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Presurgical psychosocial predictors of acute postsurgical pain and quality of life in children undergoing major surgery

Jennifer A. Rabbitts, M.B., Ch.B.^{a,b}, Cornelius B. Groenewald, M.B., Ch.B.^{a,b}, Gabrielle G. Tai, M.P.H.^b, and Tonya M. Palermo, Ph.D.^{a,b}

^aDepartment of Anesthesiology and Pain Medicine, University of Washington, Seattle, WA, USA

^bSeattle Children's Research Institute, Seattle, WA, USA

Abstract

Limited research has examined presurgical risk factors for poor outcomes in children after major surgery. This longitudinal study examined presurgical psychosocial and behavioral factors as predictors of acute postsurgical pain intensity and health-related quality of life (HRQOL) in children 2 weeks after major surgery. Sixty children aged 10–18 years, 66.7% female, and their parent/guardian participated in the study. Children underwent baseline assessment of pain (daily electronic diary), HRQOL, sleep (actigraphy), and psychosocial factors (anxiety, pain catastrophizing). Caregivers reported on parental pain catastrophizing. Longitudinal follow-up assessment of pain and HRQOL was conducted at home 2 weeks after surgery. Regression analyses adjusting for baseline pain revealed that presurgery sleep duration ($\beta = -.26$, $p < .05$), and parental pain catastrophizing ($\beta = .28$, $p < .05$) were significantly associated with mean pain intensity reported by children 2 weeks after surgery, with shorter presurgery sleep duration and greater parental catastrophizing about child pain predicting greater pain intensity. Adjusting for baseline HRQOL, presurgery child state anxiety ($\beta = -.29$, $p < .05$) was significantly associated with HRQOL at 2 weeks, with greater anxiety predicting poorer HRQOL after surgery. In conclusion, child anxiety, parental pain catastrophizing, and sleep patterns are potentially modifiable factors which predict poor outcomes in children after major surgery.

Perspective—This study addresses an important gap in literature, examining presurgical risk factors for poorer acute postsurgical outcomes in children undergoing major surgery. Knowledge of these factors will enable presurgical identification of children at risk for poorer outcomes and guide further research developing prevention and intervention strategies for these children.

Keywords

Acute pain; health-related quality of life; children; spine fusion; surgery

Corresponding author. Jennifer Rabbitts, M.B., Ch.B., Jennifer.rabbitts@seattlechildrens.org, Address: 4800 Sand Point Way NE MB.11.500.3, Seattle WA 98105, Phone: (206) 987-2704, Fax: (206) 987-3935.

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INTRODUCTION

Around 5 million children undergo surgery in the United States each year^{8,38} and it is estimated that between 40–60% experience moderate-severe pain while in the hospital¹³. Reported rates of acute postsurgical pain in children have remained similar over the past 2 decades^{7,13,44} despite advances in perioperative care. Once present, moderate-severe postsurgical pain can be difficult to control¹³ and can contribute to poorer clinical outcomes, including delayed recovery, and decreased satisfaction with care^{6,19,46}. Moreover, recent studies suggest that postsurgical pain may persist beyond the healing period in many children after general or orthopedic surgical procedures such as spine fusion and pectus surgery^{3,11,21,35,47}. A critical barrier to targeted prevention and treatment strategies in this context is that modifiable presurgical risk factors have not yet been identified.

The Biopsychosocial Model of Pain demonstrates the interrelationship among biological, psychological, and social processes in determining response and adaptation to painful events and has been used to highlight factors applicable to perioperative management and postsurgical recovery²⁶. Extensive research has established the importance of biopsychosocial factors in predicting pain after surgery in adults¹⁸. In the few studies conducted in children after surgery, several factors have emerged as potentially important risk factors for poor outcomes including emotional factors (e.g., child anxiety, child pain catastrophizing^{10,33}), behavioral factors (e.g., postsurgical sleep problems¹⁶), and social factors (e.g., parental anxiety, parent pain catastrophizing^{1,10}). However, several significant methodologic limitations in this prior research (including single retrospective ratings of pain, lack of measurement of functional outcomes, and lack of baseline assessment of risk factors) has precluded interpretation and application of findings. Weak measurement strategies such as use of single retrospective pain ratings introduce recall bias³⁶, and limit conclusions that can be drawn about postsurgical pain intensity. There has also been a lack of inclusion of functional outcomes in addition to pain intensity. Multidimensional assessment of function, for example health-related quality of life (HRQOL), has been recommended for comprehensive understanding of acute pain outcomes in children²⁸. Furthermore, assessments conducted prior to surgery are necessary to test risk factors that can eventually be targeted in children before surgery. Most prior studies have not performed assessments prior to surgery and thus the literature is dominated by cross-sectional associations and limited understanding of variables that play a causal role in predicting poor postsurgical outcomes. Another limitation of prior research is that while studies have examined anxiety and pain catastrophizing in parents as potentially important factors in their child's pain experience³⁴, there has been limited investigation of parental pain catastrophizing about *their child's* pain which may be more relevant in this setting.

Therefore, this longitudinal study aims to address these methodological limitations by (1) examining the impact of major surgery on pain and HRQOL in children over time, and (2) prospectively identifying modifiable psychosocial and behavioral factors at baseline which predict acute postsurgical pain intensity and HRQOL 2 weeks after major surgery in children. Based on prior literature, we hypothesized that (1) the majority of children would report moderate-severe pain and impairments in HRQOL at 2 weeks after surgery, and that (2) presurgical assessments of higher child anxiety, higher child pain catastrophizing, shorter

sleep duration, and higher parental catastrophizing about child pain would predict greater pain intensity and impairments in HRQOL 2 weeks after surgery.

METHODS

Participants and setting

Sixty children, ages 10–18 years undergoing major surgery at a children's hospital in the northwestern United States and their parent or guardian (caregiver) were recruited into the study. The study was approved by the Institutional Review Board. Caregivers provided informed consent and children provided assent prior to research procedures.

Inclusion/Exclusion criteria—Children were eligible if they were (a) ages 10–18 years, (b) undergoing either spinal fusion or pectus repair surgery, and (c) able to speak and read English. Children were excluded if (a) they had a serious comorbid health condition (e.g. cancer, neuromuscular disease), (b) they had undergone prior major surgery, (c) they did not reside with their parent or guardian, or (d) their caregiver was not fluent in English. Eligible surgeries were chosen based on prior literature identifying these invasive procedures as at high risk for pain complications^{3,20,33,40,47}. Indications for these surgeries include adolescent idiopathic scoliosis, juvenile scoliosis, spondylolisthesis, kyphosis, pectus excavatum, and pectus carinatum.

Recruitment—Eligible participants were identified from surgery clinic and procedure schedules and review of the electronic medical record over a 21 month period. Of 110 eligible families, 99 (90%) were approached in person or by telephone interview for potential participation in the study, and 11 (10%) were unable to be reached in time for baseline assessments. Of the 99 families approached, sixty families (61%) agreed to participate and 39 (39%) refused due to lack of time or interest.

Procedures

Children underwent 2 assessments: a presurgery baseline assessment during the week immediately preceding surgery, and a follow-up assessment which started 2 weeks after surgery. Each assessment was 7 days in duration and was completed at home.

Prior to surgery, children completed 7 days of daily monitoring of sleep with actigraphy and a daily electronic pain and sleep diary, with the final night being the night before surgery. At any time during this presurgery assessment, children and caregivers completed baseline self-report measures of sociodemographics, psychosocial factors (anxiety, pain catastrophizing), pain characteristics, and HRQOL. Baseline questionnaires, Actiwatches, and personal digital assistants (PDA) used for the daily electronic diary, were couriered to the participants 1 week before surgery and subsequently collected in-person on the day of surgery.

The window of timing of participants starting the follow-up (2 week) assessment ranged from 8 to 21 days after surgery, with a mean of 14 days. During the postsurgical assessment, children repeated measures with the 7 day daily electronic pain and sleep diary, and questionnaires (pain characteristics and HRQOL) at home. Follow-up questionnaires and the PDA were couriered to the participants 2 weeks after surgery and subsequently returned by

the participant by courier service. Clinical data were collected from the electronic medical record.

During the follow-up phase, one participant dropped out of the study due to lack of time and one participant was lost to follow-up after surgery. Participants received gift cards to local stores upon completion of assessments. Participants in this study are currently undergoing longer-term follow-up for which data collection is ongoing. Thus, the focus of the present report is on short-term outcomes at 2 weeks only.

Measures

Daily electronic pain and sleep diary—Children rated their average pain intensity in an end of day diary completed each evening³⁶ on a PDA. Pain intensity was assessed using an 11-point numerical rating scale (NRS) (0 = no pain, 10 = worst pain). We defined moderate-severe pain based on prior literature as a mean pain score of equal to or greater than 4 out of 10 on the NRS⁴³. Numerical rating scales are recommended for assessment of pain intensity for acute postsurgical pain³². Diary entries were time-stamped and could only be made during the corresponding time window, thereby reducing the potential of recall bias²⁴. Children reported medication usage daily on the pain diary. Children also responded to items concerning their sleep and times that they removed the actigraph to assist with scoring actigraphy data.

Actigraphy monitoring of sleep—Daily monitoring of sleep patterns over 7 days was conducted using the Actiwatch 2 (AW2, Phillips Respironics, MiniMitter Company Inc., Bend, OR), a motion sensor actigraph. This small non-invasive watch-like device worn on the nondominant wrist senses movement by an omni-directional mercury switch that is open when there is no movement and closed when movement above a set threshold is detected. Each time the switch closes, activity counts are generated which are stored in 1-minute epochs. An event marker on the Actiwatch allows the patient to indicate bedtime and wake times. Actiware software (version 5.61.0010) was used in conjunction with the event markers and the daily diary to calculate sleep duration, the total amount of time from sleep onset to offset. Sleep onset was defined as the first 10-minute segment with no more than one epoch of activity, and sleep offset was defined as the last 10-minute segment with no more than one epoch of any recorded activity. These methods have been used in previous studies in this age group^{23,25,29}. Actigraphy has 85–95% agreement with traditional polysomnographic recordings for certain sleep variables (e.g., sleep duration)¹⁴.

Pain questionnaire—This self-report measure assesses pain characteristics. Pain location is marked on a validated body outline³⁹. Pain frequency and duration are assessed with a response time frame of “in the past 7 days” using Likert-type scales with five response options for frequency (‘not at all’ to ‘daily’) and four response options for duration (‘less than 1 hour’ to ‘all day’).

Health-related quality of life—HRQOL over the preceding 7 days was measured with the Pediatric Quality of Life Scale, Short-Form (PedsQL), acute version. This is a 15-item questionnaire assessing physical, emotional, social, and school function with response

options on a Likert-type scale from 0 = never, to 4 = almost always. The responses are reverse scored and transformed to a 0 to 100 range. Responses are then summed and divided by number of items, to yield a Total Score, and Psychosocial and Physical Health Summary subscale scores, with higher scores indicating better HRQOL. The PedsQL has been used in a wide variety of general and disease specific populations and has an established at-risk cut-off score of 69.7, below which children are considered at risk for impaired HRQOL, based on a normative sample of healthy children⁴⁵. The PedsQL Short-Form has been shown to be comparable to the full-length version².

State Trait Anxiety Inventory for Children (STAIC)—This 40-item self-report measure assesses state and trait anxiety on two separate subscales, each of which has 20-items. The trait subscale assesses stable individual differences in tendency to experience anxiety. The state subscale assesses the child's transient level of anxiety, typically elevated in stressful situations. Items are each rated on a 3-point scale. Items indicating less anxiety are reverse scored, and items are then totalled for a maximum possible score of 60 on each subscale, with higher scores indicating greater anxiety symptoms. The STAIC was shown to have good internal consistency (Cronbach's alpha = .82–.87 for state subscale, and Cronbach's alpha = .78–.81 for trait subscale) in a population-based sample of schoolchildren. Evidence of concurrent validity in this setting was shown by strong correlation with the Children's Manifest Anxiety Scale ($r = .75$) and the General Anxiety Scale for Children ($r = .63$)⁴². The STAIC has been used in prior surgical studies in children^{1,3}.

Pain Catastrophizing Scale-Child and Parent versions (PCS-C and PCS-P)—The PCS-C is a 13-item self-report measure that assesses children's thoughts and emotions in response to pain⁵. The PCS-P is a 13-item measure, assessing parental response to their child's pain. Items on both the PCS-C and PCS-P are rated on a 5-point scale yielding a maximum possible score of 52, and 3 subscale scores, rumination, magnification, and helplessness. For both the PCS-C and PCS-P higher scores indicate greater rumination, magnification and/or helplessness about pain. The PCS-C showed good internal consistency ($\alpha = .87 - .90$) in schoolchildren with and without pain, and correlated highly with pain intensity ($r = .49$) and disability ($r = .50$) in those with chronic pain⁵. The PCS-P showed good internal consistency (Chronbach's alpha = .81–.93) in children with and without chronic pain. PCS-P contributed significantly to parenting stress, and functional disability in the children with pain¹². Both the PCS-C and the PCS-P have been used in pediatric surgical studies^{10,33}.

Sociodemographics—Caregivers reported on sociodemographic information including child race, ethnicity, and parent/guardian education level and income.

Clinical factors

Demographic factors (age, sex, height, weight), and surgical factors (procedure type, duration of surgery, length of stay) were collected from the electronic medical record by study personnel. Body mass index (BMI) percentile category was calculated using the Center for Disease Control's online pediatric BMI calculator (available at: <http://>

nccd.cdc.gov/dnpabmi/Calculator.aspx). BMI categories are based on the following percentile ranges: underweight = <5%; healthy weight = 5 to <85 %; overweight = 85 to <95 %; and obese = 95%.

Statistical analyses

Summary statistics were used to describe the sociodemographic and clinical characteristics of the sample. Continuous data were summarized with means (*M*) and standard deviations (*SD*), and categorical items were summarized using frequencies (*N*) and proportions (%). Moderate-severe pain was defined as a mean pain score of equal to or greater than 4 out of 10 on the NRS based on prior literature⁴³. A child reporting moderate-severe pain on at least one day during the follow-up assessment was considered as having moderate-severe pain present at the 2 week follow-up. Mean pain was calculated for baseline and 2 weeks postsurgery for each individual from their available daily pain diary data from each assessment. On average, children completed 7 days (range 4–14) of daily diary at baseline, and 8 days (range 4–13) at follow-up. Pearson correlations were conducted to examine associations between predictor and outcome variables. Testing for multicollinearity was nonsignificant, and therefore we proceeded to conduct linear regression analyses to test trait anxiety, state anxiety, pain catastrophizing, parental pain catastrophizing, and baseline sleep as predictors of mean pain intensity and HRQOL 2 weeks after surgery, adjusting for baseline pain and HRQOL. Separate regression models were tested for Total HRQOL, Psychosocial Health, and Physical Health scales. Models testing predictors of HRQOL adjusted for the baseline values of the applicable HRQOL scale. Age and sex were not associated with pain intensity or HRQOL scales in this sample and therefore were not included in the regression models. The two participants who dropped out of the study during follow-up were not included in these models. Results of the linear regressions were reported as adjusted R^2 and standardized β . All analyses were conducted with SPSS v.21.0 (SPSS, Inc., Chicago, IL).

RESULTS

Baseline characteristics

Participants included 60 children, ages 10 to 18 years ($M=14.7$ years, $SD = 1.9$) and their parent or guardian. One primary caregiver (56 female, 4 male) participated with each child. The sample was predominantly female (66.7 %) and white (83.4 %). The majority of families (58.9 %) had an annual household income above \$70,000. Sociodemographic and clinical characteristics of the study participants are summarized in Table 1.

At baseline, most children (82.5%) endorsed some pain ($NRS = 1$) with an average pain intensity over 7 recorded days from daily diaries of 2.8 ($SD = 2.5$). The most frequently reported sites of pain were back/spine (55%), legs (8.3%), chest (6.7%), and shoulders (6.7%). Eleven children (18.3%) reported using over the counter pain medications on the daily diary during the week prior to surgery; no children reported using prescription pain medications. Children slept an average of 7.9 hours ($SD = 0.9$) per night during the week prior to their surgery. Children reported an average total health-related quality of life score

of 73.6 (SD = 17.7) at baseline, with similar scores on psychosocial and physical health on average. Pain and HRQOL data are summarized in Table 2.

Impact of surgery on pain and health-related quality of life at 2 weeks after surgery

Longitudinal data collected on daily pain diaries indicated an average pain intensity for the sample of 3.8 (SD = 2.2) at 2 weeks postsurgery. The majority of children (79.2%) reported moderate-severe pain on at least one day during this 7 day assessment period. The most frequently reported sites of pain were back/spine (52%), chest (16.7%), and shoulders (11.7%). Forty (66.7%) children reported using pain medications 2 weeks after surgery, including over the counter pain medications (61.7% of children) and opioids (36.7% of children). 6.7% of children reported using benzodiazepines.

Children reported impairments in total health-related quality of life 2 weeks after surgery ($M = 60.3$, $SD = 15.5$). Physical health was severely impaired on average ($M = 24.7$, $SD = 22.4$) compared to psychosocial health ($M = 78.0$, $SD = 16.9$) (see Table 2). Correlational analyses with baseline and 2 week variables are presented in Table 3.

Baseline risk factors for pain 2 weeks after surgery

A linear regression was conducted to test baseline predictors of pain intensity at 2 weeks after surgery. Mean baseline pain was controlled for. The following baseline predictor variables were included in the multivariate model: trait anxiety, state anxiety, child pain catastrophizing, parental pain catastrophizing, and sleep duration. As hypothesized, parental pain catastrophizing ($\beta = .28$, $p < .05$), and presurgery sleep duration ($\beta = -.26$, $p < .05$) were significantly associated with mean pain intensity reported 2 weeks after surgery. Specifically, greater parental catastrophizing about child pain, and shorter presurgery sleep duration predicted greater pain intensity at 2 weeks. However, contrary to hypotheses, child anxiety variables including trait anxiety, state anxiety, and child pain catastrophizing were not associated with child reported pain 2 weeks after surgery. Overall the model explained 33.8% of the variance (adjusted $R^2 = 0.34$, $p < 0.001$) (see Table 4).

Baseline risk factors for impairments in health-related quality of life 2 weeks after surgery

Three separate linear regressions were conducted to test baseline predictors of Total HRQOL, Psychosocial Health, and Physical Health scales at 2 weeks after surgery. Controlling for mean baseline pain and the applicable HRQOL scale, the model tested the following multivariable baseline predictors: trait anxiety, state anxiety, pain catastrophizing, parental pain catastrophizing, and sleep duration. Presurgery child anxiety was significantly associated with total HRQOL reported 2 weeks after surgery. Specifically, greater state anxiety at baseline ($\beta = -.29$, $p < .05$) predicted poorer HRQOL at 2 weeks. Trait anxiety, pain catastrophizing (child and parent) and sleep duration were not associated with total HRQOL 2 weeks after surgery. Overall the model explained 49.7% of the variability in total HRQOL reported 2 weeks after surgery ($p < 0.001$). In addition, parental pain catastrophizing at baseline predicted physical health 2 weeks after surgery ($\beta = -.34$, $p < .05$), with the total model explaining 22.0% of the variance in physical health (adjusted $R^2 = 0.22$, $p < 0.05$). The total model examining psychosocial Health explained 50.8% of the

variance in psychosocial health (adjusted $R^2 = 0.51$, $p < 0.001$), however no unique predictors of Psychosocial Health were identified (p 's $> .05$).

DISCUSSION

To our knowledge, this is the first study to prospectively identify baseline psychosocial risk factors for acute postsurgical pain and HRQOL in children after major surgery. Consistent with prior studies of acute postsurgical pain experienced while in the hospital¹³, the majority of children in our sample also reported moderate-severe pain that persisted at two weeks after surgery. As expected, children also reported health-related quality of life impairments 2 weeks after major surgery, which is consistent with studies of HRQOL at long-term follow-up in children after major surgeries^{9,22,30}. Physical health was markedly impaired with average levels 6.2 standard deviations below established mean scores for children without a chronic health condition². We were able to identify several baseline risk factors for increased pain and impairments in HRQOL at 2 weeks after discharge. Our findings indicated that psychosocial and behavioral factors including higher levels of parental pain catastrophizing and shorter child sleep duration significantly predicted higher levels of postsurgical pain. Psychosocial factors (higher child state anxiety) predicted greater impairments in HRQOL in children 2 weeks after major surgery. While a few previous studies have examined psychosocial factors associated with acute pain after surgery^{1,10,16,17,33,34}, our findings extend prior research with longitudinal assessment of presurgical risk factors and postsurgical outcomes. Identification of presurgical risk factors may present an opportunity to intervene with children (and their parents) prior to undergoing major surgery, in order to improve their pain and health outcomes.

There are several prior studies that have examined factors associated with pain after surgery. For example, one study found that child anxiety and pain catastrophizing measured 48–72 hours after major surgery were associated with greater concurrent pain intensity, and unpleasantness respectively³³. However, assessment of psychological factors during the postsurgical period can only provide information about cross-sectional associations. Multiple factors may affect the child's reporting after surgery such as their perioperative experience, experience of postsurgical pain and effects of medications. We are aware of only one prior study that has examined child pain catastrophizing prior to surgery. Contrary to our results, this study found a significant relationship between catastrophizing and pain intensity in the recovery room in a group of children having outpatient surgery¹⁰, however this was only in relation to a single pain score directly after surgery.

One of the strengths of our study is the inclusion of a broad measure of physical and psychosocial health. We are not aware of any prior studies that have examined psychosocial predictors of postsurgical health-related quality of life in child surgical populations. By including both pain and HRQOL information in our assessment, we are able to integrate information about not only how much pain the child is experiencing after surgery but importantly whether the child is experiencing any impairment in their daily life activities and perceptions of well-being.

By including parents' perceptions, we also gathered important information on the potential role of child emotions prior to surgery and parents emotions prior to surgery on the child's subsequent postsurgical outcomes. While the child's own presurgery report of pain catastrophizing did not predict their postsurgical pain, the parents' pain catastrophizing did have an important effect on the child's pain experience after surgery. Parental pain catastrophizing predicted level of physical function in children during the acute recovery phase after major surgery. These findings highlight the significant impact parents can have on their child's postsurgical recovery, particularly when they go home from the hospital. Prior research of the role of parental psychological factors in postsurgical pain in children is equivocal with some studies finding concurrent associations between parental catastrophizing and child postsurgical pain¹ and other studies finding no association^{33,34}. However, our study used a stronger methodology with measurement of parental factors *before* the child's surgery, and therefore reducing any impact that the early perioperative experience may have on parents' responses. Furthermore, in contrast to these studies, we measured parent catastrophizing specifically about their child's pain, which may be more relevant in this context. It is important to consider how to best involve parents in interventions to reduce postsurgical pain and improve HRQOL. Parents play an important role before surgery in communicating with their children about the upcoming surgery and preparing for postoperative management. After surgery, parents take over their child's postsurgical pain management at hospital discharge, and are in a unique position to apply pain management interventions. Our data suggest that future intervention efforts at preventing postsurgical pain should incorporate parents in a significant way.

Another unique aspect of our study design is that we measured sleep in the week prior to surgery using an objective assessment (actigraphy). Our finding that baseline sleep predicts subsequent postsurgical pain is consistent with studies in several adult postsurgical populations, which have identified a significant effect of presurgical sleep on postsurgical pain, with better sleep patterns even the night before surgery leading to less pain after surgery⁴⁸. One prior study has employed actigraphic assessment of sleep patterns in children after surgery, identifying postsurgical sleep to be associated concurrently with postsurgical pain intensity at home after outpatient surgery¹⁶. Our study extends this research to identify short duration of sleep in the week prior to surgery as a risk factor for acute postsurgical pain in children. While mechanistic data in children are lacking, sleep fragmentation among healthy adults results in subsequent decrements in endogenous pain inhibition and increase in pain sensitivity⁴¹. Sleep also promotes immune function and healing^{27,31}, and sleep deprivation leads to sympathetic activation and increased stress response¹⁵, and in adults has been shown to impact postsurgical recovery^{4,37}. Further research exploring the role of sleep on recovery and outcomes after major surgery in children over longer-term follow-up is needed.

The results of this study should be interpreted in light of several limitations. The sample size of the study was small and thus we were unable to examine subgroups of patients (such as by surgery type) due to small cell sizes. Our preliminary findings should be replicated in a larger sample; this would enable examination of potentially complex interactions among child and parent variables, which our study was not large enough to explore. In addition the sample size may have contributed to the lack of significant effects found with certain

baseline variables. While the refusal rate in eligible families was much lower than reported in prior surgical studies, the rate was still high enough to decrease the generalizability of our findings. It is possible that families declining to participate had a different psychosocial profile to those who participated. A limitation of our measurement approach was reliance on only one measure of physical health. The HRQOL survey completed at 2 weeks after surgery may have reflected activity restrictions related to surgery rather than impairments in physical activities due to health per se. Further research may incorporate additional measures of function to tease apart this issue. Our data are limited to the acute postsurgical period and it will be equally important to examine baseline predictors of longer-term outcomes in children after major surgery. Our ongoing study includes long-term follow-up to one year after surgery.

In summary, our preliminary findings suggest that several presurgery psychosocial and behavioral factors influence acute postsurgical pain and health-related quality of life 2 weeks after major surgery in children. Child anxiety, parental pain catastrophizing, and sleep patterns are potentially modifiable factors which may serve as targets for preventive intervention strategies. Future research is needed to develop and test presurgical interventions to improve pain and health outcomes in the pediatric surgery population.

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TABLE 1

Sociodemographic and clinical characteristics of children having major surgery

CHARACTERISTIC	N (%) / M (SD)	
Age (years)	14.7	(1.9)
Sex		
Female	40	(66.7%)
Male	20	(33.3%)
Child race		
White	50	(83.4%)
African American	2	(3.3%)
Asian	2	(3.3%)
Other/not reported	6	(10%)
Child Ethnicity		
Hispanic	1	(1.7%)
Non-Hispanic	53	(88.3%)
Not reported	6	(10%)
Annual household income		
< \$ 29,999	8	(13.3%)
\$ 30,000–\$69,999	15	(25.1%)
> \$ 70,000	33	(55.8%)
Not reported	4	(6.6%)
Body mass index category (age adjusted)	43.6	(32.3)
Underweight	8	(13.3%)
Healthy weight	41	(68.3%)
Overweight	5	(8.3%)
Obese	6	(10%)
Trait anxiety	33.9	(7.7)
State anxiety	33.7	(6.2)
Pain catastrophizing (child)	13.7	(9.6)
Pain catastrophizing (parent)	15.9	(10.6)
Presurgery sleep duration (hours)	7.9	(0.9)
Surgical procedure		
Posterior spinal fusion	48	(80%)
Anterior-posterior spinal fusion	2	(3.3%)
Nuss procedure for pectus deformity	9	(15.0%)
Ravitch procedure for pectus deformity	1	(1.7%)
Length of surgery (hours)	5.2	(1.6)
Length of hospital stay (days)	4.5	(1.1)

TABLE 2

Descriptive statistics for pain and health-related quality of life in children at baseline (presurgery) and 2 weeks after major surgery

OUTCOME	BASELINE M (SD)		2 WEEKS M (SD)	
Pain intensity (NRS) *	2.8	(2.5)	3.8	(2.2)
Health-related quality of life				
Total score	73.6	(17.7)	60.3	(15.5)
Psychosocial health	74.5	(18.1)	78.0	(16.9)
Physical health	71.9	(26.2)	24.7	(22.4)

* Numeric rating scale 0–10, daily electronic pain diary

TABLE 3

Correlations between predictor and outcome variables

<i>VARIABLES</i>	1	2	3	4	5	6	7	8	9
1. Baseline pain intensity	1.00	-.21	.32 [*]	.12	.34 [*]	.29 [*]	-.10	.56 ^{**}	.12
2. Baseline HRQOL		1.00	-.61 ^{**}	-.47 ^{**}	-.47 ^{**}	-.44 ^{**}	.01	-.04	.59 ^{**}
3. Trait anxiety, child			1.00	.36 ^{**}	.46 ^{**}	.27	.02	.12	-.50 ^{**}
4. State anxiety, child				1.00	.09	.27	.04	-.02	-.50 ^{**}
5. Pain catastrophizing, child					1.00	.32 [*]	.16	.06	-.12
6. Pain catastrophizing, parent						1.00	.15	.30 [*]	-.09
7. Presurgery sleep duration							1.00	-.30 [*]	.02
8. Pain intensity at 2 weeks								1.00	.02
9. HRQOL at 2 weeks									1.00

*
p < .05,**
p < .01

HRQOL = Health related quality of life

TABLE 4

Linear regression predicting average postsurgical pain intensity in children 2 weeks after major surgery

PREDICTORS	β	R ²	F
Mean pain intensity at 2 weeks			
Baseline pain intensity	.44 **		
Trait anxiety, child	.05		
State anxiety, child	-.16		
Pain catastrophizing, child	-.15		
Pain catastrophizing, parent	.28 *		
Presurgery sleep duration (minutes)	-.26 *		
Total		.34	4.8 **

*
p < .05,**
p < .01

TABLE 5

Linear regressions predicting postsurgical total, psychosocial, and physical health-related quality of life in children 2 weeks after major surgery

PREDICTORS	β	R^2	F
Total health-related quality of life (HRQOL)			
Baseline HRQOL	.37 *		
Baseline pain intensity	.38 **		
Trait anxiety, child	-.26		
State anxiety, child	-.29 *		
Pain catastrophizing, child	.01		
Pain catastrophizing, parent	-.11		
Presurgery sleep duration (minutes)	.05		
Total		.50	6.8 **
Psychosocial health			
Baseline psychosocial health	.48 *		
Baseline pain intensity	.29 *		
Trait anxiety, child	-.16		
State anxiety, child	-.22		
Pain catastrophizing, child	-.17		
Pain catastrophizing, parent	.05		
Presurgery sleep duration (minutes)	.12		
Total		.51	7.1 **
Physical health			
Baseline physical health	.27		
Baseline pain intensity	.30		
Trait anxiety, child	-.20		
State anxiety, child	-.19		
Pain catastrophizing, child	.29		
Pain catastrophizing, parent	-.34 *		
Presurgery sleep duration (minutes)	-.09		
Total		.22	2.6 *

* $p < .05$,

** $p < .01$