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Impact on Health Care Costs for Adolescents Receiving Adjunctive Internet-Delivered Cognitive-Behavioral Therapy: Results of a Randomized Controlled Trial

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Abstract

The economic burden of pediatric chronic pain is high, with an estimated annual cost of \$19.5 billion. Little is known about whether psychological treatment for pediatric chronic pain can alter health care utilization for youth. The primary aim of this secondary data analysis was to evaluate the effect of adjunctive internet cognitive-behavioral therapy intervention (I-CBT) or adjunctive internet education (I-EDU) on health care-related economic costs in a cohort of adolescents with chronic pain recruited from interdisciplinary pain clinics across the United States. For the full sample, health care expenditures significantly decreased from the year prior to intervention to the year following intervention. Results indicated that the rate of change in health care costs over time was not significantly different between the I-CBT and I-EDU groups. Further research is needed to replicate these findings and determine patterns and drivers of health care costs for youth with chronic pain evaluated in interdisciplinary pain clinics and whether psychological treatments can alter these patterns. This trial was registered at clinicaltrials.gov (identifier NCT13165471).

Keywords

chronic pain; child; adolescent; cognitive-behavioral therapy; internet; health care costs

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Introduction

Chronic pain is a costly condition in childhood, with an estimated societal economic cost of \$12 billion annually in the United States¹⁶. Indeed, high rates of health service use have been documented for youth with chronic pain around the world including in the United States^{15, 29, 36, 40}, Europe^{19, 30}, the United Kingdom^{33, 41}, and Asia²⁶. Recognizing this concern, economic impact was recommended as an important outcome domain to assess in clinical trials for pediatric chronic pain³².

However, to our knowledge economic outcomes have been reported in only 3 published randomized controlled trials (RCTs) of any clinical intervention for pediatric chronic pain^{17, 22, 23}. In one RCT, a cross-over design was used to compare a 3-week intensive pain rehabilitation program (with physical therapy and psychological treatments) to a control condition where intensive pain rehabilitation was delivered after a 3-week waiting period. Health care utilization, parental missed work, and subjective financial burden decreased over time for the full sample; however, it was not possible to evaluate between-group treatment effects due to the cross over-design. The impact of cognitive-behavioral therapy (CBT) on doctor's visit utilization was evaluated in two recent parallel-group RCTs for youth with functional abdominal pain²² and inflammatory bowel disease²³. Findings were mixed, with significantly greater reductions in doctor's appointments for the CBT group compared to education control reported in one trial²², while there was no significant treatment effect in the other trial²³. To our knowledge, no prior published RCTs of CBT for youth with chronic pain have reported on health care-related economic costs as a treatment outcome^{8, 13, 14}, limiting understanding of relevancy and potential impact of this intervention.

To address this gap, the aim of this study was to examine the effect of adjunctive internet-delivered CBT (I-CBT) versus internet-delivered education (I-EDU) on health care costs among adolescents with chronic pain evaluated in interdisciplinary pain clinics in the United States. We previously reported on the primary outcomes from this multi-site randomized controlled trial, which demonstrated positive effects of I-CBT on reducing adolescent activity limitations, anxiety, and depression, and maladaptive parenting behaviors at six-month follow-up compared to I-EDU²⁷. For this secondary data analysis, we hypothesized that health care costs for the full sample would decrease from pre-treatment (costs during the year prior) to 12-month follow-up. Furthermore, we hypothesized that the I-CBT group would demonstrate greater reductions in health care costs over time compared to the I-EDU group.

Methods

Procedure

This clinical trial was registered in advance of participant enrollment ([clinicaltrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT01316547) identifier NCT013165471). Potential participants were referred from one of 15 interdisciplinary pediatric pain clinics dispersed throughout the United States (12 clinics, n = 228) and Canada (3 clinics, n = 32). For the purposes of this report, only data from the 228 adolescents living in the United States were included in analyses to facilitate interpretability of health care cost data (excluded n = 32 adolescents from Canada).

The study was approved by the Institutional Review Board by the primary site and all referring sites. Potential participants were identified by referring providers when they presented for an initial new patient evaluation. Adolescents presenting as new patients were enrolled over a 3.5-year period from September 2011 to April 2014. Study staff received contact information for potential participants from referring providers, and then conducted eligibility screening and informed consent via telephone. Eligible participants provided parental informed consent and adolescent assent prior to initiating any research procedures. Parents completed a measure of health care costs, the Client Services Receipt Inventory³³, over the prior 12 months at pre-treatment and again at 12-month follow-up. All measures were completed in participant's homes via a secure, password protected online assessment website. After completion of the pre-treatment assessment, adolescents and their parents were randomized to receive either I-CBT or I-EDU, which was adjunctive to any treatment in the referring interdisciplinary pain clinic. Participants were blinded as to whether they received an active or control treatment. The I-CBT and I-EDU treatment programs were designed to be completed over eight to ten weeks. Gift cards were given to families after completion of each assessment time point.

We have published four manuscripts from this clinical trial, including our report on primary treatment outcomes²⁷, associations between trajectories of pain and functioning during the treatment period²⁸, concordance between parent and adolescent pre-treatment goals¹², and longitudinal associations between parent and adolescent functional outcomes²¹. We have not previously reported on health care costs as a treatment outcome from this clinical trial. Please see Palermo et al. (2016)²⁷ for full details on the study procedures and intervention conditions. Participants did not report any study-related adverse events during the trial period.

Participants

For this report, participants included 228 youth with chronic pain and their parents. For the clinical trial, inclusion criteria were: 1) ages 11–17 years, 2) chronic pain present over the past three months, 3) pain occurred at least once per week, 4) pain interfered with at least one area of daily functioning, and 5) adolescent evaluated as a new patient in one of the participating interdisciplinary pediatric pain clinics. Adolescents were excluded if any of the following were present: 1) serious co-morbid psychiatric or chronic medical condition (e.g., diabetes), 2) parent report of a developmental disability, 3) parent or adolescent was non-English speaking, 4) family did not have regular internet access on a desktop, laptop or handheld device, 5) adolescent did not live at home. For this report, in order to facilitate interpretation of health care costs data, participants were excluded from analyses if they lived in Canada.

Study Flow

As shown in the CONSORT Diagram (Figure 1), 530 participants were assessed for eligibility and 257 were excluded after screening, primarily due to having a co-morbid chronic health condition or not meeting the age range specified in the enrollment criteria. 273 participants were randomized to receive I-CBT (n=138) or I-EDU (n=135). From pre-treatment to 12-month follow-up there were 13 participants (I-CBT n = 12; I-EDU n = 1)

who withdrew, were lost to follow-up or were excluded from analyses due to significant life events during the trial. In order to facilitate interpretation of health care cost data, an additional 32 participants (I-CBT $n = 14$; I-EDU $n = 18$) were excluded from analyses because they lived in Canada. Thus, the final sample for this report included 112 families in the I-CBT group and 116 families in the I-EDU group (total $n = 228$).

Randomization Procedure

A fixed allocation, blocked randomization scheme was used for this parallel-group randomized controlled trial. Treatment group assignments were determined in blocks of ten using a computerized random number generator. Group assignments were programmed into a password protected excel spreadsheet. After completion of the pre-treatment assessment, a research assistant not involved in treatment delivery un-blinded the group assignment and entered it in the web program. This triggered a message to participants within the web program, which provided instructions for the treatment phase.

Intervention Conditions

All participants received standard care from their local interdisciplinary pediatric pain clinic, which may have included recommendations for medication management, physical therapy, psychology, and/or complementary and alternative medicine. Participants received either I-CBT or I-EDU treatment in addition to any care they pursued in their pain clinic.

I-CBT—Guided by cognitive behavioral and social learning theories, the I-CBT program consists of eight modules to complete over eight to ten weeks. Separate versions of the program were developed for adolescents and their parents. Adolescents complete modules focused on pain education, goal setting, relaxation, distraction strategies, cognitive strategies, lifestyle factors (sleep, nutrition), staying active, and relapse prevention. Parents complete modules targeting pain education, goal setting, operant training, cognitive strategies, communication skills, and relapse prevention. Each module is designed to be completed within 30 minutes at a rate of 1 module per week. Parents and adolescents completed weekly homework assignments in 6 of the 8 modules. An online coach (PhD level post-doctoral psychology fellow) provided feedback on each homework assignment via a message center. In addition, participants could initiate messages to the online coach at any time during the treatment period. In total, treatment duration was estimated at 9 hours per family including 4 hours of adolescent modules, 4 hours of parent modules, and 1 hour of online coach time.

I-EDU—The I-EDU condition served as an attention control condition and was designed to deliver relevant pain education and to control for nonspecific treatment effects (e.g. participant burden, and website usage). Participants in the I-EDU group received access to a website consisting of eight modules that provided educational information from publicly available websites about pediatric chronic pain (e.g., National Headache Foundation). The I-EDU program did not provide any training in CBT skills for pain management. Parents and adolescents accessed separate versions of the I-EDU program and were instructed to log in weekly at the same interval as the I-CBT group to read information about pediatric chronic pain.

Measures

Sociodemographics—At pre-treatment, parents reported on their education, and their adolescent's age, sex, and race.

Health care cost outcomes—Health care costs were measured at pre-treatment and 12-month follow-up using the Client Service Receipt Inventory (CSRI)³³. The CSRI is a validated, parent-report measure of health care costs over the prior 12 months. The CSRI has been used in numerous studies detailing health care costs associated with chronic conditions in childhood^{4, 9, 31}, including chronic pain^{15, 33}. At each time point, parents reported retrospectively on their adolescent's direct health care service use, direct non-medical costs, and indirect costs over the preceding 12 months. The following 4 health care costs metrics were used in analyses:

Direct medical costs: Parents reported on the type and quantity of emergency department visits, hospitalizations, ambulatory medical care visits, medications, diagnostic testing (laboratory and imaging), and other community-based services (e.g. social work, home health services). Direct medical costs were imputed by linking these parent-reported health service use data to nationally representative health service unit costs provided by the 2010 Medical Expenditure Panel Survey (MEPS) database (one year before the clinical trial opened for enrollment). The MEPS database provides the most complete set of data on specific costs of health care services in the United States¹. To calculate costs for a health care service, we used the "total expenditure variable" in the MEPS database, which aggregates data on costs from private insurance, public insurance and out-of-pocket costs. We calculated mean costs for each health care service for participants from the MEPS database who were 10–17 years of age if at least 10 participants received the service. If data were available for fewer than 10 MEPS participants, we then also included mean costs for MEPS participants 10–64 years of age to estimate the mean cost for that health care service.

Direct medical costs also included medication costs, which were imputed using the Federal Supply Schedule (FSS)³⁹. Medication costs listed in the FSS are negotiated by the United States federal government for use by federal customers, such as the Veterans Health Administration. To represent the usual cost of medications in the United States health care system, we used an adjustment of 121% of the medication costs reported in the FSS as recommended by the United States Department of Veterans Affairs Health Economics Resource Center³⁸.

Direct non-medical costs: Parents reported on an estimate of their out-of-pocket costs spent on special foods, special medical equipment, and transportation to medical appointments. Cost imputation was not required for this variable.

Indirect costs: This included two main components: (1) productivity losses due to parents taking time off work due to their adolescent's pain, and (2) opportunity losses for parents due to providing informal care for their adolescent with pain (e.g. assistance with activities of daily living). To impute indirect costs, we used the human capital approach, which is a standard method to assign monetary value to calculate productivity losses²⁴. We assigned a

monetary value of \$22.77 to each hour of work and leisure time lost by parents due to their adolescent's pain. This is the average hourly wage of a U.S. worker in 2010 (one year before the clinical trial opened for enrollment) according to the Consumer Price Index from the United States Department of Labor, Bureau of Labor Statistics³⁷.

Total health care costs: Total health care costs were calculated by summing direct medical costs, direct non-medical costs, and indirect costs.

Data Analysis Plan

Analyses were conducted with Stata version 12.1³⁴. During data preparation, all costs were CPI adjusted to 2014 dollars to facilitate comparisons. Demographic characteristics were summarized using descriptive statistics. For categorical variables, frequency statistics are reported, and for continuous variables, we report means and standard deviations. Independent samples *t* tests with Bonferroni correction and χ^2 analyses were conducted to confirm that randomization produced equivalent groups on demographic variables and pre-treatment costs.

Analyses were conducted separately for the following health care cost outcomes: Total health care costs, direct medical costs, direct non-medical costs, and indirect medical costs. We first examined distributions of baseline and follow-up costs for the full sample. As expected, cost data did not follow a normal distribution and were heavily positively skewed. This pattern is typical for medical costs data and occurs because a small number of patients use a large amount of medical services (resulting in very high costs) while a large number of patients use no medical services (resulting in zero costs). To reduce potential bias introduced by these extreme values, we used the standard approach to apply Winsorization at the 1st and 99th percentile^{6, 7}. Winsorization is a statistical technique that sets all data below the 1st percentile to the 1st percentile and all data above the 99th percentile to the 99th percentile. In our study, Winsorization addressed the small proportion of extremely high values above the 99th percentile by setting those values to the 99th percentile. In regard to the extremely low values, most of the outcomes analyzed in this study had more than 1% zero values. As such, these zero cost values remained in our data even after Winsorization.

To address the excess of zero values, we applied a two-step approach. First, we compared the proportion of zero cost values between the I-CBT and I-EDU groups. Results indicated that these proportions did not differ on any outcome at either time point ($p > 0.05$). Then, we examined how health care costs changed over time and whether the I-CBT and I-EDU groups had different rates of change in healthcare costs by applying generalized estimating equations (GEEs) with a log-link and gamma family distribution on the non-zero costs. Significance was set at $p < 0.05$. Adolescent race (dichotomized 1 = Anglo-American, 0 = not Anglo-American) was included as a covariate in all regression analyses due to baseline differences between the two treatment groups (see Table 1). We conducted two sets of regression analyses on each healthcare cost outcome to determine: 1) change over time in costs for the full sample, regardless of treatment group status (see Table 3), and 2) whether treatment group status (I-CBT vs I-EDU) modified change over time in costs (i.e., group $\times$ time interaction, representing change over time for the I-CBT group relative to the I-EDU

group) (see Table 4). The beta, *P* value, and 95% confidence interval are reported for each interaction.

Results

Descriptive Characteristics

Participants included 228 adolescents ages 11–17 years ($M = 14.73$, $SD = 1.65$) and their parents. As shown in Table 1, adolescents were primarily Caucasian (83.5%) and female (74.9%). The majority of parents were mothers (93.9%) who had completed some college education or higher. Adolescents most commonly endorsed having musculoskeletal pain (41.7%), abdominal pain (11.3%), or headache (7.8%), and many youth reported pain in multiple locations (39.2%) with moderate average pain intensity ($M = 5.95$, $SD = 1.90$).

Group Equivalence on Demographic and Pretreatment Variables

Participants in the two groups were equivalent with respect to age, sex, primary pain location, parent education, parent marital status, parent employment status, and household annual income (Table 1). However, the I-CBT group had a significantly higher proportion of Anglo-American adolescents and parents compared to the I-EDU group, $\chi^2(1) = 9.77$, $p = 0.002$, and $\chi^2(1) = 9.04$, $p = .003$, respectively. The two treatment groups did not have statistically significant differences on any other demographic characteristics (see Table 1). Independent samples *t*-tests indicated that the two treatment groups did not differ on any of the health care costs outcomes at baseline (p values > 0.24).

Health Care Costs Outcomes

Table 2 shows summaries of un-Winsorized health care costs at pre-treatment and follow-up, in dollar amounts. Table 3 shows summaries of GEE analyses examining change over time in costs for the full sample, regardless of treatment group status. Table 4 shows summaries of GEE analyses examining whether treatment group status (I-CBT vs I-EDU) modifies change over time in costs (i.e., group $\times$ time interaction, representing change over time for the I-CBT group relative to the I-EDU group).

Direct medical costs—Hypotheses about change in direct medical costs were not supported. Although direct medical costs decreased from pre-treatment to follow-up for the full sample, this was not significant, $b = 0.82$, $p = 0.13$, 95% CI [0.63 – 1.06]. Furthermore, there was not a significant difference between the I-CBT group and the I-EDU group on change in direct medical costs over time, $b = 0.84$, $p = 0.50$, 95% CI [0.51 – 1.39].

Direct non-medical costs—Results indicated partial support for hypotheses about change in direct non-medical costs. For the full sample, direct non-medical costs significantly decreased from pre-treatment to follow-up, $b = 0.60$, $p = 0.04$, 95% CI [0.37 – 0.97]. However, the reduction over time in direct non-medical costs was not statistically different between the I-CBT group and the I-EDU group, $b = 0.45$, $p = 0.09$, 95% CI [0.18 – 1.12].

Indirect costs—For indirect costs, our hypotheses were partially supported. From pre-treatment to follow-up, there was a significant reduction in indirect costs for the full sample, $b = 0.42$, $p = 0.006$, 95% CI [0.22 – 0.78]. However, there was no statistically significant treatment effect on indirect costs over time, $b = 0.36$, $p = 0.07$, 95% CI [0.12 – 1.07].

Total costs—We found partial support for our hypotheses about total costs. Total costs decreased significantly over time for the full sample, $b = 0.72$, $p = 0.01$, 95% CI [0.55 – 0.93]. As shown in Table 2, total costs for the full sample decreased an average of \$4,567 from pre-treatment ($M = \$16,443$, $SD = \$21,380$) to follow-up ($M = \$11,876$, $SD = \$21,569$). However, the reduction in total costs was not statistically different between the I-CBT group and the IEDU group, $b = 0.77$, $p = 0.32$, 95% CI [0.46 – 1.29].

Discussion

This is the first large multicenter RCT to evaluate the effect of internet-delivered CBT (I-CBT) on health care costs over one year for youth with chronic pain in the United States. Adolescents in the treatment and control conditions received evaluation and were recruited from one of 12 interdisciplinary pediatric pain clinics in the United States, and were randomized to receive either adjunctive I-CBT or internet education (I-EDU). Across treatment conditions, in the year prior to treatment, the mean annual total health care cost per adolescent was \$16,443. This is consistent with previous studies that have also demonstrated the high economic burden of pediatric chronic pain. For example, studies that have also used a comprehensive cost of illness approach have reported estimates of mean annual costs ranging from \$11,800–\$16,400^{15, 33}. In the 12 months post-intervention, across treatment conditions, we found that total health care costs significantly decreased by an average of \$4,567 per adolescent. This reduction in total health care costs corresponded with significant decreases in direct non-medical costs and indirect costs. Prior, uncontrolled cohort studies of interdisciplinary pain clinics^{18, 25} and an intensive pain rehabilitation program¹⁰ (where patients received psychological treatment along with physical therapy and medication management) have also demonstrated significant reductions over time in health care costs.

Contrary to our hypothesis, however, direct medical costs did not significantly change over time for youth in our sample. One prior uncontrolled cohort study of an inpatient pain rehabilitation program including psychological treatment also found no significant change in direct medical costs following treatment³². Although not previously studied, it is possible that treatment recommendations from pain clinic providers may lead to increases in some types of direct medical costs and decreases or no change in others. For example, treatment recommendations at an initial interdisciplinary pain clinic visit may include initiating or continuing outpatient physical therapy, complementary/alternative therapies (e.g., acupuncture, massage), outpatient mental health treatment, and/or medications. Further research is needed to understand expected vs unexpected health care costs among youth with chronic pain in order to begin to define optimal outcomes along this domain.

We also did not find support for our hypothesis that adjunctive I-CBT would result in greater reductions in health care costs compared to adjunctive I-EDU over a one-year period. The

rate of change in health care costs from pre-treatment to follow-up was similar for the two intervention groups (i.e., non-significant group $\times$ time interaction effect). The two prior RCTs of CBT which reported on health service use as a treatment outcome did not use comprehensive cost data but rather used doctor's visit utilization^{22,23}; as such, it is difficult to make direct comparisons between those findings and our results. There are several possible explanations for our findings, although these should be interpreted cautiously.

First, our data on health care costs were heavily positively skewed with a small proportion of patients reporting much higher costs than the general sample. This pattern is typical of health care cost data and has been found in prior studies of health care costs for youth with chronic pain^{10, 15}. Analytic approaches for health care costs data must account for extremely high values because these values may decrease over time simply due to regression to the mean. Although our analytic approach accounted for this extreme skewness, it is still possible that a different pattern of results could emerge with a much larger sample size. Second, it is possible that more time may be needed to determine the impact of the adjunctive I-CBT program on health care costs. Among the handful of published studies that have evaluated change over time in health care costs among youth with chronic pain, all have been limited by the use of only two time points and none have examined trajectories beyond a 12-month follow-up period^{10, 17, 18, 25, 32}. It is possible that realization of reductions in health care costs require a longer follow-up period (e.g., 3–5 years or more). Third, our prior research has shown this program to be effective for reducing children's disability and decreasing maladaptive parenting behaviors²⁷. It is possible that receiving an effective, adjunctive treatment program may have increased patient and/or parental motivation or willingness to initiate or continue other pain treatments recommended by their local interdisciplinary pain clinic, and thereby leading to appropriate but not reduced health care expenditures.

Further research is needed to identify appropriateness of costs for youth with chronic pain, including the extent to which health care costs reflect adherence to pain clinic treatment recommendations. Currently, there are not published guidelines available to inform hypotheses about the types of costs that would be expected to increase vs. decrease in response to treatment. Research is also needed to identify drivers of health care costs for youth with chronic pain. This research could be guided by existing conceptual models^{2, 5} which highlight personal, family, and socioeconomic factors that may influence health care decision making and service use. For example, among adults with chronic pain, there are well-documented racial, ethnic, and wealth disparities in pain assessment and treatment^{3, 20, 35} and little is known about whether similar patterns exist for youth.

Importantly, prior studies have used a variety of methods to assess health care costs including hospital billing data²⁵, as well as proxy estimates including patient charges¹⁸ and clinic records of healthcare utilization¹⁰ (which may overestimate economic burden¹¹). Whereas our study used a comprehensive cost-of-illness approach, prior studies have not routinely assessed indirect costs and direct non-medical services, which are important for understanding total burden on families. Further, assessments of direct medical services in prior studies have been incomplete (e.g., data on medication costs were not included). Due

to these methodological differences, it is difficult to make direct comparisons between our findings and the cost-estimates from these prior studies that used different methodologies.

This study has several additional limitations. Due to the design of our study, we are not able to make conclusions about the unique effects of interdisciplinary pain clinic treatment vs. I-CBT and I-EDU on changes in health care costs over time. Our goal was to specifically evaluate the impact of adjunctive I-CBT in a real-world population of patients who sought evaluation in tertiary care interdisciplinary pain clinics. Thus, our sample likely represents those youth with the highest health care costs. Alternative designs will be needed in studies evaluating potential cost savings in youth who seek evaluation in primary care or other community settings and do not transition to tertiary care. An additional limitation is that we used retrospective self-report methods to assess health care costs. Although commonly used in health service research, this may have impacted our findings because of recall bias. In addition, while consistent with other studies of youth with chronic pain, our sample was predominantly female, Anglo-American, and middle to upper socioeconomic status. Research is needed among youth from more varied demographic backgrounds, which may influence access to health care services and associated health care costs. Findings from this study also may not generalize to youth with chronic pain who live outside of the United States.

In summary, findings from this study indicate that health care costs decline over a one-year period for youth with chronic pain receiving I-CBT and I-EDU adjunctive to interdisciplinary pain care. Contrary to hypotheses, I-CBT did not lead to reductions in costs compared to I-EDU. Further research is needed to understand patterns of expected change in health care costs with psychological treatments for pediatric chronic pain.

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Highlights

- Estimated annual health care costs were \$16,443 per child.
- Total health care costs significantly decreased across both treatment conditions.
- Research to determine patterns and drivers of health care costs is needed.

Perspective

Health care expenditures significantly decreased in youth with chronic pain from the year prior to initiating treatment to the following year in both intervention conditions, adjunctive internet cognitive-behavioral therapy and adjunctive internet education. Contrary to our hypothesis, the rate of change in health care costs over time was not significantly different between intervention conditions.

Figure 1.
CONSORT flow diagram.

Table 1

Adolescent and parent demographic characteristics at pre-treatment

Adolescent Demographic Characteristics	Total (n=228)	CBT (n=112)	Education (n=116)	
Sex (% female)	74.9	77.2	72.6	$\chi^2(1) = .63, p = .45$
Age (M, SD)	14.73 (1.65)	14.54 (1.66)	14.91 (1.62)	$t(229) = -1.76, p = .08$
Race, %				$\chi^2(1) = 9.77, p = .002$
Anglo-American	83.5	90.4	76.9	
Black or African American	5.1	.8	9.4	
Hispanic/Latino	4.0	3.5	4.0	
Other	4.4	3.1	7.0	
Missing	3.0	2.2	3.0	
Primary Pain Location, %				$\chi^2(3) = 1.69, p = .64$
Head	7.8	9.6	5.9	
Abdomen	11.3	12.3	10.3	
Musculoskeletal	41.7	38.6	45.3	
Multiple	39.2	39.5	38.5	
Parent Demographic Characteristics	Total (n=228)	CBT (n=112)	Education (n=116)	
Sex (% female)	93.9	93.0	94.9	$\chi^2(1) = .55, p = .59$
Race, %				$\chi^2(1) = 9.04, p = .003$
Anglo-American	86.1	92.1	80.3	
Black or African American	3.9	0	7.6	
Hispanic/Latino	3.9	3.5	4.3	
Other	3.9	1.8	5.8	
Missing	2.2	2.6	2.0	
Marital Status (% married)	68.6	73.2	64.1	$\chi^2(1) = 2.20, p = .14$
Education, %				$\chi^2(1) = 2.77, p = .10$
High School or less	12.5	8.9	16.2	
Vocational School/Some College	28.1	28.9	27.4	
College	38.6	33.3	43.6	
Graduate/Professional School	18.6	25.4	11.8	
Missing	2.2	3.5	1.0	
Household Annual Income, %				$\chi^2(5) = 6.28, p = .28$
< 10,000	3.0	3.0	.8	
10,000–29,999	12.6	8.0	17.1	
30,000–49,999	11.3	11.4	11.1	
50,000–69,999	31.6	30.1	32.4	
70,000–100,000	10.0	13.2	6.8	
>100,000	26.0	26.3	25.6	
Missing	5.5	8.0	6.2	
Employment Status, %				$\chi^2(2) = 3.10, p = .21$
Full time	47.2	47.4	47.0	

Adolescent Demographic Characteristics	Total (n=228)	CBT (n=112)	Education (n=116)
Part time	22.1	24.6	19.7
Not working	24.7	19.3	30.1
Missing	6.0	9.7	3.2

Table 2
Health care costs in dollars by treatment group (unadjusted costs, without Winsorization)

Cost Categories	Full Sample		I-CBT		I-EDU	
	Pre-treatment (\$), <i>M</i> (<i>SD</i>)	12-month follow-up (\$), <i>M</i> (<i>SD</i>)	Pre-treatment (\$), <i>M</i> (<i>SD</i>)	12-month follow-up (\$), <i>M</i> (<i>SD</i>)	Pre-treatment (\$), <i>M</i> (<i>SD</i>)	12-month follow-up (\$), <i>M</i> (<i>SD</i>)
Total costs	16443 (21380)	11876 (21569)	17011 (22813)	13732 (26083)	15905 (20013)	10191 (16380)
Direct medical costs	11097 (14154)	9069 (17080)	12291 (17566)	10529 (20383)	9965 (9841)	7743 (13358)
Primary care	1113 (1625)	636 (1102)	1457 (2054)	652 (1057)	787 (972)	622 (1147)
Medical specialty	1366 (2387)	1269 (2203)	1373 (2273)	1388 (1940)	1359 (2500)	1159 (2425)
Surgical specialty	634 (1824)	399 (1828)	561 (1362)	539 (2524)	704 (2177)	269 (741)
Emergency room	1207 (1881)	805 (1611)	1023 (1338)	566 (1035)	1381 (2273)	1021 (1974)
Inpatient admission	2481 (9937)	2392 (11702)	3557 (13004)	3249 (14409)	1432 (5369)	1556 (8236)
Other services	454 (2998)	175 (777)	360 (2890)	142 (605)	542 (3107)	205 (909)
Mental health	751 (1448)	999 (2331)	796 (1447)	923 (1738)	709 (1454)	1070 (2776)
PT/OT	1076 (2781)	839 (2061)	827 (2513)	933 (2014)	1313 (3004)	752 (2111)
CAM	528 (1403)	535 (1074)	465 (933)	483 (898)	588 (1737)	583 (1216)
Diagnostic tests	237 (644)	103 (658)	268 (715)	86 (659)	208 (570)	119 (661)
Community services	338 (1452)	157 (701)	216 (715)	194 (831)	453 (1901)	122 (557)
Medications	973 (2692)	1046 (5833)	1371 (3554)	1527 (8143)	563 (1199)	566 (1336)
Direct non-medical costs	1169 (3773)	936 (4588)	929 (2732)	815 (2518)	1397 (4546)	1048 (5899)
Indirect costs	4177 (13170)	1983 (7455)	3791 (13071)	2487 (9748)	4543 (13310)	1518 (4391)

Note. PT/OT = Physical Therapy/Occupational Therapy; CAM = Complementary and Alternative Medicine.

Table 3

Generalized estimating equations (GEEs) with gamma family distribution and log link with Winsorized costs evaluating change over time in costs for the full sample (regardless of treatment group status).

Predictors	Direct medical costs			Direct non-medical costs			Indirect costs			Total costs		
	beta	p	95% CI	beta	p	95% CI	beta	p	95% CI	beta	p	95% CI
Time	0.82	0.13	0.63–1.06	0.60	0.04	0.37–0.97	0.42	0.006	0.22–0.78	0.72	0.01	0.55–0.93
Adolescent race	1.20	0.29	0.86–1.69	0.90	0.79	0.40–2.02	0.48	0.10	0.20–1.15	1.01	0.98	0.67–1.51

Generalized estimating equations (GEEs) with gamma family distribution and log link with Winsorized costs evaluating examining whether treatment group status (I-CBT vs I-EDU) modifies change over time in costs. The group $\times$ time interaction represents change over time in costs for the I-CBT group relative to the I-EDU group.

Table 4

Predictors	Direct medical costs			Direct non-medical costs			Indirect costs			Total costs		
	beta	p	95% CI	beta	p	95% CI	beta	p	95% CI	beta	p	95% CI
Time	0.89	0.58	0.59–1.34	0.91	0.81	0.42–1.95	0.63	0.31	0.26–1.53	0.81	0.32	0.53–1.23
Group	0.87	0.34	0.66–1.16	1.56	0.29	0.69–3.51	1.17	0.70	0.53–2.59	0.94	0.72	0.67–1.31
Group $\times$ Time	0.84	0.50	0.51–1.39	0.45	0.09	0.18–1.12	0.36	0.07	0.12–1.07	0.77	0.32	0.46–1.29
Adolescent race	1.12	0.52	0.79–1.58	0.91	0.84	0.37–2.23	0.42	0.03	0.19–0.90	0.96	0.84	0.63–1.45