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Development and validity of the Burns-Child Adult Medical Procedure Interaction Scale (B-CAMPIS) for young children

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ARTICLE INFO

Article history:
Accepted 17 August 2018

Keywords:
Observation
Pediatric
Parenting
Behavior
Procedural pain
Anxiety
Coping
Distress
Psychometrics
Validity
Reliability

ABSTRACT

Background: Young children are at increased risk of burn injury and of procedural distress during the subsequent wound care. There are currently few observational measures validated for use with young children during medical procedures. The aim of this research was to adapt the Child–Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R) to assess parent-young child interactions during burn wound care by including nonverbal behavioral coding.

Method: Eighty-seven families of children (1–6 years old) were recruited at their first burn dressing change. Potential behaviors were identified through a literature review, consulting health professionals, and direct observation of parents and children during burn wound care. Nonverbal behaviors were coded live, and verbal behaviors were audio recorded for later assessment.

Results: Inter-coder reliability was good to excellent for the Burns-CAMPIS (B-CAMPIS). The additional behaviors were correlated with the hypothesized coping, distress, coping-promoting and distress-promoting categories of the CAMPIS-R. Some behaviors differed in frequency across child age groups, with older children demonstrating more verbal behaviors. Convergent validity was demonstrated through correlations with previously validated observational parent–child behavior measures, and parent- and nurse- reported measures of child pain and anxiety. Univariate regression analyses demonstrated the child categories of the B-CAMPIS accounted for equal or more of the variance of parent- and nurse- reported child pain and anxiety, compared to the CAMPIS-R.

Conclusions: The B-CAMPIS is a reliable and valid measure, for assessing coping and distress relationships in young children and their families. Pending further validation, the B-CAMPIS assists researchers and clinicians to recognize and target important behaviors to improve young child coping during pediatric burn wound care.

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https://doi.org/10.1016/j.burns.2018.08.027
0305-4179/

1. Introduction

Young children are at risk of increased pain-related distress during medical procedures because they have an underdeveloped cognitive capacity and thus difficulty rationalizing procedural pain as necessary, helpful and temporary [1,2]. Research on child pain-related distress during medical procedures has predominantly been conducted on children undergoing oncology [3], perioperative anesthetic induction [4], and immunization procedures [5]. The majority of children who are hospitalized due to injury (e.g. drowning, poisoning, falls, and burns), are under 5-years-old [6]. Monitoring child behavior during all types of medical procedures is valuable, because behavior is often indicative of pain and distress [7]. Medical procedures relating to injuries might be particularly distressing for children, as it can serve as a reminder of the injury itself, and has been implicated in posttraumatic stress development [8]. Considering the prevalence of injuries in young children, there is a unique need for an observational tool to assess young child (1–6-years-old) procedural distress, and for it to be validated for use in a variety of injury-related medical procedures.

One important yet understudied cohort is families undergoing pediatric burn wound care. Burn wound care (debridement and dressing change) is often painful and distressing, and is repeated until re-epithelialization (wound healing). Understanding the young child's experience during burn wound care is particularly relevant because the procedure can be especially painful due to physiological changes can interfere with the provision of adequate pharmacological pain management [9]. Also, burn injuries are related to more frequent posttraumatic stress symptoms compared to other injuries [10]. Posttraumatic stress symptomology (avoidance, hyper-arousal, intrusive thoughts, negative mood) can be especially prevalent and affect a child's behavior during burn wound care. Observational research in young child burn wound care is important because increased pain and anxiety during pediatric burn wound care has been associated with delayed re-epithelialization [11,12] as well as ongoing psychological distress [13].

In addition to pharmacological intervention, non-pharmacological pain management interventions are available for school-aged children undergoing burn wound care. Children 4 years and older are commonly offered the Ditto™ device (an evidence-based electronic preparation and distraction device, and is available through Diversionary Therapy Technologies, Queensland, Australia) [11]. Other work has recognized the benefits of virtual reality, which is suitable for children 6-years-old and older [14]. The availability of these interventions rely on uptake by the particular burns center. Burns centers may also employ psychologists and child life therapists to assist with procedural distress. However, there are currently no non-pharmacological pain management interventions available for young children, despite their high risk for experiencing procedural distress. Understanding a young child's experience during burn wound care is necessary to inform interventions for improving care.

Parenting behavior is a key factor in child coping and distress behaviors during medical procedures [15]. A medical procedure can be highly distressing for young children [16], and children are particularly attentive to their parents' reactions during a stressful event [17,18]. A parent engaging in emotion co-regulation (appropriately assisting the child to regulate their emotional responses) [19–21] will likely result in a calmer procedure. However, parenting behavior during a child's burn wound care may be impacted by the additional stress of witnessing their child in pain, the shock of seeing the wound, ongoing worry about the injury severity, need for grafting, and the potential for scarring [22–24].

Key parent–child behaviors have been previously identified and validated. Child distress behaviors include crying, screaming, flailing, requiring restraint, resisting, fear, pain, negative emotion, seeking emotional support and information [3,25]. Behaviors that indicate child coping include making a coping statement, non-procedural talk, deep breathing, playing, and looking at their parent [3,5,25]. For parents, distress-promoting behaviors include criticism, reassurance, giving the child control, apologizing, and empathy [3,4]. Finally, parent coping-promoting behaviors include humor, non-procedural talk, command to engage in a coping strategy, playing, offering soothing item, and demonstrating what to do [3,5,25]. A common observational measure used for interpreting parent and child (4–13-years-old) behavior during medical procedures is the Child–Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R) [3,26]. The CAMPIS-R identifies 35 verbal behaviors that are grouped into three child behavior categories (coping, neutral, and distress), as well as three adult behavior categories (coping-promoting, neutral, and distress-promoting). The CAMPIS-R was initially developed using a sample of children undergoing bone marrow aspiration/lumbar puncture procedures as part of cancer treatment [26].

To date, no studies have observed parent–child interactions during burn wound care. A variety of observational instruments have been utilized to assess child distress behavior during burn wound care. Studies investigating child distress behavior during burn wound care have used the Observational Scale of Behavioral Distress (OSBD) measure [27–29], Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) [30], COMFORT behavior scale (COMFORT-B) [31], Pain Observation Scale for Young Children (POCIS) [32], or the Face, Legs, Arms, Cry, Consolability (FLACC) measure [12,33]. The OSBD and CHEOPS require videoing, while the FLACC, POCIS, and COMFORT-B can be coded live. Five of the studies assessed young children with mean ages between 2–4-years-old [28,30–33], and three studies assessed older children with mean ages between 6–8-years-old [12,27,29]. These measures do not code child coping behaviors or adult behaviors, which are important for identifying the parent's influence (i.e. emotion co-regulation) on their child's behavior [15]. In comparison, the CAMPIS-R does code child coping behavior and adult behavior, however it is not able to be used with preverbal children. Further work is required to create a valid and reliable measure for specifically assessing parent–young child interactions during burn wound care.

In order to expand the CAMPIS-R to be relevant for use with families of young children undergoing burn wound care, the measure must include child and parent nonverbal behavior. Adding nonverbal coding to the measure is important because young children (1–3-years-old) primarily communicate emotion through nonverbal behavior [34,35]. With regards to

developing a measure that assesses all young children, it is expected that children who are 1 years of age will show the lowest rates of verbal behavior, children who are 2-years-old will show an increase in verbal behavior, and comparatively children aged between 3–6 years will show the highest rates of verbal behavior. Only coding verbal behavior would miss the majority of interactions between young children and their parents. There may also be additional important parenting behaviors specific to burn wound care. Considering the unique burden of witnessing burn wound care [22,23], it is possible there are other parenting behaviors that are unique to burn wound care that are related to child coping or distress. It is expected that including these additional behaviors will improve the measure's validity.

A new observational measure should show convergent validity with alternative measures, regarding the parent, child, and associations between parent and child behaviors. Previous research has established varying degrees of convergent validity in parent–child observational measures. Relevant measures include the CAMPIS-SF [25], Measure of Adult and Infant Soothing and Distress (MAISD) [5], and Perioperative-CAMPIS (P-CAMPIS) [4]. Parental behavior was validated during the development of the CAMPIS-SF, but not the P-CAMPIS or MAISD. In comparison, child behavior has been validated with various alternative observational, parent-report, nurse-report, and child self-report measures. Specifically, child coping behavior and child distress behavior was validated in the development of the CAMPIS-SF, however only child distress behavior was validated in the development of the P-CAMPIS and MAISD. To more effectively validate our new measure, we aim to analyze the convergent validity of parental behavior and child behavior (coping and distress) with a range of alternative measures.

Beyond testing for convergent validity, it is recommended that other types of validity be evaluated [36]. For the current study, we will modify an existing measure (the CAMPIS-R) to a specific population (i.e. burn wound care for young children), and as such incremental validity (the value of the new measure compared to the original measure in assessing a construct) should also be demonstrated. Therefore, upon developing a new measure, the purposes of this paper are to 1) report inter-coder reliability; 2) confirm the nature of additionally identified behaviors in relation to existing validated behaviors (used in other instruments); 3) assess behavioral differences in children of different ages, and; 4) test whether the modified measure is valid for assessing parent and child behavior, using convergent and incremental tests of validity.

2. Materials and methods

2.1. *Participants*

Parents of children aged 1–6-years-old who had sustained an unintentional burn injury, were recruited at the child's first burn wound care appointment, at the Pegg Leditschke Children's Burns Centre, Lady Cilento Children's Hospital, Brisbane, Australia, during September 2015–July 2016. A pilot sample was recruited to refine the measure and reach inter-coder reliability before the main sample was recruited to assess validity. To test for coder drift, inter-coder reliability was also assessed in 20% of the main sample. All recruited children were given pharmacological pain relief prior to the dressing removal; however sedative medication was not administered to any child in this study. Exclusion criteria specified 1) if the dressing had been changed prior to this appointment; 2) if the number of days since the injury exceeded 7 days (to exclude delayed presentations); 3) if the child had a diagnosed developmental disorder, or; 4) comorbid head injury; 5) the injury was suspected abuse or neglect; 6) the primary care giver was absent, or; 7) the family spoke insufficient English for questionnaire completion and verbal behavior coding. The University of Queensland Human Research Ethics (approval number 2015000623) and the Children's Health Queensland Hospital and Health Service Human Research Ethics Committee (approval number HREC/15/QRCH/27) approved this study. Participating parents provided written informed consent. Participating children were not required to give assent as all children were under the age of 7-years-old.

2.2. *Procedure*

Potential participants were approached upon arrival to the centre. Prior to the dressing removal and debridement, parents were asked to report on demographic information, including items regarding ages, ethnicity, gender, education, and annual family income. The nonverbal behavior of the child and parent was coded before, during and after dressing removal and debridement. Given the small examination rooms often held all attending family members (i.e., both parent/s, grandparent/s, and sibling/s) and at least one nurse, the raters stood in close proximity whilst not intruding or potentially interfering with the procedure, in an attempt to observe the same behaviors while under instruction to ignore the other rater's coding behavior. Audio recordings were made concurrently, and subsequently transcribed for coding verbal behavior. Consistent with previous research [5], coding initiated when the nurse began to remove the dressing, and completed 2 min after debridement (the washing and cleaning of the wound), unless the child left the room earlier. Following coding, the coder asked the parent to report the child's procedural pain and anxiety retrospectively, and the nurse reported the child's pain-related distress behavior.

2.3. *Measures*

2.3.1. *Development of the Burns-CAMPIS (B-CAMPIS)*

The B-CAMPIS was developed under the recently published guidelines for pediatric behavioral coding [36]. A pool of potential behaviors were identified through a literature search, consulting health professionals, and direct observations. Firstly, verbal behaviors were identified from the CAMPIS-R measure [3], and nonverbal behaviors were identified from the MAISD [5], CAMPIS-SF [25], and P-CAMPIS [4] measures. Additionally, nonverbal behaviors specific to burn wound care were identified through consultations with a range of pediatric burns healthcare professionals (doctors, nurses, occupational therapists, social workers, psychologists, and physiotherapists) and the researcher observed a large number of burn wound care procedures prior to commencing

the study. Identified additional nonverbal child behaviors included gaze to injury, using the Ditto™ device, watching television, and aggressive behavior (i.e. intentionally kicking or hitting someone). Identified additional nonverbal parent behaviors included crying and unengaged distress. A parent demonstrated unengaged distress when they did not initiate or respond to their child because they were distressed themselves. All behaviors were operationalized in terms of behavior examples and how to score each behavior.

2.3.1.1. *Scoring*. The frequency of each discrete behavior was calculated. The frequency of continuous behavior (i.e. playing) was coded in 10-s time blocks, similar to previous methods [3,5]. For example, a child who looked at the television screen for 1 s (discrete behavior), looked away for 2 s, then reengaged with the screen for 2 s (discrete behavior), was represented by a frequency score of 2. In comparison, a child who looked at the television screen for 11 s (continuous behavior) is also represented by a frequency score of 2. The frequencies of behaviors relating to each CAMPIS-R category (child coping, child distress, parent coping-promoting, parent distress-promoting) were summed then divided by the procedure duration to give a proportion of behavior, as recommended previously [36].

2.3.1.2. *Coder training and inter-coder reliability*. Two coders were trained on the first version of the B-CAMPIS to establish reliability. A pilot sample of parents of 15 children aged 1–6-years-old presenting for burn dressing changes was recruited for reliability training and refinement of the B-CAMPIS measure. Children were predominantly male (n=11, 73%), with a mean age of 2.45 years old (SD=1.53). Data from the pilot study was not included in the main study sample. For coding verbal behavior, the coders reviewed the CAMPIS-R manual. The coders discussed reasons for coding discrepancies after coding each transcript for verbal behavior. Inter-coder reliability was assessed using intra-class correlations (ICCs) rather than Kappa because the data is ordinal in nature (i.e. 2 instances of reassurance is larger than 1 instance) and Kappa analyses are appropriate for data that is nominal in nature [37]. Additionally, ICCs consider the magnitude rather than absolute disagreement, and this is valuable because of the difficulty in attaining absolute reliability when scoring *in vivo* data that is expected to occur at a low frequency (i.e. Coder #1 recording 2 instances of a behavior, and Coder #2 observing 1 instance) [37]. After coding the verbal behavior of 10 families, ICCs reached excellent agreement for parent (ICCs .98–1.00) and child (ICCs .99–1.00) behaviors.

For coding nonverbal behavior, the coders reviewed the operationalized definitions and examples. The coders discussed reasons for coding discrepancies after coding each dressing removal and debridement for nonverbal behavior. Closer examination of inter-coder reliability data from the pilot study revealed certain behavior codes could be collapsed. For example, it was common to observe a parent demonstrating to their young child how to play with a toy. Because of how young the children were, this behavior could be easily interpreted as 'engaging in play' 'action example' and/or 'offering a soothing item'. These codes were merged into the single adult nonverbal coping-promoting behavior, entitled 'distract'. After coding nonverbal behavior of 15 families, ICCs reached good to excellent agreement for parent behaviors (ICCs .74–.90), and fair to excellent agreement for child behaviors (ICCs .52–1.00). Familiarization of the codes, recruiting and training for nonverbal coding during outpatient clinics, and verbal coding from transcripts was completed in approximately 5 days.

Although agreement was lower than preferred, this rate is similar to agreement rates on previous nonverbal behavioral measures [5]. Lower reliability rates have been associated with low base behavior frequencies [38], which was the case in the pilot sample. Greater variability is also to be expected when coding behavior live because there is increased potential to overlook behaviors. Only child nonverbal behavior 'requiring restraint' failed to attain at least good agreement in the pilot sample (i.e. an ICC of .60). In addition, a number of parent behaviors (criticism, apology, empathy, command to engage in a coping strategy, crying, unengaged distress) and child behaviors (scream, seeking emotional support, verbal fear, verbal emotion, information seeking, making a coping statement, non-procedural talk, humor, breathing, reading, aggression) were not observed in the pilot sample. These behaviors will be tested for inter-coder reliability in the main sample.

2.3.1.3. *Subsequently identified parent behavior*. When reviewing transcripts from the main sample, there were three additional verbal adult behaviors that were not present in the pilot sample, but seemed to represent important information parents communicated to their child during burn wound care. Additional verbal parenting behaviors included 'prompting disclosure of pain', 'threat to remove coping strategy', and 'negative evaluation of the wound'. Parents prompted the child to disclose pain, such as "That looks painful, does it hurt a lot?" Parents also threatened the child to remove a coping strategy (i.e. a distracting toy) in an attempt to control behavior, such as "I'll take away the iPad if you can't play quietly". Finally, burn wounds are uniquely graphic compared to other pediatric medical procedures, and parents reacted with negative evaluations of the wound such as "That looks disgusting!". These behaviors were added to the B-CAMPIS.

2.3.2. *Validity measures for child behavior*

2.3.2.1. *Parent-reported child pain*. Parents rated their child's procedural pain score using the Numerical Pain Rating Scale [39]. The 11-point scale was used to identify the parent's report of the "worst pain your child has experienced during this medical treatment". The left anchor was titled *no pain*, and the right anchor was titled *worst imaginable pain*. Parent-reported procedural pain scales have been positively correlated with child self-reported pain [40].

2.3.2.2. *Parent-reported child anxiety*. Parents reported their child's procedural anxiety using the Visual Analogue Scale-Anxiety (VAS-A) [41]. The VAS-A is a single item measure of state anxiety consisting of a continuous line 10 cm in length. The left anchor is *no anxiety or fear* and the right anchor is *worst possible anxiety or fear*. The VAS-A was developed to be a self-report tool, but has been also used as a proxy-report tool

for pediatric medical procedures [42]. Parent-reported child anxiety has been validated against child self-reported anxiety [42].

2.3.2.3. *Child behavior*

The child behavior scales in the CAMPIS-SF [25] were used to assess construct validity for child behavior in the B-CAMPIS. An observer gives overall scores for child coping behavior and child distress behavior on two validated 5-point Likert scales (*none/one* to *maximum/continuous*), based on the child's verbal and nonverbal behaviors. The CAMPIS-SF has good reliability (αs > 0.88), and validity against other child distress measures (rs > .39, ps < .001). For the current study, good to excellent reliability was established (coping ICC = .63, distress ICC = .82).

2.3.2.4. *Nurse-reported child pain-related distress behavior*

A nurse rated the child's procedural pain-related distress behavior using the FLACC [43]. The FLACC is an additive observational measure with five subscales. Each subscale (Faces, Legs, Arms, Consolability, Cry) can score 0–2, for a total score of 0–10 (0 represents no distress, 10 represents highest distress possible). The FLACC has excellent responsiveness, reliability, and validity [44], and is recommended for nurse-reported young child distress across a range of hospital departments [45].

2.3.3. *Validity measures for parent behavior*

2.3.3.1. *Parenting behavior*. The CAMPIS-SF [25] and the CAMPIS-R [3] were used to validate parenting behavior. As for the child, the CAMPIS-SF has two 5-point Likert scales to give overall scores for parental coping-promoting behavior and distress-promoting behavior. The CAMPIS-SF has good reliability (αs > 0.74) and validity for parental coping-promoting and distress-promoting behavior against the CAMPIS-R parenting behavior categories (rs > .75) [25]. For the current study, good to excellent inter-coder reliability was obtained (coping-promoting ICC = .81, distress-promoting ICC = .70). The CAMPIS-R consists of three coping-promoting behaviors (nonprocedural talk to the child, humor to the child, commands to use coping strategy), and five distress-promoting behaviors (verbal reassurance, apologies, empathy, giving control to the child, criticism). The CAMPIS-R has strong reliability (αs > 0.78) and validity for parental coping-promoting and distress-promoting behavior against child distress behaviors (rs > .33) [3]. For the current study, excellent inter-coder reliability was obtained (coping-promoting ICCs > .99, distress-promoting ICCs > .99).

2.4. *Statistical analyses*

Descriptive statistics were presented using medians and inter-quartile ranges (IQR) for non-normally distributed data. Categorical variables were presented using frequencies and percentages. Inter-coder reliability of the pilot and final versions of the B-CAMPIS were assessed between the two coders using ICC analyses in SPSS 24 for Windows. All ICCs were calculated using ordinal measure, two-way mixed effect, absolute agreement, and averages [37]. ICCs were rated in accordance with Cicchetti's values of poor (0.00–0.39), fair (0.40–0.59), good (0.60–0.79) and excellent (0.80–1.00) [46]. Due to the non-normality of the data, Spearman's Rho correlation analyses were used to assess the relationship between raw frequencies of additional identified behaviors with raw frequencies of previously validated behaviors.

Table 1 – B-CAMPIS behaviors for child and parent.

	Child		Parent	
	Coping	Distress	Coping-promoting	Distress-promoting
Verbal behavior	Making a coping statement Non-procedure related talk by child Audible deep breathing	Cry Scream Verbal resistance Seek emotional support Verbal fear Verbal pain Verbal emotion Information seeking	Humor directed to the child Non-procedure related talk to child Command child to engage in a coping strategy	Criticism Verbal reassurance Giving child control Apologizing Empathizing *Prompt disclosure of pain* *Negative evaluation of the wound* *Threat to remove coping strategy*
Nonverbal behavior	Play Point to décor Self-soothing Gaze to parent *Gaze to injury* *Using the Ditto device* *Watch television*	Flail Requires restraint *Aggression*	Point to distract Distract (play, action example, offer)	Reassuring contact[a] *Parent Cry* *Unengaged distress*

[a] Classified as distress-promoting in the P-CAMPIS. Italicized behaviors not previously included in observational measures.

The data retained non-normality when the proportion of behavioral frequency per minute was calculated. Therefore, the effect of child's age group on rates of displayed behavior was analyzed using Kruskal–Wallis tests. Based on the increase in language acquisition from 2-years-old [47], we divided the cohort into three groups of children aged 1.0–1.9, 2.0–2.9, and 3.0–6.9 years old. Significant findings were followed up using the one-tailed Jonckheere–Terpstra test to test for potential trends in rates of behavior by age. In addition to the J test-statistic, we reported the z score (a z score of >1.65 indicates a significant trend, and a positive z score indicates the rate of behavior is increasing as the child's age increases), and the effect size of the trend, *r*.

Analyses were performed to test convergent and incremental validity. Convergent validity was tested using Spearman's Rho correlations for the B-CAMPIS proportion scores against the CAMPIS-SF scales and the CAMPIS-R proportion scores. Incremental validity was examined using univariate linear regression analyses. This served to compare the variance accounted for by the B-CAMPIS child categories to the CAMPIS-R child categories in predicting parent-reported child procedural pain and anxiety, and nurse-reported child pain-related distress behavior. The proportion of variance in the outcome explained by each model (B-CAMPIS and CAMPIS-R) was presented using the R^2 value. All analyses were performed using SPSS 24 for Windows [48] and *p*-values with $p<.05$ were considered statistically significant.

3. Results

Three previously reported child coping behaviors (reading, humor by child, nodding) remained unobserved in the final sample, and were therefore omitted from the final B-CAMPIS measure. These behaviors were likely unobserved because of the young age of the children. Child B-CAMPIS codes not previously found in the CAMPIS-R include gaze to injury, using the Ditto™ device, watching television, and aggression. Parent B-CAMPIS codes not previously found in the CAMPIS-R include prompt disclosure of pain, negative evaluation of the wound, threat to remove coping strategy, parent cry, and unengaged distress. These behavior codes were hypothesized to relate to the indicated categories, as reported in Table 1. The manual and coding sheets for the final version of the B-CAMPIS can be obtained from the corresponding author.

3.1. Demographics

Of the recruited 92 families, 3 families were excluded due to speaking a language other than English during the dressing removal and debridement, one child's injury was superficial in depth, and for one child the wound mechanism was an infection rather than due to a thermal cause. The remaining sample consisted of 87 parent–child dyads. See Table 2 for the sample characteristics.

Table 2 – Sample characteristics.

Sample characteristics	N=87
Child	
Age, mean±SD (range), years	2.40±1.12, (1.04–6.94)
Sex, *n* (%)	
Male	50 (57)
Female	37 (43)
Ethnicity, *n* (%) *n*=76	
Anglo/European	60 (69)
Pacific Islander	8 (9)
Asian	5 (6)
African	2 (2)
Aboriginal/Torres Strait Islander	1 (1)
Parent	
Sex, *n* (%)	
Mothers	73 (84)
Fathers	14 (16)
Age, mean±SD (range), years, *n*=75	32.37±5.31 (21–43)
Education, *n*=73, *n* (%)	
High school education or less	21 (22)
Technical training	20 (27)
University degree	32 (44)
Annual family income, *n*=69, *n* (%), $AUD	
Less than $40,000	9 (10)
$40,000–80,000	19 (22)
$80,000–120,000	21 (24)
More than $120,000	20 (23)
Injury	
Burn depth, *n* (%)	
Superficial-partial	63 (72)
Deep-partial	21 (24)
Full-thickness	3 (4)
%TBSA, mean±SD (range)	1.90±2.10 (0.50–12.00)
Injury mechanism, *n* (%)	
Scald	42 (48)
Contact	42 (48)
Friction	2 (3)
Radiant Heat (sunburn)	1 (1)
Number of days following injury when procedure was observed, mean±SD (range)	3.24±0.99 (1–6)
Procedure duration, mean±SD (range), min:sec	12:28±3:33 (5:57–23:25)
Number of pharmacological intervention, mean±SD (range)	1.98±0.63 (1–4)

SD=Standard deviation; $AUD=Australian dollars; %TBSA=Percentage of total body surface area burned.

3.2. Inter-coder reliability

The primary coder coded all 87 medical procedures, and the secondary rater coded 18 (20%) transcripts, and a further 15 (17%) nonverbal live observations. Table 3 reports the inter-coder reliabilities for parent and child behavior in the main sample. Inter-coder reliability was good to excellent. The average ICC for verbal child behavior was .90, and for nonverbal child behavior was .85. The average ICC for verbal parenting behavior was .87, and for nonverbal parenting behavior was .83. Although nonverbal behaviors aggression (child) and unengaged distress (parent) were not observed during the 15 selected live observations, it was observed by the primary coder during other observations and therefore retained in the final version of the B-CAMPIS.

Table 3 – Inter-coder reliability of behavior.

Behavior	ICC	Ratings of agreements[a]
Child behavior		
Child verbal behavior (N=18)		
Cry	.99	Excellent
Scream	.89	Excellent
Verbal resistance	.92	Excellent
Emotional support	.79	Good
Verbal pain	.99	Excellent
Information seeking	.90	Excellent
Non-procedural talk by child	.89	Excellent
Verbal fear	.99	Excellent
Verbal emotion	.80	Excellent
Making a coping statement	.80	Excellent
Breathing	.99	Excellent
Child nonverbal behavior (N=15)		
Play	.90	Excellent
Point	.60	Good
Requires restraint	.79	Good
Flail	.79	Good
Self soothe	.85	Excellent
Using the Ditto device	.93	Excellent
Watching television	.96	Excellent
Gaze to injury	.88	Excellent
Gaze to parent	.96	Excellent
Aggression	–	–
Parenting verbal behavior (N=18)		
Verbal (N=18)		
Criticism	.70	Good
Verbal reassurance	.97	Excellent
Giving control to the child	.93	Excellent
Apology	.62	Good
Empathy	.91	Excellent
Humor to child	.99	Excellent
Nonprocedural talk to child	.86	Excellent
Command to engage in coping strategy	.93	Excellent
Prompting disclosure of pain	.79	Good
Threat to remove coping strategy	.99	Excellent
Negative evaluation	.88	Excellent
Parenting nonverbal behavior (N=15)		
Point to décor	.91	Excellent
Distract (play, action example, offer)	.78	Good
Reassuring contact	.74	Good
Parent cry	.88	Excellent
Unengaged distress	–	–

[a] According to Cicchetti's (1994) interpretation.

3.3. *Nature of additionally identified behavior*

3.3.1. *Child behavior*

Frequencies of using the Ditto™ device, gaze to injury, watching television, and aggressive behavior were associated with frequencies of previously validated child behaviors. Using the Ditto™ device was positively associated with coping behaviors (making a coping statement, r_s=.30, p=.005; non-procedural talk by the child, r_s=.37, $p<.001$), and negatively associated to distress behaviors (crying, r_s=−.26, p=.016; requiring restraint, r_s=−.24, p=.027). Gaze to injury was positively related to one coping behavior (making a coping statement, r_s=.21, p=.049), and negatively associated with distress behaviors (crying, r_s=−.37, $p<.001$; screaming, r_s=−.38, $p<.001$; flail, r_s=−.34, p=.001; requiring restraint, r_s=−.36, p=.001). Understandably, watching television was negatively associated with coping behavior (playing, r_s=−.22, p=.040), however watching television was also negatively associated with distress behaviors (screaming, r_s=−.23, p=.031; verbal resistance, r_s=−.23, p=.031). Aggressive behavior was only negatively associated with gaze to injury (r_s=−.28, p=.009). Therefore, the additional behaviors using the Ditto™ device, gaze to injury and watching television were added to the child coping category, and aggressive behavior was added to the child distress category.

3.3.2. *Parenting behavior*

Frequencies of negative evaluation of the wound, prompting disclosure of pain, threatening to remove coping strategy, crying, and unengaged distress were associated with frequencies of previously validated parenting behaviors. Negative evaluation of the wound was positively associated with distress-promoting behaviors (empathy, r_s=.26, p=.014; threat to remove coping strategy, r_s=.31, p=.003). Prompting disclosure of pain tended to be associated with distress-promoting behaviors (giving control to the child, r_s=.19, p=.085; empathy, r_s=.19, p=.077). Surprisingly, threat to remove coping strategy was positively associated with one coping-promoting behavior (command to engage in a coping strategy, r_s=.31, p=.004), but it was also associated with a distress-promoting behavior (verbal reassurance, r_s=.29, p=.007). Crying was negatively associated with one coping-promoting behavior (distract, r_s=−.23, p=.033). Unengaged distress was positively associated with a negative evaluation of the wound (r_s=.23, p=.031), and threat to remove coping strategy (r_s=.29, p=.007). Therefore, negative evaluation of the wound, prompting disclosure of pain, threatening to remove coping strategy, crying, and unengaged distress were added to the parental distress-promoting category.

The nature of parental reassuring contact required additional analyses as previous measures code it differently. In the current study, reassuring contact was positively related with other distress-promoting behaviors verbal reassurance (r_s=.31, p=.004), and giving control to the child (r_s=.24, p=.023), however it was not associated with any coping-promoting behaviors. Therefore, reassuring contact was added to the parental distress-promoting category in the B-CAMPIS.

3.4. *Child development*

The effect of child development on displayed behavior was assessed by categorizing children into age groups. Table 4 demonstrates the median proportion of child behavioral frequency per minute by child age. Kruskal–Wallis tests demonstrated that child behavior (making a coping statement, non-procedural talk by child, crying, verbal resistance, seeking emotional support, verbal pain, verbal emotion, information seeking, self-soothing, requiring restraint, using the Ditto™ device, and gaze to injury) was significantly affected by child age, ($Hs(2)\geq 6.48$, $ps\leq .039$). Jonckheere's test revealed

Table 4 – Median proportion of behavior per minute and interquartile range by child's age.

Behavior (N=87)	1 year old (n=33)		2 years old (n=23)		3–6 years old (n=31)	
	Median	IQR	Median	IQR	Median	IQR
Child verbal behavior						
Verbal						
Making a coping statement	0.00	0.00–0.00	0.00	0.00–0.12	0.00	0.00–0.18
Non-procedural talk by child	0.00	0.00–0.19	0.00	0.00–0.48	0.42	0.00–1.16
Breathing	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Cry	1.94	0.85–4.46	1.68	0.00–4.34	0.08	0.00–2.45
Scream	0.00	0.00–0.23	0.00	0.00–0.18	0.00	0.00–0.00
Verbal resistance	0.00	0.00–0.00	0.00	0.00–0.14	0.00	0.00–0.21
Emotional support	0.00	0.00–0.18	0.21	0.00–0.58	0.00	0.00–0.34
Verbal fear	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Verbal pain	0.00	0.00–0.17	0.17	0.00–0.31	0.41	0.00–1.41
Verbal emotion	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Information seeking	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Child nonverbal behavior						
Self soothe	0.00	0.00–0.33	0.13	0.00–0.68	0.00	0.00–0.00
Requires restraint	0.35	0.05–0.77	0.18	0.00–0.54	0.00	0.00–0.07
Flail	0.21	0.00–0.70	0.13	0.00–0.34	0.00	0.00–0.24
Play	0.09	0.00–0.38	0.00	0.00–0.18	0.00	0.00–0.00
Point	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Gaze to parent	0.00	0.00–0.21	0.00	0.00–0.18	0.15	0.00–0.38
Watch television	0.00	0.00–0.18	0.00	0.00–1.01	0.00	0.00–0.20
Using the Ditto device	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.79
Gaze to injury	0.71	0.15–1.10	1.25	0.79–1.90	0.85	0.30–1.37
Aggression	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Parenting verbal behavior						
Verbal						
Criticism	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.16
Verbal reassurance	0.23	0.57–1.85	0.40	0.00–0.94	0.34	0.00–1.05
Giving control to the child	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Apology	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Empathy	0.00	0.17–0.46	0.00	0.00–0.17	0.00	0.00–0.26
Humor to child	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Nonprocedural talk to child	0.25	0.55–1.49	0.36	0.00–1.29	0.70	0.34–1.54
Command to engage in coping strategy	0.00	0.28–0.86	0.27	0.00–1.01	0.24	0.09–0.94
Prompting disclosure of pain	0.00	0.00–0.09	0.00	0.00–0.00	0.00	0.00–0.18
Threat to remove coping strategy	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Negative evaluation	0.00	0.00–0.20	0.00	0.00–0.23	0.00	0.00–0.14
Parenting nonverbal behavior						
Point to décor	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Distract (play, action example, offer)	0.00	0.30–0.68	0.12	0.00–0.38	0.15	0.00–0.29
Reassuring Contact	0.06	0.81–1.15	0.34	0.13–0.73	0.61	0.18–1.02
Parent cry	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00
Unengaged distress	0.00	0.00–0.00	0.00	0.00–0.00	0.00	0.00–0.00

IQR=interquartile range.

significant trends in the data: As the children increased in age, the proportion of some child behaviors (making a coping statement, non-procedural talk by child, verbal resistance, verbal pain, verbal emotion, information seeking, using the Ditto™ device) increased ($Js \geq 1414.5$, $zs \geq 2.47$, $rs \geq .27$). In comparison, the proportion of other child behaviors (crying, self-soothing, requiring restraint) decreased as the children increased in age ($Js \leq 1025.5$, $zs \leq -2.03$, $rs \geq .22$). Significant trends were not found across child age for seeking emotional support and gaze to injury. One difference was found in the proportion of parental behavioral frequency (empathy) between child age groups, ($H(2)=6.52$, $p=.038$). Jonckheere's test revealed that as the children increased in age, parent verbal behavior empathy decreased ($J=1030.5$, $z=-1.86$, $r=-.20$).

3.5. *Convergent validity*

Descriptive statistics for each category of the B-CAMPIS (behavioral frequency per minute) are presented in Table 5. Spearman's Rho correlations were conducted to test the convergent validity of the B-CAMPIS proportion scores against the CAMPIS-SF scales and the CAMPIS-R proportion scores. Significant positive correlations were found between the corresponding B-CAMPIS and CAMPIS-SF categories, and

Table 5 – Spearman's Rho correlations between B-CAMPIS, CAMPIS-SF, and CAMPIS-R child categories (frequency of behavior per minute).

	B-CAMPIS categories			
	Child coping behavior	Child distress behavior	Parent coping-promoting behavior	Parent distress-promoting behavior
Median	2.10	2.34	1.39	1.69
Range	0–12	0–20	0-13	0–15
B-CAMPIS categories				
Child coping behavior	–	−.57***	.25*	−.24*
Child distress behavior		–	−.07	.47***
Parent coping-promoting behavior			–	.28**
Parent distress-promoting behavior				–
CAMPIS-SF categories				
Child coping behavior	**.63*** **	−.75***	.18	−.43***
Child distress behavior	−.52***	**.78*** **	−.06	.50***
Parent coping-promoting behavior	.30**	−.36**	**.55*** **	.07
Parent distress-promoting behavior	−.29**	.45***	.03	**.49*** **
CAMPIS-R categories				
Child coping behavior	**.67*** **	−.33**	.12	−.24*
Child distress behavior	−.50***	**.98*** **	−.09	.47***
Parent coping-promoting behavior	.25*	−.07	**.97*** **	.32**
Parent distress-promoting behavior	−.22*	.59***	.26*	**.86*** **

B-CAMPIS = Burns–Child–Adult-Medical Procedure Interaction Scale; CAMPIS-SF = Child–Adult-Medical Procedure Interaction Scale; CAMPIS-R = Child–Adult-Medical Procedure Interaction Scale-Revised. *** $p < .001$, ** $p < .01$, * $p < .05$. Bolding indicates the equivalent category on previously validated measures.

between the corresponding B-CAMPIS and CAMPIS-R categories. Table 5 also demonstrates that associations were found in the expected directions: B-CAMPIS child coping was negatively associated to CAMPIS-SF and CAMPIS-R child coping, and B-CAMPIS child distress was negatively associated to CAMPIS-SF and CAMPIS-R child distress.

3.6. *Incremental validity*

Linear regressions were conducted to assess the variance accounted for by the B-CAMPIS child categories compared to the existing CAMPIS-R child categories on nurse-report pain-related behavioral distress score (FLACC), parent-report child procedural pain score, and parent-report child procedural anxiety score. See Table 6 for results. The B-CAMPIS child distress category accounted for slightly more variance in the variability of nurse-reported child behavioral distress (B-CAMPIS=46%, CAMPIS-R=44%), and equivalent variability in parent-reported child procedural pain (B-CAMPIS=26%, CAMPIS-R=26%) and parent-reported child procedural anxiety (B-CAMPIS=26%, CAMPIS-R=26%). The B-CAMPIS child coping category accounted for more variability in nurse-reported child behavioral distress (B-CAMPIS=16%, CAMPIS-R=0%), parent-reported child procedural pain (B-CAMPIS=5%, CAMPIS-R=0%) and parent-reported child procedural anxiety (B-CAMPIS=17%, CAMPIS-R=4%) scores.

4. Discussion

The aims of this study were to develop and test the reliability and validity of the B-CAMPIS, an extension of the CAMPIS-R observational measure. There was a gap in the field for an observational measure to assess parent–child interactions during burn wound care, and particularly for young children (under 6-years-old) who are commonly at greater risk of procedural distress, as well as sustaining a burn injury. Several additional child and parent behaviors were identified and added to the B-CAMPIS. As the Ditto™ device (currently used in pediatric burn centers across the UK, USA, and Australia) and television watching are common methods of distraction for coping [49], it was important to include these behaviors. In comparison, increased gaze to injury was an unexpected child coping behavior, despite a minority of children who displayed increased distress at the sight of the wound. Preferred coping style of the child (i.e. approach vs. avoidant coping style) should be considered before encouraging this specific coping strategy [50]. Parental reassuring contact was uniquely associated with distress-promoting behaviors in this sample. Research on infants demonstrate the analgesic benefits of contact [51]. However, for young children it appears that reassuring contact is more likely to be present with other distress-promoting behaviors, than coping-promoting behaviors.

Table 6 – Twelve univariate linear regression analyses demonstrating the predictive natures of the B-CAMPIS and CAMPIS-R child categories on parent- and nurse-reported measures of child distress.

Predictor	Nurse-reported pain-related distress behavior N=87				Parent-reported procedural pain N=85				Parent-reported procedural anxiety N=85			
	F	β	p	R^2	F	β	p	R^2	F	β	p	R^2
Child coping behavior												
CAMPIS-R	0.06	−.03	.812	.00	0.00	.00	.996	.00	3.04	−.20	.085	.04
B-CAMPIS	16.61	−.40	<.001	.16	5.10	−.24	.027	.05	15.92	−.41	<.001	.17
Child distress behavior												
CAMPIS-R	59.95	.66	<.001	.44	27.40	.51	<.001	.26	27.18	.51	<.001	.26
B-CAMPIS	65.81	.68	<.001	.46	27.57	.51	<.001	.26	26.90	.51	<.001	.26

B-CAMPIS = Burns–Child–Adult-Medical Procedure Interaction Scale; CAMPIS-R = Child–Adult-Medical Procedure Interaction Scale-Revised.

Inclusion of the additional child behaviors allowed the B-CAMPIS to reflect child coping and child distress across the developmental stages of children 1–6-years-old. Previous measures have not reported differences across age groups [4]. Older children displayed higher frequencies of verbal behaviors and using the Ditto™ device, and this was expected because young children do not have the vocabulary and metacognitive skills for these behaviors [1,11]. Younger children showed higher frequencies of crying and required more physical restraint, which also aligns with the literature [2].

The B-CAMPIS was found to be a valid measure of parent and child behavior during burn wound care. Future research should continue to disentangle the relationship between parenting behavior and child coping outcomes. The B-CAMPIS also appeared to account for more variability in parent- and nurse- reported child distress scores, particularly through identifying young child coping behavior, and is a strength of the measure.

4.1. *Clinical and research applications*

The B-CAMPIS can be used in a variety of research and clinical contexts. Further validation is required to ensure the B-CAMPIS is acceptable in different centers. The field of pediatric burns has limited evidence-based resources for intervening to reduce procedural distress. The addition of the B-CAMPIS will assist researchers to design studies to better understand and support the important role parents play in influencing child distress during pediatric burn wound care. Understanding the parents' role can lead to the development of parent-level interventions, for example, training and reinforcing beneficial behaviors during pediatric burn wound care. With regards to clinical application, it may not be feasible for healthcare professionals to code frequency of behaviors. However, healthcare professionals can still be aware of the range of evidence-based influential behaviors, in terms of their own interactions with the child, as well as the behaviors they encourage parents to use. Concerns have been raised previously regarding the potential for parental distress during pediatric burn wound care [52], however, recent research has highlighted that parents generally prefer to be present [53]. With an increasing focus towards family-centered care, it is important for parents to feel empowered to assist their child during wound care, and providing the parents with an explicit role such as distraction may be extremely helpful for the child as well as the parent.

4.2. *Limitations and future directions*

While it was a strength of the current study to test multiple types of validity, and validate child and parent behaviors, there were also some limitations to report. It is a limitation that the B-CAMPIS was not compared against observational procedural distress measures separate from the CAMPIS coding scheme (i.e. OSBD, CHEOPS), because repeated items inflated validity scores. However, with live coding nonverbal behavior, it was not feasible for multiple observational measures to be used. Another weakness was to exclude analyzing healthcare professional behavior. It is possible that parenting behaviors in the B-CAMPIS can be applied for assessing healthcare professional interactions during burn wound care. Further work could validate healthcare professional behavior within a burn wound care context. Additionally, the current research has built on the existing framework of the CAMPIS-R, which was designed to consist of four categories. Therefore the B-CAMPIS was designed to emulate the CAMPIS-R constructs. While a factor analysis would be beneficial in theory, the B-CAMPIS scores behaviors that have a broad range of frequency of occurrence and also the frequency of behaviors can differ significantly across the age groups assessed in this study. As such, a factor analysis is not recommended in this case.

5. Conclusions

Creating the B-CAMPIS is important for future research to be able to quantify parent and child interactions during pediatric burn wound care. Young children are an important yet under studied population regarding interventions for improving coping during burn wound care. Understanding the parents' and child's experiences during wound care can inform the development of targeted behavioral interventions, with the aim to reducing distress experienced by the child and their parents.

Conflicts of interest

None. Funding sources had no such involvement in the research.

Funding

E.A.B. was supported by the Australian Government Research Training Program Scholarship, the Children's Hospital Foundation, and is a trainee member of Pain in Child Health (PICH), a Strategic Training Initiative in Health Research of the Canadian Institutes of Health Research.

Acknowledgements

The authors would like to acknowledge Professor Ronald Blount and Dr. Christine Chambers for guidance with forward-developing the CAMPIS-R measure. Furthermore, the authors would like to acknowledge Krittika Vongkiatkajorn and Gillian Montague for assistance with data collection, and Anne Bernard for statistical guidance. We would also like to acknowledge the families involved in this study, and the clinical staff of the Pegg Leditschke Children's Burns Centre who graciously opened their workplace to our research.

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