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Preliminary evaluation of the clinical implementation of cognitive-behavioral therapy for chronic pain management in pediatric sickle cell disease

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Abstract

Objectives: Evaluate the implementation of cognitive-behavioral therapy (CBT) for chronic pain in a clinical setting by comparing youth with sickle cell disease (SCD) who initiated or did not initiate CBT.

Design: Youth with SCD (ages 6–18; n=101) referred for CBT for chronic pain were compared based on therapy attendance: Established Care; Early Termination; or Comparison (i.e., did not initiate CBT).

Setting: Outpatient pediatric psychology and comprehensive SCD clinics in 3 locations at a southeastern children's hospital.

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Interventions: CBT delivery was standardized. Treatment plans were tailored to meet individualized needs.

Main Outcome Measures: Healthcare utilization included pain-related inpatient admissions, total inpatient days, and emergency department reliance (EDR) at 12-months pre-post CBT. Patient-reported outcomes (PROs) included typical pain intensity, functional disability, and coping efficacy pre-post treatment.

Results: Adjusting for age, genotype, and hydroxyurea, early terminators of CBT had increased rates of admissions and hospital days over time relative to comparisons; those who established care had faster reduction in admissions and hospital days over time relative to comparisons. EDR decreased by 0.08 over time for Established Care and reduced by 0.01 for every 1 completed session. Patients who completed pre- and post-treatment PROs reported decreases in typical pain intensity, functional disability, and improved coping efficacy.

Conclusions: Establishing CBT care may support reductions in admissions for pain, length of stay, and EDR for youth with chronic SCD pain, which may be partially supported by patient-reported improvements in functioning, coping, and lower pain intensity following CBT. Enhancing clinical implementation of multidisciplinary treatments may optimize the health of these youth.

Keywords

sickle cell disease; chronic pain; cognitive-behavioral therapy; healthcare utilization; patient-reported outcomes

Pediatric sickle cell disease (SCD) is a genetic disorder of the hemoglobin in which the course of acute pain from vaso-occlusion and its sequelae vary widely across genotypes and individual patients. SCD pain often begins during childhood and can progress to chronic pain for approximately 23% of children and adolescents[1]. Youth with chronic SCD pain, that is pain that is present on most days per month and persists for at least 6 months[2], report high levels of functional disability, elevated depressive and anxiety symptoms, and reduced quality of life relative to youth with SCD without chronic pain[1]. The complex, multifactorial nature of chronic SCD pain can also contribute to increased healthcare utilization for pain[1,3–5]. The most effective management and treatment of chronic SCD pain likely requires individualized, multimodal, multidisciplinary treatments that go beyond pharmacological management alone[6]. A range of evidence-based non-pharmacological treatments, such as behavioral health, complementary, and integrative health approaches, are recommended for chronic pain management and are gaining greater awareness and integration into comprehensive chronic pain care[6,7].

Behavioral health treatment, such as cognitive-behavioral therapy (CBT) for pain, focuses on improved daily functioning and coping through several core treatment components such as psychoeducation about how the body processes pain, relaxation skills training, and cognitive strategies[8]. CBT is effective for youth with a variety of chronic pain conditions, including chronic headache, recurrent abdominal pain, fibromyalgia, and recurrent sickle cell pain, in reducing pain intensity immediately following treatment and reducing pain-related disability post-treatment and up to 12 months later[9]. The few existing randomized clinical trials (RCTs) of CBT for acute or recurrent SCD pain in pediatrics are primarily

limited by small sample sizes, poor treatment engagement, and inadequate randomization, stratification, or blinding; further, no RCTs have yet to specifically target chronic SCD pain[10].

Like most evidence-based treatments that are found efficacious through RCTs, there are limitations that affect direct translation of CBT into clinical practice. For example, treatment engagement in behavioral health and mental health services are variable and can be even more disparate for racial minority populations[11–13]. Patients who seek behavioral health treatment may also present with a range of co-morbid psychological and medical concerns, which are often excluded in trials. Thus, in practice patients often require more complex treatment plans that are of longer duration than the treatment manuals shown to be effective through RCTs. One pediatric behavioral health outpatient clinic implemented CBT for pain for pediatric chronic pain conditions in which 75% of youth demonstrated clinically significant changes in functional disability, pain intensity, or coping, thereby highlighting the clinical effectiveness of CBT for chronic pain in a real-world clinical setting[14]. At this time, the direct translation and implementation of CBT for chronic SCD pain in clinical settings is not well known.

The overall purpose of this study was to evaluate the effectiveness of clinical implementation of CBT for chronic SCD pain in a naturalistic clinical setting by comparing youth with SCD who were referred for chronic pain management who either initiated or did not initiate CBT treatment. The primary aim examined changes in healthcare utilization over time for children and adolescents with SCD who participated in outpatient CBT for chronic pain relative to a comparison group of youth with SCD who were referred but never initiated CBT for chronic pain. Patients who established care in CBT were expected to have greater reductions in healthcare use for pain than youth who did not initiate or establish care. An exploratory aim was to evaluate changes in patient-reported outcomes (PROs) from pre- to post-treatment. Patients who completed pre- and post-treatment PROs were expected to report clinically meaningful reductions in disability and pain, as well as improved coping efficacy.

Materials and Methods

Participants

Participants included children and adolescents receiving care at comprehensive SCD clinics at three tertiary care locations at a large southeastern children's hospital. Youth were included if they were aged 6–18 years, had a confirmed medical diagnosis of SCD (any genotype), and were referred to the institution's pediatric psychology outpatient psychotherapy clinic for behavioral chronic pain management between November 2014 and March 2018. Patients were excluded if they had received a bone marrow transplant during the study period (n=3), were engaged in active, ongoing psychotherapy beyond the study period (n=6), or did not have at least 1 year of ongoing medical care in the SCD clinic from which patients were referred (n=5). Participants were referred for therapy primarily by the SCD medical team (physicians, advanced practice providers). Participants were members of 2 groups: a treatment group and a comparison group. The treatment group included patients with chronic SCD pain, defined as pain on most days per month for 6 or more months per

patient-report[2] and/or chronic pain syndrome included on their problem list in the electronic medical record (EMR), who participated in at least 1 therapy appointment. Given that patients with chronic SCD pain may present with comorbid psychosocial concerns[1,15], the treatment plan must have included CBT for pain management. The comparison group included patients who were referred for pain management but did not schedule any therapy visits. Institutional Review Board approval was obtained prior to EMR data extraction.

Procedure

CBT is an evidenced-based psychological intervention for pediatric chronic pain and is recommended for SCD-related pain[9,10]. The primary goals of CBT are to teach pain coping skills to increase ability to cope with pain and to increase functioning in activities of daily living. A standard course of CBT for pain may include 8 sessions[8]. Following evidence-based CBT protocols for pain, the treatment protocol typically included the following components: psychoeducation about pain, behavioral strategies for parents, relaxation training, behavioral activation, activity pacing, cognitive restructuring techniques, and healthy lifestyle habits (e.g., sleep, hydration)[8]. A Cochrane review of CBT for SCD and pediatric chronic pain (headache) literature suggests that the CBT treatment components that are commonly included across studies include: psychoeducation, relaxation training, and cognitive interventions[9,10]. Patients in this study may have received any combination of the CBT treatment components, and sessions must have included at least psychoeducation, relaxation training, or cognitive interventions. Although treatment administration was not manualized, a clinician toolkit was available and used across providers to support an organized approach to instruction and delivery of treatment components[14]. Comparable to standard CBT treatment, typical sessions were between 45–60 minutes. Treatment plans were tailored to meet the individualized needs of patient and family, accounting for age, distance from clinic, complexity of medical follow-up, comorbidities affecting chronic pain, and patient preferences (e.g., prioritization of specific treatment components that aligned with treatment goals, flexible follow-up schedules, etc.). Treatment was provided by 4 licensed clinical psychologists and 4 psychology postdoctoral fellows trained in evidence-based CBT interventions for chronic pain. To assess the effectiveness of this treatment, patients also completed the patient-reported outcomes at intervals indicated by the treating providers (e.g., first session, every 2–3 sessions, last session) to assess pain, functional disability, and pain coping efficacy. All patients participated in standard medical care as prescribed in inpatient and outpatient settings, which may include multidisciplinary care such as social work, child life, educational support, and/or consultation from psychology, psychiatry, and physical therapy. As these services were provided on an as needed basis to patients, it is difficult to quantify the relative contributions of each service from the EMR.

Measures

Patient Characteristics.—Information on patient age, sex, race, address as a measure of the distance from the clinic, insurance type (i.e., private or public) as a proxy for socioeconomic status, sickle cell genotype, and presence/absence of disease-modifying treatments (i.e., hydroxyurea and chronic transfusion therapy) were abstracted from the EMR and maintained in a sickle cell clinical database.

Healthcare Utilization.—The following information was abstracted from the EMR: number of inpatient admissions with pain or acute chest syndrome as the discharge diagnosis, number of inpatient days for pain, and emergency department reliance (EDR), calculated as the ratio of total number of ED visits to the sum of ED and outpatient visits. A value of 0.33 or greater is considered high[16,17]. For the treatment groups, utilization outcomes were calculated from 12-months prior to the first CBT visit, and from 12-months following the last CBT visit. For the comparison group, outcomes were calculated for 12-months prior to the referral date, and from 12-months following the average duration of CBT for treatment groups (i.e., 3.5 months) to account for passage of time.

Treatment Attendance.—Patients in the Treatment Group were further classified into one of two groups based on treatment attendance guided by recommendations for defining adherence and dropout in child psychotherapy[18]: Established Care or Early Termination. Patients were described as having Established Care by attending 3 or more sessions within 3 consecutive months. Patients were described as having Early Termination if less than 3 sessions were completed within 3 consecutive months. As common in clinical practice, some patients re-initiated therapy after either completing treatment (e.g., new co-morbid concerns affecting chronic pain) or terminating early. If one or more sessions were completed after a duration of 6 or more months in which no therapy sessions were completed, this re-initiation of services was considered a new course of treatment. As such, some patients had more than one course of treatment during the study period. Dates of visits, total number of sessions, and overall duration of the course of treatment were obtained from the EMR.

The following patient-reported outcome (PRO) measures were completed by patients via paper and pencil or read aloud by the psychology provider (based on patient preference) during CBT sessions and electronically entered into the EMR. PROs were collected intermittently over the course of therapy at intervals indicated by the treating psychology provider (e.g., first session, every 2–3 sessions, last session).

Pain Intensity.—A numeric rating scale was used to assess the typical, worst, and least pain intensity experienced by the patient over the past week rating from 0 (no pain) to 10 (worst pain possible)[19,20]. Typical pain intensity was the primary rating used in analyses. A 30% decrease in typical pain intensity is indicative of a clinically meaningful and positive response to treatment[14,21].

Functional Disability.—The patient's perception of difficulty engaging in daily activities due to pain was assessed using the Functional Disability Inventory (FDI)[22]. The15-item child self-report measure has been classified as well-established in its validity and reliability[23,24]. Items are rated on a Likert-type scale of 0 (no trouble) to 4 (impossible). Total scores range from 0–60, with clinical reference cutoffs: <12 indicating no/minimal, 13–29 indicating moderate, and >30 indicating severe levels of disability[25]. Although clinically significant change in FDI has not yet been well-defined, a 25–40% decrease in functional disability were found to be clinically meaningful[14,26]. For analysis, a 25% decrease was used as suggestive of a positive response to behavioral treatment[14].

Pain Coping Efficacy.—Three items from the Pain Coping Questionnaire[27] were used to assess the patient's perception of their efficacy in coping with pain. Patients rated their ability to do something to change their pain (from 1-"never" to 5-"very often"), deal with being in pain (1-"really hard" to 5-"really easy), and ability to change mood and feelings when in pain (1-"never" to 5-"very often"). Total score range from 3–15, with higher scores indicating greater pain coping efficacy. A 40% increase in coping efficacy over the course of treatment was found to be suggestive of a positive response to behavioral treatment[14].

Statistical Analysis Plan

A sickle cell clinical database was used to identify SCD patients. For all patients, the database was merged with study data to include demographic (e.g., age, race, genotype), treatment histories (e.g., hydroxyurea, chronic transfusion therapy), and healthcare utilization. Variables were examined for missingness and confirmed via chart review to ensure completeness. There were no missing data for healthcare utilization outcomes. Descriptive analyses were conducted on patient characteristics and treatment characteristics, including therapy attendance, number of sessions, and overall duration of therapy. Descriptive statistics were calculated at pre- and post-treatment time points for healthcare utilization outcomes.

Change over time in healthcare utilization outcomes was assessed using linear mixed effect models with random effect for person-specific intercepts and slopes, a flexible approach for correlated, repeated measurements[28]. Separate models were conducted for inpatient admissions for pain, total hospital days, and EDR. Random effects were retained based on their model contribution, as determined by Bayesian Information Criterion (BIC)[29]. Residual maximum likelihood estimation (REML) was used to model parameters and standard errors to produce unbiased estimates in the presence of any missing data. When analyzing change over time in utilization outcomes, the influence of patient characteristics (age, SCD genotype) and disease-modifying treatments (hydroxyurea, chronic transfusion therapy) were controlled for by including these variables as covariates. In addition, time, therapy attendance, total number of sessions, and the interaction effect for time by therapy attendance were initially included in the models. Backward selection procedure was used to select the most parsimonious model. This procedure started with all candidate variables in the model and iteratively removed the variable with the largest p-value until the p-values for all remaining variables were <.05 significance level. Main effects for variables that were part of an interaction term were not removed until the nonsignificant interaction term was removed from the model. Modeling allowed for comparisons within therapy attendance groups (by evaluating the direction and significance of change in slope) and between groups (by comparing the difference between group slopes).

For patient-reported outcomes, baseline measures were completed for 37 participants. A subset of patients (n=18; 31.6%) in the treatment group completed PROs at the beginning and end of treatment. Analyses were conducted for this subset of patients. It is important to note that assumptions cannot be made about the nature of and causes for this missing data. As such, these analyses should be considered preliminary and exploratory. Paired t-tests

were conducted to examine differences between pre- and post-treatment reports of functional disability, pain coping efficacy, and pain ratings.

Results

Patient Characteristics

A total of 115 patients were referred for outpatient psychotherapy for chronic pain management during the study period, which represents approximately 8% of patients 6–18 years old who are actively followed by our SCD clinics. Approximately 30% of patients were referred for comorbid psychosocial concerns in addition to chronic pain management, such as mood concerns, treatment non-adherence, and significant psychosocial stressors. Fourteen patients (12.2%) met exclusion criteria. The final sample included 101 children and adolescents who were on average 13.4 years old (SD=2.92), 56.4% female, 98% Black or African American, 68.1% HbSS or HbSβ^0, 63.9% prescribed hydroxyurea, and 12.6% received chronic transfusion therapy. A predominately female and early adolescent sample is consistent with other studies in pediatric chronic pain[14,30]. Most patients had public insurance (75.0%) whereas the remaining had private insurance (25.0%) at time of referral. Patients generally resided within the local metropolitan area (91.4%), on average 28.0 miles (SD=23.5) from the hospital location from which they were referred. Child age was not significantly associated with any of the pre- or post-treatment healthcare utilization outcomes (all r's < .12, p's > .17). The Comparison Group (n=44) and Treatment Group (n=57) did not significantly differ by age (t = −0.34, p=.73), sex (χ^2 = 1.64, p = .19), SCD genotype (χ^2 = 0.16, p = .69), treatment with hydroxyurea (χ^2 = 0.001, p = .97) or chronic transfusion therapy (χ^2 = 1.66, p = .19), distance to hospital campus (t = −0.47, p=.64), or insurance type (χ^2 = 0.86, p = .35).

Treatment Characteristics

Based on therapy attendance, 62% of the treatment group were classified as established care in CBT with an average attendance of 6.98 sessions (range: 3–31, SD=5.29) over an average of 4.5 months (range: 1.6–15, SD=3.67). The median duration of time between each of these sessions was 2 weeks (IQR = 1–4 for sessions 1–4; IQR = 1–9 for sessions 5–7). Early termination group comprised 38% of the treatment group, attending on average 2 sessions (range: 1–5, SD=1.19) over the course of 3.09 months (range: 0–26.5, SD=6.15). The median duration of time between sessions 1–2 was 7 weeks (IQR = 1.75–13.25), and the median duration of time between sessions 2–3 was 11 weeks (IQR = 3–43). The Established Care in CBT, Early Termination, and Comparison groups did not significantly differ by patient demographics (i.e., age, sex; p's > .42), clinical characteristics (i.e., SCD genotype, disease-modifying treatments; p's > .41), distance to hospital campus (F = 0.87, p = .424), insurance type (χ^2 = 0.53, p = .77), or 12-month pre-treatment healthcare utilization outcomes (i.e., admissions, length of stay, or EDR; all p's > .05).

Licensed clinical psychologists (n=4) treated 88% of patients and psychology postdoctoral fellows (n=4) treated12% of patients in the Treatment Group. Two providers (1 psychologist and 1 fellow) did not have any patient-reported outcome data completed for the patients they treated, which comprised 14% of patients in the Treatment Group (χ^2 = 18.87, p=.009).

Among the remaining 6 treating providers who did have baseline patient-reported outcome data completed for their patients, there was no difference in completion of only pre-treatment measures versus pre- and post-measures among providers ($\chi^2 = 9.21$, $p = .24$). Total number of sessions ($t = -1.38$, $p = .17$) and therapy attendance ($\chi^2 = 0.62$, $p = .70$) did not differ between psychologists and fellows.

There were no significant differences in baseline functional disability, typical pain intensity, or pain coping efficacy between patients who completed patient-reported outcomes at both pre- and post-treatment versus those who only completed self-reported outcomes at pre-treatment (p'$s > .08$). Additionally, pre- and post-treatment healthcare utilization outcomes did not differ based on whether patients completed PRO measures (all t's < 1.48, all p's > .05).

Healthcare Utilization Outcomes across Treatment

Table 1 summarizes the average utilization outcomes at 1-year pre-treatment and 1-year post-treatment for the treatment and comparison groups. There were no significant differences between the treatment and comparison groups on ED visits, EDR, inpatient admissions, or total hospital days at 12-months pre-treatment (p's>.17). Patients in the Treatment Group had more outpatient SCD visits at pre-treatment than those in the Comparison Group ($t = -2.63$, $p<.05$); however, this difference did not impact group differences in EDR. EDR was considered high (>.33) for both groups at pre- and post-treatment. As expected, pre- and post-treatment utilization outcomes were highly intercorrelated for the full sample (see Table 2) warranting mixed effect modeling to evaluate changes over time.

Inpatient Admissions for Pain

The most parsimonious model for inpatient admissions for pain adjusted for patient age, genotype, and hydroxyurea, and included the interaction effect of therapy attendance by time, $F(2,123.85)=3.27$, $p<.05$. Main effects for therapy attendance and time were retained in the model although nonsignificant. Patients who terminated CBT early had increased rate of admissions over time relative to comparisons; those who established care had a faster reduction in admissions over time relative to comparisons (see Table 3).

Hospital Days for Pain

The selected model for total hospital days for pain included the interaction effect of therapy attendance by time, $F(2, 106.11)=3.61$, $p<.05$. To improve model fit, patient age, genotype, and hydroxyurea were retained in the model although not significant. Patients who terminated CBT early had increased rate of total hospital days over time relative to comparisons; those who established care had a faster reduction in hospital days over time relative to comparisons (see Table 3).

Emergency Department Dependency

The most parsimonious model for EDR included genotype, total number of therapy sessions, and time. Therapy attendance was retained in the model although not significant. For patients who established care, EDR decreased by 0.08 over time, $F(1, 133)=3.81$, $p<.05$; for

every 1 completed CBT session, EDR was reduced by 0.01, $F(1, 133)=7.84$, $p<.01$ (see Table 4).

Patient-Reported Outcomes

Eighteen patients (31.6% of the treatment group) completed patient-reported outcomes of typical, worst, and least pain intensity, functional disability, and pain coping efficacy at the onset of treatment and immediately post-treatment. Patients reported statistically significant decreases in typical pain intensity, functional disability, and improved coping efficacy from pre- to post-treatment (see Table 5). In terms of a clinically meaningful treatment response, 65% of patients who completed PROs achieved ≥25% reduction in functional disability, 35% reported ≥30% reduction in typical pain, and 29% reported ≥40% improvement in pain coping efficacy. A smaller proportion of patients reported ≥30% clinically significant reduction in worst (17%) or least (26%) pain intensity. Collectively, 77% of patients who completed PROs reported a positive treatment response, which included at least one of the following: ≥25% decrease in disability, ≥40% increase in pain coping efficacy, or ≥30% reduction in typical pain intensity[14].

Discussion

There is a significant gap in evidence-based management guidelines for the treatment of chronic pain in children and adolescents with SCD calling for the need for both non-opioid pharmacological therapies and nonpharmacological approaches for SCD pain management[6]. Results from this study offer preliminary support of the clinical effectiveness of CBT as one nonpharmacological approach for chronic pain management in pediatric SCD. Specifically, establishing care in CBT may support reductions in healthcare utilization in terms of inpatient admissions for pain, hospital days, and emergency department reliance, beyond the potential effects of disease progression that evolve with age and benefits of disease-modifying treatments, such as hydroxyurea.

It is important to note that the rates of change in utilization over time between groups was most meaningful, rather than within-group changes over time. The faster reductions in utilization evidenced by patients who established care in CBT may be partially supported by improved self-management for chronic SCD pain. Of the patients who completed PROs, 77% reported improved daily functioning, lower typical pain, and improved coping that were both statistically and clinically meaningful, which is consistent with the positive CBT treatment response rate evidenced by youth with mixed chronic pain conditions[14]. Patients who engaged in CBT may utilize cognitive and behavioral pain management strategies more readily as first-line approaches or in combination with medications, thereby enhancing their control over descending or top-down pathways of pain processing and cognitive reappraisal of chronic pain[31,32]. CBT for chronic pain in other disorders has been found to affect neurophysiological changes in the structure and function of the brain as well as changes in pain modulation that collectively may contribute to more effective self- and chronic-pain management across settings[32,33].

In our clinical practice, approximately 56% of patients who were referred for behavioral health services sought treatment by scheduling at least 1 appointment, which is comparable

to the rate of patients initiating psychological treatment for chronic pain management (59%) as part of a multidisciplinary pediatric chronic pain clinic[34]. Furthermore, 38% of patients and families who pursued treatment were considered early termination or dropout, which is consistent with the dropout rates (40–60%) for child psychotherapy for mood, behavior management, or mental health services[35,36]. In fact, research on psychosocial treatment indicates that 40–70% of early terminations occur early on in treatment – primarily the first two sessions[36]. Although the reasons for early termination and not initiating treatment are difficult to determine in this study, early termination in child psychotherapy is predicted by a wide variety of factors, such as socioeconomic status, parenting stress, life events, and child functioning (e.g., IQ, social skills), with perceived barriers to participation in treatment often emerging as the strongest predictor of dropout[18,35,37]. Systemic, socio-cultural, and parental factors such as access, affordability, ethnicity, prior negative experience with mental health treatment, family conflict, low parental education attainment, and single parenthood may also contribute to lower engagement and adherence to health-related visits, whether medical or behavioral[36]. Furthermore, one-third of the patients in this sample presented with psychological comorbidities in addition to chronic pain, and anxiety is known to interfere with youth's response to CBT treatment for chronic pain[38]. It is possible that medical providers may be more likely to refer patients with more complex clinical presentations, such as multiple medical or psychological co-morbidities, strained family dynamics, or patterns of healthcare use. Several factors that were not captured through our data, such as patient or family's motivation to change, parent work schedules, financial difficulties, significant family stressors, or inconsistent school attendance, may affect therapy attendance. On the other hand, many patients and families who initiate child psychotherapy may perceive a benefit after only 1–2 sessions, and many who terminate therapy early still improve in their symptoms and outcomes[39,40].

Therapy dose response (i.e., number of sessions) is often strongly linked to positive outcomes among adults pursuing psychotherapy, yet the benefits of longer duration of therapy for youth are inconclusive. In this study for patients who established care in CBT for pain, each completed session was associated with a modest reduction in emergency department reliance, suggesting possible skill building may support improved chronic pain management outside the hospital setting. Recent longitudinal research suggests that EDR for pain among pediatric patients aged 0–18 years did not significantly change over the course of 4 years[41]. As such, a statistically significant yet modest reduction in EDR may indicate some positive effects beyond the mere passage of time. Although the clinical significance may be difficult to interpret, the potential collective impact within the context of high reliance on the ED for SCD care should not be overlooked. The study sample demonstrated high EDR rates (> .33) at both 12-months preand post-treatment, which is in contrast to other SCD programs that found consistently low EDR rates for pain among youth[41]. It is possible that the study sample (representing approximately 8% of patients 6–18 years old in our program) referred for CBT may reflect patients who have higher disease exacerbation rates, thereby contributing to higher EDR rates.

In addition to therapy dose response, it is likely that consistency in attendance, within-session engagement, and session-by-session involvement (e.g., homework completion) may be equally if not more important than number of attended sessions or duration of

therapy[36,42]. The variability in the duration of time between the first and second session for patients who established care (about 2 weeks) compared to those who terminated early (about 7 weeks) also highlights potential differences in individual and family level factors or barriers that were not captured in this study yet likely contributed to reasons for early dropout. These elements of psychosocial treatment adherence warrant further study in pediatrics.

Implementing CBT for chronic pain in a naturalistic clinical setting must be considered within the context of certain limitations and challenges. Given the nature of the clinical dataset, there are many clinical and familial characteristics that may be related to therapy adherence, utilization, and patient-reported outcomes that remain difficult to assess. For example, concurrent medication use and adherence to SCD treatments, alternative treatments such as physical therapy, family constellation, and child and parent psychiatric and chronic pain history may influence outcomes and should be evaluated through prospective randomized trials of CBT for chronic SCD pain to help clarify possible predictors that contribute to engaging in behavioral health treatments. Although study inclusion was contingent on referral for chronic pain management, the comparison group may have included a combination of patients with persistent and chronic pain since it was not possible to confirm the presence of chronic pain via self-report from patients who did not attend CBT. Missing data on patient-reported outcomes also limits opportunities for providers to engage in routine outcome monitoring and feedback, which has been found to reduce dropout rates in psychotherapy and nearly double clinically meaningful improvements in outcomes[10,43]. Further, evaluation of treatment effectiveness was limited as there were likely patients who completed treatment but did not complete PROs and those who established care but did not complete treatment. Future work focused on a systematic and empirically-supported method of defining treatment completion that considers individual patient needs is needed to offer greater generalizability within the context of clinical practice. Lastly, the creation of a Day Hospital at one of our hospital locations may have biased EDR values, as these outpatient visits may function similarly to ED care for some patients and families.

Within the context of these limitations, the study results offer valuable insight and guidance for implementing evidenced-based behavioral treatments like CBT for chronic SCD pain. There is a clear need to consider strategies that may enhance access to care and improve the clinical implementation of CBT for chronic SCD pain. Treatment engagement in behavioral RCTs in pediatric SCD pain historically have been limited[10], even when CBT was offered in the home setting[44]. This may highlight the need for increased flexibility in CBT treatments to address co-morbidities that may be common among youth with chronic pain in order to have a meaningful clinical impact[45]. Strategies that support enhanced child and parent participation and buy-in may facilitate motivation to change and lead to more favorable therapeutic outcomes as well as attendance[42]. For example, identifying patient-friendly methods of sharing results of the potential benefits of CBT for pain with families at the time of referral may aid parents in their decision-making regarding treatment engagement. Such information may help families consider the possible cost to benefit ratio for their family, such as scheduling short times away from work and school for CBT appointments relative to unpredictable, longer periods of time away from work and school due to hospitalization or ED visits. Additionally, providers may consider close monitoring of patients with complex

presentations and/or comorbidities who display difficulty initiating and establishing care in therapy to identify additional supports that may be needed to help patients and families engage in multidisciplinary treatments. Drawing from programs that are already established for pediatrics[46] and adults with chronic pain[47], incorporating CBT into a comprehensive pain program designed for pediatric chronic SCD pain may offer more efficacious and cost-effective treatment relative to conventional medical treatment alone.

Conclusions

Establishing care in CBT for pain as part of multidisciplinary care for chronic SCD pain management collectively may contribute to faster reductions in healthcare utilization over time compared to youth and families who do not initiate or establish care in CBT. Implementation of a standardized approach to CBT treatment across a range of psychology providers in a naturalistic clinical setting across multiple hospital campuses for youth who present with chronic SCD pain may enhance the generalizability of study findings. Efforts to improve individualized, multidisciplinary care that combines non-opioid therapies and non-pharmacological approaches may offer the best health-related outcomes for youth with chronic SCD pain.

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Abbreviations: Full terms or phrases:

BIC	Bayesian Information Criterion
CBT	Cognitive-behavioral therapy
ED	Emergency department
EDR	Emergency department reliance
EMR	Electronic medical record
FDI	Functional Disability Inventory
Hb	Hemoglobin
IQR	Interquartile range
M	Mean
PRO	Patient-reported outcome
RCT	Randomized clinical trial
REML	Residual maximum likelihood estimation

SD	Standard deviation
SCD	Sickle cell disease

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Highlights

- Establishing care in cognitive-behavioral therapy for pain as part of multidisciplinary care for chronic SCD pain management collectively may contribute to faster reductions in healthcare utilization over time compared to youth and families who do not initiate or establish care in CBT.
- Individualized, multidisciplinary care that combines non-opioid therapies and nonpharmacological approaches may offer the best health-related outcomes for youth with chronic SCD pain.

Table 1.

Descriptive statistics for healthcare utilization outcomes at pre- and post-CBT treatment

	Comparison Group						CBT Treatment Group					
	Pre-Treatment			Post-Treatment			Pre-Treatment			Post-Treatment		
	M	SD	Range	M	SD	Range	M	SD	Range	M	SD	Range
Outpatient Visits	.4	.51	0–24	.7	.9	0–12	7.56	.95	1–27	.11	.99	0–12
ED Visits	.02	.71	20–10	.08	.55	0–10	3.01	.5	0–26	.2	.13	0–10
EDR	.45	.24	00–1	.47	.26	0–1	0.5	.22	0–0.9	.46	.27	0–1
Admissions *	.6	.68	0–14	.42	.48	0–11	5.2	.38	0–16	.3	.18	0–11
Length of Stay (days)	.41	.27	0–24	.02	.04	0–21	4.7	.79	0–15	.07	.62	0–17

Note: ED=emergency department; EDR=emergency department reliance.

* Admissions restricted to pain crisis or acute chest syndrome based on discharge diagnosis.

Table 2.

Correlations of healthcare utilization outcomes at 12-months pre- and post-treatment for the full sample

	12-months Post-Treatment		
12-months Pre-Treatment	**Inpatient Admissions for Pain**	**Total Hospital Days**	**EDR**
Inpatient Admissions for Pain	.71**	.59**	.00
Total Hospital Days	.79**	.77**	.37**
EDR	.54**	.42**	.30**

** $p<.001$

Table 3.

Estimates of linear mixed models for changes in inpatient admissions for pain and total hospital days from 12-months pre- to post-treatment

	Inpatient Admissions			Total Hospital Days		
	Estimate	**SE**	***p*-value**	**Estimate**	**SE**	***p*-value**
Intercept	3.48	1.97	ns	11.21	12.72	ns
Child Age	0.25	0.12	ns	0.87	0.86	ns
Genotype (HbSS + $HbSB^0$)	3.11	0.88	<.001	6.78	6.21	ns
Hydroxyurea (presence)	3.35	0.87	<.001	−7.11	5.99	ns
Therapy Attendance Group						
Established Care in CBT	−0.23	1.59	ns	12.83	8.27	ns
Early Termination	2.69	1.37	ns	3.11	9.39	ns
Time	−0.18	0.49	ns	−3.15	2.63	ns
Established CBT × Time	−0.63	0.73	<.05	−5.50	4.01	<.05
Early Termination × Time	1.56	0.84	<.05	7.37	4.56	<.05

Note: Scores are estimated assuming HbSS/$HbSB^0$ genotype and hydroxyurea use for patients at the mean patient age at referral (13.4).

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Table 4.

Estimates of linear mixed model for changes in EDR from 12-months pre- to post-treatment

	Estimate	SE	*p*-value
Intercept	0.62	0.07	<.001
Genotype (HbSS + $HbSB^0$)	0.10	0.04	<.05
Number of Therapy Sessions	−0.01	0.01	<.01
Therapy Attendance Group			
Established Care in CBT	−0.05	0.04	ns
Early Termination	0.19	0.10	ns
Time	−0.08	0.04	<.05

Note: Scores are estimated assuming HbSS/$HbSB^0$ genotype

Table 5.

Means (M) and Standard Deviations (SD) Of patient-reported outcomes at the onset of treatment and immediately post-treatment

Outcome	Pre-Treatment		Post-Treatment		*t* (df); [95% CI]	*p*-value
	M	SD	M	SD		
Worst Pain Intensity	7.65	1.66	6.35	3.12	2.08 (16) [−0.03, 2.62]	.05
Least Pain Intensity	3.81	2.59	2.69	2.47	2.03 (15) [−0.6, 2.31]	.06
Typical Pain Intensity	5.47	2.24	3.76	2.84	2.97 (17) [0.49, 2.92]	.009
Functional Disability	26.24	8.45	15.18	10.85	3.83 (17) [4.94, 17.18]	<.001
Pain Coping Efficacy	8.00	2.21	9.65	2.94	−2.31 (17) [−3.16, −0.14]	.03