy* was performed to decrease pain or tension, increase motion, or improve balance or stability. Manual therapy included soft tissue mobilization, myofascial release, deep pressure massage, and muscle energy techniques. Patients received manual therapy for 45 minutes, 2 times per week, and for 6 weeks.	Disability: ODI Pain interference: BPI Pain intensity: BPI measured at 6 weeks and 3 months	There was a significant difference in postintervention and 3-month disability, with lower disability scores after graded exposure therapy. There was a significant difference in 3-month pain, with lower pain scores after graded exposure therapy.
Bello et al.[8]	62 patients (31 females) with chronic low back pain Mean age: 44.0 years	*Graded activity* included individualized, submaximal, and gradually increased performance of activities (exercises) based on patient's baseline complaints or limitations. Graded activity exercises included general strengthening and aerobic activity and were directed based on quotas. Pain education and self-management strategies were also provided. Patients performed graded activity for 45 minutes, 2 times per week, and for 12 weeks.	*Conventional exercise* included stretching, strengthening, and core stabilization. Physical therapists could also include lumbar traction, massage, and nonmanipulative therapy. Patients performed exercise for 45 minutes, 2 times per week, and for 12 weeks.	Physical function: RAND-36 Pain intensity: NRS (0–10) Bodily pain: RAND-36 Measured at 4, 8, and 12 weeks	No significant differences in physical function, pain intensity, or bodily pain between groups were observed.
Khan et al.[43]	54 patients (29 females) with chronic low back pain Mean age: 39.6 years	*Graded activity* included operant behavioral graded activity, problem-solving training, and general exercises. Graded activity involved gradual increase or pacing of activities that were important to patients with education to modify dysfunctional beliefs. General exercises included low back and lower-extremity stretching and aerobic activity. Patients attended 3 sessions per week for 12 weeks.	*General exercise* included the same general exercise program as the cognitive-behavioral-based physical therapy group. Patients attended 3 sessions per week for 12 weeks.	Disability: RMDQ Pain intensity: VAS (0–10) Measured at 12 weeks	No between-group statistical differences were reported. Both groups showed significant improvements in disability and pain.
Ludvigsson et al.[48,49] and Overmeer et al.[66]	216 patients (142 females) with chronic whiplash-associated disorder Mean age: 40.4 years	*Graded activity and basic behavioral training* included the same group of exercises as the exercise group, but the exercises were not based on symptom (pain) response. An operant-conditioning behavioral approach (graded exercise) was used. Physical therapists delivered pain education and facilitated pain management and problem-solving strategies. Patients were encouraged to practice skills at home. The graded exercise and basic behavioral training lasted 12 weeks.	*Exercise* included progressive motion and strengthening exercises for the neck region. Exercises were guided based on symptom response and capability. Additional exercises could include back, abdomen, and scapula strengthening or stretching. The exercise intervention lasted 12 weeks.	Disability: NDI, PDI Physical function: PSFS Pain intensity: VAS (0–100) Pain Bothersomeness: VAS (0–100) Measured at 3 and 6 months, and 1 and 2 years	No significant differences in disability, physical function, or pain intensity between the behavioral-based exercise and exercise group were observed.

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Table 2 (*continued*)

Summary of recent graded activity or exposure studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
Macedo et al.[50]	172 patients (102 females) with chronic low back pain Mean age: 49.2 years	*Graded activity* included individualized and submaximal exercises that were progressed on a time-contingent manner (eg, daily quotas) and through goals set by the patient and therapist. The exercises were based on activities patients reported as problematic due to back pain. Additional cognitive-behavioral strategies were used by the physical therapists and included positive reinforcement, pain education, addressing negative behaviors or anxiety, and managing relapses. Patients attended twelve 1-hour sessions over 8 weeks and 2 booster sessions at 4 and 10 months.	*Motor control exercise* was focused on motor control principles and aimed at regaining control and coordination of the spine and pelvis. Exercises were selected based on impairments and patient goals. A thorough movement-based assessment was performed to examine movement patterns, posture, and activation. Specific motor control exercises were prescribed, and manual or ultrasound feedback was used to enhance learning for proper performance. Exercises were progressed based on symptom response (pain) and towards functional activity. Patients attended twelve 1-hour sessions over 8 weeks and 2 booster sessions at 4 and 10 months.	Disability: RMDQ Physical function: PSFS Physical health: SF-36 Pain intensity: NRS (0–10) Measured at 2, 6, and 12 months	No significant differences in disability, physical function, or physical health between groups were observed.
Magalhaes et al.[52,54]	66 patients (49 females) with chronic low back pain Mean age: 46.9 years	*Graded activity* included progressive and submaximal aerobic and strengthening exercises aimed at improving physical fitness and stimulating change in behavior and attitude. Exercises were selected based on patient report of difficulty, prescribed based on moderate level of activity, and progressed on a time-contingent basis. Patients also received an educational booklet. Patients attended twelve 1-hour sessions, twice per week, for 6 weeks.	*Exercise* included back and lower-extremity stretching, abdominal strengthening, and motor control exercises. No other cointerventions such as manual therapy were included. Patients attended twelve 1-hour sessions, twice per week, for 6 weeks.	Disability: RMDQ Physical function: SF-36 Pain intensity: NRS (0–10) Pain quality: MPQ Measured at 6 weeks, and 3 and 6 months	No significant differences in disability, physical function, pain intensity, or pain quality between groups were observed.

BPI, Brief Pain Inventory; MPQ, McGill Pain Questionnaire; NDI, Neck Disability Index; NRS, Numeric Rating Scale; ODI, Oswestry Disability Index; PDI, Pain Disability Index; PIPT, psychologically informed physical therapy; PSFS, Patient Specific Functional Scale; RMDQ, Roland Morris Disability Questionnaire; VAS, visual analog scale.

psychologist. Four trials compared cognitive-behavioral-based physical therapy to standardized exercise,[10,40,76,77] whereas 5 trials compared to a multimodal (eg, manual therapy and exercise) or pragmatic rehabilitation program.[44,61,72,81,82]

Five trials reported no difference between the cognitive-behavioral-based physical therapy group compared to control.[40,44,61,72,81] Of these 5 trials, 4 trials included a control group of multimodal or pragmatic rehabilitation,[44,61,72,81] whereas the remaining trial was a small pilot study.[40] In the small pilot study of 20 patients, Hunt et al.[40] established the feasibility of a pain-coping skills training program that was later tested in a larger randomized trial. In trials by Lee et al.[44] and Reid et al.,[72] the cognitive-behavioral intervention was developed for utilization within distinctive settings of work rehabilitation and home health care, respectively.

Studies by Bennell et al.,[10] Sterling et al.,[76] Thompson et al.,[77] and Vibe Fersum et al.[82,83] showed greater efficacy after cognitive-behavioral-based physical therapy for an outcome of function, disability, or pain. Bennell et al.[10] and Thompson et al.[77] showed greater short-term efficacy compared to a standard therapy group, whereas Sterling et al.[76] and Vibe Fersum et al.[82,83] reported greater efficacy in disability and pain at 1 year (or longer for Vibe Fersum et al.). In a 3-arm randomized trial by Bennell et al.,[10] a 12-week, 10-session pain-coping skills training program combined with exercise resulted in greater effects on physical function up to 32 weeks compared to a group consisting of exercise alone for patients with knee osteoarthritis. There were duration differences between groups, with the pain-coping skills and exercise sessions lasting 70 minutes per session and the exercise only group lasting 25 minutes per session. Therapist training for delivering the pain-coping skills intervention was rigorous involving a 4-day workshop, therapist accreditation, ongoing supervision, and feedback provided by an experienced psychologist.

Sterling et al.[76] and Thompson et al.[77] examined a cognitive-behavioral-based physical therapy intervention for patients with cervical spine conditions. Sterling et al.[76] provided 10 sessions over 6 weeks of stress inoculation training—a cognitive-behavioral approach focused on helping patients manage

Table 3

Summary of recent cognitive-behavioral-based physical therapy studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
Bennell et al.[10]	222 patients (133 females) with chronic knee osteoarthritis Mean age: 63.4 years	*Pain-coping skills training* involved 10 physical therapist-delivered modules covering pain education and cognitive and behavioral pain-coping skills and application. Pain-coping skills included activity-rest cycling, pleasant activity scheduling, problem solving, addressing negative thoughts, pleasant imagery, counting backwards, and auditory stimulation. Patients were encouraged to practice skills. Patients attended 10 individual sessions over 12 weeks. Each session lasted 45 minutes. *Pain-coping skills training and exercise* (as described in other groups) were integrated. Patients attended 10 individual sessions over 12 weeks. Each session lasted 70 minutes.	*Exercise* included 6 strengthening exercises for the lower-extremity muscles. Patients were provided weights, elastic bands, and handouts for home use. Patients were instructed to perform exercises 4 times per week for 12 weeks and 3 times per week thereafter. Patients attended 10 individual sessions over 12 weeks. Each session lasted 25 minutes.	Physical function: WOMAC function Pain intensity: VAS (0–100) Pain: WOMAC pain Measured at 12, 32, and 52 weeks	The combined pain-coping skills training and exercise group showed greater improvement in physical function at 12 and 32 weeks compared to exercise. At 12 weeks, there were no significant differences between groups for overall pain intensity. However, the pain-coping skills training and exercise showed greater reductions in walking pain intensity than exercise. At 32 weeks, the combined group also showed greater improvement in pain intensity and WOMAC pain.
Hunt et al.[40]	20 patients (12 females) with chronic knee osteoarthritis Mean age: 62.5 years	*Pain-coping skills training and exercise* included a combined intervention of online pain-coping modules and home exercises. Pain-coping skills training involved 10 physical therapist-delivered modules covering pain education and cognitive and behavioral pain-coping skills and application. Pain-coping skills included activity-rest cycling, pleasant activity scheduling, problem solving, addressing negative thoughts, pleasant imagery, counting backwards, and auditory stimulation. Exercises included 6 strengthening exercises for the lower-extremity muscles and a preplanned walking program. Patients were provided weights, elastic bands, and handouts for home use. Patients attended 10 weekly individual sessions for pain-coping skills training and exercise.	*Nondirective counseling and exercise* included the same exercise intervention as the pain-coping group. In addition, patients participating in open discussions with the therapist to discuss any osteoarthritis-related problems. Specific advice was not provided by the therapist. Patients attended 10 weekly individual sessions for nondirective counseling and exercise.	Physical function: WOMAC function Pain intensity: NRS (0–10) Pain: WOMAC pain Measured at 11 weeks	No significant differences in physical function or pain between groups were observed.
Lee et al.[44]	47 patients (23 females) with acute or subacute low back pain Mean age: 37.3 years	*Cognitive-behavioral-based work rehabilitation* included a physical therapy program focused on physical function and based on cognitive-behavioral principles. Treatment included graded activity, pacing techniques, work conditioning, return to work goal setting, self-management, job analysis, and ergonomics. Cognitive-behavioral-based work rehabilitation could last up to 3 months.	*Work rehabilitation* included conventional individual physical therapy based on symptom presentation and response. Treatment could include a combination of modalities (interferential therapy, transcutaneous electrical nerve stimulation, traction), manual therapy, and exercise. Work rehabilitation could last up to 3 months.	Disability: RMDQ, ODI Pain intensity: NRS (0–10) Measured at discharge	No significant differences in disability or pain intensity between groups were observed.
Monticone et al.[61]	80 patients (60 females) with chronic neck pain Mean age: 49.6 years	*Cognitive-behavioral-based physical therapy* involved the same multimodal exercise program as the physical therapy group. In addition, physical therapists included	*Physical therapy* included a multimodal approach of active and passive mobilization, postural control, stretching and strengthening exercise, and ergonomic advice.	Disability: NPDS Physical function: SF-36 Pain intensity: NRS (0–10) Measured at 3 and 12 months	No significant differences in disability, physical function, or pain intensity between groups were observed.

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Table 3 (*continued*)

Summary of recent cognitive-behavioral-based physical therapy studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
		cognitive-behavioral strategies to address patient beliefs, thoughts, and behaviors. Strategies included graded activity, addressing escape and avoidance behaviors, pain and fear-avoidance model education, coping and pacing skills, and graded exposure. Patients attended up to twelve 45–50-minute individual sessions, scheduled once or twice per week, for a maximum of 12 weeks.	Patients were discouraged to receive other pain management treatments (ie, pain medication, physical modalities). Patients attended up to twelve 45–50-minute individual sessions, scheduled once or twice per week, for a maximum of 12 weeks.		
Reid et al.[72]	588 patients (410 females) with mixed musculoskeletal pain Mean age: 73.0 years	*Cognitive-behavioral-based physical therapy* included a 5-session cognitive-behavioral self-management program that was implemented within home care physical therapy. The sessions focused on topics including pain theory, becoming more active, relaxation, deep breathing, imagery, pleasant activity scheduling, activity pacing, sleep tips, and managing flare ups. Patients were provided a booklet reinforcing program content and encouraged to practice techniques on their own. Home care was delivered in a pragmatic manner under the direction of the physical therapist.	*Physical therapy* included pragmatically delivered care within the patient's home. Physical therapists completed a comprehensive functional assessment and evaluation of psychological functioning, home environment, and use or need of assistive devices. A treatment plan was generated and exercise was prescribed to increase strength, reduce fall risk, and improve motion, gait, transfer skills, balance, coordination, and functioning. Home care was delivered in a pragmatic manner under the direction of the physical therapist.	Disability: RMDQ Physical function: Functional status scale Pain intensity: NRS (0–10) Measured at 60 days	No significant differences in disability, physical function, or pain intensity between groups were observed.
Sterling et al.[76]	108 patients (67 females) with acute whiplash-associated disorder Mean age: 41.3 years	*Stress inoculation training and exercise* combined 6 sessions of cognitive-behavioral-based training with the same 6-week exercise program as the exercise group. Stress inoculation training facilitated problem solving and coping strategies for managing stress-related anxiety. Physical therapists taught patients strategies to identify and understand stress, develop skills for managing stress, and apply skills in different situations. Patients attended ten 50-minute sessions over a 6-week period for stress inoculation training and exercise.	*Exercise* included progressive, individualized exercises to improve movement, strength, and endurance of the neck and shoulder girdle region, and to improve eye/hand coordination. Physical therapists also provided advice on return to normal activities and aerobic exercise. Manual therapy was allowed at the therapist's discretion. Patients attended ten 50-minute exercise sessions over a 6-week period.	Disability: NDI Physical health: SF-36 Pain intensity: NRS (0–10) Measured at 6 weeks, and 6 and 12 months	The stress inoculation training and exercise group showed greater improvement in disability and pain intensity at all time points after intervention. There was no significant difference in physical health between groups.
Thompson et al.[77]	57 patients (26 females) with chronic neck pain Mean age: 47.5 years	*Cognitive-behavioral intervention and exercise* included the same exercise program as the exercise group and an IBMT. The program aimed to reduce catastrophizing and pain-related fear and improve self-efficacy through interactive sessions challenging unhelpful thoughts, emotions, and beliefs. Physical therapists facilitated cognitive-behavioral strategies such as goal setting and problem solving. The	*Exercise* included progressive, higher-intensity neck exercises to improve strength, mobility, and endurance. Exercises included cervical isometrics, resisted motion, and stretching. Written information describing that there was no serious cause of neck pain and outlining chronic cycle of neck pain was provided to patients. Patients attended four 40-minute weekly sessions.	Disability: NPQ Pain intensity: NRS (0–10) Measured at 6 months	There was no significant difference in postintervention disability between groups. The cognitive-behavioral groups showed a greater reduction in pain intensity.

(*continued on next page*)

Table 3 (*continued*)

Summary of recent cognitive-behavioral-based physical therapy studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
		cognitive-behavioral intervention was delivered in small groups. Patients attended four 90-minute weekly sessions for the cognitive-behavioral intervention and exercise.			
van Erp et al.[81]	25 patients (14 females) with chronic low back pain Mean age: 44.0 years	*Cognitive-behavioral-based physical therapy* included a structured 12 session program (Back on Track) that stimulated patients to gain insight on pain mechanisms, behavior and beliefs, coping styles, goal setting, and self-management strategies. Graded activity and exposure were also included. Patients received a workbook with homework assignments. Patients attended four 30-minute individual sessions and eight 60-minute group sessions.	*Physical therapy* included individualized physical therapy based on best practices and guidelines for low back pain. Therapeutic strategies included manual therapy, core stability, and back strengthening. Physical therapists directed the frequency, duration, and content of sessions. Patients attended a maximum of 12 sessions of physical therapy.	Disability: QBPDS Pain intensity: NRS (0–10) Measured at postintervention and 3 months	No significant differences in disability or pain intensity between groups were observed.
Vibe Fersum et al.[82,83]	121 patients (63 females) with chronic low back pain Mean age: 41.5 years	*Classification-based cognitive functional therapy* was an individualized classification approach that addressed cognitive, movement, and lifestyle behaviors. Physical therapists based targeted strategies on the patient's initial presentation and psychosocial risk. Four components of the treatment included cognitive, specific movement, targeted functional integration, and physical activity. Cognitive strategies within the intervention included pain and fear-avoidance education, problem solving, goal setting, reflective communication, self-management, functional enhancement, and goal orientation. Patients attended weekly sessions for the first 2–3 weeks and then 1 session every 2–3 weeks for the 12-week duration.	*Manual therapy and exercise* included spine or pelvis manipulation or mobilization, general exercise, and/or motor control exercise. Inclusion of particular techniques or exercises, and dosage of procedures was based on the discretion of the treating therapist. Patients attended a 1-hour initial evaluation and 30-minute follow-up sessions.	Disability: ODI Pain intensity: NRS (0–10) Measured at 12 weeks, 12 months, and 3 years	There were significant differences in disability and pain at 12 weeks and 12 months between groups, with lower disability and pain scores after cognitive functional therapy. There was a significant difference in disability at 3 years between groups, with lower disability scores after cognitive functional therapy. No significant differences in pain between groups at 3 years were observed.

IBMT, interactive behavioral modification program; NDI, Neck Disability Index; NPDS, Neck Pain and Disability Scale; NPQ, Northwick Park Questionnaire; NRS, Numeric Rating Scale; ODI, Oswestry Disability Index; QBPDS, Quebec Back Pain Disability Score; PIPT, psychologically informed physical therapy; RMDQ, Roland Morris Disability Questionnaire; VAS, visual analog scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

stress-related anxiety—to patients with acute whiplash-associated disorder and found greater treatment efficacy in disability and pain up to 1 year. The target sample was patients at risk for poor recovery with moderate disability (based on Neck Disability Index) and hyperarousal symptoms (based on Post-traumatic Stress Diagnostic Scale) at initial presentation. Duration was matched at 50-minute sessions for both stress inoculation with exercise and exercise alone groups. Similar to the study by Bennell et al.,[10] Sterling et al.[76] used a psychologist and physician-led workshop, therapist accreditation, and a training booster session. Thompson et al.[77] combined interactive behavioral modification therapy with progressive exercises for patients with chronic neck pain. Thompson et al.[77] did not find differences in disability between the interactive behavioral modification therapy with exercise and exercise groups but did report greater pain reduction in the intervention group. Patients in the behavioral therapy group required more time with physical therapists (90 minutes per session) compared to the exercise group (40 minutes per session). Specific training for the interactive behavioral modification therapy was not described; however, therapists who delivered this intervention were reported to have prior experience in delivering pain management programs.

Vibe Fersum et al.[82,83] examined a 12-week classification-based cognitive functional therapy approach for chronic low back pain. The distinction with this method compared to previously mentioned PIPT approaches is the use of a classification system. In this system, patient characteristics were used to inform the specific strategies implemented within treatment, providing a targeted or tailored therapy approach. The cognitive functional therapy intervention included 4 components targeting cognitive, specific movement, functional integration, and physical activity. Compared to manual therapy and exercise, patients receiving classification-based cognitive functional therapy showed greater improvement in disability and pain up to 1 year. A follow-up study

by Vibe Fersum et al.[83] reported that group differences persisted at 3 years for disability, but not pain intensity. Total number and duration of sessions were similar for each group. Physical therapists delivering the cognitive functional therapy had substantial training and experience (eg, average of 106 hours of training) in this method.

3.3. Acceptance and commitment-based physical therapy

As can be seen from the previous studies, CBT has been the prime intervention underlying PIPT. This is largely based on the evidence of effectiveness for CBT in chronic pain.[89] Acceptance and commitment therapy (ACT) is a "third wave" cognitive-behavioral intervention initially developed for psychological disorders.[59,74] However, ACT has a growing evidence base for addressing chronic pain.[39] Acceptance and commitment therapy uses techniques including mindfulness, acceptance, and behavioral change strategies to increase internal flexibility and help patients reconnect with core values to lead more fulfilling lives in the presence of chronic pain.[39] Recognizing that some aspects of the chronic pain experience cannot be altered, ACT shifts focus on pain or symptom reduction towards promoting "acceptance" and simultaneous patient achievement of value-oriented goals such as improved physical functioning. The aim of ACT is to reduce experiential avoidance (avoiding unwanted sensations, thoughts, and emotions) and promote psychological flexibility through openness (acceptance and cognitive defusion [seeing thoughts as mental events that come and go, without letting them drive behavior]), awareness (present-moment contact and self-as-context [being able to observe internal experiences without identifying with them]), and activity engagement (clarifying values and committed action).[25]

One study by Godfrey et al.[32] has evaluated a physical therapy approach informed by acceptance and commitment therapy (PACT) (**Table 4**). The PACT intervention was a brief intervention spanning 3 individual visits (eg, two 1-hour in-person visits and one 20-minute telephone session) over 1 month. The strategies implemented within PACT aimed to promote self-management and psychological flexibility.[31] Specific strategies included shifting focus, value-based goal setting and adjustment, mindfulness exercises, action plans, identification of support system, and skills application. At 3 months, patients receiving PACT compared to usual physical therapy had greater improvement in disability, physical function, and physical health. This difference was not maintained at 1 year. There was no difference in pain intensity ratings between groups at any time point, which could be expected, given the PACT focus on functioning as opposed to reductions in pain. Physical therapists involved in delivering PACT were initially trained in a 2-day workshop led by psychologists with expertise in ACT and were required to apply the intervention with practice patients.[31,32] Workshop training involved education, experiential exercises, role playing, and problem solving. Supervision, feedback, and assessment of skill were provided by the team of trainers and further training was delivered as needed. Qualitative reports by the physical therapists indicated that PACT was feasible and acceptable. Although adherence to PACT was high, Godfrey et al.[53] noted that only a few ACT methods were delivered by physical therapists across sessions. The total mean total duration of therapy time was marginally less than usual physical therapy (2 hours compared to 3 hours).

3.4. Internet-based psychological programs and physical therapy

The advanced training and clinic session time required to deliver specific CBT or ACT-based strategies are potential barriers to PIPT implementation. Moreover, physical therapists may struggle with delivering psychological strategies because these may be perceived as out of their scope of practice or comfort level.[6] Internet-based psychological programs (or applications) for pain offer a potential solution for providing PIPT in a more scalable manner, especially when integrated with therapy.[11] Several widely available programs exist and have been presented in the literature.

Two studies have examined the efficacy of combining internet-based psychological programs with physical therapy (**Table 5**). Petrozzi et al.[69] randomized patients undergoing physical therapy (or chiropractic care) to receive access to MoodGYM—a free, noncondition-specific, 5-module CBT-based program that addresses patient's thoughts, feelings, and stressors. The authors reported no added benefit of including MoodGYM above what was reported by patients receiving physical therapy alone.[69] It is possible that the lack of specificity of the program or poor adherence, which was not objectively tracked in the trial, could have impacted findings. In addition, MoodGYM was not integrated as part of clinical treatment. In other words, providers did not seem to reinforce program content or help patients apply the skills learned. This was a similar approach taken by Bennell et al.[12] who had patients' access and complete PainCOACH, an interactive 8-module program emphasizing pain-coping skills, before undergoing a standard exercise program for hip pain. Similar long-term clinical outcomes were observed compared to

Table 4

Summary of recent acceptance and commitment-based physical therapy studies.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
Godfrey et al.[32]	248 patients (147 females) with chronic low back pain Mean age: 47.9 years	*PACT* was a self-management promoting intervention that included two 1-hour in-person treatment sessions (2 weeks apart) and one 20-minute phone call (1 month later). PACT included an initial physical assessment, identification of value-based goals, individualized exercise, addressing of self-management barriers and facilitators, and psychological flexibility skills training. No manual therapy was included.	*Physical therapy* included standard physical therapy treatment that could include individual physical therapy or back rehabilitation classes, dynamic control classes, manual therapy, or hydrotherapy. Physical therapy was directed by the providing physical therapists.	Disability: RMDQ Physical function: PSFS Physical health: SF-12 Pain intensity: NRS (0–10) Measured at 3 and 12 months	The PACT group showed greater improvement in disability and physical function compared to physical therapy at 3 months. No significant differences were noted at 12 months In addition, there were no differences in pain between groups at 3 or 12 months.

NRS, numeric rating scale; PACT, physical therapy approach informed by acceptance and commitment therapy; PIPT, psychologically informed physical therapy; PSFS, Patient Specific Functional Scale; RMDQ, Roland Morris Disability Questionnaire.

Table 5

Summary of PIPT studies with use of internet-based programs.

Study	Sample	PIPT intervention	Standard PT intervention	Outcomes	Summary results
Bennell et al.[12]	144 patients (82 females) with chronic hip osteoarthritis	*Internet-based pain-coping skills training, education, and exercise* included the same internet-based education and home exercise program as the control group. In addition, pain-coping skills training included 8 online modules that patients accessed during the first 8 weeks of the intervention. Pain-coping skills modules covered relaxation, activity-rest cycling, pleasant activity scheduling, cognitive restructuring, pleasant imagery, distraction, and problem solving. Patients were reminded weekly to complete modules.	*Internet-based education and exercise* included 8 information sheets related to arthritis self-care that were provided over the first 8 weeks of the intervention. Topics covered arthritis, pain, physical activity, saving energy, healthy eating, emotions, and tips for hip osteoarthritis. Patients were instructed to access 1 sheet per week. Exercise included a home-based exercise program that patients performed 3 times per week from weeks 8–24. Patients attended five 30-minute sessions with a physical therapist every 3 weeks. A physical therapist prescribed individualized strengthening exercises for the lower extremity and hip stretching.	Physical function: WOMAC function Pain intensity: VAS (0–100) Pain: WOMAC pain Measured at 8, 24, and 52 weeks	The internet-based pain-coping skills group showed immediately greater improvements in physical function at 8 weeks compared to control. This effect did not persist at 24 or 52 weeks. No significant differences in pain between groups were observed after intervention.
Petrozzi et al.[69]	108 patients (54 females) with chronic low back pain Mean age: 50.4 years	*Internet-based cognitive-behavioral program and physical treatment* included the same physical treatment as the comparison group. Patients attended up to 12 sessions at a frequency and duration based on clinical judgment and patient response. In addition, patients received access to online cognitive-behavioral program (MoodGYM). The program included 5 modules that explore thoughts, feelings, stressors, and relationship that contribute to psychosocial distress, and promotes strategies for coping and problem solving. Patients were instructed to access 1 module per week while attending physical treatment. No in-person counseling was provided as part of the intervention.	*Physical treatment* included pragmatically applied techniques such as spinal manipulation, mobilization, soft tissue massage, and exercise. Patients also received reassurance, advice about symptom management, instruction on safe manual handling, general postural advice, and encouragement to stay active. Physical treatment was provided by a physical therapist or chiropractor. Patients attended up to 12 sessions at a frequency and duration based on clinical judgment and patient response.	Disability: RMDQ Physical function: PSFS Pain intensity: NRS (0–10) Measured at 8 weeks, and 6 and 12 months	No significant differences in disability, physical function, or pain intensity between groups were observed after intervention.

NRS, numeric rating scale; PIPT, psychologically informed physical therapy; PSFS - Patient Specific Functional Scale; RMDQ, Roland Morris Disability Questionnaire; VAS, visual analog scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

internet education and standard exercise. The lack of integration by Bennell et al.[12] enhanced methodological rigor (ie, blinding of therapists),[13] but may explain the lack of added long-term benefit.

4. Discussion

4.1. Summary of findings

Summary findings from recent trials point to a few important observations. First, there continues to be evidence that graded activity is not a superior approach for chronic low back pain compared to other forms of exercise. This has been highlighted in earlier systematic reviews of the literature.[46,51,80] In the current review, none of the included studies on graded activity showed greater efficacy in improving outcomes compared to standard physical therapy. Second, despite the apparent accessibility and feasibility, internet-based psychological programs provided to patients in physical therapy do not seem to contribute to better outcomes compared to physical therapy alone. Issues related to low adherence to the online program, lack of support or integration of learned skills within therapy, or issues with program specificity may explain the apparent lack of additional benefit. Finally, as often is the case, there are areas that lack clear conclusions.

4.2. Comparison to prior reviews

Prior systematic reviews have summarized evidence on efficacy of graded activity[46,51,80] and PIPT.[1,17,33,75,90] Overall, our results are largely consistent with these reviews, which show promising effects for PIPT, namely in-person cognitive-behavioral-based physical therapy. Prior reviews have differed in their focus for condition (ie, postoperative pain,[17] general musculoskeletal pain,[1,75] low back pain,[33] and chronic pain[90]) and comparators. We intended a broad condition focus that would include both nonoperative and postoperative patients, but did not find any postoperative studies that directly compared PIPT to standard physical therapy. A few notable postoperative PIPT studies that did not meet this specific criterion, but should be considered

when determining the value of postoperative PIPT, include studies by Archer et al.,[2] Lotzke et al.,[47] Riddle et al.,[73] Peolsson et al.,[68] and Wibault et al.[88] Most of these postoperative studies compared a PIPT approach to usual postoperative care, which may have included physical therapy.

We did include similar PIPT studies as prior reviews, but also more recent trials. In contrast to prior reviews, we report summary findings related to ACT-based physical therapy and internet-based psychological programs offered in conjunction with physical therapy. These novel approaches have potential implications and can inform future directions. For example, CBT represents the most common psychological approach that has shaped PIPT. The evidence for cognitive-behavioral-based physical therapy is summarized in this review and in prior meta-analyses.[75,90] However, more recent psychological approaches such as ACT, mindfulness, and positive psychology may provide novel strategies to integrate within physical therapy. Our review suggests that ACT-based physical therapy may be a beneficial approach for chronic pain.[32] In the context of personalized medicine, targeted psychological strategies may need to consider not only psychological risk factors commonly addressed with CBT, but also whether boosting resiliency characteristics such as positive affect, hope, or optimism can translate to meaningful clinical outcome effects.[26,34]

4.3. Clinical implications and future directions

Results from recent studies examining in-person CBT-based physical therapy approaches are mixed. These findings may suggest a lack of robust superiority for PIPT compared to pragmatically delivered physical therapy.[65] It is possible that traditional physical therapy interventions such as exercise could impart similar benefits to psychological-based interventions through shared or nonspecific mechanisms.[60] Before settling on these conclusions, the quality of the randomized trials and the need to examine additional factors that may impact the role of this class of intervention should be considered. For example, half of the "positive effects" studies on cognitive-behavioral-based physical therapy were judged to be of lower methodological quality, which could bias these results. Studies demonstrating efficacy of cognitive-behavioral-based physical therapy tended to have larger sample sizes compared to trials showing no difference, suggesting a higher likelihood to detect small differences in outcomes. The exception was the study by Reid et al.[72] (>500 patients) that reported no difference in efficacy for cognitive-behavioral-based physical therapy. Reid et al.[72] acknowledge that their trial may have been affected by low psychological strategy implementation by physical therapists. The main implementation challenges were time to deliver the intervention (additional 15–20 minutes), which interfered with addressing other patient issues, and low utilization of written material or practice techniques by patients. High-quality studies by Bennell et al.,[10] Sterling et al.,[76] and Godfrey et al.[32] as well as the study by Vibe Fersum et al.,[82,83] which show greater efficacy after cognitive-behavioral-based physical therapy, describe rigorous training and implementation protocols. Moreover, most of these trials involve collaboration with a clinical psychologist and/or rehabilitation physician,[10,76] which may be an important component of both training and fidelity.

Cognitive-behavioral therapy, delivered by psychologists, is an intervention with relatively good outcome effects for chronic pain.[22] If CBT-based interventions delivered by physical therapists are similarly efficacious as traditional therapy, this begs the question of why this may be the case. Unlike CBT, physical therapy is often not standardized or protocolized. Thus, there are no established dosage and content parameters that are widely accepted as effective. In the current review, we found variability in the structure of PIPT in terms of total number, frequency and duration of sessions, and length of the treatment program. We did not observe an apparent pattern that would describe the impact of these parameters on treatment efficacy. For example, Godfrey et al.[31] reported beneficial effects after their relatively brief PIPT intervention. Optimizing parameters related to PIPT dosage and content is an important area for further exploration.

Another possible reason for mixed or comparable outcome findings could relate to the lack of targeting of the PIPT to a population "at risk." Few of the included studies directly targeted the PIPT intervention to patients exhibiting heightened psychosocial risk. One example of a trial that did was the study by Sterling et al.[76] where patients were screened for hyperarousal symptoms. Psychologically informed physical therapy strategies may not be needed by all patients with musculoskeletal pain. This approach of stratifying patients based on psychosocial risk is not new and there has been success with primary care pathways involving physical therapy for acute back pain.[36] There may be a role for personalized approaches to assess not whether PIPT works, but rather which patients benefit from these augmented rehabilitation treatments and who may not need them or respond. Recent evidence suggests a potential outcome influence for not only psychosocial risk factors, but also resiliency characteristics.[7,58,87] Future studies should examine whether complex psychological profiles including both risk and resiliency characteristics impact the efficacy of PIPT interventions.

The added cost and burden of integrating PIPT in real-world settings may not outweigh small degrees of additional benefits that have been observed in the literature. For most physical therapists, the PIPT approach represents a considerable shift from traditional physical therapy care. Transformative physical therapy practice may involve greater focus on addressing psychological risk factors, use of psychological techniques that might conflict with physical-focused interventions (in terms of time or priority), and/or adjustments to longer therapy sessions or group-based formats. Each of these practice shifts may come at a "cost" to the therapist or clinic. It was beyond the scope of this review to examine the cost implications (or savings) of a PIPT approach. However, as part of their trial, Bennell et al.[10] did report a higher cost of delivery for PIPT (pain-coping skills and exercise) due to the lengthier treatment sessions, but no difference in cost-effectiveness between groups. Godfrey et al.[32] found no major cost of delivery or utilization differences in their study, but did acknowledge the need for a one-off PIPT training cost. Thompson et al.[77] reported cost savings with their PIPT approach because of the small group format. Although a formal cost-effectiveness analysis was not conducted, Thompson et al.[77] did report no difference in healthcare utilization between groups. Future efforts examining costs supporting a PIPT model of care and cost-effectiveness are needed.

Qualitative reports emphasize physical therapist's concerns and barriers to approaching pain management in a PIPT manner.[38] There is inadequate training in psychological interventions or cognitive-behavioral pain strategies across entry-level physical therapy programs.[37] Postgraduate educational opportunities in PIPT are scarce and may not meet the rigor of training needed to support a PIPT practice model.[15,63] For example, successful behavioral intervention training programs often use multiple methods such as workshops, role playing, practice, supervision by a psychologist, and peer feedback to ensure intervention adoption and prevent drift.[35] Several of the described

trials used these methods with study physical therapists and often, the results suggested high fidelity to delivering PIPT. Even when implementation rates are low, physical therapists demonstrate ability and confidence to provide PIPT techniques as trained.[72] One of the main challenges in transforming standard practice towards PIPT is the requirement to optimally train physical therapists in delivering cognitive-behavioral-based treatment. Currently, there is no widely accepted standard for PIPT intervention training.[42] Several high-quality studies included rigorous and comprehensive training programs that would be expected to be more effective in preparing physical therapists to deliver standard psychological strategies, but also manage patients with higher psychological burden or handle unanticipated challenges that may arise with this form of therapy. For example, periodic feedback from a psychologist and peer discussion have been important aspects to address unique patient experiences and challenges.[63] This aspect of training may not be feasible for all practice settings. Future research should aim to determine optimal and standardized methods to train, supervise, and monitor physical therapists' use of PIPT strategies.

Although some approaches such as graded activity or graded exposure can be integrated seamlessly into physical therapy, other strategies such as cognitive restructuring and relaxation techniques may require modifications to existing clinical treatment structures (ie, extended treatment time or use of private rooms). Several trials described in this review offered PIPT (with or without exercise) in sessions of 45-, 60-, or 90-minute durations. The increased time for a one-on-one, in-person clinical encounter may not be feasible in some outpatient practice settings and may not yield high likelihood for implementation.[72] There may be a need to examine which specific PIPT components or strategies are the most effective and aim to incorporate only those strategies within standard practice. To the best of our knowledge, there have not been any studies that have examined content optimization for PIPT. The examination of treatment components may require more advanced research designs that will identify the most "active" components of PIPT.[16]

Internet-based programs have been developed to help overcome in-person treatment delivery challenges. To date, few studies have examined whether internet-based psychological programs can be integrated within an episode of physical therapy. The studies by Bennell et al.[12] and Petrozzi et al.[69] described PIPT approaches where physical therapists were not tasked with formally integrating internet content or skills, which may be a potential reason for the lack of additional benefit. Prior work in primary care has examined the impact of clinician support or contact on internet program utilization and efficacy.[19] Dear et al.[19] did not observe differences in clinical outcomes when an internet-based program was provided with no, optional, or regular clinician contact. Granted that the internet-based program is well developed and engaging, it is undetermined whether integration within physical therapy is needed. Future research should aim to expand on the current work described in this review to determine whether integrating internet-based programs can lead to more feasible or sustainable PIPT compared to other approaches.

4.4. Limitations

This is not the first systematic review to summarize evidence on PIPT. We advance prior work by describing characteristics of the psychological approaches informing PIPT and include novel methods such as ACT and internet-based psychological programs. Our primary aim was to describe recent approaches and offer clinical implications and possible future directions. We did not meta-analyze outcome data from our included studies and are unable to confirm efficacy of specific PIPT approaches. Despite our structured and comprehensive search strategy, we cannot confirm that we have identified all studies since 2011 meeting our eligibility criteria.

5. Conclusions

Our review summarized findings from recent randomized trials that have examined the efficacy of PIPT compared to standard physical therapy approaches in patients with musculoskeletal pain. Consistent with prior reviews, graded activity is not superior to other forms of physical activity or exercise. A few studies on cognitive-behavioral-based physical therapy demonstrated short-term efficacy, when compared to a program of standardized exercise. There is a need to further examine approaches integrating alternative strategies including acceptance-based therapies (ie, ACT or mindfulness) or internet-based cognitive-behavioral programs within physical therapy. Although PIPT remains a promising care model, more convincing evidence is needed to support widespread adoption, especially in light of extensive training demands and implementation challenges.

Disclosures

The authors have no conflicts of interest to declare.

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Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at http://links.lww.com/PR9/A79.

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References

[1] Archer KR, Coronado RA, Wegener ST. The role of psychologically informed physical therapy for musculoskeletal pain. Curr Phys Med Rehabil Rep 2018;6:15–25.
[2] Archer KR, Devin CJ, Vanston SW, Koyama T, Phillips SE, Mathis SL, George SZ, McGirt MJ, Spengler DM, Aaronson OS, Cheng JS, Wegener ST. Cognitive-behavioral-based physical therapy for patients with chronic pain undergoing lumbar spine surgery: a randomized controlled trial. J Pain 2016;17:76–89.
[3] Ariza-Mateos MJ, Cabrera-Martos I, Ortiz-Rubio A, Torres-Sanchez I, Rodriguez-Torres J, Valenza MC. Effects of a patient-centered graded exposure intervention added to manual therapy for women with chronic pelvic pain: a randomized controlled trial. Arch Phys Med Rehabil 2019; 100:9–16.
[4] Artus M, Campbell P, Mallen CD, Dunn KM, van der Windt DA. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. BMJ open 2017;7:e012901.
[5] Bandura A. Self-Efficacy: The exercise of control. New York: Freeman & Co., 1997.
[6] Barker KL, Heelas L, Toye F. Introducing acceptance and commitment therapy to a physiotherapy-led pain rehabilitation programme: an action research study. Br J Pain 2016;10:22–8.
[7] Bartley EJ, LaGattuta NR, Robinson ME, Fillingim RB. Optimizing resilience in orofacial pain: a randomized controlled pilot study on hope. Pain Rep 2019;4:e726.

[8] Bello AI, Quartey J, Lartey M. Efficacy of behavioural graded activity compared with conventional exercise therapy in chronic non-specific low back pain: implication for direct health care cost. Ghana Med J 2015;49: 173–80.
[9] Beneciuk JM, George SZ, Greco CM, Schneider MJ, Wegener ST, Saper RB, Delitto A. Targeted interventions to prevent transitioning from acute to chronic low back pain in high-risk patients: development and delivery of a pragmatic training course of psychologically informed physical therapy for the TARGET trial. Trials 2019;20:256.
[10] Bennell KL, Ahamed Y, Jull G, Bryant C, Hunt MA, Forbes AB, Kasza J, Akram M, Metcalf B, Harris A, Egerton T, Kenardy JA, Nicholas MK, Keefe FJ. Physical therapist-delivered pain coping skills training and exercise for knee osteoarthritis: randomized controlled trial. Arthritis Care Res 2016; 68:590–602.
[11] Bennell KL, Nelligan R, Dobson F, Rini C, Keefe F, Kasza J, French S, Bryant C, Dalwood A, Abbott JH, Hinman RS. Effectiveness of an internet-delivered exercise and pain-coping skills training intervention for persons with chronic knee pain: a randomized trial. Ann Intern Med 2017; 166:453–62.
[12] Bennell KL, Nelligan RK, Rini C, Keefe FJ, Kasza J, French S, Forbes A, Dobson F, Abbott JH, Dalwood A, Harris A, Vicenzino B, Hodges PW, Hinman RS. Effects of internet-based pain coping skills training before home exercise for individuals with hip osteoarthritis (HOPE trial): a randomised controlled trial. PAIN 2018;159:1833–42.
[13] Bennell KL, Rini C, Keefe F, French S, Nelligan R, Kasza J, Forbes A, Dobson F, Abbott JH, Dalwood A, Vicenzino B, Harris A, Hinman RS. Effects of adding an internet-based pain coping skills training protocol to a standardized education and exercise program for people with persistent hip pain (HOPE trial): randomized controlled trial protocol. Phys Ther 2015;95:1408–22.
[14] Broderick JE, Keefe FJ, Bruckenthal P, Junghaenel DU, Schneider S, Schwartz JE, Kaell AT, Caldwell DS, McKee D, Reed S, Gould E. Nurse practitioners can effectively deliver pain coping skills training to osteoarthritis patients with chronic pain: a randomized, controlled trial. PAIN 2014;155:1743–54.
[15] Bryant C, Lewis P, Bennell KL, Ahamed Y, Crough D, Jull GA, Kenardy J, Nicholas MK, Keefe FJ. Can physical therapists deliver a pain coping skills program? An examination of training processes and outcomes. Phys Ther 2014;94:1443–54.
[16] Collins LM, Baker TB, Mermelstein RJ, Piper ME, Jorenby DE, Smith SS, Christiansen BA, Schlam TR, Cook JW, Fiore MC. The multiphase optimization strategy for engineering effective tobacco use interventions. Ann Behav Med 2011;41:208–26.
[17] Coronado RA, Patel AM, McKernan LC, Wegener ST, Archer KR. Preoperative and postoperative psychologically informed physical therapy: a systematic review of randomized trials among patients with degenerative spine, hip, and knee conditions. J Appl Biobehav Res 2019; 24:e12159.
[18] de Morton NA. The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study. Aust J Physiother 2009;55: 129–33.
[19] Dear BF, Gandy M, Karin E, Staples LG, Johnston L, Fogliati VJ, Wootton BM, Terides MD, Kayrouz R, Perry KN, Sharpe L, Nicholas MK, Titov N. The Pain Course: a randomised controlled trial examining an internet-delivered pain management program when provided with different levels of clinician support. PAIN 2015;156:1920–35.
[20] GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1211–59.
[21] Driver C, Kean B, Oprescu F, Lovell GP. Knowledge, behaviors, attitudes and beliefs of physiotherapists towards the use of psychological interventions in physiotherapy practice: a systematic review. Disabil Rehabil 2017;39:2237–49.
[22] Eccleston C, Morley SJ, Williams AC. Psychological approaches to chronic pain management: evidence and challenges. Br J Anaesth 2013; 111:59–63.
[23] Edwards RR, Cahalan C, Mensing G, Smith M, Haythornthwaite JA. Pain, catastrophizing, and depression in the rheumatic diseases. Nat Rev Rheumatol 2011;7:216–24.
[24] Ehde DM, Dillworth TM, Turner JA. Cognitive-behavioral therapy for individuals with chronic pain: efficacy, innovations, and directions for research. Am Psychol 2014;69:153–66.
[25] Feliu-Soler A, Montesinos F, Gutierrez-Martinez O, Scott W, McCracken LM, Luciano JV. Current status of acceptance and commitment therapy for chronic pain: a narrative review. J pain Res 2018;11:2145–59.
[26] Finan PH, Garland EL. The role of positive affect in pain and its treatment. Clin J Pain 2015;31:177–87.
[27] Gaskin DJ, Richard P. The economic costs of pain in the United States. J Pain 2012;13:715–24.
[28] Gatchel RJ, McGeary DD, McGeary CA, Lippe B. Interdisciplinary chronic pain management: past, present, and future. Am Psychol 2014;69:119–30.
[29] George SZ, Wittmer VT, Fillingim RB, Robinson ME. Comparison of graded exercise and graded exposure clinical outcomes for patients with chronic low back pain. J Orthop Sports Phys Ther 2010;40:694–704.
[30] George SZ, Zeppieri G. Physical therapy utilization of graded exposure for patients with low back pain. J Orthop Sports Phys Ther 2009;39: 496–505.
[31] Godfrey E, Galea Holmes M, Wileman V, McCracken L, Norton S, Moss-Morris R, Pallet J, Sanders D, Barcellona M, Critchley D. Physiotherapy informed by Acceptance and Commitment Therapy (PACT): protocol for a randomised controlled trial of PACT versus usual physiotherapy care for adults with chronic low back pain. BMJ Open 2016;6:e011548.
[32] Godfrey E, Wileman V, Galea Holmes M, McCracken LM, Norton S, Moss-Morris R, Noonan S, Barcellona M, Critchley D. Physical therapy informed by acceptance and commitment therapy (PACT) versus usual care physical therapy for adults with chronic low back pain: a randomized controlled trial. J Pain 2020;21:71–81.
[33] Hall A, Richmond H, Copsey B, Hansen Z, Williamson E, Jones G, Fordham B, Cooper Z, Lamb S. Physiotherapist-delivered cognitive-behavioural interventions are effective for low back pain, but can they be replicated in clinical practice? A systematic review. Disabil Rehabil 2018;40:1–9.
[34] Hassett AL, Finan PH. The role of resilience in the clinical management of chronic pain. Curr Pain Headache Rep 2016;20:39.
[35] Herschell AD, Kolko DJ, Baumann BL, Davis AC. The role of therapist training in the implementation of psychosocial treatments: a review and critique with recommendations. Clin Psychol Rev 2010;30:448–66.
[36] Hill JC, Whitehurst DG, Lewis M, Bryan S, Dunn KM, Foster NE, Konstantinou K, Main CJ, Mason E, Somerville S, Sowden G, Vohora K, Hay EM. 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.
[37] Hoeger Bement MK, Sluka KA. The current state of physical therapy pain curricula in the United States: a faculty survey. J pain 2015;16:144–52.
[38] Holopainen R, Simpson P, Piirainen A, Karppinen J, Schutze R, Smith A, O'Sullivan P, Kent P. Physiotherapists' perceptions of learning and implementing a biopsychosocial intervention to treat musculoskeletal pain conditions: a systematic review and metasynthesis of qualitative studies. PAIN 2020;161:1150–68.
[39] Hughes LS, Clark J, Colclough JA, Dale E, McMillan D. Acceptance and commitment therapy (ACT) for chronic pain: a systematic review and meta-analyses. Clin J Pain 2017;33:552–68.
[40] Hunt MA, Keefe FJ, Bryant C, Metcalf BR, Ahamed Y, Nicholas MK, Bennell KL. A physiotherapist-delivered, combined exercise and pain coping skills training intervention for individuals with knee osteoarthritis: a pilot study. Knee 2013;20:106–12.
[41] Kamper SJ, Apeldoorn AT, Chiarotto A, Smeets RJ, Ostelo RW, Guzman J, van Tulder MW. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain: cochrane systematic review and meta-analysis. BMJ 2015;350:h444.
[42] Keefe FJ, Main CJ, George SZ. Advancing psychologically informed practice for patients with persistent musculoskeletal pain: promise, pitfalls, and solutions. Phys Ther 2018;98:398–407.
[43] 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(4 suppl):1113–16.
[44] Lee WYA, Lee WCE, Law SW, Lau WKA, Leung SM, Sieh KM, Luk FYS, Law KYR. Managing psychosocial contributors in low back pain patients—a randomised controlled trial. J Orthop Trauma Rehabil 2013; 17:46–51.
[45] Lethem J, Slade PD, Troup JD, Bentley G. Outline of a Fear-Avoidance Model of exaggerated pain perception-I. Behav Res Ther 1983;21:401–8.
[46] Lopez-de-Uralde-Villanueva I, Munoz-Garcia D, Gil-Martinez A, Pardo-Montero J, Munoz-Plata R, Angulo-Diaz-Parreno S, Gomez-Martinez M, La Touche R. A systematic review and meta-analysis on the effectiveness of graded activity and graded exposure for chronic nonspecific low back pain. Pain Med 2016;17:172–88.
[47] Lotzke H, Brisby H, Gutke A, Hagg O, Jakobsson M, Smeets R, Lundberg M. A person-centered prehabilitation program based on cognitive-behavioral physical therapy for patients scheduled for lumbar fusion surgery: a randomized controlled trial. Phys Ther 2019;99:1069–88.
[48] Ludvigsson ML, Peterson G, Dedering A, Peolsson A. One- and two-year follow-up of a randomized trial of neck-specific exercise with or without a

behavioural approach compared with prescription of physical activity in chronic whiplash disorder. J Rehabil Med 2016;48:56–64.
[49] Ludvigsson ML, Peterson G, O'Leary S, Dedering A, Peolsson A. The effect of neck-specific exercise with, or without a behavioral approach, on pain, disability, and self-efficacy in chronic whiplash-associated disorders: a randomized clinical trial. Clin J Pain 2015;31:294–303.
[50] Macedo LG, Latimer J, Maher CG, Hodges PW, McAuley JH, Nicholas MK, Tonkin L, Stanton CJ, Stanton TR, Stafford R. 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.
[51] Macedo LG, Smeets RJ, Maher CG, Latimer J, McAuley JH. Graded activity and graded exposure for persistent nonspecific low back pain: a systematic review. Phys Ther 2010;90:860–79.
[52] Magalhaes MO, Comachio J, Ferreira PH, Pappas E, Marques AP. Effectiveness of graded activity versus physiotherapy in patients with chronic nonspecific low back pain: midterm follow up results of a randomized controlled trial. Braz J Phys Ther 2018;22:82–91.
[53] Magalhaes MO, Franca FJ, Burke TN, Ramos LA, de Moura Campos Carvalho e Silva AP, Almeida GP, Yuan SL, Marques AP. Efficacy of graded activity versus supervised exercises in patients with chronic non-specific low back pain: protocol of a randomised controlled trial. BMC Musculoskelet Disord 2013;14:36.
[54] Magalhaes MO, Muzi LH, Comachio J, Burke TN, Renovato Franca FJ, Vidal Ramos LA, Leao Almeida GP, de Moura Campos Carvalho-e-Silva AP, Marques AP. The short-term effects of graded activity versus physiotherapy in patients with chronic low back pain: a randomized controlled trial. Man Ther 2015;20:603–9.
[55] Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Phys Ther 2003;83:713–21.
[56] Main CJ, George SZ. Psychologically informed practice for management of low back pain: future directions in practice and research. Phys Ther 2011;91:820–4.
[57] Main CJ, Sowden G, Hill JC, Watson PJ, Hay EM. Integrating physical and psychological approaches to treatment in low back pain: the development and content of the STarT Back trial's 'high-risk' intervention (StarT Back; ISRCTN 37113406). Physiotherapy 2012;98: 110–16.
[58] Martinez-Calderon J, Zamora-Campos C, Navarro-Ledesma S, Luque-Suarez A. The role of self-efficacy on the prognosis of chronic musculoskeletal pain: a systematic review. J Pain 2018;19:10–34.
[59] McCracken LM, Vowles KE. Acceptance and commitment therapy and mindfulness for chronic pain model, process, and progress. Am Psychol 2014;69:178–87.
[60] Miciak M, Gross DP, Joyce A. A review of the psychotherapeutic 'common factors' model and its application in physical therapy: the need to consider general effects in physical therapy practice. Scand J Caring Sci 2012;26:394–403.
[61] Monticone M, Baiardi P, Vanti C, Ferrari S, Nava T, Montironi C, Rocca B, Foti C, Teli M. Chronic neck pain and treatment of cognitive and behavioural factors: results of a randomised controlled clinical trial. Eur Spine J 2012;21:1558–66.
[62] Nahin RL, Sayer B, Stussman BJ, Feinberg TM. Eighteen-year trends in the prevalence of, and health care use for, noncancer pain in the United States: data from the medical expenditure panel survey. J Pain 2019;20: 796–809.
[63] Nielsen M, Keefe FJ, Bennell K, Jull GA. Physical therapist-delivered cognitive-behavioral therapy: a qualitative study of physical therapists' perceptions and experiences. Phys Ther 2014;94:197–209.
[64] O'Connor AM, Anderson KM, Goodell CK, Sargeant JM. Conducting systematic reviews of intervention questions I: writing the review protocol, formulating the question and searching the literature. Zoonoses Public Health 2014;61(suppl 1):28–38.
[65] O'Keeffe M, Purtill H, Kennedy N, Conneely M, Hurley J, O'Sullivan P, Dankaerts W, O'Sullivan K. Comparative effectiveness of conservative interventions for nonspecific chronic spinal pain: physical, behavioral/psychologically informed, or combined? A systematic review and meta-analysis. J Pain 2016;17:755–74.
[66] Overmeer T, Peterson G, Landen Ludvigsson M, Peolsson A. The effect of neck-specific exercise with or without a behavioral approach on psychological factors in chronic whiplash-associated disorders: a randomized controlled trial with a 2-year follow-up. Medicine (Baltimore) 2016;95:e4430.
[67] Peng P, Choiniere M, Dion D, Intrater H, Lefort S, Lynch M, Ong M, Rashiq S, Tkachuk G, Veillette Y; STOPPAIN Investigators Group. Challenges in accessing multidisciplinary pain treatment facilities in Canada. Can J Anaesth 2007;54:977–84.
[68] Peolsson A, Lofgren H, Dedering A, Oberg B, Zsigmond P, Hedevik H, Wibault J. Postoperative structured rehabilitation in patients undergoing surgery for cervical radiculopathy: a 2-year follow-up of a randomized controlled trial. J Neurosurg Spine 2019;31:1–154.
[69] Petrozzi MJ, Leaver A, Ferreira PH, Rubinstein SM, Jones MK, Mackey MG. Addition of MoodGYM to physical treatments for chronic low back pain: a randomized controlled trial. Chiropractic Man Ther 2019;27:54.
[70] Pitcher MH, Von Korff M, Bushnell MC, Porter L. Prevalence and profile of high-impact chronic pain in the United States. J Pain 2019;20:146–60.
[71] Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. Expert Rev Neurother 2009;9:745–58.
[72] Reid MC, Henderson CR Jr, Trachtenberg MA, Beissner KL, Bach E, Barron Y, Sridharan S, Murtaugh CM. Implementing a pain self-management protocol in home care: a cluster-randomized pragmatic trial. J Am Geriatr Soc 2017;65:1667–75.
[73] Riddle DL, Keefe FJ, Ang DC, Slover J, Jensen MP, Bair MJ, Kroenke K, Perera RA, Reed SD, McKee D, Dumenci L. Pain coping skills training for patients who catastrophize about pain prior to knee arthroplasty: a multisite randomized clinical trial. J Bone Joint Surg Am Vol 2019;101:218–27.
[74] Scott W, McCracken LM. Psychological flexibility, acceptance and commitment therapy, and chronic pain. Curr Opin Psychol 2015;2:91–6.
[75] Silva Guerrero AV, Maujean A, Campbell L, Sterling M. A systematic review and meta-analysis of the effectiveness of psychological interventions delivered by physiotherapists on pain, disability and psychological outcomes in musculoskeletal pain conditions. Clin J Pain 2018;34:838–57.
[76] Sterling M, Smeets R, Keijzers G, Warren J, Kenardy J. Physiotherapist-delivered stress inoculation training integrated with exercise versus physiotherapy exercise alone for acute whiplash-associated disorder (StressModex): a randomised controlled trial of a combined psychological/physical intervention. Br J Sports Med 2019;53:1240–7.
[77] Thompson DP, Oldham JA, Woby SR. Does adding cognitive-behavioural physiotherapy to exercise improve outcome in patients with chronic neck pain? A randomised controlled trial. Physiotherapy 2016;102:170–7.
[78] Turk DC, Gatchel RJ. Psychological approaches to pain management: a practitioner's handbook. New York: The Guilford Press, 2002.
[79] United States Bone and Joint Initiative. The burden of musculoskeletal diseases in the United States (BMUS), 3rd ed. 2014. Rosemont, IL. Available at: http://www.boneandjointburden.org. Accessed July 4, 2018.
[80] van der Giessen RN, Speksnijder CM, Helders PJ. The effectiveness of graded activity in patients with non-specific low-back pain: a systematic review. Disabil Rehabil 2012;34:1070–6.
[81] van Erp RMA, Huijnen IPJ, Ambergen AW, Verbunt JA, Smeets RJEM. Biopsychosocial primary care versus physiotherapy as usual in chronic low back pain: results of a pilot-randomised controlled trial. Eur J Physiother 2019:1–8. doi: 10.1080/21679169.2019.1630855 [Epub ahead of print].
[82] Vibe Fersum K, O'Sullivan P, Skouen JS, Smith A, Kvale A. Efficacy of classification-based cognitive functional therapy in patients with non-specific chronic low back pain: a randomized controlled trial. Eur J Pain 2013;17:916–28.
[83] Vibe Fersum K, Smith A, Kvale A, Skouen JS, O'Sullivan P. Cognitive functional therapy in patients with non-specific chronic low back pain-a randomized controlled trial 3-year follow-up. Eur J Pain 2019;23:1416–24.
[84] Vlaeyen JW, de Jong J, Geilen M, Heuts PH, van Breukelen G. Graded exposure in vivo in the treatment of pain-related fear: a replicated single-case experimental design in four patients with chronic low back pain. Behav Res Ther 2001;39:151–66.
[85] Vlaeyen JW, de Jong J, Geilen M, Heuts PH, van Breukelen G. The treatment of fear of movement/(re)injury in chronic low back pain: further evidence on the effectiveness of exposure in vivo. Clin J Pain 2002;18:251–61.
[86] Vlaeyen JW, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. PAIN 2000;85:317–32.
[87] Wertli MM, Held U, Lis A, Campello M, Weiser S. Both positive and negative beliefs are important in patients with spine pain: findings from the Occupational and Industrial Orthopaedic Center registry. Spine J 2018;18:1463–74.
[88] Wibault J, Oberg B, Dedering A, Lofgren H, Zsigmond P, Peolsson A. Structured postoperative physiotherapy in patients with cervical radiculopathy: 6-month outcomes of a randomized clinical trial. J Neurosurg Spine 2018;28:1–9.
[89] Williams AC, Eccleston C, Morley S. Psychological therapies for the management of chronic pain (excluding headache) in adults. Cochrane Database Syst Rev 2012;11:CD007407.
[90] Wilson S, Cramp F. Combining a psychological intervention with physiotherapy: a systematic review to determine the effect on physical function and quality of life for adults with chronic pain. Phys Ther Rev 2018;23:214–26.