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REVIEW ARTICLE

The effectiveness of cognitive behavioural therapy for pain in childhood and adolescence: a meta-analytic review

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Objectives. A variety of chronic painful conditions are present in the paediatric population. Patients with chronic pain often experience considerable scepticism and avoidance by health care providers. This meta-analytic review aimed to utilise well-designed studies, in examining the effectiveness of cognitive behavioural therapy (CBT) in the treatment of chronic pain in children and adolescents.

Methods. Nine randomized controlled trial studies examining CBT for chronic pain were reviewed. Outcome measures were child reported pain intensity, pain duration and functional disability.

Results. CBT had a large effect on pain intensity for recurrent abdominal pain (RAP), a small effect on headaches, and a medium effect on fibromyalgia. CBT had a medium effect on pain duration across pain types. CBT had a large effect on functional disability for RAP, a small effect on fibromyalgia and a moderate effect on headaches. Findings are limited by the small number of studies and varied control conditions.

Conclusions. CBT may be effective in reducing child reported pain symptomology. Future studies using a larger sample and examining the differential impact of varied control conditions are needed.

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Key words: Children and adolescents, cognitive behavioural therapy, fibromyalgia, headaches, meta-analysis, migraine, pain, recurrent abdominal pain.

Introduction

Pain is an aversive and complex multidimensional phenomenon (Carr, 2006). The development of the child's concept of pain is affected by both cognitive maturation and the child's experience of pain (McGrath, 1995). Pain is considered a chronic condition when it has persisted for at least 3 months and does not remit with typical treatments (Carter & Thewlkeld, 2012). Between 11% and 38% of children and adolescents have chronic or recurrent pain (King *et al*. 2011; Weiss *et al*. 2013). Pain prevalence rates are generally higher in girls and increase with age for most pain types (King *et al*. 2011). The reported prevalence of pain types amongst children and adolescents have been found to vary substantially across studies as follows; headache (8–83%), abdominal pain (4–53%), musculoskeletal pain (4–40%) (King *et al*. 2011).

There are a wide variety of chronic painful conditions that present in the paediatric population which have previously been understood as medically unexplained symptoms (MUS) (Johnson, 2007). This dualistic approach to chronic pain conditions such as juvenile fibromyalgia, recurrent abdominal pain (RAP) and tension headaches conceptualises the mind and body as functioning separately and independently (Gatchel *et al*. 2007). Patients with these kind of symptoms often experience considerable scepticism and avoidance by health care providers (Carter & Thewlkeld, 2012). Furthermore, referral to a child psychologist or psychiatrist may often be unwanted on the part of the patient and/or family, who may place a high value on finding a specific physical explanation (Carter & Thewlkeld, 2012). The inadequacy of the dualistic model in understanding chronic pain has contributed to a growing recognition that psychosocial factors, such as emotional stress, could impact the reporting of symptoms and response to treatment (Gatchel *et al*. 2007). A biopsychosocial conceptualization of chronic pain suggests a conceptual shift away from attempting to differentiate physical from mental or emotional pain (Carter & Thewlkeld, 2012). This shift acknowledges the multidimensional nature of pain in which biological, psychological, individual, social and environmental variables interact in the development and maintenance of pain and disability

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(Bursch *et al*. 1998). This conceptual shift may aid in removing the stigma surrounding the treatment of chronic pain.

Cognitive behavioural therapy (CBT) was introduced to the paediatric and adolescent populations to facilitate improvement in pain control (McGrath, 1990). One of the primary goals of CBT is to identify and correct cognitive distortions and maladaptive behaviour, which may involve patient and parental beliefs about the child's illness and factors such as activity restriction, school attendance and social involvement (Carter & Thewlkeld, 2012). CBT is the most well validated non-pharmacological treatment for chronic pain in paediatric patients, with demonstrated effectiveness in the treatment of chronic and recurrent pain, such as headaches, abdominal, musculoskeletal and disease related pain (Christie & Wilson, 2005; Eccleston *et al*. 2009, 2014). CBT approaches to paediatric pain have been shown to alter patient symptom related beliefs and subsequently reduce level of functional disability (Jensen *et al*. 2001).

Juvenile fibromyalgia is a chronic musculoskeletal pain disorder in children and adolescents (Kashikar-Zuck *et al*. 2012). A meta-analytic review of randomized controlled trial's (RCT) on the impact of psychological therapies for the management of chronic pain in youth demonstrated that psychological therapies such as CBT, relaxation and biofeedback, reduced pain intensity by at least 50% in significantly more young people than control groups with headache, abdominal pain and fibromyalgia (Palermo *et al*. 2010). Effects were maintained at 3 month follow-up. Furthermore, 40% of children and adolescents with fibromyalgia who completed CBT demonstrated clinically significant improvement in functional disability and pain intensity *versus* 28% who received fibromyalgia education only (Sil *et al*. 2014).

As headaches are one of the most common recurrent painful conditions in childhood, the majority of treatment literature has focused on this area (Eccleston *et al*. 2014). A distinction may be made between tension and migraine headaches (Carr, 2006). Tension headaches are frequent, occur bilaterally, are accompanied by dizziness and are experienced as a tight band or a heavy weight in the head, often in response to stress or anxiety (Carr, 2006). Chronic migraines are more severe, having at least 15 days of headache per month, with associated features such as symptoms of nausea, vomiting, phonophobia and photophobia (Powers *et al*. 2013). Psychological treatments have been found effective in reducing pain intensity for children and adolescents with headaches with improvements maintained at follow-up (Eccleston *et al*. 2014). Furthermore, a meta-analysis of behavioural and pharmacological interventions for paediatric migraine concluded that treatments combining biofeedback and progressive muscle relaxation were significantly more effective than other psychological interventions and pain medication in improving pain symptomology (Hermann *et al*. 1995).

In RAP, repeated stomach aches are the main concern (Sanders *et al*. 1994). In a review of RAP, Fritz *et al*. (1997) concluded that family based CBT was more effective than standard medical care in alleviating RAP and that gains made during therapy were maintained at 1 year follow-up. Furthermore, psychological treatments delivered to children with abdominal pain have been found to produce greater improvement in disability outcomes compared to interventions delivered to children with headache and fibromyalgia (Palermo *et al*. 2010).

Some studies have found that there is no connection between children's pain intensity and level of disability (Kowalik *et al*. 2011). A review of epidemiological studies across countries demonstrated that up to 30% of children may have chronic or recurrent pain severe enough to impair functioning (Zeltzer *et al*. 2006). Therefore, it is vital that the chronic conditions be accurately assessed and treated in order to reduce pain intensity, improve functioning and prevent long terms sequelae and deviation from a normal developmental trajectory (Leo *et al*. 2006).

The limited number of currently published RCT studies on the use of CBT in the treatment of pain in children and adolescents means that interpretation of findings is limited by several factors. The small number of studies, the different pain related symptoms measured, lack of RCTs and lack of follow-up data drawing on homogenous samples are just some of these limitations. Studies are needed comparing results related to using different treatment settings, intensities, durations, combinations of specific modalities and follow-up care plans (Celedon *et al*. 2014). While a previous Cochrane review has been conducted on chronic pain by Eccleston *et al*. (2014) it differs to the current study in a number of ways. Eccleston *et al*. (2014) examined psychological therapies more generally while the current study will specifically focus on CBT and will include measures of pain duration which Eccleston *et al*. (2014) did not. Eccleston *et al*.'s (2014) inclusion criteria was quite broad as pain types included those related to sickle cell disease and mixed pain conditions. This study will to focus on clear, specific types of pain understood in previous research as MUS in order to explore the effectiveness of CBT and a biopsychosocial approach in treating these chronic pain conditions. The aim of this meta-analytic review is to draw conclusions from RCT studies, in examining the effectiveness of CBT in the treatment of pain in children and adolescents. More specifically, the effectiveness of CBT in the

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treatment of chronic pain conditions; RAP, headaches and fibromyalgia as assessed on the primary outcome measure pain intensity and secondary outcome measures, pain duration and functional disability will be examined. These measures have been chosen due to their consistent use in RCT studies of pain.

Methods

A literature search was conducted with the aim of identifying RCTs on CBT interventions for chronic pain in children and adolescents. Studies in which CBT was delivered in addition to other interventions, for example, standard medical care, were included if control conditions were present to allow for the treatment effects of CBT to be isolated. Only studies published in English, from 1994 to 2014 in peer reviewed journals were included in order to utilise articles published relatively recently, while not overly restricting the pool of data. A search of the major databases; PsycINFO and MEDLINE was conducted using combinations of search terms relating to pain (i.e. pain OR headache OR migraine OR recurrent abdominal pain OR musculoskeletal pain OR fibromyalgia OR MSPS OR JPFS) were combined with terms for CBT intervention (i.e. Cognitive behavioral therapy* OR CBT OR Cognitive behavior therapy* OR cognitive OR behavioural OR behavioral) and terms for children and adolescents (i.e. childhood and adoles* OR children AND adoles* OR young people OR child* OR teenager* OR teens OR juvenile) and finally with terms for RCTs (i.e. randomized controlled trial OR random* OR RCT OR controlled trial OR control*). The last search was performed on the 11 December 2014. This computer search was complemented by a manual search of relevant journals and the bibliographies of review papers. In total 1901 articles were identified. After an initial screening of titles, non-relevant articles, for example, duplicates, review articles, single case studies and process articles ($k = 3$) were removed. Computerised CBT was excluded from the review to control for the potentially differential impact of computerised interventions. Studies were selected for review if they had a group design, included a homogenous group of cases, were RCTs and utilised reliable pre- and post-measures. A preliminary database search revealed few articles which met these criteria for pain with a medical cause. Consequently this meta-analysis focused on the chronic pain conditions; RAP, headaches and fibromyalgia. Applying the above search criteria, 615 articles were screened at abstract level and 65 studies were assessed at full text level. A total of 13 studies met the minimum criteria, four of which were removed due to insufficient data present to calculate effect sizes. In total nine studies were selected for inclusion in this meta-analysis. The literature search flow is displayed in Fig. 1.

Overview of studies

The characteristics of the nine studies selected for review are given in Tables 1, 2 and 3. Five were conducted in the United States of America, two in Germany, one in the Netherlands and one in Australia. All studies were published between 1994 and 2014. Studies were categorised into three groups based on type of pain in order to control for the possible differential effect of CBT; (i) RAP ($k = 5$) (ii) fibromyalgia ($k = 2$); and (iii) headaches or migraines ($k = 2$). The limited number of RCT studies examining fibromyalgia and headaches necessitated the use of a small number of studies. The combined number of children and adolescents across studies is $n = 771$ in the CBT ($n = 401$) and control groups ($n = 370$). Participants' ages ranged from 6 to 18 years, with the majority being female. In six studies participants were referred by a physician, the remaining participants were recruited via advertisement. Five studies were conducted in outpatient clinics, two in academic/university settings and two in participants own homes. All studies included a CBT intervention, one of these was a self-help format, one included a family based approach, two were in group format, while the rest were individual CBT.

Methodological features

Methodological features of all studies included in this review are summarised in Table 4. All studies included CBT intervention, control group, random assignment to groups and diagnostically homogenous groups. Two studies detailed the presence of co-morbid difficulties, while the remaining studies highlighted co-morbid difficulties as exclusionary criteria. Pre- and post-intervention assessment measures were collected in all studies, and 3–12 month follow-up data was collect in all but one study (Kashikar-Zuck *et al*. 2005). All studies included measures of pain symptomology by some combination of children, parents and researchers. Only four studies utilised manualized interventions (Kroener-Herwig & Denecke, 2002; Kashikar-Zuck *et al*. 2005, 2012; Groß & Warschburger, 2013). Treatment integrity checks and therapy supervision were provided in only three studies. This limitation may be reduced by the use of experienced therapists, committed to their therapy model in all studies. Dropout was reported in seven studies, deterioration was assessed in six and information on concurrent and subsequent treatment was provided in four studies. The statistical significance of treatment gains was reported in all studies, while in six studies the clinical significance of treatment in terms of the number of cases judged to be clinically improved following treatment was reported. From a methodological viewpoint

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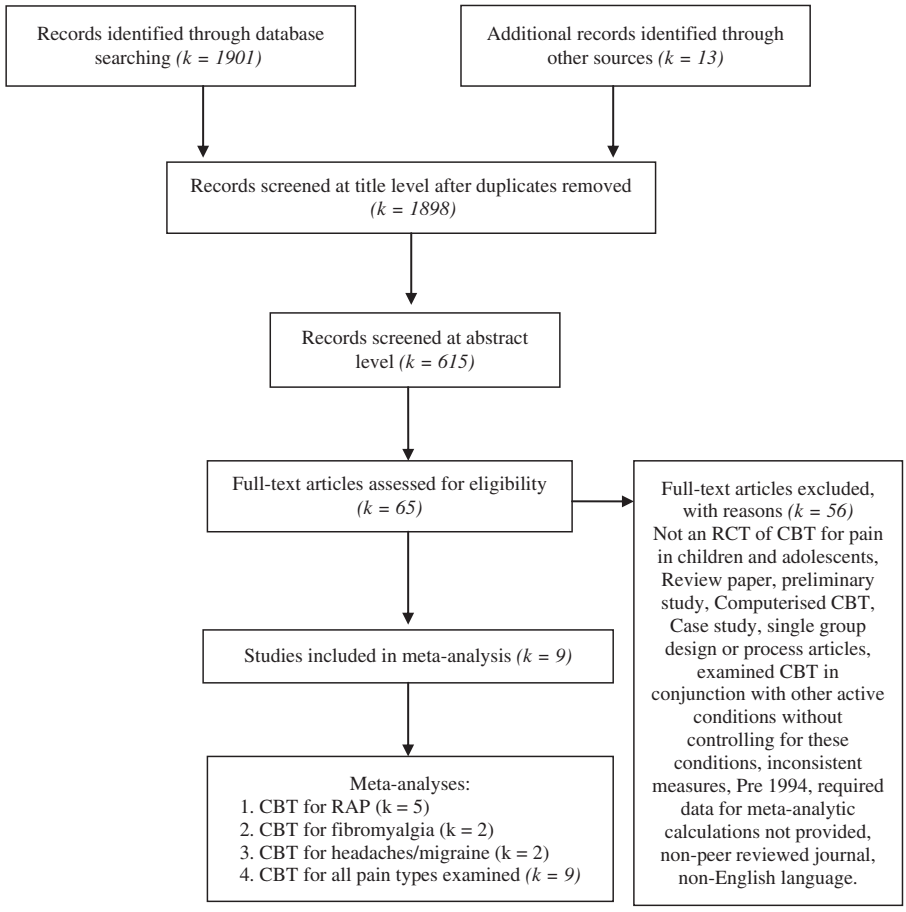

Fig. 1. Literature search and study categorisation flow.

Table 1. *Characteristics of treatment outcome studies for recurrent abdominal pain*

Study number	Study type	Authors	Year	Country	*n*/group	Mean age and range	Gender	Treatment duration
1	PI	Groß & Warschburger	2013	Germany	CBT = 15 WLC = 14	9y 6–11y	m 14% f 86%	6 sess over 6 w
2	PI	Van der Veek *et al.*	2013	The Netherlands	CBT = 52 IMC = 52	11y 8–17y	m 28% f 72%	6 sess
3	PI	Sanders *et al.*	1994	Australia	CBFI = 22 SPC = 22	9y 7–14y	m 36% f 64%	6 sess
4	PI	Levy *et al.*	2010	USA	SLCBT = 100 EI = 100	11y 7–17y	m 6% f 94%	3 sess
5	PI	Warner *et al.*	2011	USA	CBT = 20 WLC = 20	12.4y 8–16y	m 35% f 65%	12 sess over 10 w

PI, a study of psychological intervention only; CBT, cognitive behaviour therapy; w, week; sess, sessions; y, year; m, male; f, female; WLC, wait-list control; IMC, intensive medical care; CBFI, cognitive behavioural family intervention; SPC, standard paediatric care; SLCBT, social learning and cognitive behavioural therapy; EI, educational intervention.

it may be concluded that the studies reviewed here are sufficiently well designed to allow relatively reliable conclusions to be drawn about types of psychological treatments they evaluated and constitute a relatively low risk of bias within studies.

Substantive findings

Tables 5, 6 and 7 contain summaries of the results of all nine studies. Studies were grouped into three categories based on type of pain; (i) RAP (ii) fibromyalgia and

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Table 2. *Characteristics of treatment outcome studies for juvenile fibromyalgia*

Study number	Study type	Authors	Year	Country	*n*/group	Mean age and range	Gender	Treatment duration
6	PI	Kashikar-Zuck *et al.*	2012	USA	CBT = 57 FE = 57	15 y 11–18 y	m 8% f 92%	8 sess
7	PI	Kashikar-Zuck *et al.*	2005	USA	CST = 15 SM = 15	15.3 (median) 13–17 y	m 0% f 100%	6 sess over 8 w

PI, a study of psychological intervention only; CBT, cognitive behaviour therapy; w, week; sess, sessions; y, year; m, male; f, female; FE, fibromyalgia education; CST, coping skills training; SM, self-monitoring.

Table 3. *Characteristics of treatment outcome studies for headaches/migraines*

Study number	Study type	Authors	Year	Country	*n*/group	Mean age and range	Gender	Treatment duration
8	PI	Kroener-Herwig & Denecke	2002	Germany	TG = 29 SH = 27 WLC = 19	12y 10–14y	m 53% f 47%	8 sess over 8 w
9	PI	Powers *et al.*	2013	USA	CBT + A = 64 HE + A = 71	14y 10–17y	m 21% f 79%	10 sess over 20 w

PI, a study of psychological intervention only; CBT, cognitive behaviour therapy; w, week; sess, sessions; y, year; m, male; f, female; TG, therapist administered group format CBT; SH, self-help CBT format; WLC, wait-list control group; CBT + A, cognitive behavioural therapy plus amitriptyline; HE + A, headache education plus amitriptyline.

(iii) headaches or migraine. The primary outcome measure is child reported pain intensity, with pain duration and functional disability as the secondary outcomes. Effect sizes for all variables were calculated using Cohen's d. Given many participants required medication as part of their standard medical care for pain management, use of medication was not exclusionary if this was controlled for via the use of a comparison group.

RAP

Participants across all five RAP studies were randomly assigned to groups, aged under 18 years, meeting diagnostic criteria for abdominal pain. The presence of a co-morbid psychiatric disorder was exclusionary in three studies (Sanders *et al*. 1994; Levy *et al*. 2010; Groß & Warschburger, 2013). Only one study utilised a manualized intervention (Groß & Warschburger, 2013). These studies all have the strength of containing follow-up data 3–6 months post-intervention. All studies compared a CBT intervention lasting 3–12 sessions, with a control group. CBT interventions consisted of one to one intervention, group intervention, family components and self-help CBT. Control groups consisted of wait-list control (WLC), standard medical care and educational information.

The primary outcome, child reported pain intensity was measured in three studies using a pain diary with a visual analogue scale (VAS) 1–2 weeks before each assessment point (Sanders *et al*. 1994; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). Child and parent reported pain intensity was calculated in two studies, using the Faces Pain Scale Revised, and an 8-point Likert scale (Levy *et al*. 2010; Warner *et al*. 2011). One study utilised the abdominal pain index (API) to assess parent reported pain intensity (Walker *et al*. 1997). Pain duration was assessed in two studies using child completed pain diaries, and the parent completed API (Walker *et al*. 1997; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). Functional disability was assessed in three studies. Child reported functional disability was assessed using the KINDL-R questionnaire (Ravens-Sieberer & Bullinger, 2000) in one study (Groß & Warschburger, 2013) while parent and child reported functional disability was assessed using the functional disability inventory (Claar & Walker, 2006) in two studies (Levy *et al*. 2010; Van der Veek *et al*. 2013). Child functioning was assessed by researchers using the Children's Global Assessment Scale (Shaffer *et al*. 1983).

RAP results

For the primary outcome measure, pain intensity, CBT was compared with a control group across five RAP

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Table 4. *Methodological features of pain studies*

Feature	Study number								
	S1	S2	S3	S4	S5	S6	S7	S8	S9
Control or comparison group or condition	1	1	1	1	1	1	1	1	1
Random assignment	1	1	1	1	1	1	1	1	1
Diagnostic homogeneity	1	1	1	1	1	1	1	1	1
Comparable for co-morbidity	0	1	0	0	1	0	0	0	0
Demographic similarity	1	1	1	1	1	1	1	1	1
Pre-treatment assessment	1	1	1	1	1	1	1	1	1
Post-treatment assessment	1	1	1	1	1	1	1	1	1
3 month follow-up assessment	1	0	0	0	1	0	0	0	1
6 month follow-up assessment	0	1	1	1	0	1	0	1	1
9 month follow-up assessment	0	0	0	0	0	0	0	0	1
12 month follow-up assessment	0	1	1	0	0	0	0	0	1
Children's self-report	1	1	1	1	1	1	1	1	1
Parent's ratings	0	1	1	1	1	0	0	1	0
Child's symptom assessed	1	1	1	1	1	1	1	1	1
Deterioration assessed	1	1	1	0	0	1	0	1	1
Dropout assessed	0	1	0	1	1	1	1	1	1
Clinical significance of change assessed	1	1	1	0	0	1	0	1	1
Experienced therapists used	1	1	1	1	1	1	1	1	1
Treatments were equally valued	0	1	1	1	0	1	1	1	1
Treatments were manualized	1	0	0	0	0	1	1	1	0
Therapy supervision was provided	0	1	0	0	0	1	0	1	0
Treatment integrity checked	0	0	0	1	0	1	1	0	0
Data on concurrent treatment given	0	0	1	1	0	1	0	0	1
Data on subsequent treatment given	0	1	0	0	1	1	0	0	1
Total	13	19	16	15	16	19	13	17	19

S, study; 1, design feature was present; 0, design feature was absent.

studies (Sanders *et al*. 1994; Levy *et al*. 2010; Warner *et al*. 2011; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). Effect sizes for child reported pain intensity ranged from 0 to 5.75, post-intervention. The mean effect size was 1.92. This indicates that the average treated case was functioning better than 97% of untreated cases. Follow-up data was available for all but one study (Warner *et al*. 2011). At 3 to 6 months post-intervention effect sizes ranged from 0 to 1.39. The mean effect size at follow-up is 0.8 (large). Effect sizes for parent reported child pain intensity ranged from 0 to 5. The mean effect size was 2.43 (large) (Sanders *et al*. 1994; Levy *et al*. 2010; Warner *et al*. 2011; Van der Veek *et al*. 2013). Parent follow-up data ranged from 0 to 3.27, with a mean effect size of 0.96. These findings conclude that CBT had a large effect post-intervention and at 3–6 month follow-up, based on parent and child reported pain intensity. For three studies, rates of clinically significant improvement ranged from 56% to 91% for the treatment *versus* 9–45% for the control groups post-intervention (Sanders *et al*. 1994; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). At 3–6 month follow-up one study demonstrated an improvement in clinically significant change following CBT (56% to 67%) (Sanders *et al*. 1994) while another study found that the control group receiving standard medical care also demonstrated clinically significant improvement from 47% to 63% (Van der Veek *et al*. 2013).

CBT for pain duration was assessed in two RAP studies and identified effect sizes of 0.8 and 0.0. The latter identified no significant difference between groups (Groß & Warschburger, 2013; Van der Veek *et al*. 2013). The average effect size was medium at 0.4 indicating the average treated case was functioning better than 66% of untreated cases. Functional disability measures demonstrated no significant difference between groups in one study (Van der Veek *et al*. 2013) with an effect size of 0. A significant improvement in the CBT group of Groß & Warschburger's (2013) study was identified with an effect size of 1.76. The mean effect size 0.9 (large) indicates that the average case was functioning better than 82% of untreated cases. This effect size increased to 1.97 at 3 month follow-up (Groß & Warschburger, 2013).

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Table 5. *Summary of results of effects of psychological treatments for pain intensity*

	Study number and condition										
	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Study 7	Study 8			Study 9
Variable	CBT *v.* WLC	CBT *v.* IMC	CBFI *v.* SPC	SLCBT *v.* EI	CBT *v.* WLC	CBT *v.* FE	CST *v.* SM	TG *v.* WLC	SH *v.* WLC	TG *v.* SH	CBT + A *v.* HE + A
Symptomatic improvement after treatment											
Children's self-report	1.52	0.0	0.44	–	5.75	0.33	0.76	−0.00	0.19	−0.19	–
Parent's ratings	–	0.0	0.47	5	4.25	–	–	–	–	–	–
Symptomatic improvement at follow-up											
Children's self-report	1.39	0.0	0.99 (6m)	–	0.06[b]	0.18 (6m)	–	–	–	−0.03 (6m)	–
Parent's ratings	–	0.0	0.37 (6m)	3.66 (3m); 3.27 (6m)	−0.2	–	–	–	–	–	–
Positive clinical outcomes											
% Improved after treatment	90.6% *v.* 9.4%	66.6%[a] *v.* 47.5%	55.6% *v.* 23.8%	–	–	–	–	56.3% *v.* 40.4%	54.4% *v.* 40.4%	56.3% *v.* 54.4%	–
% Improved at follow-up	–	65.8%[a] *v.* 62.8%	66.7% *v.* 27.8%	–	–	14% *v.* 8.6%	–	76.2% *v.*	67.9% *v.*	76.2% *v.* 67.9%	–
Negative clinical outcomes											
% Deterioration	–	4%	0%	10.5%	–	0%	–	19.5% *v.* 35.1%	13.6% *v.* 35.1%	19.5% *v.* 13.6%	–
% Deterioration at follow-up	–	6%	–	–	–	–	–	2.4% *v.*	8.6 *v.*	2.4% *v.* 8.6%	–
% Dropout	–	10%	–	–	–	12.3%	10%	12%	12%	12%	–

CBT, cognitive behavioural therapy; CBFI, cognitive behavioural family intervention; WLC, wait-list control; IMC, intensive medical care; SPC = standard paediatric care; SLCBT, social learning and cognitive behavioural therapy; EI, educational intervention; FE, fibromyalgia education; CST, coping skills training; SM, self-monitoring; TG, therapist administered group format CBT; SH, self-help format CBT; CBT + A, cognitive behavioural therapy plus amitriptyline; HE + A, headache education plus amitriptyline; m, months.

[a] Combination of pain intensity and pain duration score.

[b] CBT group only.

Table 6. *Summary of results of effects of psychological treatments for pain duration*

	Study number and condition										
	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Study 7	Study 8			Study 9
Variable	CBT *v.* WLC	CBT *v.* IMC	CBFI *v.* SPC	SLCBT *v.* EI	CBT *v.* WLC	CBT *v.* FE	CST *v.* SM	TG *v.* WLC	SH *v.* WLC	TG *v.* SH	CBT + A *v.* HE + A
Symptomatic improvement after treatment											
Children's self-report	0.80	0.0	–	–	–	–	–	−0.24	−0.14	−0.08	0.48
Parent's ratings	–	–	–	–	–	–	–	–	–	–	–
Symptomatic improvement at follow-up											
Children's self-report	1.68	0.0	–	–	–	–	–	–	–	0.25	–
Parent's ratings	–	–	–	–	–	–	–	–	–	–	–
Positive clinical outcomes											
% Improved after treatment	–	66.6%[a] *v.* 47.5%	–	–	–	–	–	56.3% *v.* 40.4%	54.4% *v.* 40.4%	56.3% *v.* 54.4%	66% *v.* 36%
% Improved at follow-up	–	65.8%[a] *v.* 62.8%	–	–	–	–	–	76.2% *v.* –	67.9% *v.* –	76.2% *v.* 67.9%	86% *v.* 69%
Negative clinical outcomes											
% Deterioration	–	4%	–	–	–	–	–	19.5% *v.* 35.1%	13.6% *v.* 35.1%	19.5% *v.* 13.6%	–
% Deterioration at follow-up	–	6%	–	–	–	–	–	2.4% *v.* –	8.6 *v.* –	2.4% *v.* 8.6%	–
% Dropout	–	10%	–	–	–	–	–	12%	12%	12%	6%

CBT, cognitive behavioural therapy; CBFI, cognitive behavioural family intervention; WLC, wait-list control; SPC = standard paediatric care; IMC, intensive medical care; SLCBT, social learning and cognitive behavioural therapy; EI, educational intervention; FE, fibromyalgia education; CST, coping skills training; SM, self-monitoring; TG, therapist administered group format CBT; SH, self-help format CBT; CBT + A, cognitive behavioural therapy plus amitriptyline; HE + A, headache education plus amitriptyline.

[a] Combination of pain intensity and pain duration score.

Table 7. *Summary of results of effects of psychological treatments for pain related functional disability*

	Study number and condition										
	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Study 7	Study 8			Study 9
Variable	CBT *v.* WLC	CBT *v.* IMC	CBFI *v.* SPC	SLCBT *v.* EI	CBT *v.* WLC	CBT *v.* FE	CST *v.* SM	TG *v.* WLC	SH *v.* WLC	TG *v.* SH	CBT + A *v.* HE + A
Symptomatic improvement after treatment											
Children's self-report	1.76	0.0	–	–	–	0.34	0.18	–	–	–	0.42
Parent's ratings	–	0.0	–	3.37	–	–	–	–	–	–	–
Researcher's ratings	–	–	–	–	−4.81	–	–	–	–	–	–
Symptomatic improvement at follow-up											
Children's self-report	1.97	0.0	–	–	–	0.37 (6m)	–	–	–	–	–
Parent's ratings	–	0.0	–	0.3 (3m) 1.26 (6m)	–	–	–	–	–	–	–
Researcher's ratings	–	–	–	–	0.31	–	–	–	–	–	–
Positive clinical outcomes											
% Improved after treatment	–	–	–	–	–	–	–	–	–	–	75% *v.* 56%
% Improved at follow-up	–	–	–	–	–	37% *v.* 11.8%	–	–	–	–	88% *v.* 76%
Negative clinical outcomes											
% Deterioration	–	–	–	–	–	0%	–	–	–	–	–
% Deterioration at follow-up	–	–	–	–	–	–	–	–	–	–	–
% Dropout	–	10%	–	10.5%	–	12.3%	10%	–	–	–	6%

CBT, cognitive behavioural therapy; CBFI, cognitive behavioural family intervention; WLC, wait-list control; IMC, intensive medical care; SLCBT, social learning and cognitive behavioural therapy; EI, educational intervention; FE, fibromyalgia education; CST, coping skills training; SM, self-monitoring; TG, therapist administered group format CBT; SH, self-help format CBT; CBT + A, cognitive behavioural therapy plus amitriptyline; HE + A, headache education plus amitriptyline.

Table 8. *Summary of main findings of nine treatment outcome studies of pain*

Study number	Study type	Authors	Year	*n*/group	Number of sessions	Group differences	Key findings
1	PI	Groß & Warschburger	2013	1. CBT = 15 2. WLC = 14	6	1 > 2	The CBT intervention significantly reduced child self-reported pain intensity, frequency, duration and impairment, as compared to the WLC. 90.6% of the CBT group made clinically significant improvement following intervention as opposed to 9.4% for the WLC group. At 3 month follow-up significant reductions in the CBT group remained
2	PI	Van der Veek *et al.*	2013	1. CBT = 52 2. IMC = 52	6	1 = 2	Both CBT and IMC resulted in significant decreases in abdominal pain intensity, duration and functional disability. No significant difference in effectiveness was found between groups. At 12 month follow-up 65.8% of children in the CBT group *v.* 62.8% of IMC group had significantly improved or recovered pain intensity and duration. These rates did not significantly differ between groups. CBT was equally as effective as IMC in reducing abdominal pain
3	PI	Sanders *et al.*	1994	1. CBFI = 22 2. SPC = 22	6	1 = 2	CBFI and SPC significantly improved child and parent reported pain intensity and behaviour. However, children in the CBFI group had a higher rate of clinically significant change, with 55.6% *v.* 23.8% in the SPC group pain free post-intervention and demonstrated lower levels of relapse at 6 and 12 month follow-up
4	PI	Levy *et al.*	2010	1. SLCBT = 100 2. EI = 100	3	1 > 2	Children in the SLCBT group demonstrated greater significant improvement in parent reported child pain intensity than in the comparison condition from baseline to 6 month follow-up. Functional disability, as reported by parents, decreased from baseline to post-intervention for both groups. This reduction was greater for the SLCBT group at follow-up, but not to a significant degree
5	PI	Warner *et al.*	2011	1. CBT = 20 2. WLC = 20	12	1 > 2	CBT was found to be significantly superior to WLC for reducing pain intensity and functioning in a population with co-occurring anxiety, post-intervention based on both child and parent reported outcomes. CBT gains were maintained at 3 month follow–up. 80% of the CBT group were rated as treatment responders by independent evaluators compared to 0% of the WLC group
6	PI	Kashikar-Zuck *et al.*	2012	1. CBT = 57 2. FE = 57	8	1 > 2	Both groups demonstrated significant reductions in functional disability and pain. However, CBT was significantly superior to FE in reducing child reported functional disability, with 37% of participants demonstrating clinically significant improvement. Reduction in pain intensity was not clinically significant for either group. Pain severity was reduced by 14% in the CBT group and 8.6% in the FE group at follow-up
7	PI	Kashikar-Zuck *et al.*	2005	1. CST =15 2. SM = 15	6	1 > 2	The CST group demonstrated a significantly greater improvement in pain levels at time 2 than the SM group. However, there were no significant differences between groups with respect to functional disability. A significant within subjects improvement in functional disability was identified
8	PI	Kroener-Herwig & Denecke	2002	1. TG = 29 2. SH = 27 3. WLC = 19	8	1 = 2 > 3	No significant difference between the two treatment groups was identified. Both treatment groups demonstrated significant improvements above the WLC group in relation to headache frequency and intensity. Change in duration of headache episodes did not differ significantly between treatment groups and the WLC. Post-intervention, across the three headache variables the TG, SH and WLC groups demonstrated 56%, 54% and 40% clinically significant improvement, respectively. At 6 month follow-up this rose to 76% and 68% for the TG and SH groups, respectively. The highest rate of deterioration or unchanged headache symptomology was for the WLC group at 35%
9	PI	Powers *et al.*	2013	1.CBT + A = 64 2. HE + A = 71	10	1 > 2	The CBT + A group reported significantly greater reductions in headache duration and functional disability than the HE + A control group. In the CBT + A group, 66% had a clinically significant reduction in headache duration *v.* 36% in the HE + A group. At 12 month follow-up this rose to 86% and 69% for the CBT + A and HE + A groups, respectively. 75% of the CBT + A group *v.* 56% of the HE + A demonstrated clinically significant improvement in functional disability. This rose to 88% *v.* 76%, respectively, at 12 month follow-up.

PI, a study of psychological intervention only; CBT, cognitive behaviour therapy; WLC, wait-list control; IMC, intensive medical care; CBFI, cognitive behavioural family intervention; SPC, standard paediatric care; SLCBT, social learning and cognitive behavioural therapy; TG, therapist administered group format CBT; SH, self-help CBT format; CBT + A, cognitive behavioural therapy plus amitriptyline; HE + A, headache education plus amitriptyline; EI, educational intervention; CBT + SMC, cognitive behavioural therapy plus standard medical care.

Fibromyalgia

Two studies on fibromyalgia were identified which met inclusion criteria (Kashikar-Zuck *et al*. 2005, 2012). Participants were aged 11–18 years, diagnosed with juvenile fibromyalgia and receiving stable medication. Exclusion criteria were other musculoskeletal diseases, current panic disorder or major depression, or lifetime bipolar disorder or psychosis. Both studies utilised a manualized CBT intervention lasting six to eight sessions and random assignment to groups. One CBT intervention had an emphasis in coping skills training while control groups involved fibromyalgia education and self-monitoring (Kashikar-Zuck *et al*. 2005, 2012). Both studies assessed child reported pain intensity and functional disability using a VAS, pain diary and the FDI pre- and post-intervention. The clinical significance of improvements was assessed post-intervention. Data was collected for one study at 6 months follow-up (Kashikar-Zuck *et al*. 2012).

Fibromyalgia results

Post-CBT intervention, pain intensity, effect sizes were 0.33 and 0.76 (Kashikar-Zuck *et al*. 2005, 2012). The mean effect size was 0.54 (medium) indicating that the average treated case was functioning better than 69% of untreated cases. These findings conclude that CBT had a medium effect post-intervention. This reduced to a small effect (0.18) post-intervention in one study (Kashikar-Zuck *et al*. 2012) with clinically significant change reducing from 47% in the treatment group post-intervention to 14% at 6 month follow-up.

Measures of functional disability were collected in both studies, with effect sizes of 0.34 and 0.18 post-intervention (Kashikar-Zuck *et al*., 2005, 2012). The mean effect size was 0.26 (small) indicating that the average treated case was functioning better than 58% of untreated cases. Follow-up data was only available for one study, which identified an effect size of 0.37 (medium) at 6 month follow-up (Kashikar-Zuck *et al*. 2012) with 37% of participants in the treatment group *versus* 11.8% in the control group demonstrating clinically significant improvement at follow-up. While CBT was significantly superior to the control group in both studies post-intervention, control participants receiving fibromyalgia education in Kashikar-Zuck *et al*.'s (2012) study also demonstrated significant improvements in pain intensity and functional disability.

Headache and migraine

Two headache and migraine studies met inclusion criteria for this meta-analysis (Kroener-Herwig & Denecke, 2002; Powers *et al*. 2013). Participants were aged 10–18 years old and had a diagnosis of chronic headaches/migraines by a physician. Exclusion criteria were secondary or symptomatic headache and other pain conditions. Participants completed 8–10 sessions of CBT or a control condition. Powers *et al*. (2013) compared CBT combined with amitriptyline medication with a control group receiving the medication only while Kroener-Herwig & Denecke (2002) compared two forms of manualized CBT, therapist administered group CBT and self-help CBT, supported with weekly telephone support from a therapist. Pain intensity and duration were assessed in one study using a headache diary (Kroener-Herwig & Denecke, 2002). Functional disability was assessed via the PedMIDAS (Olesen *et al*. 2006). Measures were collected pre- and post-intervention and 3–12 months follow-up. Six month follow-up data will be reported as this is the consistent time point between studies.

Headache and migraine results

In Kroener-Herwig & Denecke's (2002) study pain intensity effect sizes were calculated for each CBT format, group (TG) or self-help (SH) as compared with WLC. TG had an effect size of 0.0, while SH had a larger effect size of 0.19. The mean effect size of 0.09 (large) indicates that the average treated case was functioning better than 82% of untreated cases. The TG group demonstrated clinically significant improvement in 56% of participants *versus* 40% in the WLC group, while the SH group demonstrated 54% clinically significant improvement post-intervention. At 6 month follow-up the number of participants reaching clinically significant improvement in pain intensity for the TG and SH groups increased to 76% and 68%, respectively. While the WLC group also demonstrated clinically significant improvement in 40% of participants post-intervention, they also demonstrated deterioration in 35% of cases. A dropout rate of 12% was reported for this study. These results conclude that CBT had a large effect size when compared with controls on a measure of pain intensity.

Kroener-Herwig & Denecke (2002) identified no significant difference between groups in terms of pain duration while Powers *et al*. (2013) did. The effect size for treatment *versus* control group ranged from 0.14 to 0.49. The mean effect size of 0.3 (medium) indicates that the average treated case was functioning better than 58% of untreated cases. Clinically significant improvement was identified in 54–66% of treatment groups, which increased to 68–86% at 6 month follow-up. However, clinically significant improvement was also identified in 36–40% of control participants who received headache education and amitriptyline (HE + A) only or WLCs. These results conclude that CBT had a moderate effect size post-intervention.

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Functional disability was assessed in Powers *et al*. (2013) study and identified a significantly superior improvement in the CBT + A group than the control group. The effect size of 0.42 post-intervention indicates that the average treated case was functioning better than 66% of untreated cases. Post-intervention, 75% of the CBT + A group demonstrated a clinically significant improvement in functional disability *versus* 46% of HE + A group. This improved to 88% *versus* 76% clinically significant improvement at 12 months follow-up, demonstrating improvements for both groups. These results indicate that CBT had a moderate effect size when compared with a control group post-intervention.

All pain types

Table 8 summarises findings of all studies in narrative form. Effects sizes for CBT in comparison with control groups across all pain types, range from 0 to 5.75 in child reported pain intensity. The mean effect size was 1.12 (large) which indicates that the average treated case was functioning better than 86% of untreated cases. This reduced to 0.51 (medium) at follow-up. Parent reported pain intensity effect sizes ranged from 0 to 5. The mean effect size was 2.43 (large). This reduced to 0.96 (large) at follow-up. Child reported pain duration effect sizes ranged from 0 to 0.48. The mean effect size was 0.33 (medium) indicating that the average treated case was functioning better than 62% of untreated cases. Child reported functional disability effect sizes ranged from 0 to 1.76. The mean effect size was 0.54 (medium) indicating the average treated case was functioning better than 69% of untreated cases. This increased to 0.78 at follow-up. While parent reported functional disability effect sizes ranged from 0 to 3.37, with a mean of 1.68 (large) which decreased to 0.63 at follow-up. These findings conclude that CBT had a medium effect on child reported pain intensity, duration and disability post-intervention, which remained medium at 3–12 month follow-up.

Conclusions

This meta-analysis examined the effect of CBT for chronic pain in children and adolescents on pain intensity, duration and functional disability. CBT was found to improve child ($d = 1.92$) and parent ($d = 2.43$) reported RAP intensity more than those in the control conditions with large effect sizes maintained relatively stable at follow-up (Sanders *et al*. 1994; Levy *et al*. 2010; Warner *et al*. 2011; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). Child self-reported pain intensity demonstrated high rates of clinically significant improvement (56–91%) for the CBT group. This is similar to the impact of a self-help CBT format in significantly reducing headache pain intensity with a small effect (0.19) (Kroener-Herwig & Denecke, 2002). This supports previous findings of CBT as an effective treatment in childhood for chronic headache and abdominal pain (Eccleston *et al*. 2009, 2014). Interestingly, while group CBT was less effective in comparison with WLC for headache pain intensity, the WLC group demonstrated deterioration (35%) post-intervention (Kroener-Herwig & Denecke, 2002). This suggests many participants pain symptomology may have worsened due to the lack of intervention. CBT was found to have a medium effect ($d = 0.54$) on fibromyalgia pain intensity when compared with controls. However, this reduced to a small effect ($d = 0.18$) post-intervention (Kashikar-Zuck *et al*. 2012). This suggests fibromyalgia pain intensity may be more responsive to CBT than headaches, but less effective than RAP. Findings highlight the importance of relating negative outcome to improvement scores to give an adequate picture of treatment effects (Kroener-Herwig & Denecke, 2002).

In examining pain duration, a discrepancy was found between the impact of CBT in studies examining RAP and headaches. While Van der Veek *et al*. (2013) identified no significant difference between treatment and control groups post-intervention for RAP, Groß & Warschburger (2013) identified a large effect. A possible explanation for this may be the use of intensive medical care as a control group by Van der Veek *et al*. (2013) which is likely to have had a greater positive impact than WLC conditions. Conflicting findings were also identified in terms of CBT for headache pain duration (Kroener-Herwig & Denecke, 2002; Powers *et al*. 2013).

In examining functional disability, CBT was found to have a large effect (0.9) for RAP, a small effect ($d = 0.2$) for fibromyalgia and a moderate effect ($d = 0.42$) for headaches, in comparison with controls post-intervention (Kashikar-Zuck *et al*. 2005, 2012; Groß & Warschburger, 2013; Van der Veek *et al*. 2013). This supports previous research identifying psychological treatments delivered to children with abdominal pain as producing greater improvement in disability outcomes compared to children with headache and fibromyalgia (Palermo *et al*. 2010). While CBT was superior to the control group in both fibromyalgia and headache studies, control participants receiving fibromyalgia and headache education also demonstrated significant improvements in pain intensity and functional disability post-intervention (Kashikar-Zuck *et al*. 2012; Powers *et al*. 2013). This supports the findings of Sil *et al*. (2014), that children and adolescents with fibromyalgia who completed CBT demonstrated clinically significant improvement in functional disability and pain intensity *versus* 28% who received fibromyalgia education only. As in this review, while fibromyalgia education does

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impact pain symptomology, it is less effective than CBT. This suggests that fibromyalgia education does have potential as an intervention in pain, perhaps as part of a stepped care approach in which CBT is given to those with higher levels of need. These findings provide good preliminary evidence for the effectiveness of CBT for relieving pain intensity, duration and functional disability in children and adolescents presenting with chronic pain.

This meta-analysis is limited by the small number of studies included and highlights a number of limitations which should be addressed in future research. First, future studies should examine the differential impact of various control conditions such as education, WLC, medication as well as CBT in order to disentangle the elements that are leading to positive treatment response. Second, future research is required with follow-up periods over a longer time in order to assess stability of improvements over time. Finally, future research would benefit from the consistent inclusion of parent as well as child measures of pain symptomology as parents play an integral role in the management of pain and functioning (Sil *et al*. 2014).

Overall, examination of CBT across pain types identified a large effect for child reported, pain intensity ($d = 1.12$), and a moderate effect for pain duration ($d = 0.33$) and functional disability ($d = 0.54$). This suggests that CBT is a strategy that empowers children and adolescents to assume control over symptom management and is a cost effective intervention that enables young people with chronic pain to return to productive life (Zagustin, 2013). Findings have implications for the use of more conservative, cost effective approaches to reducing pain and functional disability in children. These findings support the argument for a biopsychosocial conceptualization of chronic pain which acknowledges the multidimensional nature of pain in which multiple variables are interactive in the development and maintenance of pain and disability (Bursch *et al*. 1998). This conceptual shift may aid in removing the stigma surrounding the treatment of chronic pain, utilising CBT for the treatment of pain before medication becomes a main coping strategy.

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Conflicts of Interest

None.

Ethical Standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institional committee on human experimentation with the Helsinki Declaration of 1975, as revised in 2008. The authors assert that ethical approval for publication of this review was not required by the local REC.

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