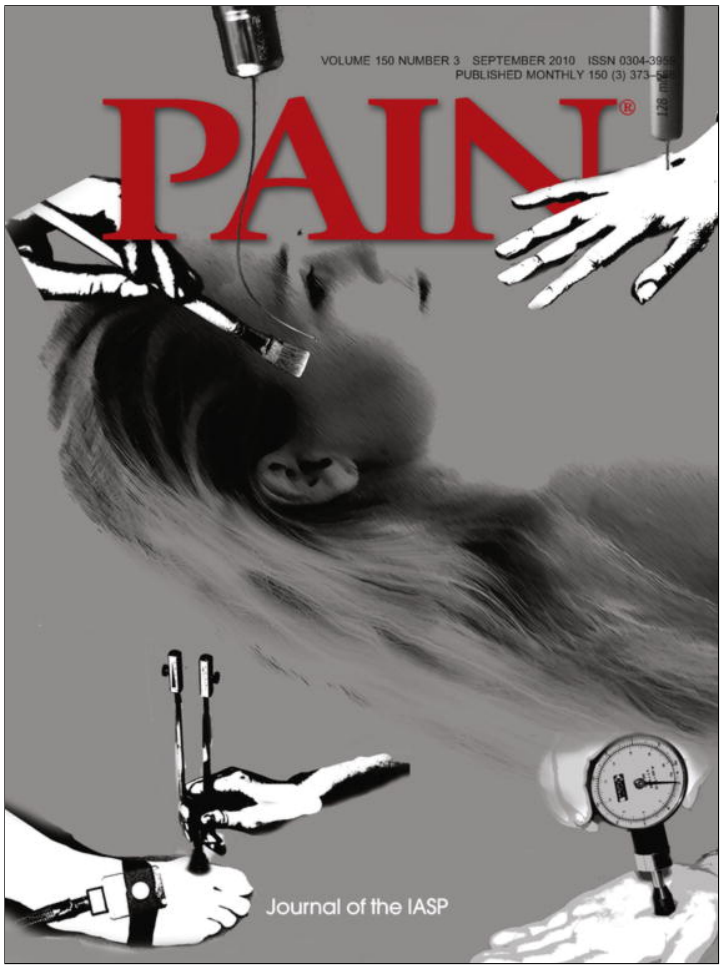

PAIN® 150 (2010) 561–567

PAIN®

www.elsevier.com/locate/pain

# Reliability, validity and clinical utility of three types of pain behavioural observation scales for young children with burns aged 0–5 years

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ARTICLE INFO

*Article history:*
Received 12 October 2009
Received in revised form 3 June 2010
Accepted 15 June 2010

*Keywords:*
Burns
Children
Pain measurement
Behaviour
Observation

ABSTRACT

Pain measurement is a prerequisite for individualized pain management and research into pain interventions. There is a need for reliable and valid pain measures for young children with burns. The aim of this study was to investigate whether the pain observation scale for young children (POCIS), the COMFORT behaviour scale (COMFORT-B) and the nurse observational visual analogue scale (VAS obs) are reliable, valid and clinically useful instruments to measure pain in children with burns aged 0–5 years. Participating trained nurses ($N = 102$) rated pain of 154 children during hospitalization. Two trained nurses simultaneously assessed pain at fixed intervals by using the previous mentioned measures. Cronbach's alpha for POCIS was .87 for background and .89 for procedural pain. Intraclass Correlation Coefficients (ICCs) were .75 for background and .81 for procedural pain. COMFORT-B observations yielded Cronbach's alpha of .77 for background and .86 for procedural pain and ICCs of .83 for background and .82 for procedural pain. The VAS obs resulted in ICCs of .55 for background and .60 for procedural pain. Correlation coefficient between POCIS and COMFORT-B was .79 ($p < .01$), Standardized response mean was 1.04 for both POCIS and COMFORT-B. Background pain measured with POCIS and COMFORT-B was lower than procedural pain ($p < .001$). Nurses found POCIS easier and quicker to use, but COMFORT-B was found to indicate pain more accurately. Both POCIS and COMFORT-B are reliable, valid and practical scales for pain measurement in young children with burns and can be used in practice and research. The VAS obs was found to be unreliable.



## 1. Introduction

Burn pain can be long lasting, has a fluctuating course and is related to extensive repetitive daily wound care procedures. A distinction is made between background pain and procedural pain [19]. Background pain, experienced while resting, is caused immediately postburn when an inflammatory response is initiated, which sensitises nociceptors in and around the burn. Procedural pain is caused by every manipulation involving the burn, which leads to additional stimulation of the nociceptors. Although procedures such as skin transplantations and removal of staples are performed under general anaesthesia, wound care procedures, lasting minimal 30 min and including removal of dressings, washing, debridement and application of new dressings (usually ceriumsilversulfadiazine cream or hydrofiber for primary burns), are carried out by using pharmacological and non-pharmacological interventions. Procedural pain is usually of higher intensity, but of shorter duration than background pain.

Adequate management of burn pain is important for many reasons. It is essential to the relationship between the patient and the multidisciplinary team, it increases comfort and makes recovery more tolerable. In addition, adequate pain management affects morbidity by preventing elevated metabolism, thereby reducing the chance of deterioration of the immune system [19]. Furthermore, adequate pain management might reduce acute stress symptoms [25,27].

To evaluate the adequacy of pain management, pain measurement is essential. Pain measurement is the nurses' responsibility, because, of all health care professionals, nurses are, as inflictors of pain and providers of pain relief, mostly confronted with pain of patients

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0304-3959/$36.00 
doi:10.1016/j.pain.2010.06.016

admitted at the burn centre. Approximately 30% of the admitted patients are children up to four years old who got, due to their development stage of motor and cognitive skills, hold of cups filled with coffee or tea or pull down hot liquid containers [25,33,35], causing severe dermal and deep dermal burns. Although some 3-year-olds and many 4-year-olds may be capable of providing self-reports, which is the commonly used method of pain assessment, most of these children are too young to express background and procedural pain by self-reports. Their pain should therefore be assessed by behavioural observation [36].

Since pain measurement is a prerequisite for individualized pain management, there is a need for pain behavioural observation measurement instruments with sufficient psychometric properties for young children with burns. Therefore, the aim of this study was to investigate the reliability, validity and clinical utility of three types of pain behavioural observation scales in order to measure procedural and background pain in children with burns aged 0–5 years.

## 2. Methods

### 2.1. Participants

Participating nurses were employed at the three Dutch burn centres: the Red Cross Hospital in Beverwijk, the Maasstad Hospital in Rotterdam and the Martini Hospital in Groningen.

### 2.2. Measures

Three pain behavioural observation scales were investigated and a questionnaire was used to assess the clinical utility of these instruments.

#### 2.2.1. Pain behavioural observation scales

*2.2.1.1. Pain observation scale for young children (POCIS).* The POCIS provides a list of behaviours that are marked as either present or absent. The POCIS was initially developed to measure postoperative pain intensity in children after adenotonsillectomy, adenotomy or insertion of ventilation tubes. The scale comprises seven behavioural items (Table 1) with dichotomous answer categories, which enables easy and quick use of the scale. The presence or absence of each item is scored 0 or 1. The POCIS has proven to be reliable, based on inter-rater agreement and internal consistency, and valid, based on a principal components' analysis that supports construct validity [4]. The POCIS showed moderate to good reliability when children with burns were observed from video fragments [11].

**Table 1**
Pain observation scale for young children [4].

| | Score |
|---|---|
| *Facial* | |
| At rest, neutral | 0 |
| Grimace, nose wrinkled, eyebrows frown | 1 |
| *Cry* | |
| No cry | 0 |
| Moan, scream | 1 |
| *Breath* | |
| Relaxed, regular | 0 |
| Irregular, hold in, gasping | 1 |
| *Torso* | |
| At rest, neutral, relaxed | 0 |
| Tense, restless, contorted, writhed, trembling | 1 |
| *Arms/fingers* | |
| At rest, neutral, relaxed | 0 |
| Tense, restless, clenched fist, wild | 1 |
| *Legs/toes* | |
| At rest, neutral, relaxed | 0 |
| Tense, restless, pulled up, kicking | 1 |
| *Arousal* | |
| Calm sleepy, calm alert, playing | 0 |
| Restless, touchy, fussy | 1 |
| Total | |

*2.2.1.2. COMFORT behaviour scale (COMFORT-B).* The COMFORT scale incorporates ratings of intensity and frequency of each behaviour and is appropriate for longer periods of observation [3]. The version that was used in this study, the COMFORT Behaviour Scale, is assumed to measure pain intensity and distress associated with pain and is an adapted version of the one developed by Ambuel et al. [1]. The adapted version has shown good reliability and congruent validity in children with postoperative pain after abdominal and thoracic surgery [31]. The scale comprises six behavioural items with five response categories for each item (Table 2). One of the six items is divided into the options respiratory response and crying. Depending on mechanical ventilation or spontaneous breathing, either respiratory response or crying has to be assessed. As it is very rare for children with burns caused by hot liquids to be mechanically ventilated, the option respiratory response was not considered in this study.

*2.2.1.3. Nurse observational visual analogue scale (VAS obs).* A visual analogue scale (VAS) provides a rating of the observer's global impression of a patient's pain [36]. The VAS is a frequently used instrument by nurses to assess pain in children [6,14,15,22–24,30]. It may provide information on individual variations in pain sensitivity, idiosyncratic behaviours and situational influences [32]. The VAS is a quick and easy to use instrument with ratio scale properties. The scale was considered reliable on the basis of inter–rater reliability for procedural pain in neonates and in children with chronic pain [20,34] and demonstrated a high correlation with postoperative behavioural observation pain measurement instruments [23,28]. Although the VAS showed poor to moderate inter–rater reliability from video assessments in children with burns [11], the scale has not yet been investigated for use with wound care procedures in real life. The VAS in this study is a straight horizontal continuous 10-cm line with clearly marked terminal ends, with the anchor words "no pain" at the left side of the line and "unbearable pain" at the right side. A mark has to be placed on this line and a ruler is needed to read the obtained score. In order to avoid confusion with other applications of the VAS, which is mostly used as a patient self-report tool, in this study, a more specific name for this tool is used, namely, the nurse observational visual analogue scale (VAS obs).

#### 2.2.2. Clinical utility questionnaire

To survey clinical utility of the scales from the nurses' point of view, structured closed-ended self-reports by means of a 5-point Likert scale questionnaire were used. The questionnaire is based on clinical utility criteria as assessed by Harris and Warren [16]. It includes items about the extent of the scales in providing clinically useful patient information and readily understandable scores. In addition, items about ease of use, time required and clarity of the scales were included. The degree of the severity of pain, the ability to differentiate between no pain and unbearable pain and the relevance of the scale items were questioned as well.

### 2.3. Data collection procedure

Approval of the medical ethics committees of the participating hospitals was obtained. Parents received written and verbal information about the study and were asked to give verbal consent. They were assured that standard medical and pain treatment remained

**Table 2**
COMFORT behaviour scale [31].

| | | Score |
|---|---|---|
| Alertness | Deeply asleep (eyes closed, no response to changes in environment) | 1 |
| | Lightly asleep (eyes mostly closed, occasional responses) | 2 |
| | Drowsy (child closes eyes frequently, less responsive to environment) | 3 |
| | Awake and alert (responsive to environment) | 4 |
| | Awake and hyper-alert (exaggerated responses to environmental stimuli) | 5 |
| Calmness/agitation | Calm (child appears serene and tranquil) | 1 |
| | Slightly anxious (child shows slight anxiety) | 2 |
| | Anxious (child appears agitated but remains in control) | 3 |
| | Very anxious (child appears very agitated, just able to control) | 4 |
| | Panicky (severe distress with loss of control) | 5 |
| Crying | No crying sounds | 1 |
| | Occasional sobbing or moaning | 2 |
| | Whining (monotonous sound) | 3 |
| | Crying | 4 |
| | Screaming or shrieking | 5 |
| Physical movement | No movement | 1 |
| | Occasional (three or fewer), slight movements | 2 |
| | Frequent (more than three), slight movements | 3 |
| | Vigorous movements limited to extremities | 4 |
| | Vigorous movements including torso and head | 5 |
| Muscle tone | Muscles totally relaxed; no muscle tone | 1 |
| | Reduced muscle tone; less resistance than normal | 2 |
| | Normal muscle tone | 3 |
| | Increased muscle tone and flexion of fingers and toes | 4 |
| | Extreme muscle rigidity and flexion of fingers and toes | 5 |
| Facial tension | Facial muscles totally relaxed | 1 |
| | Normal facial tone | 2 |
| | Tension evident in some facial muscles (not sustained) | 3 |
| | Tension evident throughout facial muscles (sustained) | 4 |
| | Facial muscles contorted and grimacing | 5 |
| | Total | |

unchanged and that the study would not cause any burden to their children.

Nurses were trained to use the POCIS and COMFORT-B before taking part in the study. Two nurses from each burn centre followed training at the two hospitals where these scales were developed. Subsequently, these nurses trained their colleagues in the burn centres using a standardized one-hour educational programme about pain and pain assessment. The training also included video and in vivo observations with both scales. The in vivo observations focussed on procedural pain as it was assumed that assessing this type of pain required most training. Each trainee completed ten assessments per scale with one of the trainers, of which five were video observations and another five were in vivo observations. When inter–rater reliability was acceptable, with intraclass correlation coefficients (ICCs) of 0.75 or more, nurses were allowed to rate children for the study and train other nurses.

Children that met the inclusion criteria, i.e. children aged 0–5 years with burns and without developmental delays, were observed by means of the POCIS, COMFORT-B and VAS obs three times a day at fixed intervals by two nurses who kept independent records. Background pain was recorded in the morning, at least one hour before wound care, and in the afternoon, at least one hour after wound care. Children were observed during two minutes. Procedural pain was assessed directly after wound care. Since procedural pain can be categorised into peak and overall pain, nurses were asked to rate overall pain of the whole wound care procedure only. Peak pain is usually caused by bandages that stick to one or more areas in the wound, is of short duration but of high intensity and does, if it occurs, not represent pain intensity of the whole procedure. Furthermore, in practice, pain interventions are adapted to accommodate overall pain, not peak pain. Research has also shown that peak pain is included in overall pain ratings: a sizable correlation between peak and overall pain is reported [12,29].

Two data collection forms comprising the three measures were developed. On each form, the POCIS and COMFORT-B were ordered differently to vary the order of completion of scales, which might avoid giving answers that are satisfactory (i.e. a box on the form is filled in), but not optimal [18]. The assumption, namely, is that the nurses may produce different patterns of responses as the previous questions may influence the latter. The VAS obs was in all cases completed after the POCIS and COMFORT-B. The following instruction for its use was given to nurses: Please estimate the level of the childs' pain by making a mark on the line. Nurses were requested not to discuss and compare their individual ratings.

The following characteristics of the participating nurses were recorded: age, gender, parenthood, education and number of years working in burn care. As for the included children, age, gender, extent and cause of the burns and length of stay were recorded. Nurses and children were encoded.

### 2.4. Data analysis

Data was analysed with the statistical program SPSS 16.0 (SPSS Inc., Chicago USA). Descriptive statistics were used to assess characteristics of nurses and children and clinical utility. Reliability, which is the degree to which an instrument measures a concept in a reproducible fashion, was judged by internal consistency (the degree in which the items of the scale belong to the same concept) and inter–rater reliability (the degree in which observers assign the same ratings) [26]. Internal consistency was assessed by Cronbach's alpha, inter–rater reliability by calculating intraclass correlation coefficients (ICCs). Acceptable reliability coefficients are $\geqslant .75$ [26]. Validity, which is the degree to which an instrument measures what it is intended to measure, was determined by convergent validity and responsiveness. Convergent validity was assessed in order to evaluate how a scale correlates with another

measure of the same construct [26]. Responsiveness is the ability of an instrument to detect clinically important change [7,13]. Spearman's rho was used to determine convergent validity, since patient characteristics were not normally distributed. Independent-samples' *T*-tests and a standardized response mean (SRM) were calculated to assess responsiveness. The value of an SRM can be considered as an effect size index. An acceptable effect size should be $d \geqslant .5$ [13,21], where .5 is a medium effect and .8 a large effect.

## 3. Results

Data were collected from June 2007 until June 2008. All parents gave verbal consent. The number of children included in the study was 154, 101 (66%) of which were boys and 53 (34%) girls. The mean age was 20 months (SD 11). Causes of the burns were scalds in 147 children (95.5%), contact burns in six children and electricity in one child. The mean total body surface area was 6.5% (SD 4.5, min 5–max 28) and the mean length of stay 10 days (SD 7.7, min 1–max 39).

### 3.1. Participants characteristics

A total of 102 nurses working in the three Dutch burn centres, which is 65% of all nurses working in this field, participated in the study. The characteristics of the nurses are described in Table 3.

### 3.2. Reliability

#### 3.2.1. Internal consistency

Internal consistency results of the POCIS and COMFORT-B are presented in Table 4. It shows that both instruments are reliable since Cronbach's alpha should range between .70 and .90 [26]. An item contributes to a scale if alpha, when calculated after this item is deleted, has a lower value than alpha of the entire scale. All alpha values were lower when items were deleted. The POCIS showed higher alphas than the COMFORT-B.

#### 3.2.2. Inter–rater reliability

As presented in Table 4, ICCs for the POCIS and COMFORT-B total scores met the criterion of $\geqslant .75$ [26] and showed small confidence intervals (CIs) for background and procedural pain, indicating good reliability. The COMFORT-B showed higher ICC than POCIS. ICCs for the VAS obs were not acceptable for both background and procedural pain.

### 3.3. Validity

#### 3.3.1. Convergent validity

In order to assess validity of the POCIS and COMFORT-B, the correlation between these two measures should be rho $\geqslant .3$ [26]. Spearman's rho was .45 for background pain and .88 for procedural pain, which was statistically significant ($p < .01$). As the POCIS and COMFORT-B correlate for both types of pain, they probably measure the same construct. The correlation for background pain, however, is lower than that for procedural pain. Since it is first necessary that an instrument measures a concept in a reproducible fashion [26], the validity of the VAS obs was not assessed because it did not meet the reliability criterion.

#### 3.3.2. Responsiveness

A *t*-test demonstrated that the POCIS total scores for background pain were statistically significantly lower than those for procedural pain (mean background pain = 0.33 (SD 1.10, median 0), mean procedural pain = 3.41 (SD 2.60, median 4), $t = -51.60$, df = 3872, $p < .001$, 95% CI = −3.3 to −3.0). Also, the mean COMFORT-B total scores for background pain were statistically significantly lower than those for procedural pain (mean background pain = 12.61 (SD 2.95, median 9), mean procedural pain = 18.54 (SD 4.12, median 18), $t = -51.69$, df = 3886, $p < .001$, 95% CI = −6.3 to −5.6).

The POCIS and COMFORT-B turned out to have a similar SRM of 1.04, which is considered a large effect. As background pain differed significantly from procedural pain and the SRM was large, it was assumed that both scales are able to measure change.

### 3.4. Clinical utility

To assess the clinical utility of the POCIS and COMFORT-B, 86 of 102 questionnaires (84% response) were analysed. The results are presented in Table 5. In general, nurses found the POCIS easier and quicker to use than the COMFORT-B, but the COMFORT-B was perceived to address procedural and background pain more accurately and to have better properties to connect to a pain management protocol. Since the VAS obs was not reliable and therefore not tested on validity, clinical utility of the VAS obs was not considered.

## 4. Discussion

The aim of this study was to assess if the POCIS, COMFORT-B and VAS obs are reliable, valid and practical instruments to measure procedural and background pain in children with burns aged zero to five years.

Both the POCIS and COMFORT-B seem to be reliable measures to assess two types of pain in children with burns. Both scales showed high and equal internal consistency. Cronbach's alpha was higher for the POCIS than for COMFORT-B, suggesting that the POCIS items show more coherence. This is in line with the assumption that the POCIS is a unidimensional scale, measuring pain intensity, while the COMFORT-B is supposed to be a multidimensional scale, including measurement of distress [36]. However, internal consistency of the COMFORT-B does not suggest a multidimensional structure.

Good inter-rater reliability was seen for both the POCIS and COMFORT. This corresponds with findings of Boelen-van der Loo [4] and De Jong et al. [11] for the POCIS, and Van Dijk et al. [31], Bear and Ward-Smith [2] and Caljouw et al. [8] for, respectively, the COMFORT-B, the COMFORT scale and the adapted COMFORT scale. The higher ICC for COMFORT-B background pain than for POCIS may be explained by a restricted range of variance in total POCIS scores, ranging from 0 to 7 when compared to the variance in COMFORT-B total scores ranging from 6 to 30.

The POCIS and COMFORT-B seem to measure the same concept and are able to distinguish between two types of pain with differences in intensity, suggesting validity of both instruments. The lower correlation between POCIS and COMFORT-B for background pain when compared to procedural pain could also be due to a restricted range of variance in total POCIS scores. SRM for both the POCIS and COMFORT-B was large. This can be explained by the substantial difference between procedural and background pain, which was already demonstrated with the *t*-test.

In contrast to the good psychometric properties of the POCIS and COMFORT-B, the VAS, when used by nurses as a global rating scale to report the patients' pain, turned out to be unreliable not only in this study but also in earlier research in children with burns [11], in adults with burns [9,12,17,29], and in children without burns but with postoperative or procedural pain [20,24]. In children with burns, De Jong et al. [11] found ICC between 0.46 and 0.66. In adult patients with burns, Pearson correlation coefficients between 0.33 and 0.47 were found [9,29]. Geisser et al. [12] consid-

**Table 3**
Nurses' characteristics ($N$ = 102).

| | | |
|---|---|---|
| Mean age (years ± SD) | | 40.8 (8.5) |
| Gender (% female) | | 86.3 |
| Nurse is parent (%) | | 67.6 |
| Education (%) | BSc | 13.7 |
| | IC | 38.2 |
| | PC | 33.3 |
| | BC | 65.7 |
| Years of experience in burn care (%) | <1 year | 14.7 |
| | ⩾1 year < 5 years | 27.5 |
| | ⩾5 years < 10 years | 25.5 |
| | ⩾10 years | 32.3 |

BS: bachelor of science, IC: intensive care, PC: paediatric care, and BC: burn care.

ered a rating to be correct when the nurse rated pain within 1 cm of the patients' rating. Using this criterion, it was found that nurses correctly assessed patients' pain in only 25% of the time. Iafrati [17] found correct assessments in only 31% of the time. In non-burn settings a range of correlation coefficients from 0.42 to 0.91 was found [20,24]. It should be noted that correlation coefficients may be of limited value to assesses inter–rater reliability because they reflect only relative positions of scores [32] and are usually higher than the true reliability [26]. It is possible that nurses are unable to express the patients' pain on a global rating scale as a 10-cm line, because they have their pain assessment affected by other than behavioural factors. Cognitive, emotional, situational and/or relational factors may play conscious or subconscious roles in their observations. These findings for the VAS support the statement of Von Baeyer and Spagrud [36], namely, that global observational scales are not recommended as outcome measures for pain.

An important issue in the pain literature is the distinction between pain intensity and fear-laden items like distress. Although this distinction was not subject of investigation, this study demonstrates that the POCIS and COMFORT-B appear to measure the same construct and it is assumed that this construct is pain. Interestingly, although the POCIS is assumed to measure, according to the developers, pain intensity, while the COMFORT-B measures pain intensity and distress, this distinction could not be confirmed by this study. Distress has been defined as behaviours of negative affect associated with pain, anxiety and fear [1]. Although distress is inextricably bound up with pain intensity, especially in children with burns undergoing repetitive wound care procedures, the concept differs from pain intensity. The ability of the scales in making distinction between these concepts was not detected in this study.

The question arises whether or not it is possible to distinguish pain intensity from affective components of pain. Von Baeyer and Spagrud [36] have stated that few researchers have presented data showing that their observational instruments can differentiate pain intensity from its affective components. This study seems to support this difficulty. Since the POCIS and COMFORT-B seem to measure the same concept, it is assumed that the affective pain component distress is embedded in the POCIS, suggesting that the presence of vocalizations, facial expressions and physical movements are not only indicators for pain intensity but also for distress. Or, with regard to COMFORT-B, distress is a component of pain intensity in children with burns and cannot be seen separately from pain intensity. This is in accordance with Blount and Loiselle [3], who have postulated that both emotional and sensory components of pain seem to be assessed by pain behavioural assessment scales and that many behaviours do not appear to have specificity as an indicator of pain or distress. They consider this, however, not necessarily problematic, since pain and distress are both included in the most commonly accepted definition of pain ('Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage [5]'). The inability of the scales to differentiate between pain intensity and the emotional components of pain may not be problematic, but only from psychometric and theoretical perspective. However, from daily practice perspective, the

**Table 4**
Results reliability for POCIS, COMFORT behaviour scale and VAS obs.

| Scale | Type of pain | Internal consistency | | Inter-rater reliability | |
|---|---|---|---|---|---|
| | | Cronbach's α | $N$ | ICC (CI) | $N$ |
| POCIS | Background | .872 | 2552 | .75 (.72–.77) | 1277 |
| | Procedural | .883 | 1322 | .81 (.78–.84) | 659 |
| COMFORT | Background | .769 | 2564 | .83 (.82–.85) | 1277 |
| | Procedural | .861 | 1323 | .82 (.80–.85) | 659 |
| VAS obs | Background | | | .55 (.51–.59) | 1277 |
| | Procedural | | | .60 (.55–.65) | 659 |

$N$ Cronbach's α: number of observations, $N$ ICC: number of paired observations, ICC: intraclass correlation coefficient, CI: confidence interval.

**Table 5**
Results clinical utility POCIS and COMFORT behaviour scale.

| | POCIS (% agree) | COMFORT-B (% agree) |
|---|---|---|
| Provides information that is clinically useful | 60.0 | 90.1 |
| Is short to administer | 81.2 | 56.1 |
| Is easy to administer | 77.6 | 65.9 |
| Is clear and easy to understand | 63.1 | 71.2 |
| Reflects the extent of background pain | 44.0 | 81.7 |
| Reflects the extent of procedural pain | 56.5 | 85.4 |
| Discriminates children with pain from children without pain | 43.5 | 82.9 |
| Score is readily understandable and allows to adapt pain management to childs' need | 39.3 | 82.9 |
| Reflects procedural pain-specific features | 77.4 | 87.7 |
| Reflects background pain-specific features | 70.4 | 87.8 |

$N$ = 86 (number of responding nurses).

differentiation between pain intensity and the affective pain components cannot be ignored. Both components require different treatments that should focus on both multimodal pharmacological and non-pharmacological interventions and should be started as soon as possible after the burn incident.

A last issue in this study concerns the clinical utility of the scales. Nurses found the POCIS easier and quicker to use, which can be attributed to the dichotomous answer categories of a behaviour checklist. The COMFORT-B, however, was perceived addressing procedural and background pain more accurately. According to nurses, this was due to the COMFORT-B's ability to allow reporting degrees of severity within the answer categories. The multiple answer categories per COMFORT-B item gave nurses the impression that a middle course was also optional and that the POCIS presence or absence options were found to be too limited to accurately assess both types of pain.

A limitation of this study is that, although it was assumed that the POCIS and COMFORT-B are able to measure change, we did not assess the minimum clinical significant difference that can be measured. Assessing the minimum clinical significant difference is essential to be able to evaluate declines in pain intensity and the percentage of clinical significant pain decrease can be achieved by comparing pre- and post-treatment pain measurements [10]. These data, however, were not collected during the present study. Another limitation may relate to the use of repeated measurements. Since observations were not independent of each other, this may bias the results. Although it is assumed that repeated measurements have a minor impact on research in which the measurement instrument itself is a subject of investigation, analyses were replicated on two subsets of the sample, i.e. one subset comprising the three paired observations attained on one randomly selected day for each child, and a second subset comprising only one paired observation per child. The obtained results remained unchanged, thereby rejecting a possible impact of dependency of observations in this study.

## 5. Conclusion

Three behavioural observation instruments are investigated for the use in a particular patient group with specific types of pain. These types of pain can be assessed with currently available measurement instruments: the POCIS and COMFORT-B showed good reliability and validity in this study and are considered clinically useful. The VAS obs, when completed by nurses, showed poor reliability to estimate children's pain.

### 5.1. Recommendations for practice

The POCIS and COMFORT-B can be used to measure background and procedural pain in daily burn nursing practice. Development of pain management protocols is recommended in order to connect them to the total scores of the scales. A global observational rating scale like the VAS obs when completed by nurses is not recommended as pain measurement instrument in children with burns.

### 5.2. Recommendations for further research

With the aim of connecting the total scores of the scales to a pain management protocol, cut off scores should be assessed to differentiate pain intensity. Also, the minimum clinical significant difference is an important issue to investigate. Furthermore, when pain is measured and treated, the adequacy of pain management can be evaluated. Finally, global observational rating scales completed by nurses are not recommended for the use of validity assessment of pain behavioural observation scales in children with burns.

## Conflict of interest

The authors have no financial or other relationships that can lead to conflicts of interest.

## Acknowledgements

The authors would like to thank all nurses from the Dutch burn centres, Mrs. O. Duijndam, Mrs. M. Fuchs, Mrs. C. Hulsmann, Mrs. N. Kruger, Mrs. J. Leeman, Mrs. A. Nijman, Mrs. I. Oen, Mrs. H. Renkema, Mrs. C. Roerhorst and Mr. R. Scheffer for their participation, support and advices. They would also like to thank Prof. dr. R. de Vet for her statistical advice. This study was supported by a Grant (06.301) from the Dutch Burn Foundation, Beverwijk, The Netherlands.

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