Testing the intergenerational model of transmission of risk for chronic pain from parents to their children: an empirical investigation of social transmission pathways

Kristen S. Higgins[a,b,*], Christine T. Chambers[a,b,c], Natalie O. Rosen[a,b], Simon Sherry[a], Somayyeh Mohammadi[b,c], Mary Lynch[d,e], Marsha Campbell-Yeo[b,f], Alexander J. Clark[d,e]

Abstract

Children of parents with chronic pain have higher rates of pain and internalizing (eg, anxiety and depressive) symptoms than children of parents without chronic pain. Parental modeling of pain behaviour and reinforcement of child pain have been hypothesized to underlie these relationships. These mechanisms were tested in a sample of 72 parents with chronic pain and their children (aged 8-15 years). Standardized measures were completed by parents (pain characteristics, pain interference, and child internalizing) and children (pain catastrophizing, pain over previous 3 months, and internalizing). In a laboratory session, children completed the cold pressor task in the presence of their parent, and parent–child verbalizations were coded. Significant indirect effects of parental pain interference on child self-reported (B = 0.12, 95% confidence interval [CI]: 0.01-0.29) and parent-reported (B = 0.16, 95% CI: 0.03-0.40) internalizing symptoms through child pain catastrophizing were found (parental modeling mechanism), and were not moderated by child chronic pain status. Significant indirect effects were found between parent pain-attending verbalizations and child self-reported (B = 2.58, 95% CI: 1.03-5.31) and parent-reported (B = 2.18, 95% CI: 0.93-4.27) cold pressor task pain intensity and tolerance (B = −1.02, 95% CI: −1.92 to −0.42) through child pain-attending verbalizations (parental reinforcement mechanism). Although further understanding of the temporal relationships between these variables is needed, the current study identifies constructs (eg, parent pain interference, child pain catastrophizing, and parent reinforcement of child pain) that should be further examined as potential targets for prevention and intervention of pain and internalizing symptoms in children of parents with chronic pain.

Keywords: Chronic pain, Parents, Children, Social learning, Modeling, Reinforcement

1. Introduction

Parents play a critical role in children's pain.[47,48] Higher rates of pain and internalizing (ie, anxiety and depressive) symptoms are found in offspring of parents with vs without chronic pain.[35] Improved understanding of factors underlying these relationships is needed.[35,67] Stone and Wilson's[67] model of intergenerational transmission of risk posits that parental chronic pain impacts children's pain and psychological functioning through several mechanisms (eg, pain-specific social learning) impacting child vulnerabilities (eg, pain-related cognitions), in this order. Pain-specific social learning is hypothesized to occur through parental pain modeling and/or reinforcement of child pain, as in other conditions.[31,39] In adolescents with abdominal pain, parental chronic pain predicted adolescent pain through parental modeling.[65] Modeling may be more salient in children with vs without chronic pain.

Parental pain modeling may occur through parents' pain interference (ie, extent that pain interferes with mental/physical/social activities[1]), which is highly correlated with adolescent- and self-reports of parent pain behaviour.[66] Parental pain interference may be a proxy for pain modeling by capturing parents' engagement in activities when in pain, which is likely observable to children. Greater parental pain interference is associated with greater child pain[24,36,80] and parent-reported internalizing.[26] Observing parental pain interference may impact children's outcomes through pain-related cognitions.[67] Greater pain catastrophizing is a robust predictor of poorer pain-related[27,51] and internalizing outcomes[22,27,51] in children with and without chronic pain[6,7,21,74] and is associated with more parental pain.[81] Greater parent and child pain intensity were associated through the mediator of higher child pain catastrophizing in children with rheumatic disease.[59] Consistent with theory,[67] observing greater parental pain interference may be associated with greater child pain catastrophizing, and in turn with greater child pain and internalizing.

Parent reinforcement of child pain is another proposed social learning mechanism for the transmission of risk for chronic pain.[67]

Parental responses directing increased attention to (ie, positively reinforcing) child pain predict poorer child chronic[52,61,62,76] and acute[13,25,45,63,77,79] pain-related outcomes. Parent pain-attending predicted children's decreased use of adaptive coping strategies[9,63] and increased pain-attending,[77] in turn predicting higher child pain and distress.[10] Preliminary evidence indicates that parents with chronic pain report more pain-reinforcing responses than other parents.[80] Consistent with this theory,[67] more parent pain-attending behaviours may predict more child pain-attending, in turn predicting poorer child pain outcomes in this population.

This study examined pain-specific social learning mechanisms in the intergenerational transmission of pain and internalizing,[67] building on previous research by examining mechanisms in adults with chronic pain and their children, incorporating multi-informant assessment, and observing interactions during child pain. Hypotheses were (1) child pain catastrophizing mediates the relationship between parental pain interference and child chronic pain and internalizing symptoms (parental modeling), and these relationships are moderated by child chronic pain status, and (2) during experimental pain, parents' pain-attending verbalizations predict child pain through child pain-attending verbalizations (parental reinforcement). Given concerns about chronic pain biasing parent reports,[33] self- and parent-reported child internalizing and pain intensity were collected.

2. Method

The data described in the current article were collected as part of a larger study examining 2 separate research questions, which are described in 2 articles. The current article tests a theoretical model of the mechanisms through which parental chronic pain impacts child pain and mental health outcomes. The other article examines the measurement of a novel construct, child catastrophizing about parental chronic pain, and the intrapersonal and interpersonal effects of parent and child catastrophizing about one another's pain (Higgins et al., in preparation). The study procedures were approved by the IWK Health Centre Research Ethics Board with reciprocal approval from the Nova Scotia Health Authority Research Ethics Board.

2.1. Participants

Seventy-two parent-child dyads participated in the current study. Parents with chronic pain were recruited through a local adult pain management clinic (n = 50) and using community recruitment methods (eg, posters placed in community locations, social media advertisements; n = 22). Parents were considered eligible for the current study if they: (1) had experienced pain for at least 6 months (consistent with the International Association for the Study of Pain recommendations for research on chronic pain[69]); (2) had bodily pain over the previous 4 weeks rated as moderate, severe, or very severe on a verbal rating scale (from the Short Form-36 Health Survey[78]); and 3) had an eligible child between the ages of 8 years 0 months and 15 years 11 months. Exclusion criteria for parents included cognitive impairments that would impact their ability to participate in study activities (eg, dementia), not living with the eligible child at least 50% of the time, being unable to read, write, and speak English well enough to participate in study activities, or having uncorrected hearing or vision impairments.

Children were eligible to participate if they were the child of an eligible parent (one child per parent) and were between the ages of 8 years, 0 months, and 15 years, 11 months. Exclusion criteria for children included having developmental delays that would impact their ability to participate in study activities, inability to read, write, and speak English well enough to participate in study activities, having uncorrected hearing or vision impairments, or having contraindications to participating in the cold pressor task (CPT) (eg, blood or circulation disorders, current injury or history of frostbite to the nondominant hand or arm[2]).

2.2. Experimental pain task

Children completed the CPT, a safe and ethically acceptable method for inducing brief, mild-moderate pain in the laboratory.[8] Children were asked to place their nondominant hand in a bath of cold water (10 ± 0.2°C) up to their wrist. They were asked to keep their hand in the water for as long as they could, but were informed that they could remove their hand at any point if it became too uncomfortable or painful. Children were able to keep their hand in the water for a maximum of 4 minutes, but were not informed of this limit beforehand. These parameters are consistent with published safety guidelines for this task.[2] During the CPT, parents sat across from their child and watched, and dyads were asked to speak to one another as they normally would elsewhere. Parents' and children's interactions during the CPT were videotaped throughout the duration of time that the child's hand was in the water.

2.3. Measures

2.3.1. Demographics

Parents completed an author-developed questionnaire assessing demographic characteristics of themselves and their child including age, sex, racial/ethnic identity, level of education, and marital status. Parents were also asked whether any other members of the child's immediate or extended family had chronic pain.

2.3.2. Pain characteristics

Parents and children each reported on their own pain over the past 3 months using a questionnaire modified from previous research[50] and based on established guidelines for pain assessment in research with children and adults.[44,70] Parents completed the written questionnaire, whereas children completed the questionnaire verbally with a research assistant. The research assistant began by establishing the 3-month timeline (eg, by asking children about the activities they had engaged in over the past 3 months) and asking children about any pain they may have experienced during this period. They were asked to indicate which of these pains had occurred most often over the past 3 months, and answered questions about the location, duration, frequency, and usual intensity of this pain (using an 11-point numeric rating scale). Children were classified as having chronic pain if they had experienced pain (other than muscle soreness due to physical activity) at least once per week for at least the past 3 months. Parents completed the same questions in written form, and this information was used to characterize the sample.

2.3.3. Parent pain interference

Parents completed the Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Interference Short Form 8a measuring the extent to which pain limits or interferes with an individual's functioning (eg, physical and social

activities) and enjoyment of life.[1] This measure contains 8 items (eg, "How much did pain interfere with your ability to participate in social activities?"), each responded to on a 5-point scale from "Not at all" to "Very much." Total scores can range from 8 to 40, and higher scores indicate greater interference with functioning. Evidence of the measure's internal consistency and validity (including construct, discriminant, and ecological validity) has been found in general samples and individuals with a variety of chronic health conditions including chronic pain.[1,14,19] The internal consistency of this measure in the current study was α = 0.95.

2.3.4. Child pain catastrophizing

Children completed the Pain Catastrophizing Scale for Children[20] to assess trait tendency to engage in catastrophic thinking about their own pain (eg, "When I am in pain, I worry all the time about whether the pain will end," "When I am in pain, I can't keep it out of my mind"). Evidence of internal consistency and validity (including factorial, construct, and predictive validity) has been found for this measure in community samples and in samples of children with chronic pain aged 8 to 16 years.[20,49,51] It is considered well established in terms of its psychometric properties in youth with chronic pain.[27] In the current study, the internal consistency of this measure was α = 0.92.

2.3.5. Child internalizing symptoms

Child and parent reports of child internalizing symptoms were collected using the Internalizing Problems composite scale of the Behavior Assessment System for Children,[56] a widely used system of multidimensional clinical measures of children's overall behaviour and emotional functioning. The Internalizing Problems composite scale assesses the child's inwardly directed distress (ie, symptoms of anxiety and depressive disorders). T scores (M = 50, SD = 10) for this scale were generated using the BASC-2 ASSIST computer scoring program. T scores of 70 or above on this scale represent clinically significant levels of internalizing symptoms.[56] Children completed the Self-Report of Personality Child version (for ages 8-11 years; 139 items) or Adolescent version (for ages 12-15 years; 176 items), comprising items answered on true/false or 4-point response scales (ranging from "never" to "almost always") assessing a wide range of behaviors and emotions. Parents completed the Parent Rating Scale Child version (160 items) or Adolescent version (150 items); all items on the parent forms were answered using the 4-point response scale ("never" to "almost always"). Internal consistency scores for this sample were not available, given the use of BASC-2 ASSIST scoring. However, evidence for the reliability (internal consistency and test–retest reliability) and validity (including factorial, concurrent, and discriminant validity) of both forms has been found.[56] In the original standardization sample for the measure, the internal consistencies of the Internalizing Problems subscale were α = 0.95 to 0.96 in children and adolescents in the general norm sample and α = 0.94 to 0.96 in children and adolescents included in the clinical norm sample (including those with learning disabilities and attention-deficit hyperactivity disorder[56]).

2.3.6. Child experimental pain outcomes

After completion of the CPT, children and parents were independently asked to rate the child's average pain intensity during the task using the Faces Pain Scale-Revised, a well-validated scale considered appropriate for assessing acute pain intensity in children aged 4 to 16 years.[18,34] Evidence of strong test–retest reliability and concurrent validity has been found.[64] This scale has also been used in studies to provide parent reports of child experimental and procedural pain intensity.[6,11,63] The scale includes 6 faces ranging from "no pain" to "very much pain," resulting in a score ranging from 0 to 10.

Children's pain tolerance during the CPT was measured as the time in seconds that the child kept their hand in the cold water, up to a maximum of 4 minutes (240 seconds). Given the typically bimodal distribution of this variable, it was dichotomized, with children classified as having reached the ceiling tolerance time or not.

2.3.7. Observed parent and child verbalizations during experimental pain task

Parents' and children's verbalizations during the CPT were transcribed verbatim and coded utterance by utterance using a version of the Child and Adult Medical Procedure Interaction Scale Revised (CAMPIS-R[10]) modified for use in the context of the CPT.[45] The CAMPIS-R is a well-established observational coding system for parent–child interactions during painful procedures, and the modified CAMPIS-R is considered approaching well-established in terms of its psychometric properties.[3] Given that several parents and children discussed the parent's chronic pain during the CPT, a subcode for these verbalizations was added to the coding system for the current study. Parent verbalizations were coded into 3 categories following previous studies.[6,45,77] The primary focus for the current study was the attending talk category (ie, verbalizations drawing attention to child cold and pain symptoms), which included 4 subcodes: (1) symptom-focused talk and commands to child, (2) sympathy to child, (3) procedure-related praise to child, and (4) procedure time talk and commands to child. Other coded categories were nonattending talk (ie, verbalizations aimed at drawing attention away from child cold and pain symptoms; comprising subcodes (1) non–symptom-focused talk and commands to child, and (2) humor to child) and other talk (ie, represented verbalizations not fitting into the above categories; comprising subcodes (1) other procedure talk and commands to child, (2) criticism to child, (3) parent talk about own pain symptoms, and (4) other talk to child such as sentences cut off before meaning could be ascertained and parents asking for clarification about child statements). Children's verbalizations during the CPT were grouped into 2 categories. The focus for the current study was on the child symptom complaints category, which was composed of 4 subcodes: (1) cold/pain symptom talk to parent, (2) anxiety talk to parent, (3) procedure time talk to parent, and (4) resistance talk to parent. The other coded category was child other talk, which included 5 subcodes: (1) child non–symptom-focused talk to parent, (2) other procedure talk to parent, (3) child coping talk to parent, (4) child talk about parent pain symptoms to parent, and (5) other talk to parent. Proportion scores were calculated for each category (number of utterances made in each category divided by total number of utterances made by the participant) to account for between-participant differences in the number of utterances made during the CPT, consistent with previous studies.[6,45] These proportion scores were used in all analyses of coded variables.

Coding of all participant transcripts was completed by a primary coder who was trained on the coding system by the first author. The first author was trained on the coding system and demonstrated interrater reliability with coded training videos developed for

previous studies. The first author coded a randomly selected subset of 20% of the transcripts coded by the primary coder to determine interrater reliability. Excellent interrater reliability was established for both parent (subcode level: 90.10% agreement, κ = 0.85, SE = 0.02; code grouping level: 90.60% agreement, κ = 0.85, SE = 0.03) and child utterances (subcode level: 86.60% agreement, κ = 0.81, SE = 0.03; code grouping level: 93.20% agreement, κ = 0.80, SE = 0.04).[4]

2.4. Procedure

Parents and children attended one study visit, which began with completing informed consent and assent procedures. Children and parents completed the questionnaire and interview measures as described above, and children completed the CPT in the presence of their parent. The order of these tasks was counterbalanced across parent–child pairs (CPT first: n = 36 pairs; 50.00%). While completing the questionnaires, children were accompanied by a research assistant. Parents completed the questionnaires independently in a separate room, but could approach the research assistant at any time to ask questions. The study visit took approximately 90 minutes to complete, and parents and children were compensated for their time and travel expenses.

2.5. Data analysis

Missing data on study variables was minimal (1.00%) and found to be missing completely at random (Little's MCAR test χ^2 (3326) = 0.00, P = 1.00). For participants missing 10% or less of a particular questionnaire, missing data were handled using expectation maximization imputation (n = 3 children, n = 2 parents).[23,40,68] In mediation models with continuous outcomes, full information maximum likelihood was used,[23,40] including to address missing data from 2 children who did not complete the pain catastrophizing measure. Correlations were used to examine relationships between study variables and potential covariates (parent and child age, parent and child sex, parent chronic pain duration, and first task completed during study visit) to be controlled for in mediation analyses. Where correlation

coefficients were $r \geq 0.30$, a covariate was included in analyses involving that study variable.[28]

Mediation models were tested with path analysis in R using lavaan.[58] Two theoretical models based on Stone and Wilson's theory[67] were tested with child-reported, parent-reported, and observed outcomes. The parental modeling mechanism was tested by examining the indirect effects of parental pain interference on child outcomes (child chronic pain status, child self-reported internalizing symptoms, and parent-reported child internalizing symptoms) through the mediator of child pain catastrophizing. The parental reinforcement mechanism was tested within the context of the CPT; the indirect effects of parental attending talk during the task on child outcomes (child self-reported average pain intensity during CPT, parent-reported child average pain intensity during CPT, and observed child CPT tolerance) through child symptom complaints were examined. Separate models were run for each outcome.

Mediation models were tested using MLR estimation for models with continuous outcomes and using weighted least squares mean and variance-adjusted for models with dichotomous outcomes; standardized and unstandardized path coefficients are reported. In each model, indirect effects were tested using bias-corrected bootstrapped (5000 samples) 95% confidence intervals (CIs).[41,53] If the 95% CI for the indirect effect did not include 0, the indirect effect was considered significant.[53] Based on simulation study results, the current study was estimated to be adequately powered (power of 0.80 or higher) to detect indirect effects using bias-corrected bootstrapped CIs in cases when both paths of the indirect effect were medium in effect size.[29]

Moderated mediation was used to examine the secondary hypothesis that the parental modeling mechanism would be moderated by child pain status. Analyses followed established recommendations for this method[54] and were tested using lavaan syntax with MLR estimation and bias-corrected bootstrap CIs (5000 samples). Our sample size exceeded the required size for testing moderated mediation using bias-corrected boot-strapped CIs with power of 0.80 or higher assuming medium-sized direct effects.[54]

Table 1		
Parent pain characteristics.		
	Mean (SD) or n (%)	**Observed range**
Duration of chronic pain	10.92 y (9.46)	0.42-37.60 y
Most common pain over the past 3 months	Back pain: 21 (29.17%) Muscle pain: 14 (19.44%) Multisite pain: 11 (15.28%) Headaches: 7 (9.73%) Joint pain: 5 (6.94%) Nerve pain: 3 (4.17%) Abdominal pain: 2 (2.78%) Migraines: 2 (2.78%) Neck pain: 2 (2.78%) Other types (including bone, thoracic, tooth, and pelvic pain): 5 (6.94%)	
Frequency of most common pain over the past 3 months	More than once per week: 68 (94.44%) About once per week: 2 (2.78%) Once or twice per month or less: 2 (2.78%)	
Usual intensity of most common pain over the past 3 months	6.94 (1.91)	3-10

Table 2

Descriptive statistics and correlations.

	Mean (SD) or n (%)	Observed range	1	2	3	4	5	6	7	8	9	10
1. Parent pain interference	29.26 (8.15)	10-40	—	0.20	0.17	0.22	0.24	0.27*	0.12	0.14	0.16	−0.02
2. Child pain catastrophizing	18.25 (11.46)	0-51		—	0.39**	0.46***	0.46***	−0.16	−0.08	0.25*	0.04	−0.16
3. Child chronic pain status	Yes: n = 24 (33.33%); No: n = 48 (66.67%)				—	0.31**	0.31*	−0.09	−0.01	0.13	0.00	−0.16
4. Child self-reported internalizing problems	51.06 (10.99)	36-79				—	0.58***	−0.14	−0.01	0.29*	−0.05	−0.23
5. Parent-reported child internalizing problems	57.74 (14.40)	36-104					—	−0.01	0.10	0.23	0.07	−0.21
6. Observed parent attending talk	0.48 (0.30)	0-1.00						—	0.59***	0.24*	0.28*	−0.14
7. Observed child symptom complaints	0.52 (0.31)	0-1.00							—	0.44***	0.47***	−0.35**
8. Child self-reported average CPT pain intensity	3.72 (2.87)	0-10								—	0.30*	−0.40***
9. Parent-reported child average CPT pain intensity	3.58 (2.42)	0-10									—	−0.47***
10. Child CPT tolerance	Reached ceiling (240 seconds): n = 32 (44.44%); did not reach ceiling: n = 40 (55.56%)											—

$*P < 0.05$; $** P < 0.01$; $***P < 0.001$.

Child- and parent-reported child internalizing symptoms are presented as T scores. Observed parent attending talk and observed child symptom complaints are presented as the proportion of total utterances the individual engaged in during the CPT. Children were classified as having chronic pain if their interview answers indicated they had experienced pain (other than muscle pain due to physical activity) at least once per week for at least 3 months. Given the bimodal distribution of child CPT tolerance, this variable was dichotomized; children were classified as either reaching the ceiling tolerance (240 seconds) or not.

CPT, cold pressor task.

3. Results

3.1. Demographics

Parent participants had a mean age of 42.91 years (SD = 6.49). Most parent participants were mothers (n = 57; 79.17%), and all parents reported being the participating child's biological parent. Parents identified most often as white (n = 64; 88.89%), followed by biracial or multiracial (n = 4, 5.55%) and "other" racial/ethnic identities (n = 4, 5.55%). Regarding highest level of education completed, parents most commonly reported completing trade school or community college (n = 27; 37.50%). Others reported having some university education (at least 1 year; n = 16, 22.22%), having completed an undergraduate degree (n = 10; 13.89%) or high school education (n = 10; 13.89%), or completing graduate school or professional training (n = 7; 9.72%) or part of high school (n = 2, 2.78%). Most parents reported being married (n = 47; 65.28%) or in a common-law relationship (n = 10; 13.89%). The majority of parents reported that the participating child lived with them full time (n = 62; 86.11%) and that they typically spoke English together at home (n = 71; 98.61%). Twenty-two parents (30.56%) reported that another member of their or their child's extended family also has chronic pain.

Child participants had a mean age of 12.12 years (SD = 2.45) and were approximately evenly split between girls (n = 39; 54.17%) and boys (n = 33; 45.83%). Parent reports identified children most often as white (n = 57; 79.17%), followed by biracial or multiracial (n = 9, 12.50%) and "other" racial/ethnic identities (n = 6; 8.33%).

3.2. Descriptive statistics

Parent pain characteristics are provided in **Table 1**. Back pain was the most common type of pain among parents. On average, parents reported the usual pain intensity for their most common pain over the past 3 months to be nearly 7 out of 10 (moderate pain[12]). Descriptive statistics and correlations among study measures included in the mediation models are provided in **Table 2**. Approximately one-third of child participants had chronic pain based on self-report responses. The most common pain locations reported by children with chronic pain were the head (n = 8, 33.33%) and stomach (n = 6, 25.00%). Overall, children's mean usual pain intensity of their most common pain over the past 3 months was 4.93 (SD = 2.08, range 1.00-10.00). Three children reported having had no pain over the past 3 months. Six children (8.33%) had Internalizing Problems composite scores that fell within the clinically significant range based on child report; based on parent report, 13 children (19.12%) scored in this range.
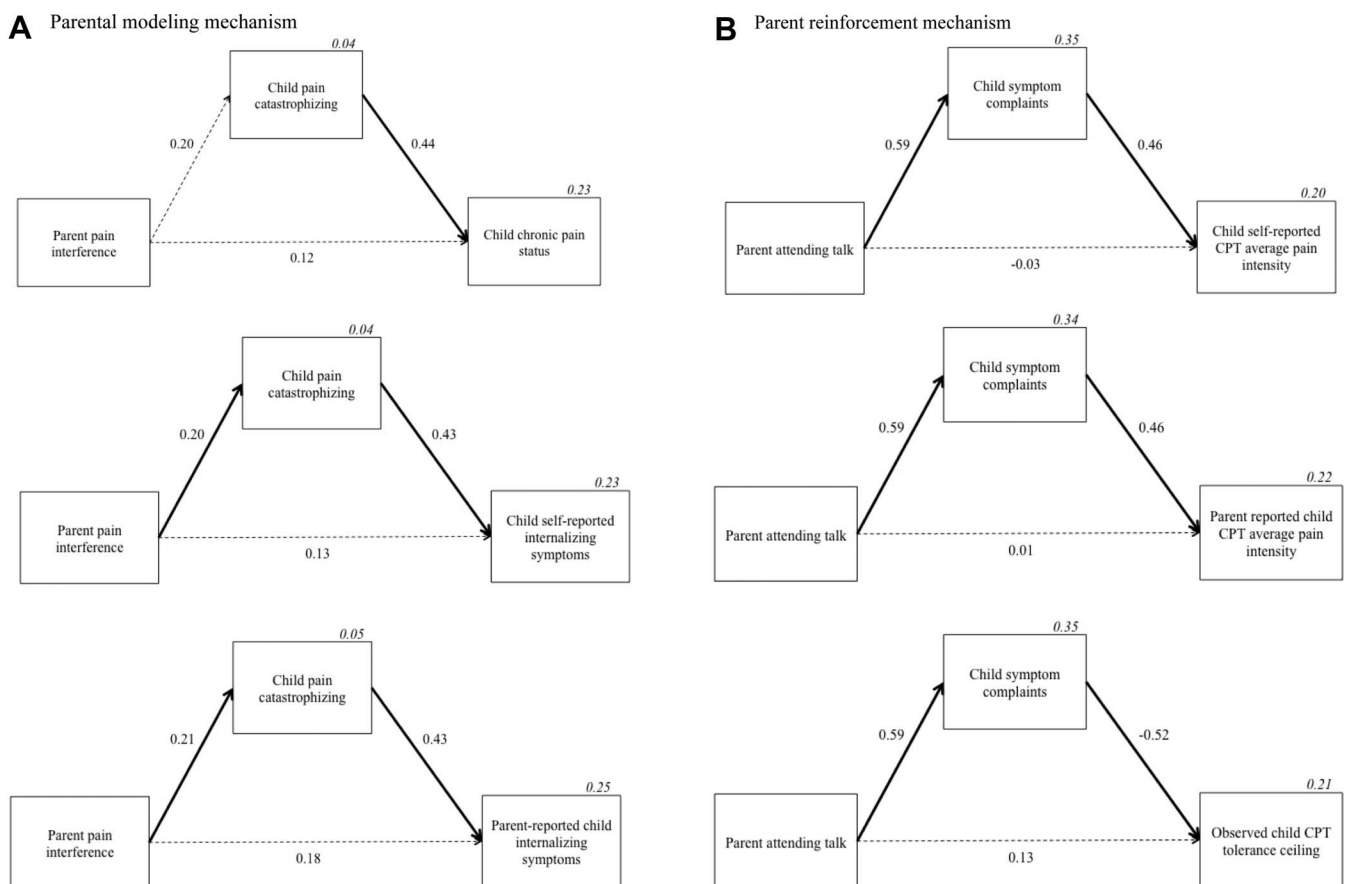
Figure 1. Path diagrams for tested mechanisms of transmission of risk from parents with chronic pain to their children. Solid black lines represent significant paths ($P < 0.05$). Dashed lines represent nonsignificant paths ($P \geq 0.05$). Statistics presented are standardized path coefficients for each path. Italicized values above the upper right corner of mediator and outcome variables represent the proportion of variance explained for that variable (R^2). (A) Parental modeling mechanism. (B) Parent reinforcement mechanism. CPT, cold pressor task.

3.3. Potential covariates

Correlations where $r \geq 0.30$ were identified between the child reaching ceiling CPT tolerance and child age ($r = 0.36$, $P = 0.002$) and parent age ($r = 0.38$, $P = 0.001$). Mediation analyses were run controlling for these covariates; however, given that the pattern and significance of results was the same as the results without covariates included, only the most parsimonious model is presented. No other correlations between potential covariates and study variables where $r \geq 0.30$ were found.

3.4. Testing parental modeling mechanism

Figure 1A shows the path analyses testing the parent modeling mechanism with the outcomes child chronic pain status, child self-reported internalizing, parent-reported child internalizing, and child CPT tolerance. Tests of the indirect effects are provided in **Table 3**. Parent pain interference had significant indirect effects on child self-reported internalizing and parent-reported child internalizing through child pain catastrophizing, supporting the hypothesized parental modeling mechanism. The moderated mediation analysis indicated that there were no significant differences in these indirect effects for children with vs without chronic pain for the outcomes of child self-reported internalizing (−0.10, SE = 0.09, 95% bootstrapped CI: −0.37 to 0.01) or parent-reported internalizing (−0.09, SE = 0.12, 95% bootstrapped CI: −0.44 to 0.08). The indirect effect

of parent pain interference on child chronic pain status through child pain catastrophizing was not significant (**Table 3**).

3.5. Testing parental reinforcement mechanism

Figure 1B shows the path analyses testing the parent reinforcement mechanism in the context of the CPT with the outcomes child self-reported average pain intensity, parent-reported average pain intensity, and child reaching ceiling CPT tolerance. Parent attending talk had a significant indirect effect on each of these outcomes through child symptom complaints (**Table 3**), supporting the hypothesized parental reinforcement mechanism.

4. Discussion

Results of the current study partially supported the hypothesized pain-specific social learning mechanisms underlying the intergenerational transmission of risk of chronic pain and related outcomes.[67] The parental pain modeling mechanism, represented by parental pain interference predicting child outcomes through child pain catastrophizing, was supported for child internalizing symptoms, but not for the presence of child chronic pain. These results are consistent with studies examining relationships between parental pain and disability and child internalizing symptoms.[27,38] However, they differ from studies finding support for parental pain modeling in adolescents with

Table 3

Tests of the indirect effect in each mediation model.

Indirect effect	Unstandardized estimate of indirect effect (B)	Standardized estimate of indirect effect (β)	Standard error	95% bias-corrected bootstrapped CI (lower-upper)
Parent modeling mechanism				
Parent pain interference → Child pain catastrophizing → Child chronic pain status	0.01	0.09	0.01	(0.00 to 0.03)
Parent pain interference → Child pain catastrophizing → Child self-reported internalizing problems	0.12	0.09	0.07	(0.01 to 0.29)
Parent pain interference → Child pain catastrophizing → Parent-reported child internalizing problems	0.16	0.09	0.09	(0.03 to 0.40)
Parent reinforcement mechanism				
Parent attending talk → Child symptom complaints → Child self-reported average CPT pain intensity	2.58	0.27	1.09	(1.03 to 5.31)
Parent attending talk → Child symptom complaints → Parent-reported child average CPT pain intensity	2.18	0.27	0.83	(0.93 to 4.27)
Parent attending talk → Child symptom complaints → Observed child CPT tolerance	−1.02	−0.30	0.38	(−1.92 to −0.42)

CPT, cold pressor task

functional abdominal pain (predicting adolescents' pain severity and disability[65]) and children of mothers with irritable bowel syndrome (predicting child-reported stomachache frequency and bother of gastrointestinal symptoms[39]). Sample differences are unlikely to explain these differing results as the current study did not support child pain status as a moderator of the parental modeling mechanism. Instead, parental pain modeling may have greater influence on the impact of child pain (eg, children's disability[65]) rather than on its presence. Differences in questionnaires used (ie, measuring parental pain interference in the current study and adolescent-reported parent pain behaviour in Ref. 65) may help explain the differing results. The parent pain behaviour measure examines a limited number of potential pain behaviours in which parents may engage (eg, grimacing and thrashing). It may not capture idiosyncratic behaviours through which parents model pain behaviour. Other factors beyond pain interference may contribute to the pain modeling mechanism; for example, parent–child communication about parental pain[71] could impact children's interpretations of parents' pain behaviours. Children may vary in their awareness of parental pain behaviour, perhaps due to differences in empathy.[32]

The current cross-sectional results supported the parental reinforcement mechanism of transmission, with greater proportion of parental attending to child pain during the CPT being associated with greater child pain intensity and lower tolerance through the mediator of child pain-attending. This is consistent with previous studies of children's acute[13,25,45,63,79] and chronic pain.[52,61,62,76] Greater parent attending to child pain may contribute to the development of child chronic pain through its relationship with parent responses to child pain expression. For example, parents who could more easily shift their attention to pain-related stimuli showed more pain control behaviours in response to increased child facial cues of pain,[75] whereas those with reduced attention-shifting responded similarly regardless of child facial cues.

The results of the current article were inconsistent with those of a previous study that did not find support for the parental reinforcement mechanism in adolescents with functional abdominal pain and their

parents.[65] Several methodological differences may explain the divergent results. First, the current study used a psychometrically sound observational coding system to identify parent and child pain-attending verbalizations during a laboratory pain task, whereas the other used a parent self-report measure of solicitous responding to child chronic pain. Social desirability or retrospective reporting bias may impact parents' reporting on their own solicitous responses. Second, parents and children may have acted differently during the novel experience of the CPT than in day-to-day child pain, although results of CPT studies often mimic those found in studies of acute and day-to-day pain[6,15,25] and parents and children report similar responding to one another during experimental and other pain contexts.[6,77] Finally, parents in the current study were a sample of adults with chronic pain with fairly high levels of pain intensity and interference[12,55] and higher self-reported average pain intensity than in the previous study.[65] Parents with more severe chronic pain may engage in more pain-reinforcing responses; in the current and previous studies of parents with chronic pain,[80] those with greater pain interference engaged in more child pain reinforcing responses, as did parents with higher levels of depressive symptoms.[30]

Overall, the current results suggest that parental pain modeling is associated with higher levels of internalizing symptoms in children of parents with chronic pain, and that parental pain-attending may be associated with children's pain experiences through greater child pain-attending. A similar pattern of results was observed for child self- and parent-reported internalizing. These results present the first examination of parental pain modeling as a mechanism underlying the relationship between parental chronic pain and child internalizing symptoms. Although previous research has focused on intergenerational transmission of pain, children of parents with chronic pain are at risk for increased internalizing symptoms compared to other children.[35] Improved understanding of the mechanisms underlying these relationships is essential for developing effective prevention and intervention programs.[35,67]

The study has several strengths, including empirically testing a theoretical model of intergenerational risk transmission in a sample of adults with chronic pain and their children. Previous

research has often focused on clinical samples of children with chronic pain and their parents.[59,65,77] Assessment used multiple methods (psychometrically sound questionnaires and observational coding system) and informants (child, parent, and trained coders), whereas much previous research has relied exclusively on questionnaires[39,65] or on parent-reported child variables.[17,36,80] This approach is particularly important, given concerns of biased reporting by parents with chronic pain.[33]

The current findings must be interpreted in the context of study limitations. The cross-sectional design limits the interpretation of the directions of relationships and has the potential for biased estimates of mediation parameters compared with longitudinal samples.[42,43] However, the current study met criteria for acceptable use of mediation in cross-sectional samples, including ordering variables based on a strong theoretical rationale,[67] acknowledging the atemporal nature of the results and limitations of the design, and avoiding causal claims. It is possible that the observed relationships could be bidirectional, which was not examined with the current study design. The transmission of risk from parents with chronic pain to their children is theorized to occur through multiple mechanisms, and only social learning was examined in this study; other mechanisms are likely involved in these relationships (eg, genetics). This study also used parental pain interference to represent parents' modeling of overt pain behaviour to their children. Although this construct correlates highly with adolescent- and self-reports of parental pain behaviour,[66] parental pain behaviour was not directly assessed. Incorporating observational assessment of parental pain behaviour into future studies of these mechanisms could help disentangle these relationships. Although the use of a child pain interview likely assisted with child understanding of the measure, social desirability may have influenced children's responses. The current sample of parents was largely mothers (79.17%) and identified as white (88.89%); thus, the generalization of these results to fathers and parents of other races is unknown.

The present results highlight several areas that should be further examined to better understand their clinical implications. Consistent with family theories of pain and health,[5,47,57,67] parents' own health and coping is associated with children's well-being. Improved understanding of the temporal and causal relationships between parental pain interference, children's pain catastrophizing, and children's internalizing symptoms could assist in identifying intervention targets. If parent pain interference is shown to negatively impact children's outcomes, then ensuring that parents with chronic pain can access appropriate pain management services might improve parent and child health outcomes. If further research clarifies that child pain catastrophizing and parental responses to child pain facilitate the intergenerational transmission of chronic pain and related outcomes, then programs could be developed to help children identify their cognitions about pain and teach alternative strategies to interpret and respond to pain,[72] and to educate parents with chronic pain about helpful ways to interact with their children during pain. Such interventions may be particularly important to this population, given parents' worry about their children developing problems with pain,[80] and could be incorporated into adult pain management programs along with support to connect parents with additional child resources as needed.

Additional research is needed to clarify the mechanisms underlying the vulnerability of children of parents with chronic pain to poorer pain and psychological outcomes. Longitudinal, prospective studies are needed to determine the temporal relationships between parental pain modeling, parental reinforcement of child pain, and child outcomes. Consideration of other variables such as parental mental health,[16,31,46] neighborhood characteristics,[60] and exposure to adverse childhood events[37,73] will also be important to disentangle the influences of these factors on child health in the context of parental chronic pain. Identification of children most at risk for poor outcomes (eg, based on sex, racial/ethnic background, and socioeconomic status) may assist in appropriately targeting interventions. Although studies have focused on the important task of identifying potential risk factors in families with chronic pain, research on protective factors is also needed.[35,67] Several such factors have been hypothesized (eg, pain acceptance[67]), and should be examined in future research. Research aimed at developing prevention and intervention programs for this vulnerable population should be a priority. Programs should be cocreated with families with parental chronic pain so that such programs are not only evidence-based, but also relevant and feasible for intended users. Coordinated efforts from researchers, health professionals, and families are needed to improve our current understanding of pain-specific social learning and better support children of parents with chronic pain.

Conflict of interest statement

The authors have no conflicts of interest to declare.

Acknowledgements

References

[1] Amtmann D, Cook KF, Jensen MP, Chen WH, Choi S, Revicki D, Cella D, Rothrock N, Keefe F, Callahan L, Lai JS. Development of a PROMIS item bank to measure pain interference. PAIN 2010;150:173–82.

[2] von Baeyer CL, Piira T, Chambers CT, Trapanotto M, Zeltzer LK. Guidelines for the cold pressor task as an experimental pain stimulus for use with children. J Pain 2005;6:218–27.

[3] Bai J, Swanson KM, Santacroce SJ. Observational coding systems of parent-child interactions during painful procedures: a systematic review. Pain Pract 2018;18:130–45.

[4] Banerjee M, Capozzoli M, Mcsweeney L, Sinha D. Beyond Kappa: a review of interrater agreement measures. Can J Stat 1999;27:3–23.

[5] Bavelas JB, Segal L. Family systems: background and implications. J Commun 1982;32:89–107.

[6] Birnie KA, Chambers CT, Chorney J, Fernandez CV, McGrath PJ. Dyadic analysis of child and parent trait and state pain catastrophizing in the process of children's pain communication. PAIN 2016;157:938–48.

[7] Birnie KA, Chorney J, El-Hawary R; PORSCHE Study Group. Presurgery to 6 weeks postsurgery : examination of cross-sectional and longitudinal actor-partner. PAIN 2017;158:1886–92.

[8] Birnie KA, Noel M, Chambers CT, Von Baeyer CL, Fernandez CV. The cold pressor task: is it an ethically acceptable pain research method in children? J Pediatr Psychol 2011;36:1071–81.

[9] Blount RL, Bunke V, Cohen LL, Forbes CJ. The Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF): validation of a rating scale for children's and adults' behaviors during painful medical procedures. J Pain Symptom Manage 2001;22:591–9.

[10] Blount RL, Cohen LL, Frank NC, Bachanas PJ, Smith AJ, Manimala MR, Pate JT. The Child-Adult Medical Procedure Interaction Scale-Revised: an assessment of validity. J Pediatr Psychol 1997;22:73–88.

[11] Boerner KE, Chambers CT, Craig KD, Pillai RR, Parker JA. Caregiver accuracy in detecting deception in facial expressions of pain in children. PAIN 2013;154:525–33.

[12] Boonstra AM, Stewart RE, Köke AJA, Oosterwijk RFA, Swaan JL, Schreurs KMG, Schiphorst Preuper HR. Cut-off points for mild, moderate, and severe pain on the numeric rating scale for pain in patients with chronic musculoskeletal pain: variability and influence of sex and catastrophizing. Front Psychol 2016;7:1–9.

[13] Campbell L, DiLorenzo M, Atkinson N, Riddell RP. Systematic review: a systematic review of the interrelationships among children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioral, and contextual variables in the needle-related procedures context. J Pediatr Psychol 2017;42:611–21.

[14] Cella D, Riley W, Stone A, Rothrock N, Reeve B, Yount S, Amtmann D, Bode R, Buysse D, Choi S, Cook K, Devellis R, Dewalt D, Fries JF, Gershon R, Hahn EA, Lai JS, Pilkonis P, Revicki D, Rose M, Weinfurt K, Hays R. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. J Clin Epidemiol 2010;63:1179–94.

[15] Chambers CT, Craig KD, Bennett SM. The impact of maternal behavior on children's pain Experiences : an experimental analysis. J Pediatr Psychol 2002;27:293–301.

[16] Cho SM, Kim EJ, Lim KY, Lee JW, Shin YM. The effects of maternal depression on child mental health problems based on gender of the child. Community Ment Health J 2015;51:354–8.

[17] Chun DY, Turner JA, Romano JM. Children of chronic pain patients: risk factors for maladjustment. PAIN 1993;52:311–7.

[18] Cohen LL, Lemanek K, Blount RL, Dahlquist LM, Lim CS, Palermo TM, McKenna KD, Weiss KE. Evidence-based assessment of pediatric pain. J Pediatr Psychol 2008;33:939–7.

[19] Cook KF, Jensen SE, Schalet BD, Beaumont JL, Amtmann D, Czajkowski S, Dewalt DA, Fries JF, Pilkonis PA, Reeve BB, Stone AA, Weinfurt KP, Cella D. PROMIS measures of pain, fatigue, negative affect, physical function, and social function demonstrated clinical validity across a range of chronic conditions. J Clin Epidemiol 2016;73:89–102.

[20] Crombez G, Bijttebier P, Eccleston C, Mascagni T, Mertens G, Goubert L, Verstraeten K. The child version of the pain catastrophizing scale (PCS-C): a preliminary validation. PAIN 2003;104:639–46.

[21] Durand H, Birnie KA, Noel M, Vervoort T, Goubert L, Boerner KE, Chambers CT, Caes L. State versus trait: validating state assessment of child and parental catastrophic thinking about children's acute pain. J Pain 2017;18:385–95.

[22] Eccleston C, Crombez G, Scotford A, Clinch J, Connell H. Adolescent chronic pain: patterns and predictors of emotional distress in adolescents with chronic pain and their parents. PAIN 2004;108:221–9.

[23] Enders CK. A primer on maximum likelihood algorithms available for use with missing data. Struct Equ Model 2001;8:128–41.

[24] Evans S, Keenan TR. Parents with chronic pain: are children equally affected by fathers as mothers in pain? A pilot study. J Child Health Care 2007;11:143–57.

[25] Evans S, Payne LA, Seidman L, Lung K, Zeltzer L, Tsao JCI. Maternal anxiety and children's laboratory pain: the mediating role of solicitousness. Children 2016;3:10.

[26] Evans S, Shipton EA, Keenan T. The relationship between maternal chronic pain and child adjustment: the role of parenting as a mediator. J Pain 2006;7:236–43.

[27] Fisher E, Heathcote LC, Eccleston C, Simons LE, Palermo TM. Assessment of pain anxiety, pain catastrophizing, and fear of pain in children and adolescents with chronic pain: a systematic review and meta-analysis. J Pediatr Psychol 2018;43:314–25.

[28] Frigon JY, Laurencelle L. Analysis of covariance: a proposed algorithm. Educ Psychol Meas 1993;53:1–18.

[29] Fritz MS, MacKinnon DP. Required sample size to detect the mediated effect. Psychol Sci 2010;18:233–9.

[30] Fussner LM, Schild C, Lewandowski Holley A, Wilson AC. Parent chronic pain and mental health symptoms impact responses to children's pain. Can J Pain 2018;2:258–65.

[31] Goodman SH, Gotlib IH. Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transmission. Psychol Rev 1999;106:458–90.

[32] Goubert L, Craig KD, Vervoort T, Morley S, Sullivan MJL, de C Williams AC, Cano A, Crombez G. Facing others in pain: the effects of empathy. PAIN 2005;118:285–8.

[33] Graungaard AH, Siersma V, Lykke K, Ertmann RK, Knudsen LE, Mäkelä M. Maternal pain influences her evaluation of recurrent pain in 6- to 11-year-old healthy children. Acta Paediatr 2016;105:183–90.

[34] Hicks C, von Baeyer C, Spafford P, van Korlaar I, Goodenough B. The Faces Pain Scale-Revised: toward a common pediatric pain measurement. PAIN 2001;93:173–83.

[35] Higgins KS, Birnie KA, Chambers CT, Wilson AC, Caes L, Clark AJ, Lynch M, Stinson J, Campbell-Yeo M. Offspring of parents with chronic pain: a systematic review and meta-analysis of pain, health, psychological, and family outcomes. PAIN 2015;156:2256–66.

[36] Jamison RN, Walker LS. Illness behavior in children of chronic pain patients. Int J Psychiatry Med 1992;22:329–42.

[37] Jones GT, Power C, Macfarlane GJ. Adverse events in childhood and chronic widespread pain in adult life: results from the 1958 British Birth Cohort Study. PAIN 2009;143:92–6.

[38] Kaasbøll J, Lydersen S, Ranøyen I, Nilsen W, Indredavik MS. Parental chronic pain and internalizing symptoms in offspring: the role of adolescents' social competence—the HUNT study. J Pain Res 2018;11:2915–28.

[39] Levy RL, Whitehead WE, Walker LS, Von Korff M, Feld AD, Garner M, Christie D. Increased somatic complaints and health-care utilization in children: effects of parent IBS status and parent response to gastrointestinal symptoms. Am J Gastroenterol 2004;99:2442–51.

[40] Little TD, Jorgensen TD, Lang KM, Moore EW. On the joys of missing data. J Pediatr Psychol 2014;39:151–62.

[41] MacKinnon D, Lockwood C, Williams J. Confidence limits for the indirect effect: distribution of the product and resampling methods. Multivariate Behav Res 2004;39:99–128.

[42] Maxwell SE, Cole DA. Bias in cross-sectional analyses of longitudinal mediation. Psychol Methods 2007;12:23–44.

[43] Maxwell SE, Cole DA, Mitchell MA. Bias in cross-sectional analyses of longitudinal mediation: partial and complete mediation under an autoregressive model. Multivariate Behav Res 2011;46:816–41.

[44] McGrath PJ, Walco GA, Turk DC, Dworkin RH, Brown MT, Davidson K, Eccleston C, Finley GA, Goldschneider K, Haverkos L, Hertz SH, Ljungman G, Palermo T, Rappaport BA, Rhodes T, Schechter N, Scott J, Sethna N, Svensson OK, Stinson J, von Baeyer CL, Walker L, Weisman S, White RE, Zajicek A, Zeltzer L. Core outcome domains and measures for pediatric acute and chronic/recurrent pain clinical trials: PedIMMPACT recommendations. J Pain 2008;9:771–83.

[45] Moon EC, Chambers CT, McGrath PJ. "He says, she says": a comparison of fathers' and mothers' verbal behavior during child cold pressor pain. J Pain 2011;12:1174–81.

[46] Neville A, Soltani S, Pavlova M, Noel M. Unravelling the relationship between parent and child PTSD and pediatric chronic pain: the mediating role of pain catastrophizing. J Pain 2018;19:196–206.

[47] Palermo TM, Chambers CT. Parent and family factors in pediatric chronic pain and disability: an integrative approach. PAIN 2005;119:1–4.

[48] Palermo TM, Valrie CR, Karlson CW. Family and parent influences on pediatric chronic pain: a developmental perspective. Am Psychol 2014;69:142–52.

[49] Parkerson HA, Noel M, Pagé MG, Fuss S, Katz J, Asmundson GJG. Factorial validity of the English-language version of the Pain Catastrophizing Scale—child version. J Pain 2013;14:1383–9.

[50] Petter M, Chambers CT, McGrath PJ, Dick BD. The role of trait mindfulness in the pain experience of adolescents. J Pain 2013;14: 1709–18.

[51] Pielech M, Ryan M, Logan D, Kaczynski K, White MT, Simons LE. Pain catastrophizing in children with chronic pain and their parents: proposed clinical reference points and reexamination of the PCS measure. PAIN 2014;155:2360–7.

[52] Pielech M, Wallace DP, Fitzgerald M, Hoffart CM. Parent responses to child pain during intensive interdisciplinary pain treatment and 1 year follow-up. J Pain 2018;19:1275–84.

[53] Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods 2008;40:879–91.

[54] Preacher KJ, Rucker DD, Hayes AF, Preacher KJ, Rucker DD, Hayes AF, Rucker DD, Hayes AF. Addressing moderated mediation hypotheses: theory, methods, and prescriptions. Multivariate Behav Res 2007;42: 185–227.

[55] PROMIS Pain Interference Scoring Manual. 2017. pp. 1–16. Available at: http://www.healthmeasures.net/images/PROMIS/manuals/PROMIS_Pain_ Interference_Scoring_Manual_02232017.pdf. Accessed May 23, 2018.

[56] Reynolds CR, Kamphaus RW. Behavior assessment system for children. 2nd ed. Circle Pines: AGS Publishing, 2004.

[57] Rolland JS. Parental illness and disability: a family systems framework. J Fam Ther 1999;21:242–66.

[58] Rosseel Y. Lavaan: an R package for structural equation. J Stat Softw 2012;48:1–36.

[59] Schanberg LE, Anthony KK, Gil KM, Lefebvre JC, Kredich DW, Macharoni LM. Family pain history predicts child health status in children with chronic rheumatic disease. Pediatrics 2001;108:e47.

[60] Schild C, Reed E, Hingston T, Dennis C, Wilson A. Neighborhood characteristics: influences on pain and physical function in youth at risk for chronic pain. Children 2016;3:35.

[61] Simons LE, Claar RL, Logan DL. Chronic pain in adolescence: parental responses, adolescent coping, and their impact on adolescent's pain behaviors. J Pediatr Psychol 2008;33:894–904.

[62] Sinclair CM, Meredith P, Strong J, Feeney R. Personal and contextual factors affecting the functional ability of children and adolescents with chronic pain. J Dev Behav Pediatr 2016;37:327–42.

[63] Spagrud LJ, von Baeyer CL, Ali K, Mpofu C, Fennell LP, Friesen K, Mitchell J. Pain, distress, and adult-child interaction during venipuncture in pediatric oncology: an examination of three types of venous access. J Pain Symptom Manage 2008;36:173–84.

[64] Stinson JN, Kavanagh T, Yamada J, Gill N, Stevens B. Systematic review of the psychometric properties, interpretability and feasibility of self-report pain intensity measures for use in clinical trials in children and adolescents. PAIN 2006;125:143–57.

[65] Stone AL, Bruehl S, Smith CA, Garber J, Walker LS. Social learning pathways in the relation between parental chronic pain and daily pain severity and functional impairment in adolescents with functional abdominal pain. PAIN 2018;159:298–305.

[66] Stone AL, Walker LS. Adolescents' observations of parent pain behaviors: preliminary measure validation and test of social learning theory in pediatric chronic pain. J Pediatr Psychol 2017;42:65–74.

[67] Stone AL, Wilson AC. Transmission of risk from parents with chronic pain to offspring: an integrative conceptual model. PAIN 2016;157:2628–39.

[68] Tabachnick BG, Fidell LS. Cleaning up your act: screening data prior to analysis. In: Using multivariate statistics. Boston: Pearson Education, Inc, 2007. pp. 60–116.

[69] Task Force on Taxonomy of the International Association for the Study of Pain. Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms. 2nd ed. Seattle: IASP Press, 2002.

[70] Turk DC, Dworkin RH, Allen RR, Bellamy N, Brandenburg N, Carr DB, Cleeland C, Dionne R, Farrar JT, Galer BS, Hewitt DJ, Jadad AR, Katz NP, Kramer LD, Manning DC, McCormick CG, McDermott MP, McGrath P, Quessy S, Rappaport BA, Robinson JP, Royal MA, Simon L, Stauffer JW, Stein W, Tollett J, Witter J. Core outcome domains for chronic pain clinical trials: IMMPACT recommendations. PAIN 2003;106:337–45.

[71] Umberger WA, Martsolf D, Jacobson A, Risko J, Patterson M, Calabro M. The shroud: ways adolescents manage living with parental chronic pain. J Nurs Scholarsh 2013;45:344–54.

[72] Umberger WA, Risko J, Covington E. The forgotten ones: challenges and needs of children living with disabling parental chronic pain. J Pediatr Nurs 2015;30:498–507.

[73] Varinen A, Kosunen E, Mattila K, Koskela T, Sumanen M. The relationship between childhood adversities and fibromyalgia in the general population. J Psychosom Res 2017;99:137–42.

[74] Vervoort T, Goubert L, Vandenbossche H, Van Aken S, Matthys D, Crombez G. Child's and parents' catastrophizing about pain is associated with procedural fear in children: a study in children with diabetes and their mothers. Psychol Rep 2011;109:879–95.

[75] Vervoort T, Karos K, Johnson D, Sütterlin S, Van Ryckeghem D. Parental emotion and pain control behaviour when faced with child's pain: the emotion regulatory role of parental pain-related attention-set shifting and heart rate variability. PAIN 2019;160:322–33.

[76] Walker LS, Claar RL, Garber J. Social consequences of children's pain: when do they encourage symptom maintenance? J Pediatr Psychol 2002;27:689–98.

[77] Walker LS, Williams SE, Smith CA, Garber J, Van Slyke DA, Lipani TA. Parent attention versus distraction: impact on symptom complaints by children with and without chronic functional abdominal pain. PAIN 2006;122:43–52.

[78] Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health Survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473–83.

[79] Williams SE, Blount RL, Walker LS. Children's pain threat appraisal and catastrophizing moderate the impact of parent verbal behavior on children's symptom complaints. J Pediatr Psychol 2011;36:55–63.

[80] Wilson AC, Fales JL. Parenting in the context of chronic pain: a controlled study of parents with chronic pain. Clin J Pain 2015;31:689–98.

[81] Wilson AC, Moss A, Palermo TM, Fales JL. Parent pain and catastrophizing are associated with pain, somatic symptoms, and pain-related disability among early adolescents. J Pediatr Psychol 2014;39:418–26.