The Role of Patient and Parental Resilience in Adolescents with Chronic Musculoskeletal Pain

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Objectives To assess the level of resilience among patients with chronic musculoskeletal pain and their parents and to determine factors associated with patient and parental resilience.

Study design Cross-sectional cohort study of children aged 13-17 years diagnosed with chronic musculoskeletal pain and their parents. Patient–parent pairs were seen for initial consultation in the pediatric rheumatology pain clinic at Children's Hospital of Philadelphia between March and May 2018 and were administered a series of questionnaires including measures of resilience (Connor-Davidson Resilience Scale 10 item, The 14-item Resilience Scale, and the 7Cs of Resilience Tool). We calculated Pearson correlation coefficients to examine the relationship between the variables of interest and resilience.

Results According to all resilience measures, patients and parents had low to moderate levels of resilience. These levels were lower than those previously reported among healthy populations, as well as those with chronic medical conditions. According to the Connor-Davidson Resilience Scale 10 item, patient-level resilience was negatively correlated with pain level ($r = -0.48$), physical disability ($r = -0.54$), and symptom severity ($r = -0.53$). The level of resilience among patients was positively correlated with energy level ($r = 0.57$) and health-related quality of life ($r = 0.64$). Parental resilience was positively correlated with parental mental health ($r = 0.61$).

Conclusions Higher patient resilience was correlated with reduced disease severity among adolescents with chronic musculoskeletal pain. Future research should explore whether fostering resilience in adolescents with chronic musculoskeletal pain via the application of resilience-training interventions mitigates disease burden in this vulnerable patient population. *(J Pediatr 2019;210:118-26)*.

Resilience, a dynamic process of positive adaptation or continued development in the context of significant adversity,[1,2] manifests as a positive outcome despite the presence of a risk and can strengthen an individual's resolve against the impact of stressors.[3] Resilience involves qualities and processes not only within the individual, but also familial (including parental), environmental, and cultural contexts.[4] Resilience in adolescents with chronic musculoskeletal pain likely involves a set of adaptive responses to chronic pain such that resilient adolescents exhibit better pain coping strategies and overall better physical and psychosocial function compared with their nonresilient peers. Youth with chronic musculoskeletal pain may also experience improved outcomes if their parents are resilient as caregivers serve as an external resource for resilience.[5] In 1 study assessing children with a variety of types of chronic pain, resilience seemed to be lower in children with chronic pain than in healthy controls.[6]

Chronic pain is common in the pediatric population affecting 20.0%-37.3% of children and adolescents.[7-10] Approximately 5.1% of youth report moderate to severe chronic pain, accompanied by impaired physical and psychosocial functioning.[7,8] In a study of school-aged children, musculoskeletal pain accounted for 64% of all pains reported by children and adolescents.[9] In a systematic review,

7Cs Tool	7Cs of Resilience Tool
RS-14	14-item Resilience Scale
ACE	Adverse childhood experience
CD-RISC-10	Connor-Davidson Resilience Scale 10-item
FDI	Functional Disability Inventory
GH-10	Global Health Measure 10 item
HRQoL	Health-related quality of life
PROMIS	Patient-Reported Outcomes Measurement Information System
PGH-7	Pediatric Global Health Measure 7 item

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the prevalence rates for pediatric chronic musculoskeletal pain ranged from 4% to 40%.[10,11] Pediatric chronic musculoskeletal pain is also associated with significant morbidity and impaired quality of life in affected children and their families.[8,9,12-14]

Evidence-based treatment for pediatric chronic musculoskeletal pain consists of a nonpharmacologic multidisciplinary approach of exercise, including formal physical therapy, combined with psychological therapies including relaxation, hypnosis, coping skills training, biofeedback, and cognitive-behavioral therapy.[15,16] Despite these treatments, long-term outcomes in children with chronic musculoskeletal pain remain poor.[12,17,18] Although psychological counseling is generally effective,[19] it has not demonstrated consistent effectiveness in increasing engagement in physical activity.[20] A Cochrane review indicated that psychological treatments were beneficial for reducing pain outcomes after treatment, but these findings were not sustained at follow-up.[15]

Resilience training serves as a potential adjuvant psychosocial skills-based intervention for the treatment of pediatric chronic musculoskeletal pain. Cognitive-behavioral therapy is a psychological treatment that helps patients to test and revise their thoughts and actions to think more flexibly and accurately, and thereby effectively handle difficult situations.[15] Although cognitive-behavioral therapy focuses on a subset of internal skills and qualities that are important for resilience, resilience training includes a focus on additional individual skills and qualities (eg, character, purpose) as well as relationships (eg, parents) and external factors (eg, connection) that support resilience.[2,21,22] Furthermore, resilience training can be delivered in a group setting via telehealth or online modules and can be delivered by a variety of trained professionals allowing for increased accessibility and cost effectiveness.[23] Studies on resilience training for adolescents demonstrate the feasibility and acceptability of these interventions, as well as their efficacy in improving psychosocial outcomes and preventing psychological distress and mental health disorders.[22,24-27]

In adults with fibromyalgia syndrome, resilience has been shown to be associated with greater physical function and with lower levels of depression and pain severity.[28] We therefore hypothesized that adolescents with chronic musculoskeletal pain have low resilience and that resilience levels are associated with disease severity. Parental resilience may also correlate with patient-level resilience. In 1 study of children with chronic pain, both parent pain catastrophizing and parent pain acceptance were associated with children's pain catastrophizing and pain acceptance.[29] Additionally, parental psychological flexibility, a resilience factor, has been found to be associated with functioning, depression, and pain acceptance in adolescents with chronic pain.[30,31]

The aims of this study were to measure the level of resilience among patients with chronic musculoskeletal pain and their parents and determine factors associated with patient and parental resilience.

Methods

We conducted a cross-sectional study of children aged 13-17 years diagnosed with chronic musculoskeletal pain and their parents. Patient–parent pairs were seen for an initial consultation in the pediatric rheumatology pain clinic at Children's Hospital of Philadelphia between March and May 2018. All eligible patients received a diagnosis by the treating physician of chronic musculoskeletal pain, defined according to The International Association for the Study of Pain, as persistent or recurrent pain affecting the bone(s), joint(s), muscle(s), or related soft tissue(s) present for ≥3 months.[32-34] Parents were eligible if identified as the legal guardian of the patient. All eligible patient–parent pairs identified English as their primary language. Informed consent and child assent were obtained at the time of the study visit. Patient–parent pairs were administered a series of online questionnaires at the time of the study visit or within 12 weeks of the clinic visit via an e-mailed survey link, at the discretion of the participants. All responses were recorded securely on a research electronic data capture (REDCap) database (Vanderbilt University). Questionnaires were complemented by abstraction of clinical and demographic information from patients' electronic medical records. The study protocol was approved by the study site's institutional review board.

Questionnaires

Online questionnaires included demographic questions and survey measures. Parents participating in the study were asked questions regarding their own demographic information, including age, sex, race, ethnicity, highest level of education, household income, occupation, relationship to child, and marital status. Both patients and parents completed 2 measures of resilience: the 14-Item Resilience Scale (RS-14) and the Connor-Davidson Resilience Scale 10-item (CD-RISC-10). Patients completed another resilience measure, specific to the adolescent population, called the 7Cs of Resilience Tool (7Cs Tool). Three different measures of resilience (2 for patients and parents and 1 for patients only) were used in this exploratory study because there is no gold standard measurement of resilience and no resilience measure has been specifically developed for a chronic pain population.[35] A demonstration of consistent findings across these different measures would produce robust study findings and address potential concerns that an incorrect measure was used for this patient population. Patients and parents also completed the following measures of health-related quality of life (HRQoL): the Patient-Reported Outcomes Measurement Information System (PROMIS) Pediatric Global Health Measure (PGH-7) and Global Health (GH-10) Measure version 1.2.

Measures of Resilience. The CD-RISC-10 is a measurement tool comprised of 10 items, each rated on a 5-point scale (0 to 4). Participants are asked to respond based on how they have felt over the past month. Total scores range

from 0 to 40 with higher scores reflecting greater resilience. In addition to quantifying resilience, it was also developed as a clinical measure to assess treatment response. It demonstrates sound psychometric properties, with good internal consistency and test–retest reliability, and convergent and divergent validity.[36-38] Furthermore, it has been validated in adolescents and young adults[39] and administered to children and adolescents in a number of studies.[27,37,40-46]

The RS-14 is a well-validated questionnaire consisting of 14 items to assess resilience.[47] The resilience scale is one of the most widely used scales to measure resilience internationally.[48] It has been used for >25 years in different age groups ranging from adolescent to elderly.[48-50] Scores range from 14 to 98, with higher scores indicating greater resilience. The scale focuses on domains of resilience including purpose, perseverance, self-reliance, equanimity, and authenticity. The RS-14 takes 4-5 minutes to complete. Response choices use a 7-point Likert scale to rate the individual evaluation of each item. The respondents' choices range from 1 (strongly disagree) to 7 (strongly agree). Scores are categorized into very low (14-56), low (57-64), on the low end (65-73), moderate (74-81), moderately high (82-90), and high (91-98).[49] The RS-14 has demonstrated internal consistency with alpha coefficients ranging from 0.84 to 0.94. It also has adequate validity and acceptable test–retest reliability.[47-56] Convergent validity has been demonstrated with measures of both adolescent social self-efficacy and academic self-efficacy.[47] This questionnaire was administered to both patients and their parents.

The 7Cs Tool is a questionnaire developed for adolescents, ages ≥13 years, to measure resilience using the following components: competence, confidence, connection, character, contribution, coping, and control.[3] Each component has 3 statements built on a Likert scale. For example, confidence is assigned the following statements: I believe I can be successful in whatever I choose; I can usually be successful, but I know what my strengths and weaknesses are; and I have doubts that I will be successful, even in the things I am good at. For each component, the statements range from most to least resilient and are assigned a score of 0, 1, or 2, respectively. More points are assigned to lower resilience statements to counteract potential social desirability bias. For each Roman numeral, participants read the statements and circle the one that most describes how they feel. Points from each component are added together for a total score. Lower resilience levels correspond with higher total scores and vice versa. Internal consistency was established for this measure with a Cronbach alpha of 0.7.[3] The validity of the tool has been demonstrated through its associations with related constructs. For example, higher scores on the 7Cs Tool (indicating lower resilience) are associated with higher adverse childhood experiences (ACEs) and Health Survey for Adolescents (risk behavior) scores, as well as increased problems in school, drug use, violent behavior, recent depression, and suicidality.[3] Lower scores (representing higher resilience) are associated with participation in physical activities.[3]

Measures of HRQoL. The PROMIS PGH-7 Measure is a well-described, validated, brief, and reliable 7-item summary assessment of a child's self-reported health.[57,58] The GH-10 Measure version 1.2 is a brief and reliable 10-item summary of an adult's self-reported physical and mental health. This measure was completed by parents only.

Clinical Characteristics. Clinical and demographic information including age, race and ethnicity, sex, past medical and self-reported psychological history, and health care use (number of previous medications, interventions, providers, clinic visits, and hospitalizations for the treatment of chronic pain) were abstracted from patients' medical records. We assessed health care use to examine whether, as demonstrated in other adolescent populations, lower parental resilience would be associated with greater health care use (possibly in an attempt to treat the affected child's pain).[59] Additionally, measures that are part of routine clinical care were abstracted from patients' records including the patient- and parent-reported Functional Disability Inventory (FDI)[60] scores, visual analogue scale (0-100), verbal pain report (0-10), energy level (0-100), physician global score (0-10), Symptom Severity Score (0-12), and Widespread Pain Index (0-19).[61] Last, the presence and number of ACEs were abstracted from patients' medical records (including the evaluating psychologist's clinical documentation). ACEs are potentially traumatic childhood events that can have negative, lasting effects on health and well-being and may be mitigated by resilience.[62] Patients were considered to have a positive history for ACEs if they have been exposed to any of the following: (1) verbal abuse, (2) physical abuse, (3) sexual abuse, (4) parent with an alcohol problem, (5) parent with a drug problem, (6) parental divorce, (7) parental separation, (8) other household members with problems with drugs and/or alcohol, (9) household mental illness/suicide, (10) incarcerated household member, (11) economic hardship, (12) mother or step mother is a victim of domestic violence, and (13) bullying.[63]

Statistical Analyses

Demographic information and baseline characteristics were summarized by frequencies and percentages for categorical variables and by mean and SD, as well as median and IQR for continuous variables. Differences between patients' and parents' scores on the measures were assessed using the paired *t* test for normally distributed data and Wilcoxon signed-rank test, for non-normally distributed data. We calculated Cronbach alpha coefficients for the various resilience measures and assumed a minimum standard of 0.70 for adequate internal reliability. We calculated Pearson correlation coefficients to examine the relationship between variables of interest (pain severity, energy level, functional disability, Widespread Pain Index, Symptom Severity Score, ACEs, physician global score, HRQoL measures, and health care use) and patient resilience and parental resilience (using the CD-RISC-10), as appropriate. We chose to use the

CD-RISC-10 for the primary correlation analyses because this resilience scale was developed as a clinical measure to assess response to treatment and has excellent psychometric ratings compared with the other resilience measures.[35] We repeated these analyses using the RS-14 and the 7Cs Tool as secondary analyses. All analyses were completed using StataCorp 15.1 (College Station, Texas).

Results

Sample Characteristics

A total of 30 patient–parent pairs were consented to participate in the study; 28 patient–parent pairs completed the questionnaires for a total of 56 evaluable study subjects. All but 2 patient–parent pairs completed the study questionnaires in the clinic, upon completion of their evaluation. The remaining patient–parent pairs completed the questionnaires 14 and 69 days after their clinic evaluation. The majority of the patients (71.4%) and parents (92.9%) were female. Most of the parents were mothers (92.8%). The majority were non-Hispanic whites (75%), with 60.7% of families residing in a suburban area (n = 17), 32.1% in a rural area (n = 9), and 7.1% in an urban setting (n = 2).

The median age of the patients was 15 years (IQR 14.0-15.5 years) and median age of the parents was 48 years (IQR, 45.0-51.0 years). Table I presents the demographics of the parents. The majority of parents were well-educated. More than one-half of parents (60.7%) reported having issues with chronic pain themselves.

Table II shows the demographics and clinical characteristics of the patients. The majority of children reported constant pain (71.4%) and the median duration of pain before evaluation was 36 months (IQR, 18-66 months). Psychological comorbidities were common and included anxiety (64.2%), depression (39.3%), and a history of suicidal ideation/intent (25.0%). According to their FDI scores, patients had a moderate level of physical disability.[64,65] At least 1 ACE was documented in 71.4% of children, the most common of which was bullying (Figure 1; available at www.jpeds.com). At the time of study participation, 50% of children (n = 14) were attending school fulltime with 5 children attending part time, 5 receiving home schooling, 3 in homebound instruction, and 1 child not in school. Table III summarizes patient-reported outcome measures for children and their parents. Overall, study subjects demonstrated average quality of life.

Table I. Demographics and clinical characteristics of parents of adolescents with chronic musculoskeletal pain

	Parent (n = 28)
Demographics	
Female	26 (92.9)
Age, y	48.0 (45.0-51.0)
Non-Hispanic Caucasian	21 (75.0)
History of chronic pain	17 (60.7)
Marital status	
Married/domestic partnership	21 (75.0)
Widowed	1 (3.6)
Divorced	4 (14.3)
Separated	2 (7.1)
Education level	
No high school degree	2 (7.14)
High school/GED	6 (21.4)
Some college	2 (7.1)
College degree	15 (53.6)
Master's degree	2 (7.1)
Doctoral	1 (3.6)
Household income*	
<$100 000	14 (56.0)
$100 000-149 999	4 (16.0)
>$150 000	7 (28.0)
Residential area	
Suburban	17 (60.7)
Urban	2 (7.1)
Rural	9 (32.1)
Employment status	
Employed for wages	15 (53.6)
Self-employed	3 (10.7)
A homemaker	7 (25.0)
A student	1 (3.6)
Unable to work/disability	2 (7.1)
Religion	
Religious	12 (42.9)
Spiritual	8 (28.6)
Other	1 (3.6)
None	1 (3.6)
Prefer not to answer	6 (21.4)
Clinical characteristics	
Pain visual analogue scale (0-100)	27.0 (4.0-61.5)
Energy level (0-100)	82.5 (70.0-92.5)

GED, General educational development test.
Values are number (%) or median (IQR).
*For household income, 25 parents responded; 2 parents chose not to respond, and 1 parent did not answer the question.

Resilience Levels and Correlations among Measures

On average, patients and their parents reported mean low to moderate levels of resilience (Table III). Correlation of the resilience measures within the 2 groups of subjects was moderate to good. Among patients, the CD-RISC-10 and RS-14 correlated strongly (r = 0.7; $P < .01$). This was also true for the parents (r = 0.82; $P < .001$). Among children, the CD-RISC-10 and RS-14 correlated well with the 7Cs Tool (r = −0.59 and r = −0.70, respectively; both $P < .001$). In contrast, patients' and parents' respective scores on the CD-RISC-10 (r = −0.18; $P = .35$) and RS-14 (r = 0.23; $P = .24$) were not significantly correlated. The Cronbach alpha for both CD-RISC-10 and RS-14 was >0.70, demonstrating good internal consistency for these measures, whereas the Cronbach's alpha for the 7Cs Tool was 0.57.

Relationship between Patients' Resilience and Health Status

Figure 2 shows the Pearson correlation coefficients evaluating the relationship between patient-level resilience and variables of interest. Resilience was negatively correlated with pain level (r = −0.48; $P = .01$), functional

Table II. Demographics and clinical characteristics of patients

	Patients (n = 28)
Demographics	
Female	20 (71.4)
Age, y	15.0 (14.0, 15.5)
Non-Hispanic Caucasian	21 (75.0)
Reported duration of pain, mo	36 (18, 66)
Self-reported psychological history*	
Anxiety	18 (64.3)
Depression	11 (39.3)
Suicidality	7 (25.0)
Seen by mental health provider	22 (78.6)
At least 1 ACE	20 (71.4)
Pain and pain-related measures	
Pain visual analogue scale (0-100)	61.5 (30.0, 81.5)
Energy level (0-100)	55 (40.0, 77.5)
FDI (0-60)	23.5 (14.0, 37.0)
Widespread Pain Index† (0-19)	5.0 (2.5, 11)
Symptom Severity Score† (0-12)	6.0 (4.5, 11.0)

Values are number (%) or median (IQR).
*Psychological comorbidities were self-reported and included past and/or current.
†Widespread Pain Index and Symptom Severity Score defined according to the 2010 American College of Rheumatology Criteria for Fibromyalgia Syndrome (Wolfe et al[61]). FDI scores range from 0 to 60 with higher scores indicating more functional disability.

disability (r = −0.54; $P < .01$), and symptom severity (r = −0.53; $P < .01$). The level of resilience among patients was positively correlated with energy level (r = 0.57; $P < .01$) and HRQoL (r = 0.64; $P < .001$). There was no significant correlation between patient-level resilience and patients' age, the physician global score, parents' resilience levels, or the number of ACEs (all $P > .05$; **Table IV**; available at www.jpeds.com).

In secondary analyses, we found that patients' resilience measured by the RS-14 correlated significantly with HRQoL and energy level. Additionally, RS-14 scores were inversely related to functional disability (**Table V**; available at www.jpeds.com). Resilience measured by the 7Cs Tool correlated with HRQoL, energy level, patient FDI, and symptom severity (**Table VI**; available at www.jpeds.com).

Table III. Parent and patient resilience and HRQoL

	Patient (n = 28)	Parent (n = 28)
Resilience measures		
CD-RISC-10	25.3 (8.3)	29.9 (6.6)
RS-14	73.8 (13.6)	80.8 (12.5)
The 7Cs Tool	3.3 (2.0)	-
Quality of life measures		
PROMIS PGH-7	41.3 (36.4-46.6)	-
PROMIS GH-10 v.1.2		
Mental Health Global	-	50.8 (42.5-53.3)
Physical Health Global	-	47.7 (37.4-52.5)

Values are mean (SD) or median (IQR).
RS-14 scores range from 14 to 98, with greater scores indicating greater resilience. Scores are categorized into very low (14-56), low (57-64), on the low end (65-73), moderate (74-81), moderately high (82-90), and high (91-98). The CD-RISC-10 scores range from 0 to 40 with higher scores indicating greater resilience. The 7Cs Tool scores range from 0 to 14 with higher scores indicating lower resilience and a cutoff of ≥3 considered low resilience (Barger et al[9]). The mean level of resilience according to the CD-RISC-10 for patients meeting the 2010 American College of Rheumatology Criteria (ACR) criteria for fibromyalgia syndrome (n = 17) was 23.4 (SD, 9.3). The mean level of resilience according to the CD-RISC-10 for patients meeting the Budapest criteria (Harden et al[66]) for complex regional pain syndrome (n = 2) was 28.0 (SD, 5.6). For the remaining patients (n = 9), the mean level of resilience according to the CD-RISC-10 was 28.3 (SD, 6.1).

Parental Resilience

Parents' resilience was related to parents' mental health according to both the CD-RISC-10 (r = 0.61; $P < .001$) and the RS-14 (r = 0.67; $P < .001$) (**Table IV** and **Figure 2**). Parents' resilience assessed with the CD-RISC-10 (but not the RS-14) correlated with parents' energy level (r = 0.53; $P < .01$). We did not find any significant correlations between parental resilience (using the RS-14 or CD-RISC-10) and health care use. Parental resilience was not significantly associated with patients' level of resilience, nor was parental resilience (according to either the CD-RISC-10 or RS-14) associated with patients' health status.

With a sample size of 28 patient–parent pairs and 80% power at significance level of 0.05, we were able to detect a correlation of 0.5. Given the correlations observed in our data, this study was adequately powered to detect the correlation of the level of resilience with the majority of the studied variables.

Discussion

In this study, we found that adolescents with chronic musculoskeletal pain and their parents had low to moderate levels of resilience. Lower levels of patient resilience (on the CD-RISC-10) were associated with lower energy levels (or fatigue), poorer HRQoL, greater functional disability, and greater pain and symptom severity. These findings demonstrate an association between resilience and disease severity and HRQoL in adolescents with chronic musculoskeletal pain.

Levels of patient and parental resilience in this study appeared to be lower than the levels of resilience among historical comparators. The mean CD-RISC-10 level of patient resilience in this study was 25.3 (SD, 8.3; n = 28), which is lower than the reported mean of 30.1 (SD, 5.3; n = 605) in a large convenience sample of college students.[40] The mean level of resilience among adolescents in our study was lower than the mean level of resilience among adolescents with type 1 diabetes (30.1 ± 4.2; n = 15) and inflammatory bowel disease (30.5 ± 5.5; n = 73).[24,43] The mean CD-RISC-10 level of children in our study was also slightly lower than the mean levels reported in adolescents with cancer (27.3 ± 3.9; n = 12).[24] Parental resilience was moderate according to both the CD-RISC-10 and the RS-14 (scores ranging from 74 to 81, defined as moderate).[49] The mean CD-RISC-10 level of parental resilience was slightly lower than that of a community sample of adults with a reported mean of 31.8 (SD, 5.4; n = 764)[67] and the level of resilience among parents of children with cancer (mean 30.0 ± 6.0; n = 96).[68]

The lack of a correlation between parental and patient resilience and parental resilience may be due to a couple of reasons. First, we only assessed resilience in 1 parent and our findings, therefore, may not be reflective of the resilience

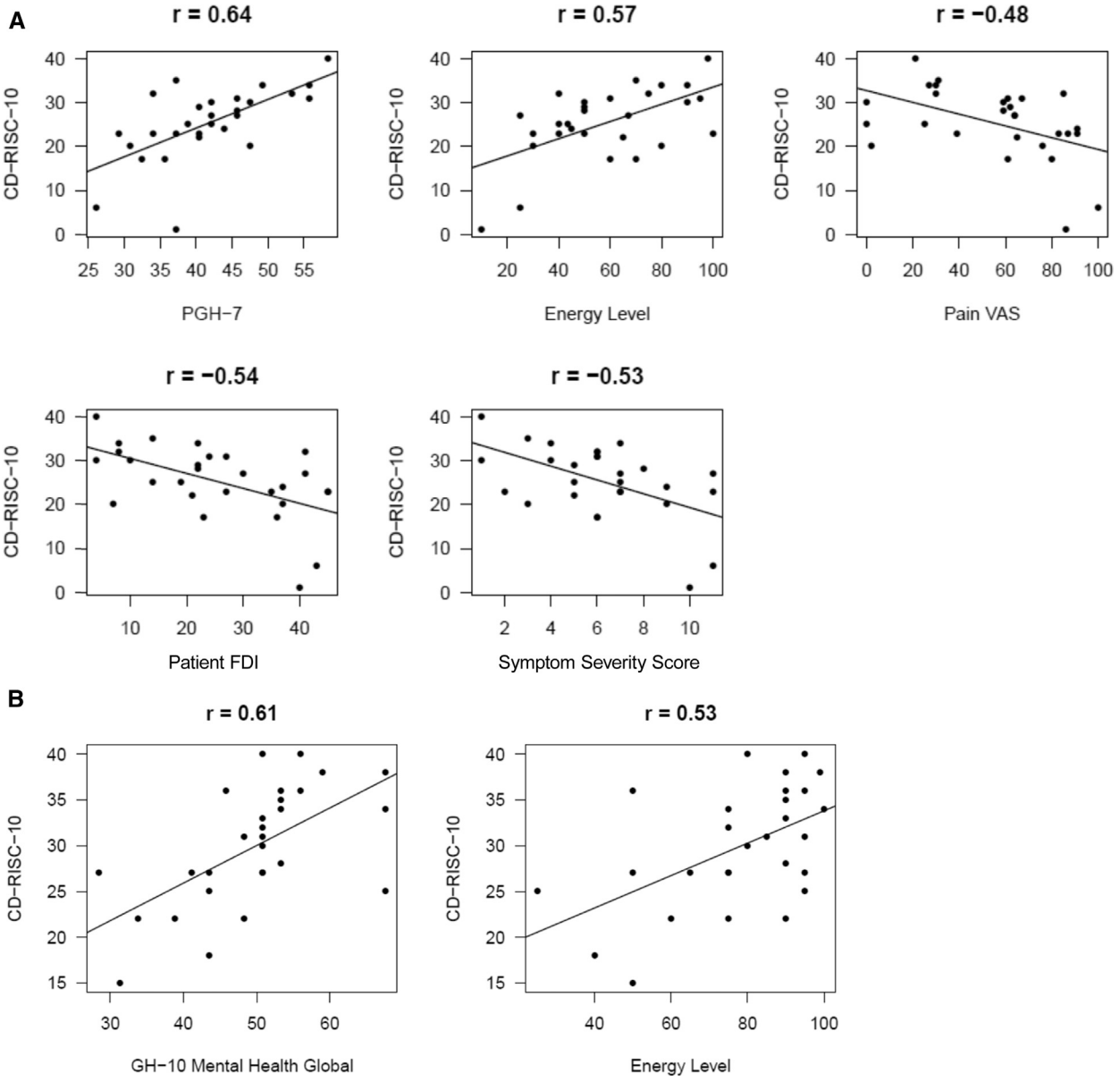

Figure 2. **A,** Significant Pearson correlation coefficients between variables of interest and patient resilience. **B,** Pearson correlation coefficients between variables of interest and parental resilience. *VAS*, Visual analogue score (0-100). On the FDI (0-60), higher scores indicate greater disability.

among the entire family unit. Second, the small sample size of this study could have resulted in an inability to detect an existing correlation between patient and parental resilience.

The biopsychosocial model of chronic pain ascribes the development of chronic pain to the complex interplay between biological, psychological, and social factors.[69,70] Resilience, therefore, is related to a number of psychological factors within the context of chronic pain, primarily coping. Coping can be considered the collection of purposeful, volitional efforts using behavioral or psychological techniques to reduce or overcome stress.[70,71] Pain coping strategies directed at the regulation of aspects of the self, such as pain acceptance, cognitive reappraisal (cognitive flexibility), and distraction, are associated with lower levels of somatic complaints and mood disturbances.[72-74] In contrast, passive coping, such as behavioral disengagement, self-isolation, and pain catastrophizing, are related to poor outcomes.[75-77] Pain catastrophizing is characterized by a negative mindset, magnification, and rumination about pain[78] and has been found to be a significant predictor of pain, functional disability, and lower HRQoL in children and adolescents with chronic pain.[79] Other pain coping mechanisms, including optimism and positive affect, have been shown to decrease pain catastrophizing and decrease pain and are

associated with active coping strategies.[6,80-83] Our study did not include measures for these pain coping mechanisms; however, coping self-efficacy is likely an internal factor that contributes to resilience.[83]

From a biological standpoint, childhood development plays a critical role in chronic pain, resilience, and pain coping. Pain coping abilities in children and adolescents are related to the developmental maturation of the brain with improved pain coping during the onset of puberty and adolescence in healthy children.[5,70] In a similar manner, early life events, such as ACEs, can induce a biological stress response in the setting of which some children will demonstrate resilience. Children with ACEs have been shown to demonstrate less resilience.[84] In this study, 70% of patients experienced ≥1 ACE compared with 20% among the general US pediatric population.[84] We did not, however, find an association between ACEs and level of resilience among our study subjects. This finding suggests that adolescents with chronic musculoskeletal pain may have low resilience independent of ACEs. Alternatively, we may not have detected an effect because of our limited sample size. In a study of youth with chronic pain (with 80% reporting ≥1 ACE), ACEs exposure was found to be associated with increased psychosocial but not functional impairment, but that study did not evaluate resilience.[85] Resilience, therefore, may have a mediating, or protective, role on the relationship between exposure to ACEs and physical function. This finding is supported by evidence suggesting that epigenetics regulating the hypothalamic-pituitary-adrenal axis and the mesolimbic dopaminergic reward system underlies the psychological building blocks of resilience by mediating the response and enduring impact of stressors throughout life.[80] The onset of chronic pain commonly occurs during adolescence and dysregulation of the hypothalamic-pituitary-adrenal axis has been implicated in the development of chronic pain as well.[86-88]

There are no measures of resilience specifically designed for a chronic pain population. Therefore, the measures administered in this study may not have assessed for all of the factors related to resilience in this specific patient population. It is reassuring, however, that the levels of resilience using the CD-RISC-10, RS-14, and 7Cs Tool all correlated well among patients. This finding suggests that these measures are assessing similar constructs in adolescents with chronic musculoskeletal pain.

This study has additional limitations. This study was limited to children ages 13-17 years and, therefore, is not applicable to younger children with chronic musculoskeletal pain. However, the majority of children with chronic musculoskeletal pain fall into this adolescent age range.[89] Additionally, our study has a small sample size of 28 patients (and their parents). This limits our ability to detect smaller effects and it is possible that some of the nonsignificant relationships in this study would be determined to be significant in larger sample sizes. The fact that our source population included only adolescents presenting to a specialty pain clinic at a tertiary care pediatric center could introduce referral bias. The majority of patients came from a higher socioeconomic status and from suburban residential levels. Therefore, these findings cannot be generalized to patients from a lower socioeconomic status.

Our study was limited to a cross-sectional study design and did not measure changes in resilience over time or in response to treatment. The timing of the administration of the questionnaires limits the generalizability of the findings in that patients were at varying points in their disease course and had likely received differing treatments for their pain. However, the majority of patients performed the questionnaire immediately upon completion of the clinic evaluation, before the initiation of our multidisciplinary treatment regimen. In sensitivity analyses, removing the 2 patient-proxy pairs who completed the questionnaires well after the clinic visit, the levels of resilience did not change significantly and all reported correlations remained statistically significant. Additionally, we did not find a correlation between self-reported pain duration and resilience.

We recognize that our study findings do not demonstrate that there is a causal relationship between resilience and chronic musculoskeletal pain and we cannot conclude from our data what constitutes a clinically meaningful difference in level of resilience. Owing to the relatively small sample size and moderate to high correlation between the variables, we did not pursue a multivariate analysis of variables potentially associated with resilience.

Our study adds to the literature by demonstrating low to moderate levels of resilience, not only among adolescents with chronic musculoskeletal pain, but also their parents. Our study findings demonstrate an association between resilience and measures of disease burden in this patient population and serve as an impetus for elucidation of resilience factors important to disease severity in adolescents with chronic musculoskeletal pain. Future research should examine the role of resilience longitudinally, not only in response to treatment, but also as a predictor of treatment adherence and long-term treatment outcomes. ■

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Data Statement

Data sharing statement available at www.jpeds.com.

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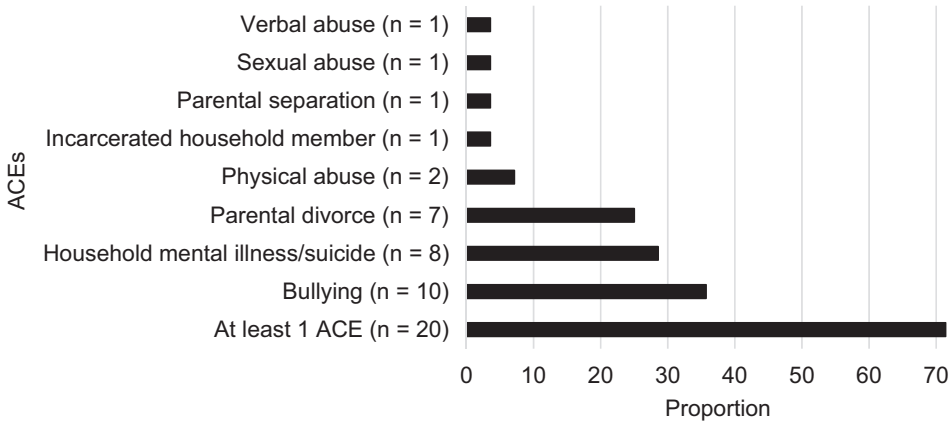

Figure 1. No study subjects had documented histories of parents with alcohol/substance abuse/misuse, household members with alcohol/substance abuse/misuse, economic hardship, or domestic violence.

Table IV. Correlation coefficients (r) between (CD-RISC-10) and the variables of interest

Variables of interest	Patient resilience (r)	Parental resilience (r)
HRQoL		
PGH-7	0.64*	-
GH-10 Mental Health Global	-	0.61†
GH-10 Physical Health Global	-	0.31
Energy level	0.57*	0.53*
Pain VAS	−0.48*	0.13
Age	−0.13	−0.10
Parental resilience	−0.18	-
Patient FDI	−0.54*	0.23
Patient's ACEs	−0.27	0.16
Physician global (0-10)	−0.15	0.24
Symptom Severity Score	−0.53‡	0.30
Widespread Pain Index	−0.04	−0.00

VAS, visual analogue scale.
*$P < .05$.
†$P < .001$.
‡$P < .01$.

Table V. Correlation Coefficients (r) between (RS-14) and the variables of interest

Variables of interest	Patient resilience (r)	Parent resilience (r)
HRQoL		
PGH-7	0.69*	-
GH-10 Mental Health Global	-	0.67*
GH-10 Physical Health Global	-	0.36
Energy level	0.53‡	0.51†
Pain VAS	−0.36	0.06
Age	0.01	0.11
Parental resilience	0.23	-
Patient FDI	−0.43‡	−0.03
Patient's ACEs	−0.28	0.06
Physician Global (0-10)	−0.05	0.15
Symptom Severity Score	−0.35	0.08
Widespread Pain Index	0.15	0.01

*$P < .001$.
†$P < .01$.
‡$P < .05$.

Table VI. Correlation coefficients (r) between resilience (7Cs Tool) and the variables of interest

Variables of interest	Patient resilience (r)
PGH-7	−0.61*
Energy level	−0.54*
Pain VAS	0.24
Age	0.33
Patient FDI	0.49*
Patient's ACEs	0.35
Physician Global (0-10)	0.07
Symptom Severity Score	0.49*
Widespread Pain Index	0.03

*$P < .05$.