What Does It Take? Comparing Intensive Rehabilitation to Outpatient Treatment for Children With Significant Pain-Related Disability

Laura E. Simons,^{1,2} PhD, Christine B. Sieberg,^{1,2} PhD, Melissa Pielech,^{1,2} MA, Caitlin Conroy,^{1,2} PsyD, and Deirdre E. Logan,^{1,2} PhD

¹*Division of Pain Medicine, Department of Anesthesiology, Perioperative and Pain Medicine, Boston Children's Hospital, and* ²*Department of Psychiatry, Harvard Medical School*

All correspondence concerning this article should be addressed to Laura E. Simons, PhD, Pain Treatment Service, Boston Children's Hospital, 21 Autumn Street, Boston, MA 02215, USA. E-mail: Laura.Simons@childrens.harvard.edu

Received March 30, 2012; revisions received and accepted September 14, 2012

Objectives This study compared outcomes between day hospital pain rehabilitation patients and patients engaged in outpatient multidisciplinary pain treatment. **Methods** This study included 100 children who presented for an initial tertiary care pain clinic evaluation. 50 patients enrolled in intensive day hospital pain rehabilitation and 50 patients pursued outpatient multidisciplinary treatment. Across 2 time points, children completed measures of functional disability, pain-related fear, and readiness to change and parents completed measures of pain-related fear and readiness to change. **Results** Across both treatment modalities, patients and parents reported improvements. Patients enrolled in intensive pain rehabilitation had significantly larger improvements in functional disability, pain-related fear, and readiness to change. Parents of day hospital patients reported larger declines in child pain-related fear and increased readiness to change compared with their outpatient counterparts. **Discussion** For patients with high levels of pain-related disability and distress, intensive pain rehabilitation provides rapid, dramatic improvements in functioning.

Key words child and adolescent; chronic pain; pain rehabilitation; treatment response.

Introduction

Chronic pain in children is a significant public health concern affecting ~15–25% of children (King et al., 2011; Roth-Isigkeit, Thyen, Stoven, Schwarzenberger, & Schmucker, 2005). The chronic pain experience in childhood is complex and conceptualized within a biopsychosocial framework with physiological, psychological, and social factors contributing to pain-related outcomes (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Research findings highlight numerous factors that contribute to the maintenance and exacerbation of pain and disability. These include pain parameters such as pain intensity (Gauntlett-Gilbert & Eccleston, 2007; Roth-Isigkeit et al., 2005); emotional factors such as anxiety (Cohen, Vowles, & Eccleston, 2010) and depression (Kashikar-Zuck, Goldschneider,

Powers, Vaught, & Hershey, 2001; Logan, Simons, & Kaczynski, 2009); cognitive factors such as pain catastrophizing (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004; Vervoort, Eccleston, Goubert, Buysse, & Crombez, 2010) and pain-related fear (Martin, McGrath, Brown, & Katz, 2007; Simons, Sieberg, Carpino, Logan, & Berde, 2011); behavioral responses such as coping (Claar, Baber, Simons, Logan, & Walker, 2008; Kaczynski, Simons, & Claar, 2011) and taking a self-management approach to pain (Guite, Logan, Simons, Blood, & Kerns, 2011); and the social context such as parent responses (Caes, Vervoort, Eccleston, Vandenhende, & Goubert, 2011; Logan, Simons, & Carpino, 2012b; Sieberg, Williams, & Simons, 2011) and peer influences (Forgeron et al., 2010). Due to this complex picture, multidisciplinary treatment of chronic pain is necessary.

Multidisciplinary treatment for chronic pain in children typically consists of some combination of medical (e.g., medication, nerve blocks), physical (e.g., physical therapy, occupational therapy), and psychological (e.g., cognitive behavioral therapy, biofeedback) treatments. There are currently 31 dedicated pediatric chronic pain programs in the United States that span outpatient, day hospital, and inpatient treatment to address the needs of children with persistent pain problems (retrieved from <http://www.ampainsoc.org/membership/sigsites/infchildadol-sig.htm> on March 23, 2012).

The growing number of these programs can likely be attributed to their demonstrated effectiveness. Flor and colleagues' (1992) meta-analysis of multidisciplinary outpatient pain management clinics supported their efficacy with within- and between-group effect superior to no treatment, waiting list, and single-discipline treatments (e.g., medications and physical therapy). They found that a multidisciplinary approach resulted in pain reduction and improvements in mood, functional disability, and health care utilization, and that these results were stable over time. These positive findings have been replicated in pediatric outpatient pain clinics (Simons, Logan, Chastain, & Cerullo, 2010). However, adherence to treatment recommendations in a pediatric multidisciplinary outpatient pain clinic is often suboptimal. Although Simons and colleagues (2010) found that patients reported significantly fewer doctor visits and decreased pain, somatic complaints, and functional disability 3 months after their initial pain clinic evaluation, adherence to treatment regimens was a barrier. Specifically, 27% of patients never initiated a recommended medication change, 20% never started a new recommended physical therapy regimen, and 49% never initiated cognitive-behavioral therapy when it was recommended. For patients who continue to struggle with their pain symptoms coupled with their inability or reluctance to engage in recommended treatments, more intensive treatment approaches may be warranted.

Previous research by Eccleston, Malleon, Clinch, Connell, and Sourbut (2003) support the effectiveness of intensive interdisciplinary pain treatment. In a sample of 57 adolescents with chronic pain and accompanying parents participating in a 3-week program that encompassed physical, occupational, and psychological therapy, adolescents and parents reported significant improvements in disability and physical functioning at posttreatment with physical improvements maintained at 3-month follow-up. Additionally, at 3-month posttreatment, adolescents reported reduced anxiety and somatic complaints. Parent reports reflected significant improvements in their

adolescent's level of disability and symptoms of parent anxiety, depression, and stress at posttreatment, which was maintained at 3-month follow-up. Additional support for intensive pain rehabilitation programs has emerged in recent years (Hechler et al., 2010; Logan et al., 2012; Maynard, Amari, Wiczorek, Christensen, & Slifer, 2010). Despite the growing evidence to support these programs, there are currently very few in the United States, likely owing to the costly nature from a hospital system and insurance perspective.

Given the demonstrated effectiveness of both outpatient and intensive (day hospital, inpatient) pain rehabilitation treatment approaches, it is important to examine unique aspects of change and degree of improvement between these two treatment modalities among patients who present with similar levels of pain-related disability to justify the cost of these approaches in treating very complex patients. At our institution, we are fortunate to have both a multidisciplinary outpatient pain treatment clinic and an intensive interdisciplinary day hospital pain rehabilitation program. In the current investigation, we examined outcomes assessed in both settings across time: functional disability, pain-related fear, and readiness to self-manage pain. These variables cut across core outcome domains that have been identified as important to assess in clinical trials of pediatric pain treatments (PedIMMPACT; McGrath et al., 2008), specifically physical and emotional functioning, and includes readiness to change, an additional component that has garnered significant attention, as it relates to engagement and response to pain treatment (Jensen, Nielson, Turner, Romano, & Hill, 2004; Logan, Conroy, Sieberg, & Simons, 2012a).

The objective of the current study was to evaluate clinical outcomes among children with significant pain-related disability who participated in a day hospital pain rehabilitation program in comparison with patients who engaged in outpatient pain treatment. Hypotheses: (1) Across treatment modalities, patients and parents will report improvements in functioning, pain-related distress, and readiness to self-manage pain. (2) Patients who complete the intensive pain rehabilitation treatment program will report significantly greater improvements compared with the outpatient group 1 month after initial evaluation.

Methods

Participants

Potential participants consisted of patients who presented for an initial tertiary care pain clinic evaluation at the Pain Treatment Service (PTS) at Boston Children's Hospital and

consecutively enrolled in a large cohort study from September 2008 to May 2010 (see Simons et al., 2011, for full study description). In total, 296 patients enrolled in the cohort study during that time (see Figure 1 flow chart for full breakdown of enrollment). Within the sample, 55 patients subsequently enrolled in the Mayo Family Pediatric Pain Rehabilitation Center (PPRC) at Boston Children's Hospital at Waltham. With no psychological data on two patients and three patients who did not complete the program, our PPRC sample consisted of 50 patients.

For the 241 patients who did not enroll in the PPRC, 198 completed follow-up data to enable comparison. Within this subsample, we selected PTS cases based on the following criteria: age group (8–12 years or 13–18 years), gender (male/female), pain diagnosis (back, musculoskeletal, neuropathic, abdominal), and functional disability level (mild, moderate, severe [Kashikar-Zuck et al., 2011]). We matched patients on the greatest number of factors possible in a step-wise fashion. All 50 control

subjects were matched on four of the five demographic and pain-related variables. The 50 PPRC and PTS control subjects were matched on age group, 49 were matched on gender, 47 were matched on pain diagnosis (three PTS patients with musculoskeletal pain were matched to three PPRC patients with neuropathic pain), and 44 were matched on disability level (six PTS patients with mild disability were matched to six PPRC patients with moderate disability). All PTS patient selections were conducted blinded to treatment outcomes by a research assistant (AP). In instances where multiple cases met match criteria, selections were randomly selected by the research assistant (AP). The total sample consisted of 50 PPRC patients and 50 PTS patients.

Initial Evaluation and PPRC Enrollment

All patients participated in a multidisciplinary pain clinic evaluation, where the patient and parent(s) jointly meet with a physician, physical therapist, and clinical psychologist for separate 1-hour sessions. After these sessions, the

Figure 1. Participant flow chart.

treatment team meets to review their assessments and recommendations for treatment. Following this meeting, the physician and clinical psychologist meet together with each family to review all findings and provide recommendations. During this feedback session, each family receives a completed Treatment Recommendation Form that outlines recommendations from medical, physical, and psychological disciplines. This specific form was designed to ensure the clarity of communicating recommended treatments from the treatment team and has become a standard of care in our service. Recommendations for PPRC treatment was based on (1) problem duration or acuity and (2) inability to progress in outpatient treatment. PPRC enrollment was dependent on (1) family willingness to enroll in the intensive program and (2) insurance provider coverage. Patients with active suicidality or current eating disorder were not eligible. Within the PTS group, eight patients were recommended for PPRC treatment, but did not subsequently enroll.

PPRC Intervention

The PPRC program primarily targets patients aged 8–18 years with persistent pain with significant impairment of mobility and daily function. The PPRC program entails intensive daily physical, occupational, and psychological therapies 8 hr a day, 5 days per week for a typical length of stay of 3 to 4 weeks. A physician and nurse evaluate patients daily to ensure continued appropriateness for treatment and to address acute or ongoing medical issues. Psychological, physical, and occupational therapies focus on helping children return to premorbid levels of functioning through progressively engaging in previously avoided activities and taking a self-management approach to pain. Psychological therapy follows a cognitive-behavioral model, an effective approach for pain rehabilitation (Wetherell et al., 2011). Patients receive daily individual and group-based cognitive-behavioral therapy, and families are actively incorporated into the program, with family therapy and parent education provided. Psychological therapy targets include the following: (1) teaching a self-management approach to pain; (2) addressing negative thinking and fears about pain, (3) engaging in valued activities and relationships in the presence of pain; and (4) reducing parental attention and protective responses to pain. Additional details on the program are provided elsewhere (Logan et al., 2012b).

PTS Outpatient Care

PTS outpatient treatment typically encompasses some combination of medical, physical, and psychological therapy. Within this sample for medical treatment, 82% were

recommended a new medication or dosage change to the current medication, 14% were recommended to undergo additional medical testing, and 28% were given recommendations for additional medical treatments (i.e., acupuncture, nerve block, and trigger point injection). For physical therapy, 34% were recommended to initiate physical therapy, and 52% were recommended to continue physical therapy. For psychology, 52% were recommended to initiate outpatient psychological treatment, and 34% were recommended to continue with their current provider. Adherence to treatment recommendations across disciplines for the PTS sample is described in the Results.

Measures

Baseline Variables

Demographic and medical characteristics were derived from patient clinical charts.

Pain Intensity. During admission to the PPRC and at the PTS multidisciplinary evaluation, children were asked to provide their average pain rating on a standard 11-point numeric rating scale (von Baeyer et al., 2009) from 0 (*no pain*) to 10 (*most pain possible*).

Pretreatment and Posttreatment Variables

Functional Disability. The Functional Disability Inventory (FDI) (Walker & Greene, 1991) is a child-completed scale that assesses difficulty in physical and psychosocial functioning due to physical health. The instrument consists of 15 items concerning perceptions of activity limitations during the past 2 weeks; total scores are computed by summing the items. Higher scores indicate greater disability. Total FDI scores of ≥ 30 are considered severe disability (Kashikar-Zuck et al., 2011). The FDI has good reliability and validity (Claar & Walker, 2006).

Pain-related Fear. The Fear of Pain Questionnaire, child and parent (FOPQ-C; FOPQ-P) (Simons et al., 2011) assesses child and parent perceptions of child pain-related fears and avoidance behaviors. It is rated on a 5-point scale from 0 (*strongly disagree*) to 4 (*strongly agree*). Items are summed to derive a total score. Higher scores indicate higher levels of pain-related fear. Using tertiles from the initial validation sample, scores of ≥ 51 are considered high levels of pain-related fear. The FOPQ-C comprises 24 items. Specific items on the FOPQ-C include: “I avoid making plans because of my pain” and “I worry when I am in pain.” Construct validity for this measure is supported with significant relations found for the FOPQ-C with child somatization, anxiety, and catastrophizing. Specific items on the 23-item FOPQ-P

include: “Pain seems to cause my child’s heart to pound or race” and “My child cancels plans when in pain.” Construct validity for this measure is supported with significant relations between the FOPQ-P and parent pain catastrophizing.

Readiness to Change. The Pain Stages of Change Questionnaire (PSOCQ) (Guite et al., 2011) is an adaptation of the adult measure to assess youth’s readiness to adopt a self-management approach to pain and parents’ own levels of readiness to adopt this approach. PSOCQ-A yields three validated subscales: (1) Precontemplation: Little perceived personal responsibility for managing pain; (2) Contemplation: Awareness of personal responsibility for pain management, considering behavioral change; and (3) Action/Maintenance: Active involvement in learning or continued use of self-management strategies. PSOCQ-P yields four validated subscales: Precontemplation, Contemplation, Action, and Maintenance. The measure has demonstrated reliability and validity (Guite et al., 2011).

Procedures

Data for the PTS group were collected as part of a larger Internal Review Board (IRB)–approved cohort study where patients completed measures at baseline for their multidisciplinary evaluation (i.e., FDI) and specifically for the study (i.e., FOPQ, PSOCQ). PTS patients were then contacted 4 weeks later to complete all measures specifically for the study (see Simons et al., 2011, for detailed procedures). Data for the PPRC cohort were collected as part of standard clinical care at admission, discharge, and at 1-month follow-up with IRB approval secured to examine these data for research purposes.

Statistical Analyses

All analyses were conducted in SPSS version 19. Descriptive statistics were calculated for all demographic, medical, and study variables. Paired Sample *t*-tests were conducted to examine within-group changes from pretreatment to posttreatment across variables of interest. Given the number of paired analyses, significance value was set to $p < .01$. Repeated measures ANOVAs were conducted to examine between-group effects by time point. Treatment effect sizes were reported as eta squared and Cohen’s *d* (Cohen, 1988).

Results

Participant Characteristics

Across the two cohorts, patients were generally Caucasian female adolescents from upper middle class intact families (see Table I for details on demographic and medical characteristics), which is reflective of patients typically seen in this tertiary care setting. Across pain diagnoses, two-thirds presented with neuropathic pain with remaining patients reporting musculoskeletal, back, and abdominal pain. Patients reported, on average, moderate levels of pain at baseline and reported experiencing pain for almost 2 years. Length of stay at the PPRC and time to follow-up for the PTS group was statistically different, but, on average, PTS follow-up was only 2 weeks longer.

PTS Treatment Adherence

PTS patients were generally given several treatment recommendations with 80% receiving three or more recommendations at their clinic evaluation. Adherence to treatment

Table I. Patient Demographic and Medical Characteristics for PPRC and PTS Groups

Variable	PPRC Mean (SD) or Frequency	PTS Mean (SD) or Frequency	ANOVA F	<i>p</i> -value
Demographic Characteristics				
Age ^a	13.9 (2.17)	13.6 (2.55)	0.40	<i>ns</i>
Female	86%	84%		
Caucasian	100%	98%		
Parents married	82%	80%		
Hollingshead socioeconomic status ^a	53.6 (9.53)	49.2 (8.72)	5.28	$p < .05$
Medical Characteristics				
Neuropathic limb pain	66%	60%		
Musculoskeletal limb pain	22%	28%		
Back/neck pain	8%	8%		
Abdominal	4%	4%		
Average pain rating	6.51 (1.92)	5.76 (2.60)	2.70	<i>ns</i>
Duration of pain (months)	20.0 (25.8) Median = 14	21.3 (22.5) Median = 13.5	0.08	<i>ns</i>
PPRC length of stay & PTS time to follow-up (weeks)	3.68 (1.20) Median = 4	5.56 (2.63) Median = 5	21.80	$p < .01$

Note. ^aSocioeconomic status ranged from laborer (22) to business owner/professional (66).

ns = nonsignificant.

recommendations was collected from parents at follow-up and medical record review. All PTS patients had documented adherence or nonadherence to at least one recommendation. Some adherence data were missing (25% across medical recommendations, 25% across physical therapy recommendations, 21% across psychology recommendations). For those who received medical recommendations, 94% completed medication changes, 100% underwent additional recommended medical testing, and 88% completed additional medical treatments (e.g., acupuncture and nerve block). For physical therapy, 86% initiated recommended physical therapy, and 100% continued physical therapy. For psychology, 59% initiated recommended psychological treatment, and 100% continued with their current provider, as recommended.

Between-group Analyses

The PPRC and PTS group did not significantly differ at baseline on functional disability, fear of pain (child and parent), and readiness to change (child and parent) (see Table III). In examining between-group differences by time, a significant interaction effect was detected for functional disability, child and parent fear of pain, child and parent precontemplation scores, and child action/maintenance and parent action and maintenance scores (see Table II; Figures 2–5 depict child reported results). For each interaction, the PPRC group showed a significantly greater improvement in function than the PTS group. Effect sizes for these interactions ranged from medium to large, suggesting that the PPRC treatment program was successful in producing significant improvements in disability, fear,

Table II. Interaction Effects for Time by Treatment Group

Variable(time × treatment)	Greenhouse geiser f	p-value	Eta squared	Cohen's d
Child				
Functional disability	49.1	.00	.33	1.40
Fear of pain	16.2	.00	.14	.81
Readiness to change				
Precontemplation	8.41	.01	.08	.59
Contemplation ^a	—	—	—	—
Action/Maintenance	32.1	.00	.25	1.15
Parent				
Fear of pain	38.5	.00	.28	1.25
Readiness to change				
Precontemplation	19.2	.00	.16	.87
Contemplation	.79	.39	.01	
Action	9.38	.00	.09	.63
Maintenance	30.2	.00	.24	1.12

Note. ^aValues identical across time points for the control group, thus an interaction term could not be calculated.

For Cohen's d, ≥ 0.5 is a medium effect and ≥ 0.8 is a large effect size (Cohen, 1988).

and readiness to change among children and parents who participated in the program.

Examining clinically significant changes between the two groups using chi-square analyses, the percentage of patients reporting clinically significant functional impairment and high levels of pain-related fear at pretreatment did not significantly differ. The two groups were significantly different at posttreatment for functional disability (PPRC = 2%, PTS = 38%), $\chi^2(2) = 27.1$, $p < .01$ and pain-related fear (PPRC = 8%, PTS = 32%), $\chi^2(2) = 9.31$, $p < .01$.

Within-group Analyses

In examining changes from pretreatment to posttreatment within each group, there were significant improvements observed in child functional disability, child and parent fear of pain, child and parent precontemplation scores, and parent maintenance scores across both groups (see Table III). Within the PPRC group, there were also significant improvements observed for child action/maintenance and parent action scores.

Table III. Paired Sample t-test Examining Psychological Characteristics Across Groups at Pretreatment and Posttreatment

Variable	Pretreatment	Posttreatment	df	t-test
Child				
Functional disability				
PPRC	31.4 (11.2)	9.62 (7.87)	49	11.0*
PTS	28.5 (10.9)	23.1 (11.8)	49	4.32*
Fear of pain				
PPRC	47.2 (18.6)	27.0 (16.3)	49	6.14*
PTS	44.2 (20.3)	39.3 (21.5)	49	2.50
Readiness to change				
Precontemplation				
PPRC	3.32 (1.01)	2.36 (.96)	49	8.69*
PTS	3.66 (.75)	3.15 (.97)	48	4.64*
Action/Maintenance				
PPRC	3.21 (.86)	4.16 (.88)	49	−9.54*
PTS	3.15 (.76)	3.32 (.82)	48	−1.83
Parent				
Fear of pain				
PPRC	48.0 (16.4)	25.6 (14.0)	49	9.77*
PTS	39.3 (21.5)	37.7 (18.0)	49	3.0*
Readiness to change				
Precontemplation				
PPRC	2.70 (.62)	1.84 (.65)	49	9.36*
PTS	3.12 (.67)	2.84 (.76)	49	3.13*
Action				
PPRC	3.69 (.77)	4.18 (.82)	49	−4.57*
PTS	3.66 (.62)	3.75 (.58)	49	−1.29
Maintenance				
PPRC	3.18 (.85)	4.35 (.77)	49	−9.20*
PTS	3.17 (.59)	3.52 (.62)	49	−4.60*

Note. * $p < .01$.

Figure 2. Functional disability scores from pretreatment to posttreatment in PPRC and PTS patients.

Figure 3. Fear of pain scores from pretreatment to posttreatment in PPRC and PTS patients.

To explore clinically significant changes, we examined the percentage of patients who reported severe functional disability (Kashikar-Zuck et al., 2011) and high levels of pain-related fear (Simons et al., 2011) at pretreatment and at posttreatment across the two treatment groups. At admission, 62% of PPRC patients were classified as severely functionally disabled, and, at discharge, only 2% continued to report severe pain-related disability. For the PTS group, 52% of patients reported severe disability at baseline, with 38% continuing to report severe disability at follow-up. For pain-related fear, 46% of PPRC patients reported high levels of pain-related fears at admission with only 8% reporting continued high levels of pain-related fears at discharge. Among patients in the PTS group, 38% reported high levels of pain-related fear at baseline, and 32% continued to report high pain-related fear at follow-up.

Maintenance of Gains After PPRC Treatment

Of the 50 PPRC patients in this study, 43 returned for an initial postdischarge follow-up evaluation (median at 10 weeks postdischarge). To examine maintenance of treatment gains, we focused on the following variables: functional disability, fear of pain, child action/maintenance scores, and parent action and maintenance scores. In examining differences between the 43 follow-up patients

Figure 4. Precontemplation scores from pretreatment to posttreatment in PPRC and PTS patients.

Figure 5. Action/Maintenance scores from pretreatment to posttreatment in PPRC and PTS patients.

and seven patients who did not return, there were no differences for level of disability and fear of pain. We did observe differences for patient action/maintenance scores. Patients who did not return for follow-up self-reported lower action/maintenance scores at discharge ($M = 3.32$, $SD = 1.95$) compared with follow-up patients at discharge ($M = 4.30$, $SD = .48$), $F(1,48) = 8.56$, $p < .01$.

In examining changes across time with paired-sample t -tests, treatment gains were maintained for functional disability ($M = 7.52$, $SD = 7.8$, $t(41) = 1.14$, non-significant [ns]), child fear of pain ($M = 22.8$, $SD = 16.3$, $t(41) = 1.19$, ns), child action/maintenance scores, ($M = 4.1$, $SD = .65$, $t(42) = 2.63$, ns) and parent maintenance scores ($M = 4.45$, $SD = .49$, $t(42) = .00$, ns). There was a decrease in parent-reported action scores ($M = 3.82$, $SD = .74$) at follow-up, $t(41) = 4.51$, $p < .01$ (see Table III for discharge means).

Discussion

The objective of the current study was to evaluate clinical outcomes among children with significant pain-related

disability who participated in a day hospital pain rehabilitation program (PPRC) in comparison with patients who engaged in outpatient pain treatment (PTS). As anticipated, patients and parents across treatment modalities reported significant improvements over time in pain-related disability, fear of pain, and readiness to take a self-management approach to pain. These findings add to the current literature supporting the efficacy of outpatient multidisciplinary pain treatment approaches (Flor, Fydrich, & Fydrich, 1992; Simons et al., 2010) and of intensive interdisciplinary pain treatment programs (Eccleston et al., 2003; Hechler et al., 2010; Logan et al., 2012b; Maynard et al., 2010) for children and adolescents suffering with persistent pain problems. Unlike previous studies, this investigation provides the opportunity to contrast outcomes between these two efficacious treatment approaches, including unique changes and degree of improvement observed between the two.

Improvements unique to the PPRC group included increased child action/maintenance and parent action scores on the pain readiness to change measure. Based on the transtheoretical model of behavior change (Prochaska & Velicer, 1997) and the stages of change conceptualized for adult (Kerns, Rosenberg, Jamison, Caudill, & Haythornthwaite, 1997) and pediatric (Guite et al., 2011) chronic pain patients, Action reflects an active involvement in learning self-management strategies and Maintenance reflects a sense of established personal responsibility for pain control. The specific improvements observed for the PPRC likely reflect the therapeutic emphasis of learning self-management strategies and pain management self-responsibility within the program, whereas patients engaged in outpatient treatment may still be receiving messages that convey treatment provider responsibility for pain management (e.g., new medication provided).

Most striking among the findings was the degree of improvement observed in the PPRC group relative to the PTS group. Only 2% of patients in the PPRC group continued to report severe pain-related disability at posttreatment compared with 32% of patients in the PTS group. Correspondingly, large treatment effects for reductions in functional disability (Cohen's $d = 1.4$) in the PPRC group were observed when compared with the PTS group. Given that we do not know the exact amount of treatment patients in the PTS group received, we cannot specifically attribute these differences to any one component of the program, but rather conclude that this format of intensive physical, occupational, and psychological therapy is associated with dramatic and impressive clinical improvements in function for significantly disabled youth.

Furthermore, we know that the primary goal of PPRC treatment is functional restoration, whereas the goals of outpatient treatment for pain may be more diffuse (e.g., finding an effective medication regimen to reduce pain, engaging in procedural interventions in addition to or instead of a rehabilitative approach).

Also notable was the difference in decline in pain-related psychological distress. Large treatment effects for the PPRC group in comparison with the PTS groups were observed for child- and parent-reported pain-related fears. The PPRC program targets re-engagement in previously avoided or feared activities through progressive exposures and addresses negative thinking and fearful cognitions related to pain through psychoeducation and cognitive restructuring in daily individual, group, and twice weekly family psychotherapy sessions. Similar to functional disability, we can conclude that the intensive day hospital model described here is associated with robust improvements in pain-related fear in a short period.

Lastly, medium-to-large effect sizes were observed for the PPRC group when compared with the PTS group for readiness to adopt a self-management approach to pain. The PPRC program requires completion of a home exercise program each evening, and each patient graduates from the PPRC with an individualized pain self-management plan. This guides the patient step-by-step through a plan of action if they experience a flare in pain symptoms. In addition, patients receive a coping toolbox (filled with patient-chosen notecards), which details their preferred active coping strategies that span distraction, relaxation techniques, physical activities, and additional cognitive strategies (e.g., mantras). We consider these elements to be integral to imparting a sense of personal responsibility in the patient to take control of their pain experience. The PPRC program views parents as active participants in the program. Parents not only transport their child to and from our program but also engage in their own weekly educational and support groups and observe their child's physical and occupational therapy sessions frequently throughout the week. The current findings suggest that parents are poised to support their child's self-management approach to pain after completing the PPRC.

In examining maintenance of treatment gains 1–3 months after discharge from the PPRC, improvements in functional disability and pain-related fear persisted at follow-up. Additionally, parent maintenance scores remained high at follow-up. There was a decline in action scores for parents, potentially reflecting less emphasis on encouraging their child to engage in self-management strategies, as children begin to take on these behaviors more independently.

Despite these promising findings, there are study limitations. The time from evaluation to completion of follow-up measures for the PTS group was closely matched to the length of stay at the PPRC, which likely does not allow sufficient time for patients in the PTS group to experience sufficient outpatient treatment. However, participants in both the PTS and PPRC groups had generally been experiencing pain for over a year and reported severe pain-related disability, almost one standard deviation above the mean for chronic pain patients (Kashikar-Zuck et al., 2011). Thus, it is likely that these patients have already engaged in many of the treatments recommended at the multidisciplinary evaluation. This assertion is further supported with half of patients in the PTS group recommended to continue physical therapy and over one third of patients recommended continuing with psychological therapy at the multidisciplinary clinic evaluation, indicating that they have already been involved with multiple treatment providers. Relatedly, the current study focuses on the efficacy of the PPRC treatment approach and not the cost-effectiveness, although this information is badly needed. Day hospital rehabilitation is a costly, condensed treatment option that cannot be simply compared with the costs of outpatient physical, occupational, and psychological treatment. To truly calculate a cost-benefit analysis, it would be essential to follow patients for ≥ 1 years after PPRC and PTS treatment to ascertain the long-term costs associated with the two treatment approaches for this significantly disabled population.

Although we attempted to match PPRC patients with PTS control subjects on demographic factors and on severity of disability, there may be a referral bias, as there are specific criteria for PPRC enrollment (e.g., did not respond to outpatient PT treatment). However, the lack of response to previous treatments in the PPRC sample may actually underscore the impressive improvements seen in the intensive day hospital setting, given that this group of patients can be considered to have pain-related disability that has been refractory to less intensive treatment approaches. Additionally, measures examined in this study were limited to constructs assessed in both settings at both time points. However, the outcomes did include measures of both physical and emotional functioning, previously identified as core domains in the assessment of pediatric pain treatment outcomes (McGrath et al., 2008). Lastly, we did not have control over what treatments were actually followed by the PTS group. Patients in this sample were highly adherent to engaging in recommended medical treatments, physical therapy, and continuing psychological treatment, but did report lower levels of adherence to beginning psychological treatment. This is likely due to a myriad of factors

including barriers to access care and negative attributions toward psychological treatment for pain (Simons et al., 2010). These adherence data provide information on treatment initiation, but do not specify amount of treatment, which is likely not identical across this group.

Many of the limitations in this study are inherent owing to the nonrandomized nature of this study. Although a truly experimental approach to comparing these treatments would be more internally valid, we conducted this study in a real-world clinical setting, wherein a host of clinical and individual factors influence the types of treatment that an individual child receives.

Beyond study limitations, these findings present promising directions for future research and provide substantive clinical implications. Despite improvements across both modalities of treatment, the increased magnitude of clinical improvements observed in the intensive PPRC program for patients with significant pain-related disability is notable. Further research is needed to explore what specific variables may account for the degree of change observed across treatments (e.g., intensity, dosage, degree of parent involvement, milieu). Additionally, the intensive PPRC treatment model may not be feasible to many families. This program is generally not a covered benefit with insurance providers, often requiring significant lobbying by parents and medical providers to obtain single case agreements or special coverage exceptions (although thus far only 3 of almost 300 patients have self-paid for treatment).¹ In addition, there are only a few programs of this kind in the country, thus requiring families to stay in local hotels and incur additional time away from work while their child is in the program. Thus, it may be beneficial to introduce an intermediate step between these two treatment models such as 1–2 days per week of interdisciplinary treatment, thereby presenting a more structured outpatient treatment experience with some of the day hospital benefits of peer interaction and a treatment milieu. Furthermore, research exists to suggest that intensive interdisciplinary pain rehabilitation has positive benefits that persist through longer term follow-up (Eccleston et al., 2003; Sherry, Wallace, Kelley, Kidder, & Sapp, 1999), but future research can determine whether the effects found in the current study persist beyond short-term assessment.

¹ Since the PPRC opened in 2008, Boston Children's Hospital has gradually negotiated the program into the contracts of the majority third-party payors. All federal insurance programs, i.e., Tricare and Federal BCBS, continue to deny payment for all bundle charge programs such as the PPRC.

In conclusion, both outpatient multidisciplinary and intensive day hospital approaches to the treatment of pediatric chronic pain appear to result in improvements in function, reductions in pain-related fear, and increased readiness to self-manage pain. In a direct comparison, the intense and integrated treatment provided in a comprehensive day hospital pain rehabilitation approach leads to more positive outcomes over a short time, suggesting that this approach has truly meaningful benefits for those children and families dealing with exceptionally complex chronic pain experiences.

Acknowledgments

The authors wish to thank Anne Pauler, BS, and Elizabeth Carpino, MS, for their work on this study.

Funding

This investigation was supported by the American Pain Society Future Leaders in Pain Small Grants Program (L.S.), Children's Hospital Boston Career Development Fellowship Award (L.S.), K23 Career Development Award from the Eunice Kennedy Shriver National Institute of Child Health and Development HD067202 (L.S.), Deborah Monroe Noonan Grant (D.L.), the Sara Page Mayo Endowment for Pediatric Pain Research and Treatment, and the Department of Anesthesiology, Perioperative and Pain Medicine at Children's Hospital Boston.

Conflicts of interest: None declared.

References

- Caes, L., Vervoort, T., Eccleston, C., Vandenhende, M., & Goubert, L. (2011). Parental catastrophizing about child's pain and its relationship with activity restriction: The mediating role of parental distress. [Research Support, Non-U.S. Gov't]. *Pain, 152*, 212–222.
- Claar, R. L., Baber, K. F., Simons, L. E., Logan, D. E., & Walker, L. S. (2008). Pain coping profiles in adolescents with chronic pain. *Pain, 140*, 368–375.
- Claar, R. L., & Walker, L. S. (2006). Functional assessment of pediatric pain patients: Psychometric properties of the functional disability inventory. *Pain, 121*, 77–84.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.
- Cohen, L. L., Vowles, K. E., & Eccleston, C. (2010). The impact of adolescent chronic pain on functioning: Disentangling the complex role of anxiety. *Journal of Pain, 11*, 1039–1046.
- Eccleston, C., Crombez, G., Scotford, A., Clinch, J., & Connell, H. (2004). Adolescent chronic pain: Patterns and predictors of emotional distress in adolescents with chronic pain and their parents. *Pain, 108*, 221–229.
- Eccleston, C., Malleson, P. N., Clinch, J., Connell, H., & Sourbut, C. (2003). Chronic pain in adolescents: Evaluation of a programme of interdisciplinary cognitive behaviour therapy. *Archives of Disease in Childhood, 88*, 881–885.
- Flor, H., Fydrich, T., & Turk, D. C. (1992). Efficacy of multidisciplinary pain treatment centers: A meta-analytic review. *Pain, 49*, 221–230.
- Forgeron, P. A., King, S., Stinson, J. N., McGrath, P. J., MacDonald, A. J., & Chambers, C. T. (2010). Social functioning and peer relationships in children and adolescents with chronic pain: A systematic review. *Pain Research & Management, 15*, 27–41.
- Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N., & Turk, D. C. (2007). The biopsychosocial approach to chronic pain: Scientific advances and future directions. *Psychological Bulletin, 133*, 581–624.
- Gauntlett-Gilbert, J., & Eccleston, C. (2007). Disability in adolescents with chronic pain: Patterns and predictors across different domains of functioning. *Pain, 131*, 132–141.
- Guite, J. W., Logan, D. E., Simons, L. E., Blood, E. A., & Kerns, R. D. (2011). Readiness to change in pediatric chronic pain: Initial validation of adolescent and parent versions of the Pain Stages of Change Questionnaire. *Pain, 152*, 2301–2311.
- Hechler, T., Blankenburg, M., Dobe, M., Kosfelder, J., Hubner, B., & Zernikow, B. (2010). Effectiveness of a multimodal inpatient treatment for pediatric chronic pain: A comparison between children and adolescents. *European Journal of Pain, 14*, 97.e1–97.e9.
- Jensen, M. P., Nielson, W. R., Turner, J. A., Romano, J. M., & Hill, M. L. (2004). Changes in readiness to self-manage pain are associated with improvement in multidisciplinary pain treatment and pain coping. *Pain, 111*, 84–95.
- Kaczynski, K. J., Simons, L. E., & Claar, R. L. (2011). Anxiety, coping, and disability: A test of mediation in a pediatric chronic pain sample. *Journal of Pediatric Psychology, 36*, 932–941.
- Kashikar-Zuck, S., Flowers, S. R., Claar, R. L., Guite, J. W., Logan, D. E., Lynch-Jordan, A. M., . . . Wilson, A. C. (2011). Clinical utility and validity of

- the Functional Disability Inventory among a multicenter sample of youth with chronic pain. *Pain*, 152, 1600–1607.
- Kashikar-Zuck, S., Goldschneider, K. R., Powers, S. W., Vaught, M. H., & Hershey, A. D. (2001). Depression and functional disability in chronic pediatric pain. *The Clinical Journal of Pain*, 17, 341–349.
- Kerns, R. D., Rosenberg, R., Jamison, R. N., Caudill, M. A., & Haythornthwaite, J. (1997). Readiness to adopt a self-management approach to chronic pain: The pain stages of change questionnaire (PSOCQ). *Pain*, 72, 227–234.
- King, S., Chambers, C. T., Huguet, A., MacNevin, R. C., McGrath, P. J., Parker, L., & MacDonald, A. J. (2011). The epidemiology of chronic pain in children and adolescents revisited: A systematic review. *Pain*, 152, 2729–2738.
- Logan, D. E., Carpino, E. A., Chiang, G., Condon, M., Firm, E., Gaughan, V. J., . . . Berde, C. B. (2012). A day-hospital approach to treatment of pediatric complex regional pain syndrome: Initial functional outcomes. *Clinical Journal of Pain*. Advance online publication. doi:10.1097/AJP.0b013e3182457619.
- Logan, D. E., Conroy, C., Sieberg, C. B., & Simons, L. E. (2012a). Changes in willingness to self-manage pain among children and adolescents and their parents enrolled in an intensive interdisciplinary pediatric pain treatment program. *Pain*, 153, 1863–1870.
- Logan, D. E., Simons, L. E., & Carpino, E. A. (2012b). Too sick for school? Parent influences on school functioning among children with chronic pain. *Pain*, 153, 437–443.
- Logan, D. E., Simons, L. E., & Kaczynski, K. J. (2009). School functioning in adolescents with chronic pain: The role of depressive symptoms in school impairment. *Journal of Pediatric Psychology*, 34, 882–892.
- Martin, A. L., McGrath, P. A., Brown, S. C., & Katz, J. (2007). Anxiety sensitivity, fear of pain and pain-related disability in children and adolescents with chronic pain. *Pain Research & Management*, 12, 267–272.
- Maynard, C. S., Amari, A., Wieczorek, B., Christensen, J. R., & Slifer, K. J. (2010). Interdisciplinary behavioral rehabilitation of pediatric pain-associated disability: Retrospective review of an inpatient treatment protocol. *Journal of Pediatric Psychology*, 35, 128–137.
- McGrath, P. J., Walco, G. A., Turk, D. C., Dworkin, R. H., Brown, M. T., Davidson, K., . . . PedIMMPACT. (2008). Core outcome domains and measures for pediatric acute and chronic/recurrent pain clinical trials: PedIMMPACT recommendations. *Journal of Pain*, 9, 771–783.
- Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12, 38–48.
- Roth-Isigkeit, A., Thyen, U., Stoven, H., Schwarzenberger, J., & Schmucker, P. (2005). Pain among children and adolescents: Restrictions in daily living and triggering factors. *Pediatrics*, 115, e152–162.
- Sherry, D. D., Wallace, C. A., Kelley, C., Kidder, M., & Sapp, L. (1999). Short- and long-term outcomes of children with complex regional pain syndrome type I treated with exercise therapy. [Clinical Trial Research Support, Non-U.S. Gov't]. *The Clinical Journal of Pain*, 15, 218–223.
- Sieberg, C. B., Williams, S., & Simons, L. E. (2011). Do parent protective responses mediate the relation between parent distress and child functional disability among children with chronic pain? *Journal of Pediatric Psychology*, 36, 1043–1051.
- Simons, L. E., Logan, D. E., Chastain, L., & Cerullo, M. (2010). Engagement in multidisciplinary interventions for pediatric chronic pain: Parental expectations, barriers, and child outcomes. *The Clinical Journal of Pain*, 26, 291–299.
- Simons, L. E., Sieberg, C. B., Carpino, E., Logan, D., & Berde, C. (2011). The fear of pain questionnaire (FOPQ): Assessment of pain-related fear among children and adolescents with chronic pain. *Journal of Pain*, 12, 677–686.
- Vervoort, T., Eccleston, C., Goubert, L., Buysse, A., & Crombez, G. (2010). Children's catastrophic thinking about their pain predicts pain and disability 6 months later. *European Journal of Pain*, 14, 90–96.
- von Baeyer, C. L., Spagrud, L. J., McCormick, J. C., Choo, E., Neville, K., & Connelly, M. A. (2009). Three new datasets supporting use of the Numerical Rating Scale (NRS-11) for children's self-reports of pain intensity. *Pain*, 143, 223–227.
- Walker, L. S., & Greene, J. W. (1991). The functional disability inventory: Measuring a neglected dimension of child health status. *Journal of Pediatric Psychology*, 16, 39–58.
- Wetherell, J. L., Afari, N., Rutledge, T., Sorrell, J. T., Stoddard, J. A., Petkus, A. J., . . . Atkinson, J. H. (2011). A randomized, controlled trial of acceptance and commitment therapy and cognitive-behavioral therapy for chronic pain. *Pain*, 152, 2098–2107.