ORIGINAL CLINICAL RESEARCH REPORT

Parental Psychosocial Factors Moderate Opioid Administration Following Children's Surgery

Alexandra S. Kain, BA,*† Michelle A. Fortier, PhD,*†‡§ Candice D. Donaldson, PhD,*†‖ Daniel Tomaszewski, PharmD, PhD,¶# Michael Phan, PharmD,¶ and Brooke N. Jenkins, PhD*†‡‖

BACKGROUND: This investigation aimed to examine the impact of parental psychosocial variables on the administration of opioids to young children experiencing postoperative pain.
METHODS: Participants in this longitudinal analysis were children ages 2–12 undergoing tonsillectomy with or without adenoidectomy and their parents. Parents completed validated instruments assessing trait anxiety, perceived stress, and coping style before surgery, and children and parents completed instruments assessing pain and administration of opioids and acetaminophen on days 1, 2, 3, and 7 at home after surgery. The structure of the data was such that parents and children completed multiple data assessments making the data multilevel (ie, days of data within dyads). To address this issue of data structure, multilevel modeling was used to analyze the dataset.
RESULTS: Participants included 173 parent-child dyads (mean child age = 5.99 ± 2.51) recruited between 2012 and 2017. We found that parent-related psychosocial variables, such as trait anxiety, stress, and coping style, moderated the relationship between the child's pain and postoperative medication administration. Specifically, when predicting hydrocodone, the interactions between anxiety and pain and stress and pain were significant; when child pain was high, high-anxiety and high-stressed parents gave their children 19% and 12% more hydrocodone, respectively, compared to low-anxiety and low-stressed parents. When predicting acetaminophen, the interactions between anxiety and pain, a blunting coping style and pain, and a monitoring coping style and pain were significant.
CONCLUSIONS: These results suggest the need to identify parents who experience high levels of perceived stress and trait anxiety and use appropriate interventions to manage stress and anxiety. This may ensure children receive optimal amounts of pain medication following surgery. (Anesth Analg 2021;132:1710–9)

KEY POINTS

- **Question:** Do parental psychosocial variables have any impact on the administration of opioids to young children experiencing postoperative pain?
- **Findings:** Parental stress and trait anxiety significantly moderate the relationship between child pain and opioid administration.
- **Meaning:** Clinicians should consider parental characteristics such as stress and anxiety; for example, highly anxious and stressed parents should be told in advance that they might tend to give their children more opioids when their children exhibit more pain.

GLOSSARY

APAP = acetaminophen; **ASA** = American Society of Anesthesiologists; **CHC** = Children's Hospital, Colorado; **CHLA** = Children's Hospital of Los Angeles; **CHOC** = Children's Hospital of Orange County; **CI** = confidence interval; **FPS-R** = faces pain scale-revised; **IQR** = interquartile ranges; **LPC** = Lucile Packard Children's Hospital at Stanford; **NRS** = numeric rating scale; **PSS** = perceived stress scale; **SD** = standard deviation; **STAI** = state-trait anxiety inventory; **T&A** = tonsillectomy and adenoidectomy

Each year, 5 million children undergo surgery in the United States. It is estimated that over 80% of these children experience pain at home.[1–4] Although there are multiple methods to manage postsurgical pain in pediatric patients, the current cornerstone of pain management includes the use of

From the *Center on Stress & Health, University of California, Irvine, Orange, California; †Children's Hospital of Orange County, Orange, California; ‡Department of Anesthesiology and Perioperative Care and §Sue & Bill Gross School of Nursing, University of California, Irvine, Irvine, California; ‖Department of Psychology and ¶Department of Biomedical and Pharmaceutical Sciences, School of Pharmacy, Chapman University, Orange, California; and #USC Healthcare Decision Analysis, Department of Pharmaceutical and Health Economics, Los Angeles, California.

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Address correspondence to Brooke N. Jenkins, PhD, Crean College of Health and Behavioral Sciences, Chapman University, One University Dr, Orange, CA 92866. Address e-mail to bjenkins@chapman.edu.

opioid and nonopioid therapies.[5,6] Opioids are commonly prescribed for children undergoing surgery,[6] and about 41% of children are prescribed opioids for outpatient management of postsurgical pain.[7] Given the widespread use of opioids in the pediatric surgical environment,[8] it is important to investigate postoperative opioid use to understand potential factors related to misuse. This is especially important because recent studies have indicated that taking prescribed opioids at a young age increases a person's likelihood of later misuse.[9–11]

Overall, parents are highly involved in children's management of postoperative pain at home.[4,12,13] Accordingly, it is necessary to examine the role of parent-related factors in the administration of opioids to children. This can allow for the identification of modifiable characteristics that are associated with parental administration of opioids to children and the development of corresponding parental interventions to mitigate opioid-related harm. There are a limited number of studies in this area.[14–16] Studies done with adolescent patients undergoing spine surgery found that parental predictors were limited to pain catastrophizing.[14,15] Gabrielle Pagé et al[16] studied children ages 8–18 years undergoing major surgery and found using multivariate multiple linear regression analysis that, while high parental pain catastrophizing predicted children's pain, an interaction between parent and child pain anxiety 48–72 hours after surgery also predicted children's pain intensity. Because in this study both child and adult anxiety were found to be risk factors for higher pain, and the anxiety of child and parent was highly correlated, it was unclear if parental anxiety is a causal risk factor.

In the present study, we aim to examine the impact of parental psychosocial variables on postoperative opioid consumption of young children undergoing surgery including parental trait anxiety, perceived stress, and coping style. The role of parental coping and anxiety in analgesic administration has been studied previously in children undergoing outpatient surgery[12,17]; however, these studies have mainly focused on nonopioids, have examined only the frequency (not dose) of medication administered, and have included homogeneous populations of primarily White children and families.[12] Moreover, research on the association between parental stress and children's pain is limited to chronic pain settings.[18]

We submit that any investigation of this kind also has to examine how the effects of various parental variables might moderate the complex association between pain and opioid administration. The present longitudinal analysis includes an ethnically diverse population of children and parents, includes both opioid and nonopioid medication and dosage of analgesics administered, and analyzes data using sophisticated multilevel statistical methodologies that include parental anxiety, stress, and coping as potential moderators of the impact of pain severity on analgesic administration to children at home after outpatient surgery.

METHODS

Participants and Procedure

Participants included in this article were parent-child dyads who participated in a larger Eunice Kennedy Shriver National Institute of Child Health and Human Development clinical trial (R01HD048935) from 2012 to 2017.[17,19,20] This clinical trial tested the effectiveness of an intervention that involved training health care providers in behaviors shown to decrease child anxiety before surgery. Four hospitals were originally involved in this trial: Children's Hospital of Los Angeles (CHLA), Children's Hospital of Orange County (CHOC), Children's Hospital, Colorado (CHC), and Lucile Packard Children's Hospital at Stanford (LPC). Baseline data were collected from all 4 sites before implementing the intervention. Following collection of baseline data, 2 of the sites were randomized for the intervention of health care providers in behaviors to decrease child anxiety before surgery, and the other 2 sides were randomized to control. Only those patients who did not receive the intervention were included in the analysis of this study to ensure that the intervention did not impact the pain and opioid outcomes of this study. Patients from a hospital that did not prescribe any hydrocodone for outpatient tonsillectomy or adenoidectomy (LPC) were excluded from this analysis (see Appendix A for site general medication instructions). Therefore, the final sample included participants from CHOC, CHLA, and CHC hospitals who were in the baseline or control group conditions. Additionally, due to the large pain differences between tonsillectomy and adenoidectomy, participants who only received adenoidectomy were excluded as well. All study procedures were approved by the local institutional review board, and parents completed written informed consent, and children completed assent as age-appropriate.

Inclusion criteria for the larger study were children aged between 2 and 15, classification as American Society of Anesthesiologists (ASA) physical status I–III, ability to read and speak English or Spanish, and undergoing tonsillectomy or adenoidectomy with general anesthesia. The age range of 2–15 was selected to capture the developmental differences across childhood and adolescence. However, given the low rate of 13- to 15-year-old children eligible for analysis in this article (n = 6), we exclude that age range from the present analyses. Families were excluded if children were categorized as ASA physical status IV or

children were born prematurely or were diagnosed with any developmental delays, which could impact pain response. Children admitted overnight were excluded from the study.

The day before surgery, potential children were identified using presurgery schedules and determined for eligibility based on prescreening. Children and parents were recruited on the day of surgery and completed validated behavioral instruments assessing demographic and psychosocial variables (eg, trait anxiety, parent stress, and coping) in the preoperative holding area before undergoing surgery. Perioperative data from their hospital stay were collected after their stay was complete. This included biological and analgesic administration data. Intraoperatively, 34% of the children received fentanyl, 32% received hydromorphone, 20% received meperidine, 8% received morphine, and 3% received acetaminophen. We conducted our models with these controls to check the robustness of our findings and the pattern of effects remained the same.

All perioperative clinical management of children who were undergoing tonsillectomy and/or adenoidectomy procedures was based on the preferences of the individual anesthesiologists and surgeons. This includes decisions regarding parental presence during induction of anesthesia, administration of sedative premedication before surgery, and the specific anesthetic management that was used during the surgery. In the surgeon's office before surgery and in the postanesthesia care unit, parents and children were provided specific directions for at-home postoperative pain management. Instructions provided for pain management varied by the 3 hospital sites as well and the specific surgeon involved in the case (Appendix A). In none of the 3 sites was there a standardized strict protocol that included all surgeons. The pain was managed per standard of care of each of the hospitals and the surgeon.

On postoperative days 1, 2, 3, and 7, at the end of the day, parents completed the observational (numeric rating scale [NRS]) and child self-reported pain (faces pain scale-revised [FPS-R]) measures. As part of the study protocol, parents were instructed on each day to document all analgesics (opioids and nonopioids) given to children. Documentation of the analgesics given included day in relation to the surgical procedure, time medication was given, and type and dose of analgesic given.

Predictive Measures

Parent Trait Anxiety. The state-trait anxiety inventory (STAI) was used to measure baseline general trait anxiety.[21] The STAI is composed of 20 items reflecting trait anxiety (eg, "I worry too much over something that doesn't really matter"). Response options ranged from never (1) to almost always (4). Items are summed together to form a total score ranging from 20 to 80, with higher values indicating higher trait anxiety. The STAI has been shown to be reliable[22] and is currently considered the gold standard in measuring anxiety in adults.

Parent Stress. The perceived stress scale (PSS) measured baseline parent stress and is composed of 14 items that ask about stress experienced in the past month (eg, "In the last month, how often have you felt nervous and 'stressed'?"). Participants rated items on a scale from 0 (never) to 4 (very often). Responses were summed to form a total score ranging from 0 to 56, with higher scores reflecting higher stress. The PSS is widely used and has excellent reliability and internal validity.[23]

Parental Coping. The Miller Behavioral Style Scale assesses parental coping using 4 stressful scenarios.[24] Parents select from 8 reactions to each scenario, which provides scale scores on the dimensions of blunting and monitoring. Responses reflecting blunting (ie, using distraction to cope) are summed together to form a total score ranging from 0 to 16 with higher scores indicating a greater blunting style while responses reflecting monitoring (ie, using an information-seeking coping style) are summed together to form a total score ranging from 0 to 16 with higher scores indicating a greater monitoring style. This scale has been shown to be reliable and valid.[24]

Parent-Reported Child Pain. Parents reported their child's pain once per evening using the NRS. This scale asked parents to report how much pain their child experienced on a scale from 0 (no pain) to 10 (severe pain).[25] Parents rated pain of children regardless of age.

Self-Reported Child Pain. In the evening, children ages 4 and above reported how much pain they had throughout the day using the FPS-R.[26] Children could select among the 6 faces (face A = 0, no pain to face F = 10, very much pain). The FPS-R is psychometrically valid and has been used with children ages 4–18.[27,28] Given that data from children ages 2–3 were not collected for pain severity, these children were not included in analyses using self-reported pain.

Outcome Measures

Opioid Use. Parents reported dosing frequency and in what increment (tsp, tbsp, mL, and mg) their children received hydrocodone/acetaminophen (APAP) at home following surgery. Doses were reported as mL, and then the mg dose of hydrocodone was calculated to examine mg/kg. This was done for each

postoperative day assessed (1, 2, 3, and 7). For children who received multiple doses of hydrocodone, a daily dose of hydrocodone was calculated by summing together the total amount of hydrocodone consumed throughout the day.

Acetaminophen Use. Parents reported on how much and in what increment (tsp, tbsp, cc, mL, and mg) their children received acetaminophen-only. We first converted all amounts into mL and then calculated the dose strength of acetaminophen per kg of child weight. This was done for each day. For children who received multiple doses of acetaminophen, a daily dose of acetaminophen was calculated by summing together their total amount of acetaminophen consumed throughout the day. Assessing acetaminophen provided us with the opportunity to control for acetaminophen in models with hydrocodone as the outcome and also test whether found associations were for opioids specifically or just analgesics in general by using acetaminophen as the outcome in parallel models. However, while hydrocodone/APAP has acetaminophen and hydrocodone in the medication, we did not include acetaminophen from hydrocodone/APAP in the total acetaminophen use calculation because it would be perfectly colinear with hydrocodone. For example, for every 1 mL of hydrocodone/APAP a child consumes, it means they are consuming 33.33 mg/mL of acetaminophen and 0.5 mg/mL of hydrocodone. Because this ratio is always the same for each 1 mL of hydrocodone/APAP, including acetaminophen as a control variable and hydrocodone as the outcome would always perfectly predict the outcome (and the same would occur in models with acetaminophen as the outcome and hydrocodone as a predictor variable).

Statistical Analysis

All analyses were performed using Stata 15 (StataCorp, 2017; Stata Statistical Software: Release 15, College Station, TX: StataCorp LLC). Descriptive statistics were used to present means, standard deviations, medians, and interquartile ranges (IQR) for child and parent demographic information, child pain data, and parent psychosocial variables. Bivariate correlations were used to illustrate the associations between parent psychosocial variables.

Parent and child data were collected throughout the week following surgery. Specifically, data included participant responses on days 1, 2, 3, and 7 after surgery. To include all data within 1 model, multilevel modeling was conducted using the xtmixed command in Stata 15. Multilevel modeling is the preferred analytic choice when individuals provide multiple responses of data[29] because it handles missing data by pooling information. For example, so long as participants have 1 full day of data, they are still included in the analysis if they have missing data from other days. Estimates are then computed using information from the full dataset. Therefore, multilevel models were used to examine the effects of the parent psychosocial factors (trait anxiety, stress, and coping style) and child pain severity on hydrocodone and acetaminophen use. We used 4 separate sets of models to assess the main effects of parent anxiety, stress, blunting coping style, and monitoring coping style on hydrocodone consumption as well as how these variables interacted with parent-reported child pain to predict hydrocodone consumption. We then used these exact same models but replaced parent-reported child pain with child self-reported pain. This allowed us to determine whether parent- or child-reported pain played a significant role in predicting opioid administration. Finally, to assess whether any found effects were specific to opioid use or were relevant to postoperative drug use in general, we ran these same models with acetaminophen as the outcome.

All models controlled for the hospital site, child sex, child age, parent education and income, chronic pain, race/ethnicity, and ibuprofen consumption. To control for hospital site, hospital was entered into the model as a categorical variable. This allowed us to keep constant hospital site effects (eg, institutional practices regarding pain medication) throughout our models. Similarly, child sex, parent education, and race ethnicity were entered into the models as categorical variables allowing us to examine effects while adjusting for these variables. Age was entered into our models as a continuous control variable allowing us to keep constant effects across age. Similarly, ibuprofen consumption was controlled for in all models as a continuous variable. In models predicting hydrocodone, acetaminophen was used as a control variable. In models predicting acetaminophen, hydrocodone was used as a control variable. Given that the dependent variables (hydrocodone and acetaminophen use) were not normally distributed (a requirement for the outcome variable in multilevel modeling), they were transformed using a log transformation and then scaled by 1000. This solved the issue of the data being skewed.

To make clear the clinical relevance of all findings, we present figures of how much medication was used for high- versus low-anxiety parents, high- versus low-stressed parents, high- versus low-blunting parents, and high- versus low-monitoring parents. For descriptive purposes, these groups were created by using parents 1 standard deviation above and 1 standard deviation below the mean level on each variable (this generally represented the top and bottom 15%). For comparison in figures, we also present participants who are at the mean level of each of the parental psychosocial variables.

Table. Demographic and Descriptive Statistics

	n	Mean (SD)/%	Median (IQR)	Range
Child age	173	5.99 y (2.51)	6 y (4, 7)	2–12 y
Surgery type				
T&A	168	97%	-	-
Tonsillectomy	5	3%	-	-
Parent education	173	14.30 y (3.14)	15 y (12, 17)	3.5–20 y
Pain				
NRS day 1	172	5.95 (2.37)	6 (4, 8)	0–10
NRS day 2	161	5.759 (2.51)	6 (4, 8)	0–10
NRS day 3	135	4.81 (2.43)	5 (3, 7)	0–10
NRS day 7	110	4.31 (2.44)	4 (3, 6)	0–10
FPS-R day 1	145	5.17 (2.72)	6 (4, 8)	0–10
FPS-R day 2	137	4.89 (2.76)	4 (2, 8)	0–10
FPS-R day 3	117	4.17 (2.76)	4 (2, 6)	0–10
FPS-R day 7	32	3.31 (2.57)	2 (2, 4)	0–10
Parent factors				
Parent trait anxiety	154	35.73 (9.09)	34.5 (29, 39)	20–63
Parent stress	164	20.16 (7.66)	19 (15, 25.5)	6–39
Parent monitoring	172	7.58 (3.23)	7.5 (5, 10)	1–15
Parent blunting	160	3.23 (2.007)	3 (2, 4)	1–12

Abbreviations: FPS-R, faces pain scale-revised; IQR, interquartile range; NRS, numeric rating scale; SD, standard deviation; T&A, tonsillectomy and adenoidectomy.

RESULTS

Descriptive and Bivariate Analyses

The final sample based on inclusion criteria was 173 parent-child dyads. The sample had a mean child age of 5.99 ± 2.51 years (range 2–12) and 46% of the children were female. The majority of the sample (43%) was non-Hispanic White, 33% were Hispanic, 12% identified as >1 race/ethnicity, 5% were Asian, 2% were African American, 0.6% were Native Hawaiian, and 4% preferred not to answer or identified as another race/ethnicity. Of the total sample, 80% of mothers completed the survey, 18% were fathers, and 2% were other. In the Table, we present descriptive information on parent and child demographic information as well as information on child postoperative pain. With regard to missing data, we report the available amount of data for each of the variables in the Table. For hydrocodone, there was 0% missing data on day 1, 3% on day 2, 19% on day 3, and 36% on day 7. For acetaminophen, there was 0% missing data on day 1, 3% on day 2, 19% on day 3, and 36% on day 7.

Parent factors, including trait anxiety, perceived stress, and coping styles were significantly correlated. Specifically, parent stress was positively correlated with trait anxiety, $r = 0.66$, $P < .001$. Monitoring and blunting were positively correlated, $r = 0.21$, $P = .008$. All other correlations were nonsignificant: parent stress and monitoring ($r = 0.09$, $P = .24$), parent stress and blunting ($r = -0.07$, $P = .384$), parent trait anxiety and monitoring ($r = 0.07$, $P = .376$), and parent trait anxiety and blunting ($r = -0.12$, $P = .138$). Additionally, parent- and child-reported pain were positively correlated (day 1: $r = 0.78$; day 2: $r = 0.80$, day 3: $r = 0.81$, day 7: $r = 0.79$, $P < .001$).

There were demographic differences across the hospital sites. Specifically, there were significant differences in parent education (F [2, 170] = 9.84, $P < .001$; CHOC mean parent years of education: 12.72 years [±3.56]; CHLA mean parent years of education: 13.74 [±3.48]; CHC mean parent years of education: 15.19 [±2.46]). Additionally, there were income differences across the site with CHOC having greater frequencies of lower-income parents compared to CHC, χ^2 (2) = 34.71, $P < .001$. Finally, there were also site differences in the distribution of ethnicity with CHOC having a larger percentage of children who identified as Hispanic and CHLA and CHC having lower percentages of children who identified as Hispanic, χ^2 (4) = 41.56, $P < .001$. Therefore, we control for the hospital site, parent education and income, and race/ethnicity in all analyses.

Multilevel Analyses

Multilevel modeling across time that controlled for hospital site; child sex, age, and ethnicity; parent education and income; chronic pain; and ibuprofen consumption was conducted for the below constructs. When multilevel modeling was used to examine how pain impacted acetaminophen and hydrocodone use, we found that parents who assessed their children as experiencing more pain, gave larger total daily doses of hydrocodone ($b = 4.45$, SE = 1.07, $z = 4.16$, $P < .001$, 95% confidence interval [CI], 2.35-6.54) and acetaminophen ($b = 22.56$, SE = 8.47, $z = 2.66$, $P = .008$, 95% CI, 5.96-39.17) each day. Similarly, when children self-reported more pain, parents gave larger total daily doses of hydrocodone ($b = 3.69$, SE = 1.05, $z = 3.51$, $P < .001$, 95% CI, 1.63-5.75) and acetaminophen ($b = 19.25$, SE = 9.22, $z = 2.09$, $P = .037$, 95% CI, 1.18-37.32) each day.

Parent Trait Anxiety. Using multilevel modeling, we found that while parent trait anxiety alone made no difference on hydrocodone use ($b = -0.10$, SE = 0.39, $z = -0.24$, $P = .807$, 95% CI, −0.86 to 0.67), it did interact with both parent-reported child pain ($b = 0.32$, SE = 0.12, $z = 2.71$, $P = .007$, 95% CI, 0.09-0.54) and child-reported child pain ($b = 0.34$, SE = 0.12, $z = 2.826$, $P = .005$, 95% CI, 0.10-0.58) to predict hydrocodone use such that at higher levels of trait anxiety, parents used more hydrocodone over the course of the day as pain increased (Figure 1). For example, parents high in anxiety who reported child pain severity of 10 gave their children 19% more hydrocodone each day compared to parents low in anxiety (0.38 vs 0.32 mg/kg). Further, low-anxiety parents did not adjust the amount of hydrocodone they gave their children based on changes in child pain.

Parent trait anxiety also interacted with parent-reported child pain ($b = 2.79$, SE = 1.15, $z = 2.43$, $P = .015$, 95% CI, 0.54-5.04) and child-reported child pain ($b = 2.78$, SE = 1.20, $z = 2.32$, $P = .021$, 95% CI, 0.43-5.13) to predict acetaminophen use. Specifically,

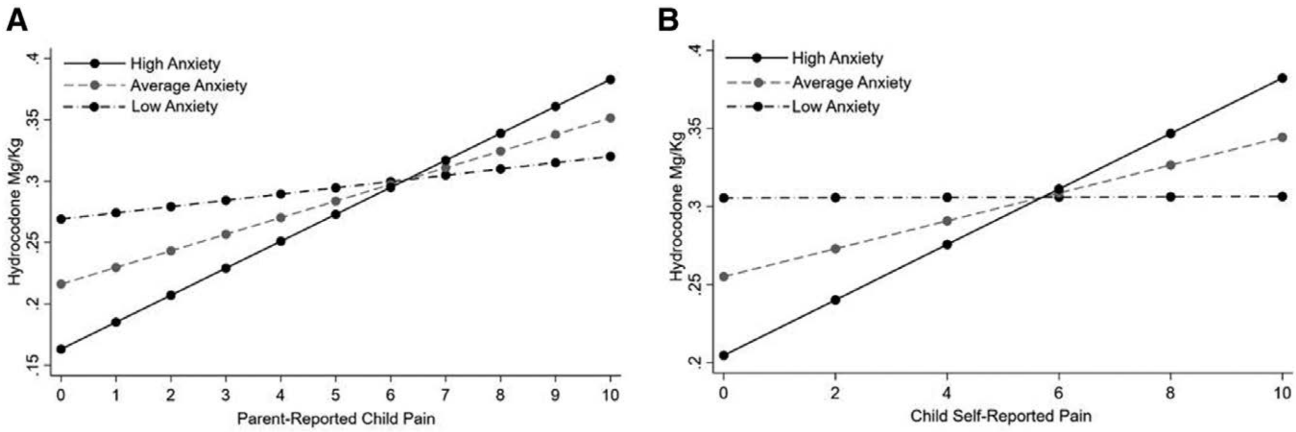

Figure 1. The impact of parent anxiety on medication administration based upon parent-report of child parent severity (A) and child-report of pain severity (B).

Figure 2. Parent numeric rating scale by parent stress on hydrocodone.

highly anxious parents used more acetaminophen over the course of the day as child pain increased. For example, high-anxiety parents who reported child pain of 10 gave their children 30% more acetaminophen each day compared to low-anxiety parents (38.87 vs 29.83 mg/kg). Further, low-anxiety parents did not adjust the amount of acetaminophen they gave their children based on changes in pain.

Parent Stress. Using multilevel modeling, we found that while parent stress level alone made no difference on hydrocodone use (b = 0.09, SE = 0.43, z = 0.20, P = .839, 95% CI, −0.76 to 0.93), it did marginally interact with parent-reported child pain (b = 0.26, SE = 0.14, z = 1.89, P = .059, 95% CI, −0.01 to 0.52). Specifically, at higher levels of stress, parents used more hydrocodone each day as pain increased (Figure 2). For example, high-stressed parents who reported child pain of 10 gave their children 12% more hydrocodone over the course of the day compared to low-stressed parents (0.37 vs 0.33 mg/kg). Whereas parent stress interacted with parent-reported child pain, stress did not interact with child-reported pain (b = 0.14, SE = 0.13, z = 1.06, P = .291, 95% CI, −0.12 to 0.40). Additionally, these same interaction effects did not take place for acetaminophen (parent-reported child pain: b = 1.25, SE = 1.18, z = 1.06, P = .291, 95% CI, −1.07 to 3.56; child-reported child pain: b = 1.38, SE = 1.22, z = 1.14, P = .255, 95% CI, −1.00 to 3.77).

Parent Coping. Using multilevel modeling, we found that parental blunting (b = 0.46, SE = 1.97, z = 0.23, P = .816, 95% CI, −3.41 to 4.33) and monitoring (b = 0.00, SE = 1.07, z = 0.00, P = .997, 95% CI, −2.09 to

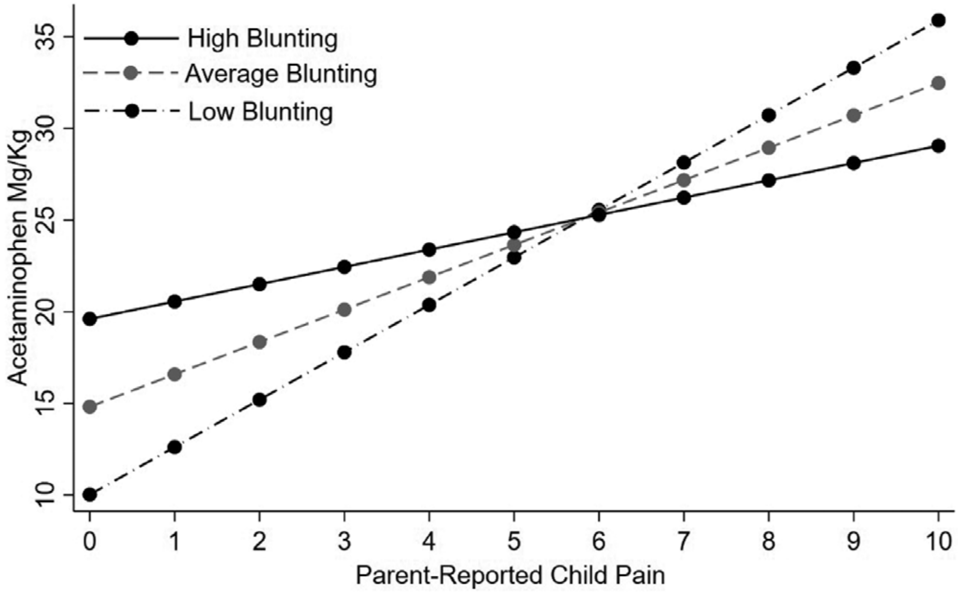

Figure 3. Parent numeric rating scale by parent blunting on acetaminophen.

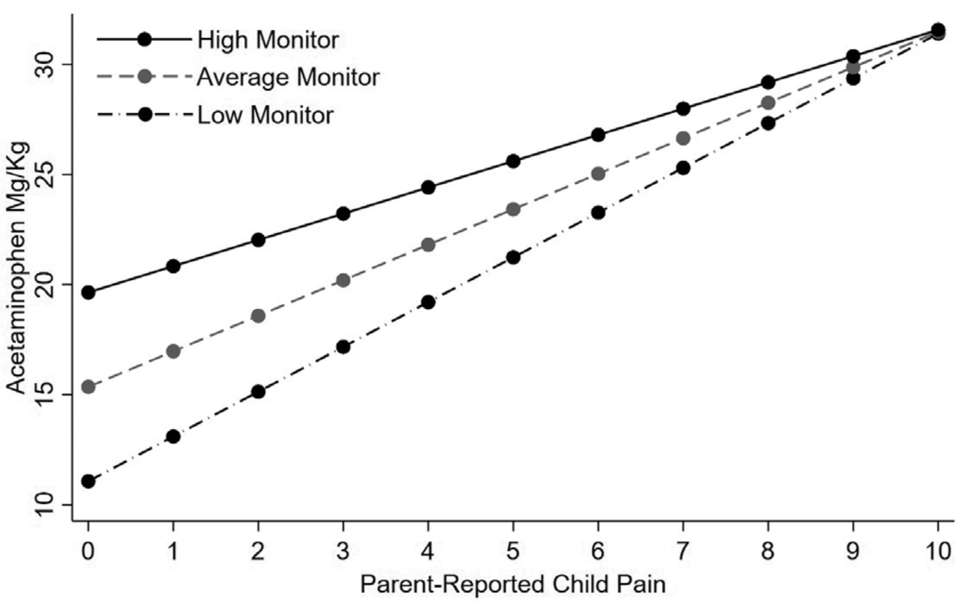

Figure 4. Parent numeric rating scale by parent monitoring on acetaminophen.

2.10) were not associated with hydrocodone use nor did they interact with parent-reported pain (blunting: $b = -0.77$, SE = 0.60, $z = -1.29$, $P = .198$, 95% CI, −1.94 to 0.40; monitoring: $b = -0.12$, SE = 0.34, $z = -0.35$, $P = .723$, 95% CI, −0.78 to 0.54) or child-reported pain (blunting: $b = -0.18$, SE = 0.61, $z = -0.30$, $P = .764$, 95% CI, −1.38 to 1.01; monitoring: $b = -0.04$, SE = 0.34, $z = -0.13$, $P = .894$, 95% CI, −0.71 to 0.62) to predict hydrocodone use. That said, parental blunting and monitoring did significantly interact with child pain to predict acetaminophen use. Specifically, the use of a blunting coping style significantly interacted with parent-reported pain ($b = -9.00$, SE = 4.26, $z = -2.11$, $P = .035$, 95% CI, −17.35 to −0.65) and child-reported pain ($b = -13.28$, SE = 4.32, $z = -3.07$, $P = .002$, 95% CI, −21.75 to −4.81) to predict acetaminophen use. For example, high-blunting parents (ie, parents more likely to use distraction techniques during stress) who reported child pain of 10 gave their children 19% less acetaminophen over the course of the day compared to low-blunting parents (29.06 vs 35.90 mg/kg; Figure 3). Further, high-blunting parents did not adjust the amount of acetaminophen they gave their children based on changes in reported pain.

Additionally, a monitoring coping style interacted with parent-reported child pain to predict acetaminophen use such that, at lower levels of monitoring, parents used more acetaminophen as the pain increased ($b = -6.85$, SE = 2.79, $z = -2.45$, $P = .014$, 95% CI, −12.32 to −1.37) (Figure 4). For example, high-monitoring

parents (ie, parents who seek information to cope) who reported child pain of 4 gave their children 27% more acetaminophen over the course of the day to their children compared to low-monitoring parents (24.41 vs 19.20 mg/kg). Further, high-monitoring parents did not adjust the amount of acetaminophen they gave their children based on changes in parent-reported child pain.

DISCUSSION

Under the conditions of this study, findings show that parent-related psychosocial variables, such as trait anxiety, stress, and coping style, moderated the relationship between children's postoperative pain severity and parental analgesic administration in the home setting. For example, high-anxiety parents gave their children 19% more hydrocodone and 30% more acetaminophen compared to low-anxiety parents. Stress seemed to impact hydrocodone use, but not acetaminophen, such that high-stressed parents gave their children 12% more hydrocodone compared to low-stressed parents. In contrast, coping style impacted acetaminophen (but not hydrocodone): high-blunting parents (ie, parents who cope by using distraction) gave 19% less acetaminophen to their children as compared to low-blunting parents while high-monitoring parents (ie, those who seek information to cope) gave 27% more acetaminophen to their children as compared to low-monitoring parents.

This article is focused on the role that parental psychosocial variables, including anxiety, stress, and coping style, play on postoperative parental use of analgesics for their children undergoing surgery. We have chosen these parental variables when designing this study because, conceptually, they may affect the administration of analgesics in children. While we appreciate that pain-specific variables, such as parent catastrophizing, are highly useful in studies examining acute pain and medication administration, the role of parent catastrophizing has been previously investigated.[14] In contrast, previous parental anxiety, stress, and coping style studies have focused on chronic pain[18] or were not ethnically diverse and focused on nonopioid analgesics.[12,17] As such, we submit that the findings described in this article are novel and of importance to the practicing anesthesiologist.

Given that parental stress and anxiety were correlated in our sample, it is not surprising that our findings for these 2 constructs were similar. While there are few publications examining the role of parental anxiety in the administration of analgesics to their children,[5,30] adult studies have found that individuals high in trait anxiety report more pain than low-trait anxiety individuals.[31,32] Our finding that high-anxiety parents administered more hydrocodone to their children has significant clinical implications because there is already an intervention developed to enhance the coping skills of high-anxiety parents.[33–35]

We also found that parents more likely to use distraction techniques during stress gave their children less acetaminophen after surgery when their children experienced greater pain. The role of distraction in the management of postoperative pain in children is well established.[36] Indeed, training parents in distraction techniques can reduce analgesic administration in children.[37] We suggest that our findings provide further support for the use of distraction as a coping strategy that can be taught to parents.[33,34]

In this study, parent stress and monitoring moderated opioid administration within the context of parent-reported pain severity in children. Interestingly, these findings did not extend to child-reported pain. Therefore, it seems that parents' perception of children's pain may be the most important factor. Despite there being a relatively high correlation between parent and child report of child pain, as presented in the current article, our group has previously found that a significant proportion of parent-child dyads disagreed on the exact pain severity of children during the postoperative period.[17] Indeed, while our correlations between parent and child report in this study were high, they did not represent a direct one-to-one relationship. Potentially, stress may impact parents' perception of children's pain and may lead parents to overestimate pain and analgesic administration. Accordingly, relying on child-reported pain when possible is key to analgesic administration. When not possible, we must focus on treating parental stress to optimize children's postoperative pain management at home.

The findings of this article need to be considered within the context of several limitations. First, it would have been interesting to also include pain catastrophizing in this study and to investigate the interactions between this measure and the general psychosocial measures we have included in the study. Second, we relied on parental report of analgesics that were administered, and although our research team called daily to remind parents to complete the daily diaries, this strategy may have led to bias and/or inaccuracies in reporting. Third, we have no data on the surgical techniques that were used, and hence this is a potential of bias. Fourth, while we consider this difference in analgesic administration clinically significant, we acknowledge that there is no published literature to support this position. Fifth, while we did have a diverse sample in terms of race/ethnicity and age span (2–12 years), conducting analyses separately by demographic factors was not possible due to small sample sizes within subgroups. However, we did adjust for such variables. Finally, it is necessary to emphasize that this secondary data analysis study of clinical trial data was exploratory in nature, and so

multiple comparisons were used to examine associations between several parental factors and analgesic administration. Therefore, in addition to the sample size being modest, it is best that these findings be interpreted tentatively and guide future research in further exploring this topic.

In conclusion, the management of postoperative pain in children poses a significant challenge to parents and physicians.[5] A recent meta-analysis found that current interventions to improve pain management consist of education in pain assessment, distraction, around-the-clock dosing, and nurse coaching.[37] The success of these interventions was modest at best. The current study suggests a new, tailored approach that involves identification and management of stress and anxiety in parents may be beneficial to optimize postoperative pain management in children. Finally, we should note that parents' perception of child pain may be playing a significant role and that, when possible, reliance on child-reported of pain is important.

APPENDIX A
Pain Medication Instructions Provided by Each Hospital Site for Parents to Manage Their Child's Postoperative Pain

Site	Instructions
CHOC	Parents were instructed to administer acetaminophen as recommended on label packaging. For those children who were prescribed codeine or hydrocodone for excessive pain, parents were instructed to administer the medication every 3–4 h as needed for pain.
CHLA	All parents were advised to administer acetaminophen (Tylenol) every 3–4 h as needed for pain. Parents of older children were allowed to administer Tylenol with codeine and hydrocodone, per prescription from the surgeon. Children were not allowed aspirin or aspirin-containing medications within 2 wk of surgery.
LPC	Younger children: For at least the first 2 postoperative days and nights, administer alternating acetaminophen and ibuprofen every 3 h. Specifically, administer acetaminophen, then, in 3 h, administer ibuprofen, and in another 3 h, administer acetaminophen. Parents should wake their children at night to continue medication, at least for the first few nights. In a few days postoperatively, parents may increase time between doses depending on child pain level.
	Older children: Parents may administer oxycodone to older children every 6 h postoperatively, in addition to the prior instructions for acetaminophen and ibuprofen.
	All children: Parents should offer children 1–2 ounces of liquid to drink during all waking hours to prevent dehydration.
CHC	Parents received specific instructions from the child's surgeon on administrating pain medication. These instructions included type of medication, dosage, and frequency. Most frequently, parents were advised to administer acetaminophen every 4 h as needed and ibuprofen every 6 h as needed. Some parents were also instructed to administer oxycodone and hydrocodone every 6 h as needed in addition to the acetaminophen and ibuprofen.

Abbreviations: CHC, Children's Hospital, Colorado; CHLA, Children's Hospital of Los Angeles; CHOC, Children's Hospital of Orange County; LPC, Lucile Packard Children's Hospital at Stanford.

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Contribution: This author helped draft the introduction and discussion and review and revise the manuscript for intellectual content.
Name: Michelle A. Fortier, PhD.
Contribution: This author helped conceive and design the study, acquire the data, and review and revise the manuscript for intellectual content.
Name: Candice D. Donaldson, PhD.
Contribution: This author helped analyze and interpret the data and review and revise the manuscript for intellectual content.
Name: Daniel Tomaszewski, PharmD, PhD.
Contribution: This author helped analyze and interpret the data and review and revise the manuscript for intellectual content.
Name: Michael Phan, PharmD.
Contribution: This author helped analyze and interpret the data and review and revise the manuscript for intellectual content.
Name: Brooke N. Jenkins, PhD.
Contribution: This author helped conduct the statistical analysis, draft the method and results, and review and revise the manuscript for intellectual content.
This manuscript was handled by: James A. DiNardo, MD, FAAP.

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