Reliability and validity of the Child Pain Anxiety Symptoms Scale (CPASS) in a clinical sample of children and adolescents with acute postsurgical pain

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

ABSTRACT

Pain anxiety refers to the cognitive, emotional, physiological, and behavioural reactions to the experience or anticipation of pain. The Child Pain Anxiety Symptoms Scale (CPASS) has recently been developed and validated in a pediatric community sample. The goal of the present study was to examine the psychometric properties of the CPASS in a sample of children and adolescents with acute postsurgical pain. Eighty-three children aged 8–18 years (mean 13.8 years, SD 2.4) completed measures of pain anxiety, anxiety sensitivity, pain catastrophizing, anxiety, depression, and pain intensity and unpleasantness 48–72 hours after major surgery; and pain intensity and unpleasantness, pain anxiety, and functional disability approximately 2 weeks after discharge from the hospital. The CPASS showed excellent internal consistency ($\alpha = 0.915$). Stronger partial correlations of pain anxiety with anxiety sensitivity ($r = 0.70$) and pain catastrophizing ($r = 0.73$) compared to pain anxiety with anxiety ($r = 0.53$) and depression ($r = 0.59$) suggest excellent construct validity. Pain anxiety was significantly associated with pain intensity ($r = 0.44$) and unpleasantness ($r = 0.32$) 48–72 hours after surgery (concurrent validity) and with pain unpleasantness ($r = 0.29$) and functional disability ($r = 0.50$; but not pain intensity, $r = 0.20$) 2 weeks later (predictive validity). The CPASS showed adequate sensitivity to change over time (mean change = 9.52; effect size = 0.49) and good sensitivity and specificity. The results of the present study provide initial validity and reliability of the CPASS in a clinical sample of children and adolescents after major surgery.

Keywords:
Pain anxiety
CPASS
Validation
Children
Adolescents
Postsurgical pain
Clinical sample

1. Introduction

Pain is a multidimensional experience comprised of sensory, affective, and evaluative dimensions [24]. A vast body of literature supports the role of pain-related psychological factors in the experience of pain. For example, pain catastrophizing, anxiety sensitivity, and pain anxiety have been associated with the development, progression, and maintenance of the pain experience [4,6–8,21,23,26,32,35,36].

Pain catastrophizing is usually defined as the extent to which individuals worry, amplify, and feel helpless about their current or anticipated pain experience [5]. Research has shown that pain catastrophizing is associated with a multitude of pain-related outcomes, including pain severity, pain tolerance, postsurgical pain, analgesic consumption, and somatisation in both adults [8,12,15,30,32] and children [5,7,27,38].

Anxiety sensitivity refers to the extent to which anxiety-related symptoms (eg, increased heart rate, feeling nauseated) are interpreted as indicators of potentially harmful somatic, psychological, and/or social outcomes [29]. Research has suggested that high levels of anxiety sensitivity are associated with pain severity, disability, and quality of life in adult (see [25] for a review) and pediatric [35–37] samples.

Pain anxiety represents the cognitive, emotional, behavioural, and physiological reactions to the anticipation and/or experience of pain [21,22]. Research has shown significant associations between pain anxiety and pain coping responses, pain disability, and pain severity in adults [4,21,23]. Studies suggest that pain-specific constructs, such as pain anxiety, account for a greater proportion of variance in pain-related outcomes compared to general measures of anxiety [43].

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While measures of pain-related psychological constructs have been developed for adults, many of these have no child equivalent. Preliminary data suggest that pain anxiety is a relevant construct in children with chronic pain [20], but only recently has a pediatric scale of pain anxiety been developed [26]. The Child Pain Anxiety Symptoms Scale (CPASS) [26] was adapted from the Pain Anxiety Symptoms Scale-20 (PASS-20) [21] for use with children aged 8 years and older. The reliability and validity of the CPASS have been examined in a pediatric community sample [26], but to date there are no data on the psychometric properties of the CPASS in clinical samples.

The goal of the present study was to provide data on the internal consistency, validity, and sensitivity and specificity of the CPASS [26] in a clinical sample of children undergoing major surgery. Based on previous research in adult populations [22,23] and a community sample of children and adolescents [26], we hypothesized that total scores on the CPASS would correlate highly with pain catastrophizing and anxiety sensitivity, and to a lesser extent (low to moderate correlation), with anxiety and depression (construct validity). In addition, it was expected that the CPASS would (1) be significantly associated with pain intensity and unpleasantness 48–72 hours after surgery (concurrent validity); (2) be significantly associated with pain intensity, pain unpleasantness, and functional disability 2 weeks after discharge from the hospital (predictive validity); (3) be sensitive to change in pain anxiety levels over a 2-week period; and (4) have adequate sensitivity and specificity. We also expected that the CPASS would have excellent internal consistency ($\alpha > 0.900$).

2. Methods

2.1. Participants and recruitment

Children between the ages of 8 and 18 years undergoing either orthopaedic (Surgery for scoliosis, osteotomy, plate insertion tibial/femur, open hip reduction, hip capsulorrhaphy) or general surgical (thoracotomy, thoracoabdominal, Nuss/Ravitch, sternotomy, laparotomy, ostomy) procedures were eligible to participate in this study. Children were excluded if they had a developmental or cognitive delay, had a cancer diagnosis, or were not fluent in written and/or spoken English.

2.2. Questionnaires

2.2.1. Child Pain Anxiety Symptoms Scale

The CPASS [26] is a 20-item scale for children adapted from the adult PASS-20 [21]. For each statement, children are asked to rate the extent to which they think, act, or feel that way on a scale from 0 ("never think, act or feel that way") to 5 ("always think, act, or feel that way"). Total scores range from 0 to 100, with higher scores indicating higher levels of pain anxiety. In a community sample of children [26], the CPASS showed excellent internal consistency ($\alpha = 0.90$). In addition, the CPASS correlated more strongly with pain catastrophizing ($r = 0.63$) and anxiety sensitivity ($r = 0.60$) than with general anxiety ($r = 0.44$) (suggesting adequate construct validity), and was associated significantly with how often children reported pain [26].

2.2.2. Multidimensional Anxiety Scale for Children

The Multidimensional Anxiety Scale for Children (MASC-10) [19] is a short, 10-item version of the 39-item Multidimensional Anxiety Scale for Children. The MASC-10 items, which tap physiological symptoms, social anxiety, harm avoidance, and separation/panic, are summed to form a global anxiety symptom score. Children are asked to rate the extent to which each of the 10 statements is true about them on a scale from 0 ("never true about me") to 3 ("often true about me"). Total scores range from 0 to 30, with higher scores indicating higher levels of anxiety. The MASC-10 has adequate internal consistency ($\alpha = 0.60–0.85$), good test–retest reliability ($r = 0.79–0.93$), good convergent validity (high correlation with the Revised Children's Manifest Anxiety Scale), and good discriminant validity (absence of a significant correlation with the Children's Depression Inventory) [19].

2.2.3. Childhood Anxiety Sensitivity Index

The Childhood Anxiety Sensitivity Index (CASI) [31] assesses the extent to which the respondent misinterprets anxiety-related symptoms (eg, increased heart rate, feeling nauseated) as indicators of potentially harmful somatic, psychological, and/or social consequences [29]. The scale is composed of 18 items such as "It scares me when my heart beats fast" and "It scares me when I feel like I'm going to throw up." Items are rated on a scale ranging from 1 ("none") to 3 ("a lot"). Total scores range from 18 to 54, with higher scores indicating higher levels of anxiety sensitivity. The CASI has good internal consistency ($\alpha = 0.87$) and test–retest reliability ($r = 0.76$), as well as adequate convergent and discriminant validity [31].

2.2.4. Pain Catastrophizing Scale – Children

The Pain Catastrophizing Scale – Children (PSC-C) [5] is a 13-item self-report measure assessing the extent to which children worry, amplify, and feel helpless about their current or anticipated pain experience [5]. The scale was modified for use with children based on the adult PCS [6,33]. For each item, children are asked to rate, on a scale from 0 ("not at all") to 4 ("extremely"), "how strongly they experience this thought" when they have pain. Total scores range from 0 to 52, with higher scores indicating higher levels of pain catastrophizing. Preliminary results suggest that the PCS-C has good internal consistency ($\alpha = 0.90$) and correlates highly with pain intensity ($r = 0.49$) and disability ($r = 0.50$) [5].

2.2.5. Center for Epidemiological Studies – Depression Scale for Children

The Center for Epidemiological Studies – Depression Scale for Children (CESD-C) [10] is a 20-item self-report measure that assesses depressive symptoms in children and adolescents. The questionnaire measures 6 broad symptom areas including depressed mood, guilt/worthlessness, helplessness/hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance. For each item, participants indicate the extent to which they have felt this way in the past week using a scale from 0 ("not at all") to 3 ("a lot"). Total scores range from 0 to 60, with higher scores indicating more severe depressive symptomatology. The CESD-C has good internal consistency ($\alpha = 0.89$) and good convergent validity (significantly correlated with the Child Trait Checklist, the Coopersmith Self-Esteem Inventory, and the Children's Global Assessment Scale) [11].

2.2.6. Functional Disability Inventory

The Functional Disability Inventory (FDI) [42] is a 15-item scale that assesses the extent to which children experience difficulties in completing specific tasks (eg, "Walking to the bathroom," "Eating regular meals," and "Being at school all day"). Typically, the FDI is used as a 5-point Likert Scale and yields total scores ranging from 0 to 60. Inadvertently, the FDI in this study was measured using a 4-point Likert scale. Children rated each item on a scale from 0 ("no trouble") to 3 ("impossible"), yielding total scores ranging from 0 to 45. Given that the majority of children rated most items as a "0," "1," or "2," the omission of the original "2" ("some trouble") likely did not impact the results. The FDI has been

used with many pediatric populations, including children with chronic pain [17,18,28] and postsurgical pain [14].

2.2.7. Eleven-point Numerical Rating Scale for Pain Intensity (NRSI) and Pain Unpleasantness (NRSU)

The Numerical Rating Scale (NRS) is a verbally administered scale that measures pain intensity ("how much pain do you feel right now?"). The NRS can also be used to measure pain unpleasantness ("how unpleasant/horrible/yucky is the pain right now?"). The end points represent the extremes of the pain experience. There are no agreed-upon NRS anchors for measuring pain in children and adolescents [40]. As such, the following anchors were used in this study: for pain intensity, they range from 0 = "no pain at all" to 10 = "worst possible pain"; for pain unpleasantness, they range from 0 = "not at all unpleasant/horrible/yucky" to 10 = "most unpleasant/horrible/yucky feeling possible." The NRS for pain intensity has been validated as an acute postsurgical pain measure in children aged 7–17 years; it correlated highly with the visual analogue scale ($r = 0.89$) and the Faces Pain Scale-revised ($r = 0.87$) [41].

2.3. Procedure

The study was reviewed and approved by the Research Ethics Boards of the Hospital for Sick Children and York University. Nurses who were not part of the research team approached potential participants to ask whether they were interested in learning about the study. Children and one of their parents (who had expressed an interest in the study) were then approached by a research team member 48–72 hours after surgery. After obtaining informed written parental consent and consent or assent from children, a research team member read to the child the following questionnaires and recorded their responses to each item: CPASS-1, PCS-C, CASI, MASC-10, CESD-C, and the NRSI-1 and NRSU-1. The order of administration of questionnaires was randomized (http://www.randomization.com) within participants to minimize potential order and fatigue effects. Telephone follow-ups were conducted approximately 2 weeks after discharge from the hospital by a research assistant who verbally administered to children the CPASS-2, FDI, and the NRSI-2 and NRSU-2. Parents also completed measures, but these results will not be presented here.

2.4. Data analysis

2.4.1. Reliability of the CPASS

Cronbach alpha and item-total correlations were used to examine the internal consistency of the CPASS-1 (measured 48–72 hours after surgery) and CPASS-2 (measured approximately 2 weeks after discharge from hospital).

2.4.2. Validity of the CPASS

Validity of the CPASS was examined using construct validity (convergent and discriminant validity) and criterion validity (concurrent and predictive validity), as well as responsiveness (sensitivity to change over time).

2.4.2.1. Construct validity. Construct validity was examined using convergent and discriminant validity. Partial correlations were used to control for the potential effects of age and gender on the measured variables. Convergent validity was determined by correlating the CPASS-1 with 2 theoretically similar pain-related psychological constructs, the PCS-C and the CASI. High correlations ($r > 0.70$) [16] would indicate adequate convergent validity. Discriminant validity was determined by correlating the CPASS-1 with the MASC-10, a measure of general anxiety, and the CESD-C, a measure of depressive symptoms. A low to moderate correlation between CPASS-1_MASC-10 and CPASS-1_CESD-C ($r < 0.70$) [16] would indicate adequate discriminant validity.

Convergent and discriminant validity were also examined by 2-tailed, paired t tests [3] comparing the magnitude of the difference in correlation coefficients between (1) CPASS-1_CASI versus CPASS-1_MASC-10; (2) CPASS-1_PCS-C versus CPASS-1_MASC-10; (3) CPASS-1_CASI versus CPASS-1_CESD-C; and (4) CPASS-1_PCS-C versus CPASS-1_CESD-C. Significantly larger correlations between CPASS-1 and the pain-specific measures (ie, CASI and PCS-C) compared to the non-pain-specific measures (ie, MASC-10 and CESD-C) would suggest good convergent and discriminant validity.

2.4.2.2. Criterion validity. Concurrent and predictive validity were used to examine the criterion validity of the CPASS. Concurrent validity (the extent to which CPASS correlated with theoretically related constructs measured at the same time) was assessed by partial correlations controlling for age and gender between CPASS-1 and NRSI-1 and NRSU-1.

Predictive validity (the extent to which CPASS correlates with theoretically related constructs measured later in time) was assessed by partial correlations controlling for age and gender between CPASS-1 and NRSI-2, NRSU-2, and FDI measured approximately 2 weeks after discharge from the hospital.

2.4.2.3. Responsiveness. (1) Pearson correlation coefficients, as well as partial correlation coefficients controlling for age and gender, between total scores of the CPASS-1 and CPASS-2, and (2) linear mixed-effects model analysis of covariance (ANCOVA) controlling for age and gender were used to examine the ability of the CPASS to detect change over time. It is expected that levels of pain anxiety will decrease over time during a 2-week period following major surgery. As such, CPASS-1 should correlate moderately with ($r < 0.70$) and be significantly more elevated than CPASS-2.

2.4.3. Sensitivity and specificity of the CPASS

Receiver operator characteristic (ROC) curves were used to examine possible CPASS cutoff scores that differentiate children who are more likely to report clinically significant levels of pain intensity and/or unpleasantness (NRS $\geqslant 4$) and functional disability (mean item score $\geqslant 1.5$) 2 weeks after discharge from hospital. To our knowledge, there are no existing cutoff scores for clinically significant pain unpleasantness levels or functional disability levels in acute pediatric postsurgical pain. As such, a cutoff score for NRSU-2 of $\geqslant 4$ was chosen based on previous research in pediatric pain [39], suggesting that a score of 4 or higher on the NRS for pain intensity indicates a probable need for pain management interventions. A cutoff score of 1.5 out of 3 on the FDI was chosen because it differentiates between children who report "none" to "a little bit" of functional impairment (scores of 0–1 on the FDI) versus those who report "a lot" of functional impairment (scores of 2–3 on the FDI).

2.4.4. Sample size calculation

Sample size was calculated a priori for Pearson correlation coefficients as well as for multiple regression analyses using G*Power version 3.1 [9]. Correlation coefficients between CPASS and other psychological constructs are expected to vary from low-medium ($0.50 < r < 0.70$) to high ($r > 0.70$). Sample size analysis showed that 26 participants would be required for the lowest expected correlation coefficient of $r = 0.50$, with $\alpha = 0.05$ and power = 80%. Sample size calculation for mixed-effects ANCOVA are difficult to estimate due to the multiple combinations of mixed and random effects involved. Research has shown that for balanced designs, the sample size required for a mixed-effects model is similar to the one required for linear regressions [13]. Using G*Power, multiple regression analysis with 4 predictors, a sample size of 85 would be

required using power = 80%, a medium effect size (Cohen's $f^2 = 0.15$) [2], and $\alpha = 0.05$.

3. Results

3.1. Recruitment

Children were recruited between July 2008 and September 2010. A total of 148 potential participants were approached; 65 refused to participate. A total of 83 children participated in this study, of whom 69 (83%) also completed the telephone follow-up approximately 2 weeks after discharge from the hospital (mean 15.6 days, SD 2.15). The flow chart in Fig. 1 depicts the recruitment process and retention of participants throughout the study.

3.2. Descriptive statistics

The final sample comprised 83 children (56 [67.5%] females) aged between 8 and 18 years (mean 13.8 years, SD 2.4). Table 1 shows the demographic and clinical variables for the present sample. The majority of children in the sample were Caucasian (64%). Eighty-nine percent of children spoke English at home as their first language.

The majority of children underwent surgery for scoliosis (spinal fusion) (n = 42, 50.6%) or osteotomy (n = 25, 30.1%). This was the first surgery for 44 children (53%); 39 others had previously undergone other surgical procedures (mean number of previous surgeries = 2.0, SD 1.6, range 1–7). When asked to rate the level of presurgical pain they had experienced, the majority of children (80.7%) reported "no pain" or "a little bit of pain."

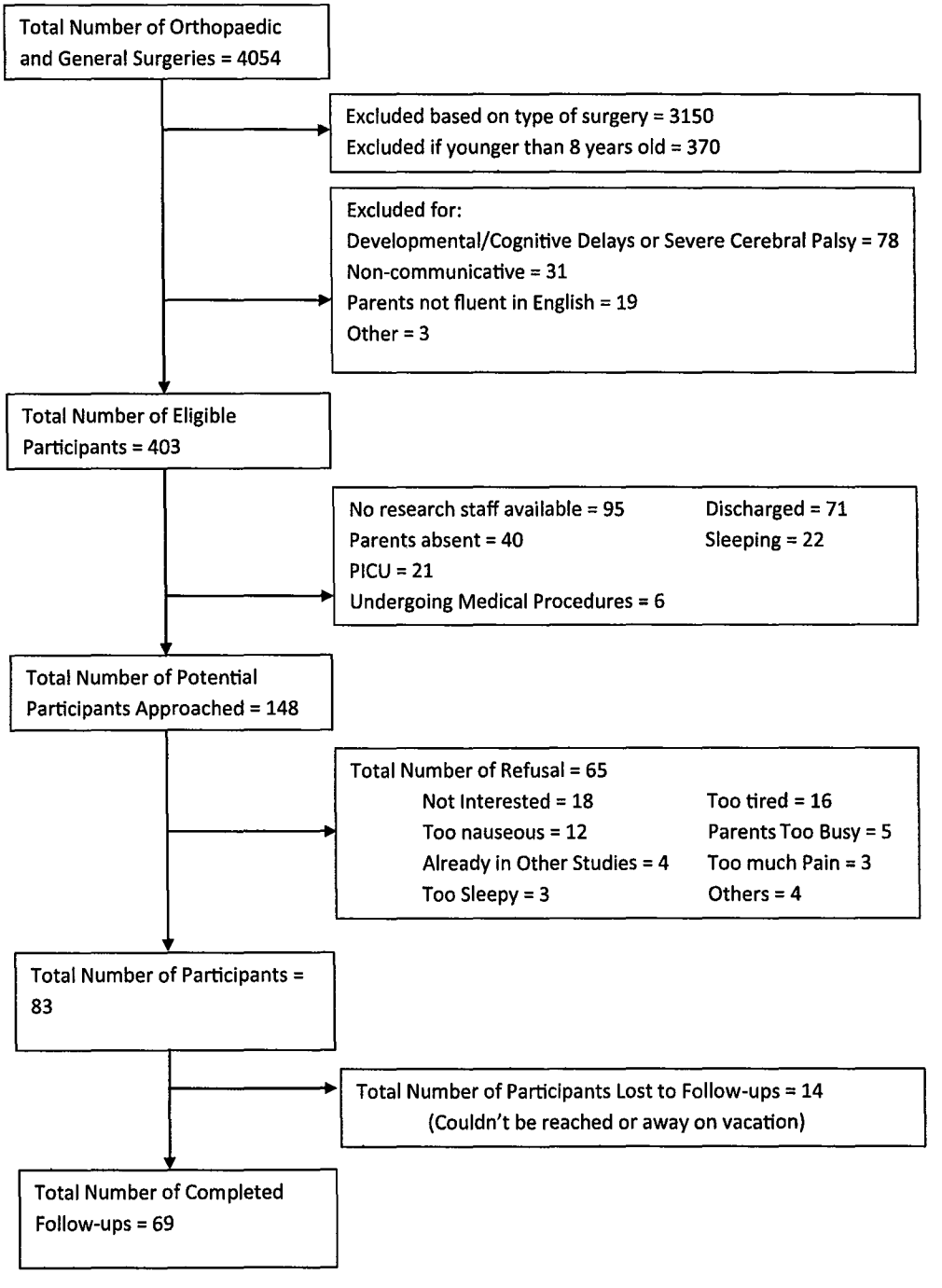

Fig. 1. Flow chart describing recruitment process.

Table 1
Demographic and clinical variables.

	Boys	Girls	Total
n (%)	27 (32.5%)	56 (67.5%)	83 (100%)
Mean age in years (SD)	13.5 (2.6)	14.0 (2.3)	13.8 (2.44)
Ethnicity, n (%)			
Caucasian	20 (74.1%)	33 (58.9%)	53 (64%)
Asian	4 (14.8%)	6 (10.7%)	10 (12%)
African-Caribbean/African-Canadian	0 (0%)	7 (12.5%)	7 (8.4%)
Middle-Eastern	1 (3.7%)	3 (5.4%)	4 (4.8%)
Hispanic	1 (3.7%)	2 (3.6%)	3 (3.6%)
Other	1 (3.7%)	5 (8.9%)	6 (7.2%)
Type of surgery, n (%)			
Surgery for scoliosis	6 (22.2%)	36 (64.3%)	42 (50.6%)
Osteotomy	13 (48.1%)	12 (10.7%)	25 (30.1%)
Nuss/Ravitch procedure	7 (25.9%)	1 (1.8%)	8 (9.6%)
Laparotomy	1 (3.7%)	6 (10.7%)	7 (8.4%)
Thoracotomy	0 (0%)	1 (1.8%)	1 (1.2%)
Prior surgery (n)			
No	11	33	44
Yes	16	23	39
Preoperative pain, n (%)			
"No pain"	19 (59.3%)	20 (35.7%)	36 (43.4%)
"A little bit of pain"	7 (25.9%)	24 (42.9%)	31 (37.3%)
"A medium amount of pain"	3 (11.1%)	10 (17.9%)	13 (15.7%)
"A lot of pain"	1 (3.7%)	2 (3.6%)	3 (3.6%)

Table 2 shows the correlation matrix for the psychometric measures as well as mean total scores and standard deviations on the CPASS-1, PCS-C, CASI, MASC-10, CESD-C, NRSI-1, and NRSU-1 48–72 hours after surgery; and the CPASS-2, FDI, NRSI-2, and NRSU-2 approximately 2 weeks after discharge from the hospital. Age significantly correlated with total scores on measures of general anxiety (MASC-10) and depression (CESD-C), but not pain anxiety (CPASS-1 and CPASS-2), anxiety sensitivity (CASI), pain catastrophizing (PCSC), pain intensity (NRSI-1 and NRSI-2), or pain unpleasantness (NRSU-1 and NRSU-2).

Mean values for boys and girls on the relevant psychological and pain measures are presented in Table 3. Girls scored significantly higher than boys on measures of anxiety sensitivity [CASI: $t_w(1,63.5) = 2.81$, $P = 0.007$] and general anxiety [MASC-10: $t_w(1,56.0) = 2.82$, $P = 0.007$], but not pain catastrophizing [PCS-C: $t_w(1,47.3) = 0.14$, $P = 0.889$], pain anxiety [CPASS-1: $t_w(1,53.0) = 0.44$, $P = 0.660$; CPASS-2: $t_w(1,47.9) = 0.79$, $P = 0.435$], or depression [CESD-C: $t_w(1,60.7) = 0.32$, $P = 0.748$]. Girls reported higher levels of pain unpleasantness at 48–72 hours [NRSU-1: $t_w(1,55.0) = 2.06$, $P = 0.044$] but not 2 weeks after discharge from the hospital [NRSU-2: $t_w(1,47.8) = 0.81$, $P = 0.422$]. Girls also scored higher on functional disability [FDI: $t_w(1,33.1) = 2.04$, $P = 0.049$] measured 2 weeks after discharge from the hospital. There was no gender difference in pain intensity 48–72 hours after surgery [NRSI-1: $t_w(1,49.4) = 1.14$, $P = 0.262$] or 2 weeks after discharge from the hospital [NRSI-2: $t_w(1,44.4) = 0.21$, $P = 0.835$].

3.2.1. Reliability of the CPASS

Using unstandardized Cronbach alpha, CPASS-1 and CPASS-2 showed excellent overall internal consistency ($\alpha = 0.915$ and $\alpha = 0.928$, respectively). Deletion of any one item did not significantly improve the internal consistency of the CPASS-1 ($\alpha = 0.907$–0.919) or CPASS-2 ($\alpha = 0.921$–0.931). Corrected item-total correlations ranged from 0.203 to 0.702 for CPASS-1 and from 0.254 to 0.774 for CPASS-2. In addition, the CPASS-1 and CPASS-2 showed excellent overall internal consistency for both girls (CPASS-1: $\alpha = 0.922$; CPASS-2: $\alpha = 0.937$) and boys (CPASS-1: $\alpha = 0.902$; CPASS-2: $\alpha = 0.905$).

Reliability of the subscales of the CPASS-1 was also examined. Subscales were based on the 4-factor solution derived from the adult PASS-20 and validated using the CPASS in a community sample [26]. In that study [26], 2 factor solutions were retained. The original factor solution was identical to the adult literature of the PASS-20, whereas the modified solution suggested that item 19 ("I worry when I feel pain") be moved from the cognitive to the fear subscale [26]. These 2 different factor solutions were tested in the present study. Cronbach alpha on the subscales of the original 4-factor solution ranged from 0.660 to 0.862. Cronbach alpha on the subscales of the modified 4-factor solution ranged from 0.660 to 0.883. Results of the internal consistency analyses are summarized in Table 3.

3.2.2. Validity of the CPASS

3.2.2.1. Construct validity. Convergent and discriminant validity: partial correlations, after controlling for age and gender, showed that the CPASS-1 significantly correlated with pain catastrophizing

Table 2
Correlation coefficients between age, pain anxiety, pain catastrophizing, anxiety sensitivity, anxiety, depression, pain intensity, pain unpleasantness, and functional disability.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age												
2. CPASS-1	−0.03		0.73**	0.70**	0.53**	0.59**	0.44**	0.32**	0.20	0.29*	0.69**	0.50**
3. PCS-C	−0.21	0.72**		0.61*	0.43**	0.50**	0.46**	0.36**	0.13	0.31*	0.51**	0.43**
4. CASI	−0.04	0.69**	0.58**		0.52**	0.54**	0.29**	0.23*	0.27*	0.33**	0.58**	0.51**
5. MASC	−0.28*	0.50**	0.45**	0.56**		0.56**	0.19	0.11	0.26*	0.32**	0.41**	0.40**
6. CESD-C	−0.34**	0.56**	0.53**	0.52**	0.59**		0.43**	0.28*	0.28*	0.26*	0.38**	0.47**
7. NRSI-1	0.19	0.43**	0.40**	0.30**	0.15	0.33**		0.66**	0.43**	0.55**	0.36**	0.45**
8. NRSU-1	0.07	0.32**	0.34**	0.28*	0.15	0.24*	0.66**		0.26*	0.37**	0.27*	0.32**
9. NRSI-2	0.08	0.20	0.11	0.26*	0.22	0.24*	0.44**	0.26*		0.79**	0.36**	0.46**
10. NRSU-2	<0.01	0.29*	0.30*	0.34**	0.32**	0.25*	0.55**	0.38**	0.78**		0.43**	0.53**
11. CPASS-2	0.07	0.68**	0.48**	0.57**	0.37**	0.33**	0.37**	0.28*	0.36**	0.43**		0.62**
12. FDI	−0.11	0.50**	0.43**	0.55**	0.47**	0.48**	0.43**	0.35**	0.44**	0.53**	0.60**	

Note: Pearson correlation coefficients are presented below the diagonal space. Partial correlation coefficients after controlling for age and gender are presented above the diagonal space.

CPASS-1, total score on the Child Pain Anxiety Symptoms Scale measured 48–72 hours after surgery; PCSC-C, total score on the Pain Catastrophizing Scale for Children; CASI, total score on the Children Anxiety Sensitivity Index; MASC, total score on the Multidimensional Anxiety Scale for Children – 10; CESD-C: Center for Epidemiological Studies – Depression Scale for Children; NRSI-1, Numerical Rating Scale for Pain Intensity measured 48–72 hours after surgery; NRSU-1, Numerical Rating Scale for Pain Unpleasantness measured 48–72 hours after surgery; NRSI-2, Numerical Rating Scale for Pain Intensity measured approximately 2 weeks after discharge from hospital; NRSU-2, Numerical Rating Scale for Pain Unpleasantness measured approximately 2 weeks after discharge from hospital; CPASS-2, total score on the Child Pain Anxiety Symptoms Scale measured approximately 2 weeks after discharge from hospital; FDI, total score on the Functional Disability Inventory measured approximately 2 weeks after discharge from hospital (in this study, the Functional Disability Inventory was measured using a Likert scale ranging from 0 [no trouble] to 3 [impossible]).

* $p < 0.05$.

** $p < 0.01$.

Table 3
Internal consistency, mean (SD) values for boys and girls and children with and without a history of prior surgery on relevant psychological and pain-related measures.

	Cronbach alpha	Total	Boys (n = 27)	Girls (n = 56)	Prior surgery	
					No (n = 44)	Yes (n = 39)
CPASS-1	0.915	47.45 (19.2)	46.11 (18.9)	48.09 (19.5)	48.36 (17.9)	46.41 (20.8)
CPASS-1-Cog	0.842	12.72 (6.0)	13.04 (6.3)	12.57 (5.9)	12.77 (5.7)	12.67 (6.3)
CPASS-1-Fear	0.862	9.40 (6.3)	8.59 (6.3)	9.79 (6.3)	9.30 (5.7)	9.51 (7.1)
CPASS-1-Esc/Avoid	0.689	14.24 (5.1)	13.44 (4.8)	14.63 (5.2)	14.93 (4.9)	13.46 (5.2)
CPASS-1-Phys	0.660	11.08 (5.2)	11.04 (4.8)	11.11 (5.4)	11.36 (5.4)	10.77 (5.0)
CPASS-1-Cog (mod)	0.837	10.06 (5.0)	10.41 (5.1)	9.89 (5.0)	10.00 (4.7)	10.13 (5.3)
CPASS-1-Fear (mod)	0.883	12.06 (7.5)	11.22 (7.8)	12.46 (7.4)	12.07 (6.9)	12.05 (8.2)
PCS-C	0.927	21.98 (12.2)	21.69 (12.7)	22.11 (12.1)	21.40 (11.8)	22.65 (12.8)
CASI	0.890	32.92 (7.4)	30.00 (6.0)	34.32 (7.6)	34.93 (6.5)	30.64 (7.7)
CESD-C	0.798	23.27 (11.7)	22.70 (10.4)	23.55 (12.4)	24.47 (12.2)	21.95 (11.2)
MASC-10	0.732	11.76 (5.4)	9.54 (4.9)	12.89 (5.3)	13.20 (4.6)	10.08 (5.8)
NRSI-1	n/a	3.86 (2.3)	3.44 (2.4)	4.06 (2.3)	3.73 (2.2)	4.01 (2.4)
NRSU-1	n/a	4.57 (2.8)	3.70 (2.6)	4.98 (2.8)	4.57 (2.8)	4.56 (2.7)
CPASS-2	0.928	37.64 (18.4)	35.23 (16.4)	38.77 (19.4)	39.54 (18.4)	35.44 (18.6)
NRSI-2	n/a	2.28 (2.2)	2.20 (2.1)	2.32 (2.2)	2.05 (1.8)	2.55 (2.5)
NRSU-2	n/a	2.57 (2.6)	2.23 (2.3)	2.73 (2.7)	2.45 (2.5)	2.72 (2.7)
FDI	0.897	19.63 (8.8)	16.24 (9.6)	21.15 (8.1)	20.14 (9.1)	19.03 (8.5)

CPASS-1, total score on the Child Pain Anxiety Symptoms Scale measured 48–72 hours after surgery; CPASS-1-Cog: cognitive subscale of the Child Pain Anxiety Symptoms Scale; CPASS-1-Fear: fear subscale of the Child Pain Anxiety Symptoms Scale: CPASS-1-Esc/Avoid: escape/avoidance subscale of the Child Pain Anxiety Symptoms Scale: CPASS-1-Phys: physiological subscale of the Child Pain Anxiety Symptoms Scale; CPASS-1-Cog (mod): cognitive subscale of the modified Child Pain Anxiety Symptoms Scale (item 19 ["I worry when I feel pain"] is moved from the cognitive to the fear subscale); CPASS-1-Fear (mod): fear subscale of the modified Child Pain Anxiety Symptoms Scale; PCSC-C, total score on the Pain Catastrophizing Scale for Children; CASI, total score on the Children Anxiety Sensitivity Index; CESD-C: Centre for Epidemiological Studies – Depression Scale for Children; MASC, total score on the Multidimensional Anxiety Scale for Children – 10; NRSI-1, Numerical Rating Scale for Pain Intensity measured 48–72 hours after surgery; NRSU-1, Numerical Rating Scale for Pain Unpleasantness measured 48–72 hours after surgery; CPASS-2, total score on the Child Pain Anxiety Symptoms Scale measured approximately 2 weeks after discharge from hospital; NRSI-2, Numerical Rating Scale for Pain Intensity measured approximately 2 weeks after discharge from hospital; NRSU-2, Numerical Rating Scale for Pain Unpleasantness approximately 2 weeks after discharge from hospital; FDI, total score on the Functional Disability Inventory measured approximately 2 weeks after discharge from hospital (in this study, the Functional Disability Inventory was measured using a Likert scale ranging from 0 [no trouble] to 3 [impossible]).

(PCS-C) ($r = 0.73$, $P < 0.001$) and anxiety sensitivity (CASI) ($r = 0.70$, $P < 0.001$), indicating good convergent validity. Partial correlations, after controlling for age and gender, showed that the CPASS-1 correlated to a lesser extent with general anxiety (MASC-10) ($r = 0.53$, $P < 0.001$) and depression (CESD-C) ($r = 0.59$, $P < 0.001$), indicating adequate discriminant validity.

Convergent and discriminant validity were also examined by comparing the magnitude of the correlation coefficients. Results indicated that pain anxiety (CPASS-1) correlated significantly more strongly with pain catastrophizing (PCS-C) [$t(80) = 3.91$, $P < 0.01$] and anxiety sensitivity (CASI) [$t(80) = 2.34$, $P = 0.02$] compared to general anxiety (MASC-10). In addition, pain anxiety (CPASS-1) correlated significantly more strongly with pain catastrophizing (PCS-C) [$t(80) = 3.20$, $P < 0.01$] and anxiety sensitivity (CASI) [$t(80) = 2.27$, $P = 0.03$] compared to depression (CESD-C). Partial correlation coefficients are summarized in Table 2.

3.2.2.2. Convergent and predictive (criterion) validity. Convergent validity: partial correlations (Table 2) showed that CPASS-1 significantly correlated with pain intensity (NRSI-1: $r = 0.44$, $P < 0.001$) and pain unpleasantness (NRSU-1: $r = 0.32$, $P < 0.001$).

Predictive validity: partial correlations (Table 2) showed that CPASS-1 significantly correlated with pain unpleasantness (NRSU-2: $r = 0.29$, $P = 0.017$) and functional disability (FDI: $r = 0.51$, $P < 0.001$). CPASS-1 did not significantly correlate with pain intensity (NRSI-2: $r = 0.20$, $P = 0.105$).

3.2.2.3. Responsiveness. Correlation coefficients between CPASS-1 and CPASS-2 ($r = 0.68$, $P < 0.001$) and partial correlation between CPASS-1 and CPASS-2 controlling for age and gender ($r = 0.69$, $P < 0.001$) were virtually identical and moderate in magnitude. Linear mixed-effects ANCOVA showed that the change in pain anxiety 48–72 hours after surgery and 2 weeks after discharge approached significance [$F(1,74.51) = 3.79$, $P = 0.055$]. Age [$F(1,74.48) = 1.17$, $P = 0.28$] and gender [$F(1,73.24) = 0.08$, $P = 0.78$] were not significantly related to the CPASS across time. The same analysis excluding the 2 nonsignificant covariates showed a significant reduction in pain anxiety over time [mean change = 9.6, $F(1,75.01) = 28.10$, $P < 0.01$; effect size = 0.49].

3.2.3. Sensitivity and specificity of the CPASS

Fig. 2 depicts the ROC curves examining the relationship between CPASS-1 and FDI and NRSU-2. A cutoff score on the CPASS-1 of 48.5 had good sensitivity (0.53) and specificity (0.70) in detecting scores on the NRSU-2 of 4 or above, yet there was a large proportion of false positives (19%) and false negatives (62%). The cutoff score on the CPASS-1 of 48.5 had good sensitivity (0.65) and specificity (0.84) in detecting children with more than "a little bit" of functional impairment (FDI) 2 weeks after discharge from the hospital, yet here too, there was a large proportion of false positives (13%) and false negatives (42%). The ROC curve for pain intensity was not examined given that the CPASS-1 was not significantly associated with NRSI-2.

4. Discussion

The goal of this study was to examine the reliability and validity of the CPASS in a sample of children and adolescents with acute postsurgical pain. Results of the reliability analysis suggest that the CPASS and its subscales have excellent overall internal consistency. The CPASS also had excellent internal consistency for both girls and boys. Deletion of any item did not improve the internal consistency of the scale. These results are comparable to those of the adult PASS-20 ($\alpha = 0.75$–0.87) [21] as well as the CPASS in a pediatric community sample ($\alpha = 0.903$) [26].

Examination of the construct validity of the CPASS suggests that it has good convergent (moderate to high correlation with pain catastrophizing and anxiety sensitivity) and discriminant validity (moderate correlation with general anxiety and depression). Examination of the criterion validity of the CPASS suggests that it has

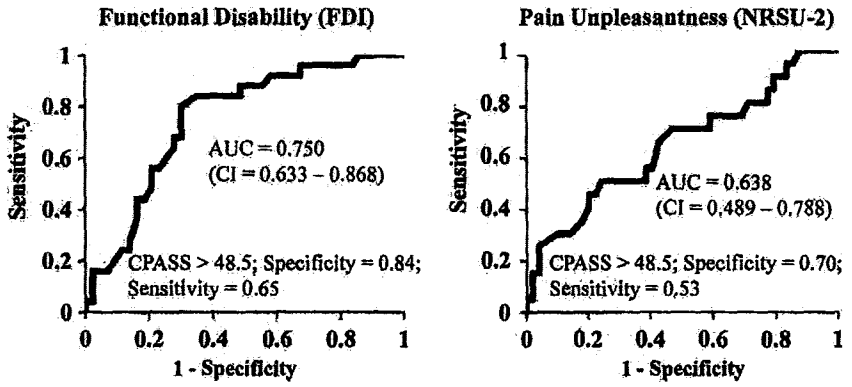

Fig. 2. Receiver operator characteristic curves examining the relationship between the Child Pain Anxiety Symptoms Scale-1 (CPASS-1) and FDI and NRSU-2.

adequate concurrent and predictive validity. In addition, the CPASS demonstrated sensitivity to change over 2 weeks as scores decreased significantly from days 2 to 3 after surgery to the 2-week follow-up. Results from the linear mixed-effects analysis indicated that the change in pain anxiety over time, after controlling for age and gender, almost reached the conventional 0.05 level of significance. Given that the zero-order and partial correlation coefficients between CPASS-1 and CPASS-2 were virtually identical, neither age nor gender acts as a suppressor in the relationship between CPASS-1 and CPASS-2. It is likely that the near-significant effect of time ($P = 0.055$) is due to the loss of power associated with adding 2 additional variables (age and gender) to the model. This was confirmed by the significant reduction over time in pain anxiety when the 2 nonsignificant covariates were excluded from the analysis.

Analyses of the sensitivity and specificity of the CPASS-1 using ROC curves suggested that a cutoff of 48.5 might be useful in identifying children who will report clinically significant levels of pain unpleasantness and functional disability 2 weeks after discharge from the hospital. It is important to note, however, that the use of this cutoff score led to high proportions of false positives and false negatives. Results from the sensitivity and specificity analyses should be considered as preliminary at this stage, and further research is needed to determine the optimal cutoff score on the CPASS that would identify children at higher risk of developing elevated pain and functional disability.

Pain anxiety significantly correlated with pain unpleasantness 48–72 hours after surgery, as well as with pain unpleasantness and functional disability approximately 2 weeks after hospital discharge. It is interesting to note that while pain anxiety significantly correlated with concurrent pain intensity, it was not significantly associated with pain intensity approximately 2 weeks after discharge from the hospital. These results suggest that the CPASS is a valid tool to predict concurrent pain intensity and unpleasantness, but that its predictive validity is more strongly associated with the affective as opposed to the sensory dimension of the pain experience. Thus, these results indicate that the Child Pain Anxiety Symptoms Scale can provide valid and valuable information about the affective dimension of the acute pain experience of children undergoing major surgery, as well as about their degree of functional impairment.

Mean total scores and standard deviations for pain catastrophizing and anxiety sensitivity were comparable to other pediatric samples with acute and chronic pain [5,36]. Not surprisingly, the total scores on the CPASS-1, CPASS-2, PCS-C, and CASI were higher in the present sample of children and adolescents with pediatric postsurgical pain compared to a community-based sample of children and adolescents [26]. In addition, correlation coefficients between measures of pain anxiety and pain catastrophizing, anxiety sensitivity, general anxiety, and depression were comparable to those reported in the adult literature [22,23]. The results did not reveal significant gender or age differences in pain anxiety scores, suggesting that pain anxiety is a relatively stable measure across gender and the age groups sampled in the present study. The absence of age differences in pain anxiety scores is consistent with a community sample of children and adolescents [26] and some community samples of adults (eg, [1]), but contrasts with other adult community samples (eg, [34]). Given this inconsistency in the literature, it would be important in the future to examine the aspects of the sensory (eg, pain intensity), affective (eg, pain unpleasantness), and cognitive/emotional (eg, pain catastrophizing, pain anxiety) dimensions of pain that are most associated with age, gender, and their interaction.

There are several limitations to the present study. First, the CPASS was adapted from the PASS-20. It is possible that pediatric pain anxiety involves dimensions other than those included in the CPASS. Nevertheless, assessing the same dimensions of pain anxiety in children and adults has the advantage of facilitating comparisons between children and their parents. Results from the present study suggest that pain anxiety, including its cognitive, escape/avoidance, fear, and physiological subscales, represents a construct that is relevant to children and adolescents with acute postsurgical pain. Second, the relatively small sample size in this study was not sufficient to examine the factor structure of the CPASS. Third, the present study did not assess psychological and pain-related measures before surgery. As such, we could not examine the preoperative psychometric properties (validity, internal consistency, and sensitivity and specificity) of the CPASS. Fourth, given the nature of the clinical sample used in this study, and the expectation for pain to decrease with time, it was not feasible to examine the test–retest reliability of the CPASS. An evaluation of the test–retest reliability might be more adequately performed using a sample of children and adolescents with chronic pain.

In conclusion, this is the first study to examine the reliability and validity of the CPASS in a clinical sample of children and adolescents with acute pain. Preliminary results suggest that the CPASS is a reliable and valid tool between the ages of 8 and 18 years. In addition, results suggest that the CPASS may be helpful in identifying children at higher risk of experiencing greater levels of functional disability and acute pain unpleasantness in the weeks after major surgery. Further evaluation is needed of the psychometric properties and factor structure of the CPASS. Future research is needed to determine whether pain anxiety also plays a role in the transition from acute to chronic pediatric postsurgical pain.

Conflict of interest statement

The authors have no conflict of interest.

Acknowledgments

M.G.P. is supported by a Canada Graduate Scholarship – Doctoral Award from the Canadian Institutes of Health Research (CIHR). M.G.P and A.M.P. are CIHR Strategic Training Fellows in Pain: Molecules to Community. M.G.P. is a CIHR Strategic Training Fellow in Pain in Child Health (PICH) and a recipient of a Lillian-Wright Maternal-Child Health Scholarship from York University. J.K. is supported by a CIHR Canada Research Chair in Health Psychology at York University. J.S. is supported by a Ministry of Health and Long-term Care Career Scientist Award.

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