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Pain and Health-Related Quality of Life after Pediatric Inpatient Surgery

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Abstract

Around 4 million children undergo inpatient surgery in the U.S. each year, however little is known about the impact of surgery and postoperative pain on children's health-related quality of life (HRQOL) during the weeks and months after surgery. We measured pain and HRQOL in a large, heterogeneous pediatric postsurgical population from baseline to 1-month follow-up. Over a 20-month period, parents of 915 children age 2–18 years (Mean=9.6 years), 50% male, 56% white, admitted to surgical services at a children's hospital enrolled in the study. Parent participants reported on sociodemographics, child HRQOL and pain characteristics at baseline and 1 month post-discharge. While the majority of children recovered to baseline by 1-month post-hospital discharge, 23% of children had a significant declination in HRQOL. Multivariate logistic regression analyses found that increasing child age (OR=2.1 for age 13–18), and presence of moderate-severe postsurgical pain at 1-month (OR=5.7) were significantly associated with deterioration in HRQOL from baseline to 1-month follow-up (p's<0.05). While HRQOL returns to baseline for most children, a sizeable proportion have significant deterioration in HRQOL, which is associated with continued postsurgical pain at 1-month after hospital discharge from surgery.

Keywords

Pain; HRQOL; Health-related quality of life; Surgery; Child

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INTRODUCTION

Around 4 million children undergo surgery in the United States each year[6,25]. Despite the common occurrence of surgery, little is known about the impact of surgery on children's health outcomes at home after hospital discharge. Specifically, there are a lack of data on patient-centered outcomes following hospital discharge in broad pediatric postsurgical populations. Disparities in outcomes for children undergoing surgery at different centers have recently fueled a debate about regionalization of pediatric surgical care to centers with higher volumes and better outcomes[30]. However, prior studies have exclusively used risk-adjusted inpatient mortality rate to assess outcomes in broad hospital-based populations of children after surgery; none have incorporated patient-reported outcomes such as pain and health-related quality of life.

Health-related quality of life (HRQOL) is a widely reported patient-centered outcome and an important marker of recovery for children after hospitalization. Baseline HRQOL in hospitalized children has been shown to predict clinical outcomes (e.g., length of stay/LOS), and changes in HRQOL from baseline to follow-up predict important cost-associated outcomes such as unplanned readmission[7]. HRQOL assessed at hospital admission and at follow-up may therefore serve as a marker of risk for poor postsurgical outcomes. Long-term follow-up in specific pediatric surgical populations shows that some surgeries are associated with improved HRQOL in the long-term (e.g. pectus surgery, scoliosis surgery)[9,13], and others are associated with impaired HRQOL (e.g. heart surgery, transplant surgery)[1,8,19]. However, these outcomes have not been examined in broad pediatric postsurgical populations or in the early postsurgical recovery period.

The initial weeks after hospital discharge represent a critical period of recovery from surgery. Multiple clinical and behavioral factors impact recovery in this time period. For example, delayed return of physical function in this period can contribute to complications in multiple organ systems[16]. Poorly controlled postsurgical pain is common[11,22], and is central in the stress response after surgery, contributing to delayed recovery and postoperative morbidity[16]. Children's sleep is disrupted after surgery and anesthesia[15], which may also impact postsurgical recovery[4,24]. The interplay of clinical and behavioral factors could potentially have significant implications on recovery for children after surgery. Health outcome data are lacking during this crucial time period and predictors of poor outcomes have not been identified. Identifying children who are recovering poorly during the weeks following surgery may allow for early intervention to improve long-term outcomes[27].

The aims of this study were therefore to 1) measure HRQOL and pain in a large, heterogeneous pediatric inpatient surgical population from pre-surgery baseline to 1-month follow-up at home, and 2) examine predictors of clinically significant change in HRQOL in these children over the first month after surgery. We aimed to examine a large heterogeneous cohort of children to maximize generalizability of our findings to the large population of children undergoing surgery in the U.S. We hypothesized that a sizeable proportion of children would demonstrate significant deterioration in HRQOL 1 month after hospital discharge from surgery and that a subset of children would experience continued

postsurgical pain. Further, we hypothesized based on prior literature that demographic and clinical characteristics including age, sex, race/ethnicity, and presence of moderate-severe pain at 1-month would predict significant deterioration in HRQOL at 1-month, adjusting for baseline pain, medical complexity and hospital length of stay.

METHODS

Study Design

The study was approved by the Institutional Review Board, and used the infrastructure of the Outcomes Assessment Program (OAP) at Seattle Children's Hospital (SCH). This program collects data on patient HRQOL and family experiences with health care from all eligible, consenting families with a child admitted to the hospital.

The OAP was established in 2009 and is funded by the Continuous Performance Improvement Department at SCH, as a collaboration with quality improvement investigators at the SCH Research Institute. The objective is to use research to enhance the quality of care delivered. The OAP infrastructure encompasses routine recruitment, consent, enrollment, and data collection in patients and families treated at SCH. Data are used to track performance on hospital goals, evaluate effectiveness of clinical pathways, and conduct quality improvement projects, as well as by the research institute for performing comparative effectiveness research. For the purposes of this postsurgical study, we added questions about pain to the ongoing data collection.

Participants

Parents of 915 children admitted at SCH over a 20 month period from January 2012 to August 2013 participated in the study.

Inclusion criteria—Parents of children age 2 to 18 years, admitted to a surgery service, and fluent in English or Spanish were eligible for the study.

Exclusion criteria—Potential participants were excluded if their child had developmental delay, had a previous hospital admission within the preceding 2 months, had a safety alert entered in the medical record by social services, or were in strict protective isolation.

Procedures

Potential participants were approached within the first 72 hours of hospital admission by a trained OAP research assistant. Parents of children admitted and discharged from the hospital within the same weekend were not approached. During the study time period 58% of parents with children admitted to the surgery units were approached, and screened for eligibility. Sixty-nine percent of eligible parents agreed to participate, giving their verbal consent.

Baseline Assessment—After consent, parents completed survey measures on a notebook computer provided by the research assistant. Parents reported sociodemographic information, and on the child's pre-admission HRQOL and pain characteristics.

Follow-up Assessment—Participants were contacted by email and phone 1 month after hospital discharge, with instructions to compete follow-up measures via a secure website or by telephone interview. Parents reported on their child's HRQOL and pain characteristics. Follow-up data were obtained from parents of 563 participants (62%). Clinical data were collected from the medical record by trained research assistants.

Measures

Questionnaire measures were available in English and Spanish.

Sociodemographic characteristics—Participants completed a questionnaire assessing children's age, sex, race/ethnicity, and parental education level.

Health-related quality of life—Participants reported on HRQOL using age appropriate versions of the Pediatric Quality of Life Inventory 4.0 Generic Core Scales (PedsQL)[34]. The PedsQL is the only measure of HRQOL that has been validated in the inpatient setting in children. The PedsQL assesses physical, emotional, social, and school functioning with response options on a Likert-type scale from 0=never a problem, to 4=almost always a problem. Items are reverse scored and transformed to a range of 0–100. These are summed and divided by the number of items answered, to yield a Total score, Physical Health Subscale, and Psychosocial Health Subscale, with higher scores indicating better HRQOL[34]. Parent proxy-report on the PedsQL has shown excellent agreement with child self-report for Total score, Physical Health, and Psychosocial Health subscales (Intraclass Correlations ≥ .81)[36]. Preliminary construct validity and responsiveness to improvement after hospitalization has recently been demonstrated in pediatric inpatients[7]. Varni et al described a 4.5 point change on the PedsQL (parent-proxy report) from baseline to follow-up assessment as a minimal clinically important difference in HRQOL, based on one Standard Error of Measurement with repeated measurement in a population sample[35]. This value has been confirmed in subsequent research[12].

Pain characteristics—Parents provided proxy report of their children's pain intensity, pain frequency, and the perceived reason for pain. Pain intensity was rated using an 11-point numeric rating scale (NRS), 0=no pain, 10=worst possible pain. Pain frequency was assessed using a Likert-type scale with five response options from 'not at all' to 'every day'. NRS are a valid and reliable assessment tool and are recommended for assessment of pain intensity for acute postsurgical pain[21]. Parent proxy reporting of child pain has been used in multiple settings when child self report cannot be readily obtained; moderate relationships have been found for child-parent report in the acute postsurgical period[17,20] and for pain at home[3].

Clinical characteristics—Surgery service (surgical category[28,29]), length of stay (LOS), and hospital readmission were collected from the electronic medical record. Readmissions were defined as inpatient and emergency room admissions occurring within 30 days of hospital discharge. Unplanned readmissions were coded using the method developed by Berry et al[2].

Medical complexity—Children were categorized into three levels of medical complexity according to the Pediatric Medical Complexity Algorithm (PMCA) using hospital discharge data: without chronic disease, noncomplex chronic disease, and complex chronic disease. PMCA has been shown to identify complex disease from hospital discharge data with good sensitivity and good to excellent specificity[31].

Statistical analyses

Data were collected and automatically transmitted to a secure web-based server for analysis and reporting via DAT-STAT (www.datstat.com). χ^2 and *t* tests were conducted to determine whether there were differences in demographic (age category, gender, race/ethnicity) and clinical characteristics (surgery category, PMCA, baseline pain intensity, LOS) between participants who completed one-month follow-up and those who did not. We applied multivariate logistic regression models to examine potential associations between demographic and clinical characteristics with change in HRQOL. For the outcome, we used a binary indicator for clinically significant change in HRQOL defined by either (1) a 4.5 point or greater decrease (clinically significant deterioration) in PedsQL scores from baseline to follow-up[35], or (2) no change or positive change in PedsQL scores. Separate analyses were conducted for Total, Physical Health, and Psychosocial Health scores. Age category, sex, race/ethnicity, presence of moderate-severe pain at follow-up, and PMCA were entered as categorical variables. Age category corresponded to the age ranges for the PedsQL generic core scales: toddler (2–4 years), child (5–12 years), or adolescent (13–18 years). We defined moderate-severe pain based on prior literature as a pain score ≥4 on the NRS[32]. Baseline pain and LOS were entered into the model as continuous variables. Results of the logistic regressions were reported as odds ratio (OR), standard error, z score, and 95% CIs.

RESULTS

Sociodemographic and clinical characteristics

Children were on average 9.6 years (*SD*=4.7), 50% were male, and 56% were white non-Hispanic and 19% were Hispanic. Forty-nine percent were without chronic disease, while 51% had a chronic disease. Children underwent general, orthopedic, otolaryngology, neuro-, plastic, cardiac, urology, and oral surgeries. Children were admitted for an average of 2.7 days (*SD*=2.8). LOS was ≥3 days in 626 children (68%), and =3 days in 289 children (32%). Sociodemographic and clinical characteristics are summarized in Table 1. No significant differences on sociodemographic or surgical variables were found between children who completed follow-up and those who did not (p's>0.05).

Change in HRQOL and pain from pre-surgery baseline to 1-month follow-up

Pain and HRQOL scores are summarized by surgical category in Table 2. Comparison of HRQOL scores from pre-surgery baseline to 1-month follow-up indicated that 77% of children had HRQOL scores demonstrating recovery to or improvement above baseline levels at 1-month, while 23% had clinically significant deterioration in HRQOL scores from baseline to 1-month. Thirty-four percent had declines in Physical Health, and 19% had declines in Psychosocial Health.

At 1-month, 8% of children had moderate-severe pain (pain intensity ≥4, 0–10 NRS) and 13% had pain occurring 4 or more days a week. Comparison of pain scores from pre-surgery baseline to 1-month follow-up indicated that 88% of children demonstrated recovery to or improvement from baseline levels of pain while 12% demonstrated worsening of pain intensity from baseline. Twenty-two percent of children were reported to have more frequent pain at 1-month compared to baseline.

Predictors of change in HRQOL from baseline to 1-month follow-up

The results of the multivariate logistic regressions examining demographic and clinical factors (age, sex, race/ethnicity, and presence of moderate-severe pain at 1-month) associated with clinically significant deterioration in HRQOL from baseline to 1 month follow-up, adjusting for baseline pain, medical complexity and hospital length of stay, are summarized in Table 3. Greater child age (OR, 2.1; 95% CI 1.1–4.1, for age 13–18 vs. 2–4 years), and presence of moderate-severe pain at 1 month after surgery (OR, 5.7; 95% CI 2.8–11.6) were significantly associated with deterioration in Total HRQOL score from baseline to 1-month follow-up.

Multivariate logistic regressions examining characteristics associated with clinically significant deterioration in Psychosocial Health and Physical Health are presented in Table 3. Moderate-severe pain at follow-up was associated with deterioration in both Physical Health (OR, 3.5; 95% CI 1.7–7.1) and Psychosocial Health scores (OR, 4.2; 95% CI 2.0–8.5).

DISCUSSION

To our knowledge, this is the first study to examine pain and HRQOL outcomes in the short-term recovery period at home in a broad population of children undergoing a wide range of inpatient surgeries. At 1-month post-hospital discharge, children had similar HRQOL and improved pain intensity as compared to baseline. However, as hypothesized, a sizeable proportion of children, 23%, had a clinically significant deterioration in HRQOL from baseline to 1-month follow-up suggesting that recovery from surgery is associated with worsening HRQOL for some children. Factors associated with significant deterioration in total HRQOL included greater child age, and presence of moderate-severe pain at 1-month follow-up. Moderate-severe pain was associated with significant deterioration in both physical and psychosocial health.

Strengths of our study include use of the PedsQL to prospectively measure HRQOL in a large sample of children admitted to a broad range of surgical services at baseline, as well as at home 1 month after hospital discharge. Preliminary validation of the PedsQL in the inpatient setting was recently performed in children, making it the only measure of HRQOL examined to date in this setting in children[7]. Measurement of broad health outcomes is essential in assessing pediatric surgical populations and should be considered in future research. Evaluation of inpatient health services from the patient and family perspective[7] is also critical when comparing outcomes of surgical care, for example by surgical center volumes, as in recent studies surrounding the debate of regionalization of pediatric surgical care. Examining change in HRQOL relative to baseline values takes into account the

baseline difference in health status between samples, making such comparisons possible. Given the impact of pain on HRQOL in our sample, pain may be an additional factor to consider when evaluating and comparing institutions' surgical care for children.

The impact of pain on HRQOL after surgery has not previously been examined in children recovering from surgery at home. Our findings demonstrated that pain impacted both physical and psychosocial health, adjusting for medical complexity and LOS. Unfortunately, little progress has been made over several decades in reducing children's pain after inpatient surgery with most children experiencing moderate-severe pain in the early postoperative period[5,11,33]. Our findings highlight the importance of refocusing efforts to better address pediatric postsurgical pain. Importantly, short-term outcomes after surgery may impact long-term outcomes in pediatric surgical populations. For example, postsurgical pain, sleep disturbance, and immobilization may have deleterious effects on multiple organ systems in the acute postsurgical period, with significant potential implications for continued recovery[16,26]. Studies are needed examining longer-term health outcomes and with inclusion of additional clinical and behavioral factors that may predict outcomes in broad pediatric postsurgical populations. Furthermore, in the light of recent studies showing that some groups of children may continue to have pain problems for months to years after surgery[10,18,23,37], studies examining the impact of pain on these children's recovery over longer-term follow-up are critically needed.

By identifying children at risk for poorer recovery in advance of surgery, closer follow-up after discharge in children at greater risk could be considered to monitor recovery and intervene if necessary. We found that greater child age was associated with poorer recovery of HRQOL after surgery admission. In addition, children of Hispanic ethnicity had greater odds of deterioration in HRQOL after surgery admission, however this was not statistically significant. Hispanic ethnicity has been shown to correlate with poorer postsurgical pain treatment in children[14], which may have contributed to poorer recovery of HRQOL.

The results of this study should be interpreted in the light of several limitations. Our study was conducted at a single regional pediatric hospital and results may be less generalizable to other settings. In addition, some families were not approached for participation in the study, which may introduce selection bias. Not all eligible families agreed to participate and it is possible that families of children who were having more postoperative problems may have been less likely to respond.

There were several limitations to our measurement approach, which may be addressed by future research. While using our institutional OAP to collect these data was a strength of the study, enabling us to obtain data across a broad inpatient pediatric surgical population, we were limited to the timeframe of the established assessments (admission and 1-month follow-up) as well as in what data could be collected and by exclusively parent report. Further detail regarding the actual surgical procedures would have aided in interpretation of results, and made subgroup analyses of procedure types possible. Parents were asked to report on baseline status after they were admitted to the hospital, which may have introduced recall bias. A further limitation of our measurement approach was reliance on only the PedsQL to assess physical health. Activity restrictions related to surgery may have affected

follow-up HRQOL in some children. Further research may incorporate additional measures of function to differentiate these aspects. We were also limited to using exclusively parent report of pain and HRQOL. While parent proxy report of HRQOL is an accepted approach and allowed us to obtain a broad sample across a wide age range, future studies need to include child self-report of HRQOL to understand the child's unique perspective on their health and well-being. Similarly, pain assessment would ideally be obtained by child-self report as parent reports have in prior research been shown to underestimate pain intensity[3]. Future studies in this context should incorporate child-report, examine parent-child concordance, and examine comprehensive health and pain outcomes over longer-term follow-up.

In summary, we found that on average HRQOL returns to baseline by 1 month after hospital discharge from pediatric surgery. However, some children have a significant deterioration in HRQOL at 1-month follow-up. Demographic and clinical factors which influenced recovery of HRQOL in the weeks following surgery included age and moderate-severe pain present one month after hospital discharge. Evaluation of inpatient health services from the patient and family perspective is essential in assessing pediatric surgical populations and evaluating outcomes of surgical care. Future research is needed to measure long-term health outcomes in broad pediatric postsurgical populations, and to identify risk factors for poor long-term outcomes.

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References

1. Bekkering WP, Vliet Vlieland TP, Koopman HM, Schaap GR, Schreuder HW, Beishuizen A, Tissing WJ, Hoogerbrugge PM, Anninga JK, Taminiau AH. Quality of life in young patients after bone tumor surgery around the knee joint and comparison with healthy controls. Pediatr Blood Cancer. 2010; 54:738–45. [PubMed: 20127850]
2. Berry JG, Toomey SL, Zaslavsky AM, Jha AK, Nakamura MM, Klein DJ, Feng JY, Shulman S, Chiang VW, Kaplan W, Hall M, Schuster MA. Pediatric readmission prevalence and variability across hospitals. JAMA. 2013; 309:372–80. [PubMed: 23340639]
3. Chambers CT, Reid GJ, Craig KD, McGrath PJ, Finley GA. Agreement between child and parent reports of pain. Clin J Pain. 1998; 14:336–42. [PubMed: 9874013]
4. Cremeans-Smith JK, Millington K, Sledjeski E, Greene K, Delahanty DL. Sleep disruptions mediate the relationship between early postoperative pain and later functioning following total knee replacement surgery. J Behav Med. 2006; 29:215–22. [PubMed: 16496209]
5. Cummings EA, Reid GJ, Finley GA, McGrath PJ, Ritchie JA. Prevalence and source of pain in pediatric inpatients. Pain. 1996; 68:25–31. [PubMed: 9251995]
6. DeFrances CJ, Podgornik MN. 2004 National Hospital Discharge Survey. Adv Data. 2006:1–19. [PubMed: 16703980]
7. Desai AD, Zhou C, Stanford S, Haaland W, Varni JW, Mangione-Smith RM. Validity and responsiveness of the pediatric quality of life inventory (PedsQL) 4.0 generic core scales in the pediatric inpatient setting. JAMA Pediatr. 2014; 168:1114–21. [PubMed: 25347549]
8. Devine KA, Reed-Knight B, Simons LE, Mee LL, Blount RL. Prospective comparison of parent and adolescent report of health-related quality of life in adolescent solid organ transplant recipients. Pediatr Transplant. 2010; 14:1000–6. [PubMed: 20846240]

9. Ersberg A, Gerdhem P. Pre- and postoperative quality of life in patients treated for scoliosis. Acta Orthop. 2013; 84:537–43. [PubMed: 24171684]
10. Fortier MA, Chou J, Maurer EL, Kain ZN. Acute to chronic postoperative pain in children: preliminary findings. J Pediatr Surg. 2011; 46:1700–5. [PubMed: 21929977]
11. Groenewald CB, Rabbitts JA, Schroeder DR, Harrison TE. Prevalence of moderate-severe pain in hospitalized children. Paediatr Anaesth. 2012; 22:661–8. [PubMed: 22332912]
12. Hilliard ME, Lawrence JM, Modi AC, Anderson A, Crume T, Dolan LM, Merchant AT, Yi-Frazier JP, Hood KK. Group SfDiYS. Identification of minimal clinically important difference scores of the PedsQL in children, adolescents, and young adults with type 1 and type 2 diabetes. Diabetes Care. 2013; 36:1891–7. [PubMed: 23340884]
13. Jacobsen EB, Thastum M, Jeppesen JH, Pilegaard HK. Health-related quality of life in children and adolescents undergoing surgery for pectus excavatum. Eur J Pediatr Surg. 2010; 20:85–91. [PubMed: 20112187]
14. Jimenez N, Jackson DL, Zhou C, Ayala NC, Ebel BE. Postoperative pain management in children, parental English proficiency, and access to interpretation. Hosp Pediatr. 2014; 4:23–30. [PubMed: 24435597]
15. Kain ZN, Mayes LC, Caldwell-Andrews AA, Alexander GM, Krivutza D, Teague BA, Wang SM. Sleeping characteristics of children undergoing outpatient elective surgery. Anesthesiology. 2002; 97:1093–101. [PubMed: 12411791]
16. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth. 1997; 78:606–17. [PubMed: 9175983]
17. Khin Hla T, Hegarty M, Russell P, Drake-Brockman TF, Ramgolam A, von Ungern-Sternberg BS. Perception of pediatric pain: a comparison of postoperative pain assessments between child, parent, nurse, and independent observer. Paediatr Anaesth. 2014; 24:1127–31. [PubMed: 25074484]
18. Kristensen AD, Pedersen TA, Hjortdal VE, Jensen TS, Nikolajsen L. Chronic pain in adults after thoracotomy in childhood or youth. Br J Anaesth. 2010; 104:75–9. [PubMed: 19915188]
19. Landolt MA, Valsangiacomo Buechel ER, Latal B. Health-related quality of life in children and adolescents after open-heart surgery. J Pediatr. 2008; 152:349–55. [PubMed: 18280839]
20. O'Hara M, McGrath PJ, D'Astous J, Vair CA. Oral morphine versus injected meperidine (Demerol) for pain relief in children after orthopedic surgery. J Pediatr Orthop. 1987; 7:78–82. [PubMed: 3793916]
21. Page MG, Katz J, Stinson J, Isaac L, Martin-Pichora AL, Campbell F. Validation of the numerical rating scale for pain intensity and unpleasantness in pediatric acute postoperative pain: sensitivity to change over time. J Pain. 2012; 13:359–69. [PubMed: 22424915]
22. Page MG, Stinson J, Campbell F, Isaac L, Katz J. Pain-related psychological correlates of pediatric acute post-surgical pain. J Pain Res. 2012; 5:547–58. [PubMed: 23204864]
23. Page MG, Stinson J, Campbell F, Isaac L, Katz J. Identification of pain-related psychological risk factors for the development and maintenance of pediatric chronic postsurgical pain. J Pain Res. 2013; 6:167–80. [PubMed: 23503375]
24. Poole L, Kidd T, Leigh E, Ronaldson A, Jahangiri M, Steptoe A. Preoperative sleep complaints are associated with poor physical recovery in the months following cardiac surgery. Ann Behav Med. 2014; 47:347–57. [PubMed: 24272231]
25. Rabbitts JA, Groenewald CB, Moriarty JP, Flick R. Epidemiology of ambulatory anesthesia for children in the United States: 2006 and 1996. Anesth Analg. 2010; 111:1011–5. [PubMed: 20802051]
26. Rabbitts JA, Groenewald CB, Tai GG, Palermo TM. Presurgical psychosocial predictors of acute postsurgical pain and quality of life in children undergoing major surgery. J Pain. 2015; 16:226–34. [PubMed: 25540939]
27. Rabbitts JA, Zhou C, Groenewald CB, Durkin LK, Palermo TM. Trajectories of postsurgical pain in children: risk factors and impact of late pain recovery on long-term health outcomes after major surgery. PAIN. Jun 30.2015 epub ahead of print.
28. Raval MV, Dillon PW, Bruny JL, Ko CY, Hall BL, Moss RL, Oldham KT, Richards KE, Vinocur CD, Ziegler MM, Committee ANPS. American College of Surgeons National Surgical Quality

Improvement Program Pediatric: a phase 1 report. J Am Coll Surg. 2011; 212:1–11. [PubMed: 21036076]

29. Rhee D, Papandria D, Yang J, Zhang Y, Ortega G, Colombani PM, Chang DC, Abdullah F. Comparison of pediatric surgical outcomes by the surgeon's degree of specialization in children. J Pediatr Surg. 2013; 48:1657–63. [PubMed: 23932603]
30. Salazar JH, Goldstein SD, Yang J, Douaiher J, Al-Omar K, Michailidou M, Aboagye J, Abdullah F. Regionalization of the surgical care of children: a risk-adjusted comparison of hospital surgical outcomes by geographic areas. Surgery. 2014; 156:467–74. [PubMed: 24953271]
31. Simon TD, Cawthon ML, Stanford S, Popalisky J, Lyons D, Woodcox P, Hood M, Chen AY, Mangione-Smith R. Pediatric medical complexity algorithm: a new method to stratify children by medical complexity. Pediatrics. 2014; 133:e1647–54. [PubMed: 24819580]
32. Stevens BJ, Harrison D, Rashotte J, Yamada J, Abbott LK, Coburn G, Stinson J, Le May S. Pain assessment and intensity in hospitalized children in Canada. J Pain. 2012; 13:857–65. [PubMed: 22958873]
33. Taylor EM, Boyer K, Campbell FA. Pain in hospitalized children: a prospective cross-sectional survey of pain prevalence, intensity, assessment and management in a Canadian pediatric teaching hospital. Pain Res Manag. 2008; 13:25–32. [PubMed: 18301813]
34. Varni JW, Seid M, Kurtin PS. PedsQL 4.0: reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. Med Care. 2001; 39:800–12. [PubMed: 11468499]
35. Varni JW, Burwinkle TM, Seid M, Skarr D. The PedsQL 4.0 as a pediatric population health measure: feasibility, reliability, and validity. Ambul Pediatr. 2003; 3:329–41. [PubMed: 14616041]
36. Varni JW, Limbers CA, Burwinkle TM. Parent proxy-report of their children's health-related quality of life: an analysis of 13,878 parents' reliability and validity across age subgroups using the PedsQL 4.0 Generic Core Scales. Health Qual Life Outcomes. 2007; 5:2. [PubMed: 17201923]
37. Wong GT, Yuen VM, Chow BF, Irwin MG. Persistent pain in patients following scoliosis surgery. Eur Spine J. 2007; 16:1551–6. [PubMed: 17410382]

- The majority of children recovered to baseline by 1-month post-hospital discharge
- 23% of children had a significant declination in HRQOL at 1-month.
- Increasing child age was associated with deterioration in HRQOL after surgery
- Moderate-severe postsurgical pain was associated with deterioration in HRQOL
- Children with greater pain had 5.7 times higher likelihood of poorer recovery

Perspective

This study addresses an important gap in the literature, examining pain and health-related quality of life (HRQOL) in a broad population of children undergoing a wide range of inpatient surgeries. Evaluation of inpatient health services from patient and family perspective is essential in evaluating outcomes of surgical care.

TABLE 1

Sociodemographic and clinical characteristics of sample (N = 915)

CHARACTERISTIC	N (%)
Age	
2–4 years	181 (20%)
5–12 years	442 (48%)
13–18 years	292 (32%)
Sex	
Male	456 (50%)
Female	459 (50%)
Race and ethnicity	
White, non-Hispanic	511 (56%)
Hispanic	173 (19%)
Asian	56 (6%)
Black	25 (3%)
Other	150 (16%)
Language for care	
English	809 (88%)
Spanish	93 (10%)
Other	13 (1%)
Parental education level	
< 12th grade	98 (11%)
12th grade	166 (18%)
Some college	293 (32%)
Bachelor's degree or higher	356 (39%)
PMCA category	
Without chronic disease	450 (49%)
Noncomplex chronic disease	237 (26%)
Complex chronic disease	228 (25%)
Surgery category	
General surgery	339 (37%)
Orthopedics	194 (21%)
Otolaryngology	144 (16%)
Neurosurgery	95 (10%)
Plastic surgery	62 (7%)
Cardiac surgery	27 (3%)
Urology	28 (3%)
Oral surgery	26 (3%)
LOS	2.7 (2.8)
Unplanned hospital readmission	85 (9%)

TABLE 2

Pain and HRQOL outcomes at baseline (N=915) and 1 month (N=563) after hospital discharge by surgical category

		TOTAL HRQOL		PAIN INTENSITY[+]	
SURGICAL CATEGORY	**N**	**BASELINE**	**1 MONTH**	**BASELINE**	**1 MONTH**
General surgery	339	78.1 (16.4)	83.1 (14.3)	0.3 (0.9)	0.6 (1.5)
Orthopedics	194	84.6 (14.7)	89.8 (13.4)	5.6 (3.5)	0.7 (1.5)
Otolaryngology	144	74.6 (17.2)	77.2 (18.9)	4.1 (3.5)	1.2 (2.0)
Neurosurgery	95	84.6 (14.3)	82.7 (15.3)	1.4 (2.8)	0.5 (1.3)
Plastic surgery	62	78.4 (17.5)	75.8 (19.3)	3.0 (3.5)	1.0 (1.6)
Cardiac surgery	27	84.5 (13.6)	88.7 (14.6)	2.4 (3.3)	0.9 (2.1)
Urology	28	84.5 (11.1)	89.7 (13.6)	0.7 (2.0)	0.5 (1.3)
Oral surgery	26	79.9 (15.0)	86.1 (13.6)	3.0 (3.6)	0.7 (1.0)
Total	915	81.9 (15.7)	84.8 (16.8)	3.7 (3.7)	0.8 (1.7)

Values are M (SD).

[+]Numeric rating scale 0–10

TABLE 3

Multivariate logistic regressions examining demographic and clinical characteristics associated with ≥ 4.5 point deterioration from baseline in HRQOL scores at 1-month

	ODDS RATIO	STANDARD ERROR	Z-VALUE	95% CONFIDENCE INTERVAL
Model A. Predictors of Change in Total HRQOL				
Moderate-severe pain at 1-month	5.7**	2.1	4.76	2.8 – 11.6
Age				
2–4 years	1.0			
5–12 years	1.3	0.4	0.92	0.7 – 2.5
13–18 years	2.1*	0.7	2.28	1.1 – 4.1
Sex (male)	1.1	0.3	0.54	0.7 – 1.8
Race				
White non-Hispanic	1.0			
Hispanic	1.7	0.5	1.94	1.0 – 3.1
Black	0.3	0.3	−1.04	0.0 – 2.8
Asian	1.5	0.7	0.97	0.6 – 3.7
Other	2.3*	0.7	2.60	1.2 – 4.2
Baseline pain+	0.9*	0.0	−2.54	0.9 – 1.0
PMCA				
Without chronic disease	1.0			
Noncomplex chronic disease	0.9	0.3	−0.29	0.5 – 1.6
Complex chronic disease	0.9	0.3	−0.25	0.5 – 1.6
LOS	1.0	0.0	0.39	0.9 – 1.1
Model B. Predictors of Change in Physical HRQOL				
Moderate-severe pain at 1-month	3.5**	1.3	3.38	1.7 – 7.1
Age				
2–4 years	1.0			
5–12 years	2.0*	0.6	2.43	1.1 – 3.5
13–18 years	2.3*	0.7	2.63	1.2 – 4.1
Sex (male)	0.8	0.2	−1.02	0.5 – 1.2
Race				
White non-Hispanic	1.0			
Hispanic	1.2	0.3	0.78	0.7 – 2.0
Asian	1.3	0.5	0.60	0.6 – 2.8
Other	1.3	0.4	0.85	0.7 – 2.3
Baseline pain+	0.9**	0.0	−2.85	0.9 – 1.0
PMCA				
Without chronic disease	1.0			
Noncomplex chronic disease	1.0	0.2	0.01	0.6 – 1.6
Complex chronic disease	0.6*	0.1	−2.20	0.3 – 0.9

	ODDS RATIO	STANDARD ERROR	Z-VALUE	95% CONFIDENCE INTERVAL
LOS	1.1	0.0	1.46	1.0 – 1.1
Model C. Predictors of Change in Psychosocial Health				
Moderate-severe pain at 1-month	4.2**	1.52	3.93	2.0 – 8.5
Age				
2–4 years	1.0			
5–12 years	0.9	0.31	−0.20	0.5 – 1.8
13–18 years	1.8	0.63	1.74	0.9 – 3.6
Sex (male)	1.1	0.26	0.26	0.7 – 1.7
Race				
White non-Hispanic				
Hispanic	1.6	0.49	1.46	0.9 – 2.9
Black	0.4	0.46	−0.78	0.0 – 3.7
Asian	1.9	0.89	1.42	0.8 – 4.8
Other	1.9	0.64	1.83	1.0 – 3.7
Baseline pain+	1.0	0.03	−1.04	0.9 – 1.0
PMCA				
Without chronic disease	1.0			
Noncomplex chronic disease	1.2	0.35	0.51	0.6 – 2.1
Complex chronic disease	1.3	0.39	0.76	0.7 – 2.3
LOS	1.1	0.04	1.59	1.0 – 1.1

** $p < .01$,

* $p < .05$

+ Numeric rating scale 0–10

PMCA Pediatric Medical Complexity Algorithm, LOS Length of Stay