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Infant Distress During Immunization: A Multimethod Assessment

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The purpose of this study was to comprehensively describe infant procedural distress and pain across assessment modalities, and to compare similarities and differences across measures. A multimethod assessment of distress was conducted to investigate infants ($N = 37$) undergoing routine immunizations. Measures of infant distress included Parent report, nurse report, infant heart rate, and an observational measure of infant distress. Parents rated their infant's distress and pain significantly higher than did nurses. Observational and physiological ratings of infant distress were found to vary significantly by phase, and there were no correlations between adult ratings of pain and distress and physiological ratings. Findings suggest that infant procedural distress can be assessed in a number of manners. The discordance between these measures emphasizes the need for multimethod assessment of pediatric procedural distress in both research and clinical settings. Given the differences between parent and nurse ratings, clinicians should be aware that different assessment methods might lead to different conclusions about infant procedural distress.

KEY WORDS: procedural distress; parent ratings; nurse ratings; multimethod assessment.

In their first year of life, healthy infants typically undergo numerous painful medical procedures including heelsticks, circumcision, and a battery of immunization injections. Until recently, infant pain and procedural distress has been overlooked, and as a result little is known about how infants typically experience pain. Some explanations for this disregard of infant pain and distress include the beliefs that infants' neural immaturity would protect them from fully experiencing pain (McLaughlin, Hull, Edwards, Cramer, & Dewey, 1993) and that early painful experiences would not be remembered or pose any long-term damage (Swafford & Allen, 1968; Zimmermann & Torrey, 1965). However, recent research has demonstrated that infants do experience procedural pain and distress in a similar manner to older individuals (e.g., Johnston, Stevens, Yang, & Horton, 1995), and that early painful experiences might sensitize infants to experience heightened pain and distress during later invasive procedures (see Porter, Grunau, & Anand, 1999, for a review).

Another reason that infant pain and distress have been understudied, and the most likely reason for the widespread undertreatment of infant procedural pain and distress, is that infants lack the ability to verbalize their pain (Alexander & Manno, 2003; Anand & Craig, 1996). Given that pain is a subjective experience, self-report might be the gold standard of pain assessment (McGrath, 1990). Although valuable, self-report is limited. In specific, self-report is subject to bias, and researchers (Doherty, Yanni, Conroy, & Bresnihan, 1993; Manne, Jacobsen, & Redd, 1992) have found discrepancies between self-report and other indices of pain. The weaknesses of self-report is related to the development of alternate measures of procedural pain and distress, and the general recommendation that pediatric pain should be assessed in a multimodal fashion (e.g., McGrath, 1990).

Along with the acknowledgment of infant pain and the growth of alternative assessment techniques, researchers have begun to develop excellent methods

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of quantifying infants' procedural experience. For example, physiological measures including heart rate, respiratory rate, and blood pressure frequently have been employed to gauge infant pain and distress experiences (see Sweet & McGrath, 1998, for a review). Of these physiological measures, heart rate change is less invasive than other procedures and relatively easy to obtain. Many researchers have examined the change in heart rate from a baseline reading as a method of assessing infant pain and distress (e.g., Jay, Elliott, Ozolins, Olson, & Pruitt, 1985). Researchers have found that heart rate typically increases during infants' painful experiences (Craig, Whitfield, Grunau, Linton, & Hakjistavropoulos, 1993; Owens & Todt, 1984), suggesting that it might be a valid indicator of the painful experience. Although heart rate has been found to increase during infants' painful experiences, little is known about how well heart rate correlates with other ratings of infant pain, such as parent or nurse report.

Other researchers have used parent and nurse report to assess infant pain and distress (Cohen, 2002; Manne et al., 1990). One method that researchers have employed to assess the parents' and nurses' perceptions of infants' procedural distress is through Visual Analogue Scales (VASs). VASs are typically a line or continuum with only the separate ends anchored (e.g., *not upset* and *very upset*). Employing VASs typically results in less bunching of scores than with categorical pain scaling methods such as Likert scales, and VASs have good validity and reliability (McGrath, 1990; Varni, Walco, & Wilcox, 1990). Given that parents often evaluate infant distress to decide whether to seek medical attention and nurses are critical in making pain-intervention decisions, parent and nurse perceptions of infant pain and distress are particularly important to consider. In fact, parents have been shown to accurately rate infants' physical distress when compared to observations of differing facial expressions (Huebner & Izard, 1988). Likewise, research has demonstrated that nurses' perception of infant's pain behavior plays a crucial role in deciding whether the infant's pain is severe enough to require medication or additional treatments (Burokas, 1985).

Although parent and nurse report of infant pain and distress are two commonly employed methods of infant pain assessment; no study to date has compared parent and nurse perceptions of infant pain. Studies comparing nurse and parent ratings of procedural pain and distress with preschoolers and older children have resulted in mixed findings. For example, Cohen, Blount, and Panopoulos (1997) found that nurses rated children's pain at higher levels than did parents; however, no statistical tests were performed on this difference. Other researchers have found the opposite, with parent ratings of child distress exceeding nurse ratings (Manne et al., 1992). Again, because researchers did not determine whether the differences between these ratings were statistically significant, it is not possible to conclude with certainty that parent and nurse ratings were significantly different. Infant pain and distress also can be assessed via observational measures, typically completed by coding videotaped procedures with a behavioral coding scheme. These measures usually focus on infant facial expression, vocalizations, and/or body movements as criteria for infant pain (see McGrath, 1998, for a review). A popular measure in this area is the Modified Behavioral Pain Scale (MBPS; Taddio, Nulman, Goldbach, Ipp, & Koren, 1994), which is a downward extension of the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS; McGrath et al., 1985). The MBPS was specifically created to assess infant injection pain and distress, has adequate reliability and validity (Taddio et al., 1994), and has been used in several studies (Cohen, 2002; Taddio, Katz, Ilersich, & Koren, 1997).

Further compounding measurement issues is the difficulty in differentiation between the infants' physical or sensory pain and infants' fear, anxiety, or emotional distress. Observational measures of procedural pain, such as the MBPS, include behaviors that appear to assess both pain and distress. Although combining the emotional and physical aspects of the experience under the blanket term of "pain" or "distress" is efficient and convenient (Siegel, 1988), given the novelty of infant pain assessment it makes sense to attempt to evaluate both constructs. We might find that parents and nurses have different ratings for infant "pain" and "distress," which might have important clinical implications. For instance, if parents and nurses respond differently depending on whether they are asked about the infants' "pain" or "distress," the inquiring clinicians might choose to treat or not treat the infants' pain or distress. Therefore, this study will include parent and nurse reports of both infant pain and distress to further our understanding of how these two constructs might differ.

In sum, researchers and clinicians are beginning to appreciate that infants experience procedural pain and distress, and that this experience can have negative consequences. Thus, infant procedural pain management is of increased importance, which in turn is reliant on accurate assessment of the pain. Given

that clinicians cannot depend on infant verbal report, they must select among parent, nurse, observational, and physiological indices. Because treatment of infant pain will likely differ depending on whether clinicians base their decisions on their own opinions, overt behavior, parents report, or physiological indices, it is critical that health care professionals understand the similarities and differences across measurement tools. The purpose of this study was to conduct a multimethod evaluation of infant pain and distress to comprehensively describe typical infant procedural distress and compare assessment modalities.

METHOD

Study Site and Participants

This study was performed at a rural health department in the northwestern United States. To control for possible effects of atypical medical histories, infants who were chronically ill or undergoing repeated painful medical procedures were excluded from participation in the study. The sample represents the randomly assigned control group of a treatment outcome study evaluating the effects of distraction on infant distress reaction (Cohen, 2002). Participants were 37 infants (18 males and 19 females) between the ages of 2 and 22 months ($M = 9.36$ months, $SD = 0.46$ months). The participants were ethnically representative of the study region, with Caucasian families comprising 75.7% of the sample, Asian families making up 5.4%, Hispanic families comprising 5.4%, and 13.5% of the sample did not identify an ethnicity. The sample was predominately middle class, with 21.6% indicating that they earned between $0 and $10,000 annually, 13.5% reporting $10,000 to $15,000 annually, 27.0% reporting $15,000 to $25,000 annually, 21.6% reporting $25,000 to $40,000 annually, 2.7% reporting $40,000 to $60,000 annually, 2.7% reporting $60,000 to $100,000 annually, and 2.7% reporting that they earned in excess of $100,000 annually. Income was not reported by 8.2% of the sample. The parents in the sample had completed an average of 2 years of education post-high school ($M = 14.11$ years, $SD = 2.92$ years).

Measures

History Interview

Parents completed a history form to obtain demographic information about the infant and parent. Specific demographic variables obtained included parent age, parent gender, parent education level, infant age, infant gender, and the number of other children in the home.

Modified Behavioral Pain Scale (MBPS)

The MBPS (Taddio, Nulman, Koren, Stevens, & Koren, 1995) examines infant distress behaviors across three domains: facial expression, body movements, and cry. This measure has been found to be a reliable and valid means of assessing pain in infants aged 4–6 months (Taddio et al., 1995). Because there are few other empirically validated observational measure of infant pain, the MPBS was adapted for this study to be employed with slightly older infants. Specifically, in light of the research findings that older infants exhibit a shorter duration of pain expression (Izard, Hembree, & Huebner, 1987), the phases of the MBPS were modified so as to capture four phases of the procedure as opposed to the original two, baseline and postinjection, captured in the original MPBS. These categories of infant distress were evaluated during the following four 10-s phases: baseline (starting 20 s prior to injection), preinjection (starting 10 s prior to injection), injection (10 s following the injection), and recovery (starting 20 s after the final injection). Scores for facial expression (0, 1, 2, 3), movement (0, 2, 3), and cry (0, 1, 2, 3, 4) are anchored with behavioral descriptors. For example, a score of 0 for facial distress indicates that the infant has a *positive expression*, 1 indicates a *neutral expression*, 2 indicates a *slightly negative expression* (such as a grimace, brow bulge, nasolabial furrow), and 3 indicates a *definite negative expression* (furrowed brow, eyes closed tightly, open lips). For all categories of the MBPS, higher scores indicate higher levels of infant behavioral distress. Scores of each category (facial expression, movement, and cry) are averaged for each phase to create a total distress score for each phase, ranging from 0 to 3.33.

Adhering to the MBPS protocol, undergraduate research assistants coded videotape recordings of the infants' immunization procedures. To evaluate interrater reliability, approximately 20% of the sample (18 randomly selected participants) was coded independently by both research assistants. Kappa coefficients for the individual distress categories were as follows: facial expression, .61; cry, .77; movements, .67. These scores suggest that there was good to excellent levels of agreement (Fleiss, 1981).

Parent and Nurse Report

VASs were employed to assess the parents' and nurses' perceptions of infants' procedural distress. The VASs were 100 mm horizontal lines anchored with question specific descriptors on opposite ends of the line. The specific questions posed to the parent were, "How much did this shot hurt your child?" with anchors of *not painful* and *very painful* and "How distressed was your child during the shot?" with anchors of *not distressed* and *very distressed*. The nurse responded to "how much did this shot hurt this child?" with the anchors of *not painful* and *very painful* and "How distressed was this child during the shot?" with anchors of *not distressed* and *very distressed*.

Infant Heart Rate

An electric heart rate monitor, the Tanita Cardio (Tanita Corporation of America, Inc., Arlington Heights, IL), was used to obtain the infants' heart rate. The Tanita Cardio monitor measures pulse via the fingertip, displays results digitally, and has an accuracy rate of ±5% of the actual heart rate. Infant heart rate was obtained by having a research assistant (for the first and fourth phases) or the nurse (for the second and third phases) placing the heart rate monitor on the infant's fingertip to obtain the infant's heart rate during four distinct phases of the procedure. The four phases were as follows: phase 1, when the family was awaiting the nurse in the waiting room (waiting room); phase 2, immediately prior to the immunization (preinjection); phase 3, immediately after the injection (postinjection); and phase 4, 3 min postimmunization (delayed).

Procedure

Families with an infant due to receive immunizations were directed by the receptionist to the researcher in the waiting room. This study was approved by the institutional review board, and researchers obtained parent's informed consent after describing the purpose of the study to the families. Of the 95 families approached for participation in the larger study, only five declined to participate, which was consistently because of time constraints. While in the waiting room, the research assistant obtained the infant's waiting room pulse and assisted the parent with the history interview. When the family was in the examination room, the researcher started the video camera recording and promptly left the room. The nurse obtained the infant's preinjection heart rate prior to the immunization procedure and obtained the postinjection heart rate after the immunizations were complete. Approximately half of the sample, 16 infants, received a single immunization, and the remaining received more than one immunization. The postprocedure VAS was completed by the nurse at the conclusion of the immunization. When the family returned to the waiting room, the researcher obtained the infant's delayed pulse and prompted the parents to complete the VASs. A total of three nurses assisted in this study, and each performed approximately the same number of immunizations.

RESULTS

Demographic Variables

To examine relations between demographic variables and distress, bivariate correlation analyses were conducted with the independent variable of child age and the dependent variables of parent-rated infant distress during the shot, parent-rated infant pain during the shot, nurse-rated infant distress during the shot, nurse-rated infant pain during the shot, average MBPS distress across phase of injection, and infant heart rate immediately following the shot. Independent-samples *t* tests were performed with child gender as the grouping variable and the same dependent distress variables listed above. Univariate analyses of variance were performed with family income as the fixed factor and the aforementioned distress variables as dependent measures. In these analyses, we limited our dependent measures to parent and nurse ratings of infant pain and distress during the shot, average MBPS scores, and infant heart rate immediately after the shot to decrease the likelihood of type I error. Child age, child gender, and family income were not related to the outcome variables of interest. Child ethnicity and distress could not be examined because of the uneven distribution of ethnic groups. More specifically, there were too few minorities in this study to be entered in this type of analysis.

Description of Infant Procedural Distress

Parent Ratings of Infant Distress and Pain During Immunization

Parent ratings of infant distress during the immunization short ranged from 1.50 to 100.00 with a

mean rating of 75.77 ($SD = 24.95$), with higher scores indicating higher pain. Parent ratings of infant pain during the immunization shot ranged from 12.00 to 100.00 with a mean rating of 64.81 ($SD = 23.74$). Whereas parent ratings of infant distress and pain during the immunization procedure were significantly related, $r = .36$, $p < .05$, paired samples t test revealed that parent ratings of infant distress was significantly higher than parent ratings of infant pain, $t = 2.42$, $p < .05$.

Nurse Ratings of Infant Distress and Pain During Immunization

Nurse ratings of infant distress ranged from 19.00 to 94.00 with a mean rating of 50.08 ($SD = 21.30$). Nurse ratings of infant pain ranged from 11.00 to 96.00 with a mean pain rating of 46.11 ($SD = 22.92$). Similar to parents, even though nurse ratings of infant distress and pain during the immunization procedure were significantly associated, $r = .90$, $p < .001$, nurses rated infant distress significantly higher than they rated infant pain, $t = 2.36$, $p < .05$.

MBPS Ratings of Infant Distress

Possible MBPS scores ranged from 0.00 to 3.33 with higher scores indicating more behavioral distress. Infant distress scores (representing a combination of face, cry, and body) across all four phases ranged from 1.00 to 2.75 ($M = 1.53$, $SD = 0.39$). Infant distress ratings during each of the four phases were as follows; baseline ($M = 0.84$, $SD = 0.48$), preinjection ($M = 0.96$, $SD = 0.64$), injection ($M = 2.26$, $SD = 0.43$), and recovery ($M = 2.05$, $SD = 0.61$).

Infant Heart Rate

Infant heart rate during each of the four phases was as follows: baseline ($M = 115.91$, $SD = 24.66$), preinjection ($M = 130.33$, $SD = 19.44$), injection ($M = 135.37$, $SD = 19.12$), and recovery ($M = 124.90$, $SD = 42.88$). Table I contains information about infant distress across measures.

Table I. Infant Distress Across Assessment Modalities

Measure	Range	Mean	*SD*
Parent rating			
Infant distress	1.50–100.00	75.77	24.95
Infant pain	12.00–100.00	64.81	23.74
Nurse rating			
Infant distress	19.00–94.00	50.08	21.30
Infant pain	11.00–96.00	46.11	22.92
MBPS score			
Average distress	1.00–2.75	1.53	0.39
Baseline	0.33–2.67	0.84	0.48
Preinjection	0–3.00	0.96	0.64
Injection	1.33–3.00	2.26	0.43
Recovery	0.67–3.00	2.05	0.61
Infant heart rate			
Baseline	61.00–166.00	115.91	24.66
Preinjection	83.00–174.00	130.33	19.44
Postinjection	88.00–170.00	135.37	19.12
Recovery	67.00–250.00	124.90	42.88

Relations Among Measures of Infant Procedural Distress

Correlational analyses were performed to examine the relation among the different measures (i.e., parent ratings, nurse ratings, observational tool, and heart rate). To guard against type I error, we used a bonferonni correction and set α at .008. No significant correlations were found other than a previously reported significant relation between nurse-rated infant pain and infant distress.

Differences Across Measures of Infant Procedural Distress

Paired sample t tests were performed to examine differences between (a) parent and nurse ratings of infant pain during the immunization and (b) parent and nurse ratings of infant distress during the immunization. These analyses revealed that parents rated infants' pain and distress significantly higher than nurses rated infants' pain and distress, $t = 3.91$, $p < .001$; $t = 4.88$, $p < .001$, respectively.

A within-subjects analysis of variance (ANOVA) was performed to examine whether or not observational ratings of infant distress were significantly different across the phases of the immunization. Within-subjects statistics are based upon the Greenhouse–Geisser F tests to guard against violations of the sphericity assumption and a .008 bonferonni corrected α level to protect against type I error. The analysis revealed that there were significant differences in average distress ratings across MBPS phases ($F = 97.12$, $p < .001$). Follow-up paired samples t tests revealed that injection phase distress was significantly higher than baseline and preinjection phase distress, $t = -15.14$, $p < .001$, $t = -11.31$, $p < .001$, respectively. In addition, recovery phase distress was significantly greater than baseline and preinjection

phase distress, $t = -9.89$, $p < .001$; $t = -8.80$, $p < .001$, respectively. Figure 1 illustrates the changes in distress behavior by procedural phase.

A within-subjects ANOVA also was performed to examine whether or not physiological (i.e., heart rate) ratings of infant disteress varied significantly by the phase of the immunization. Again, within-subjects statistics are based upon the Greenhouse–Geisser F tests and a bonferonni α of .008 was used. This analysis revealed that there were significant differences in mean heart rate across phases ($F = 6.21$, $p < .005$). Follow-up paired samples t tests revealed that injection phase heart rate was significantly higher than baseline heart rate, $t = -3.50$, $p < .005$. Figure 2 represents the change in heart rate over time.

DISCUSSION

The findings that parent ratings of infant distress and pain were significantly different, and nurse ratings of infant distress and pain were significantly different suggest that nurses and parents in this study did not have difficulty in distinguishing between the infants' distress and pain reactions. Apparently, parents and nurses were using different information in their judgements of infant distress versus pain. Future research would benefit from asking parents and nurses exactly what information factored into their ratings of infant distress versus pain. This data might help us understand why both parents and nurses rated infant distress as significantly greater than infant pain. Further, such data might be informative in the development of infant distress management interventions. One possible explanation for the significant correlations between parent ratings of infant distress and pain, as well as nurse ratings of infant distress and pain is method variance. Because of the threat of method variance, the use of different informants when measuring infant distress and pain is considered beneficial.

Consistent with research with older children (e.g., Chambers, Reid, Craig, McGrath, & Finley, 1998; Jay, 1988), we found that nurse and parent ratings, an observational measure, and heart rate were not correlated. Thus, the different measures likely highlight different perspectives of the infants' experience. Paralleling the recommendations for procedural distress work with older children, we encourage researchers in the infant pain area to adopt a multimethod approach. This is especially important given the historical neglect of infant procedural pain in the field. The lack of correspondence across informants suggests that infants might be treated differently depending on who makes the assessment of pain.

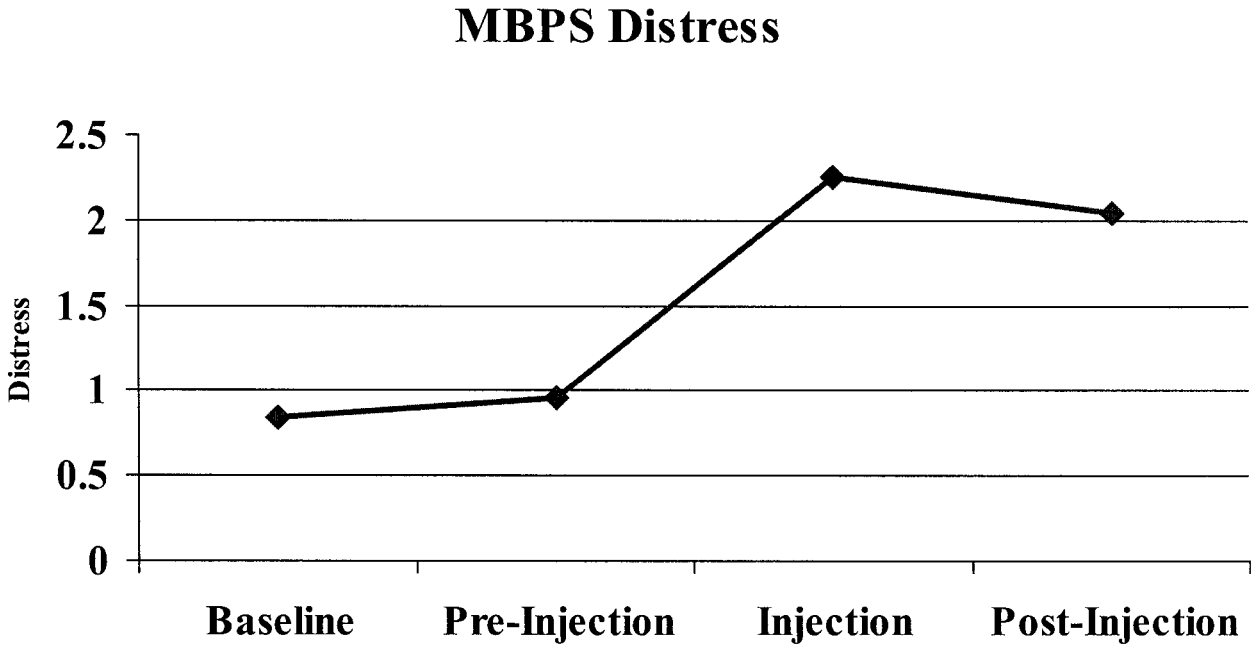

Fig. 1. MBPS distress across procedural phases.

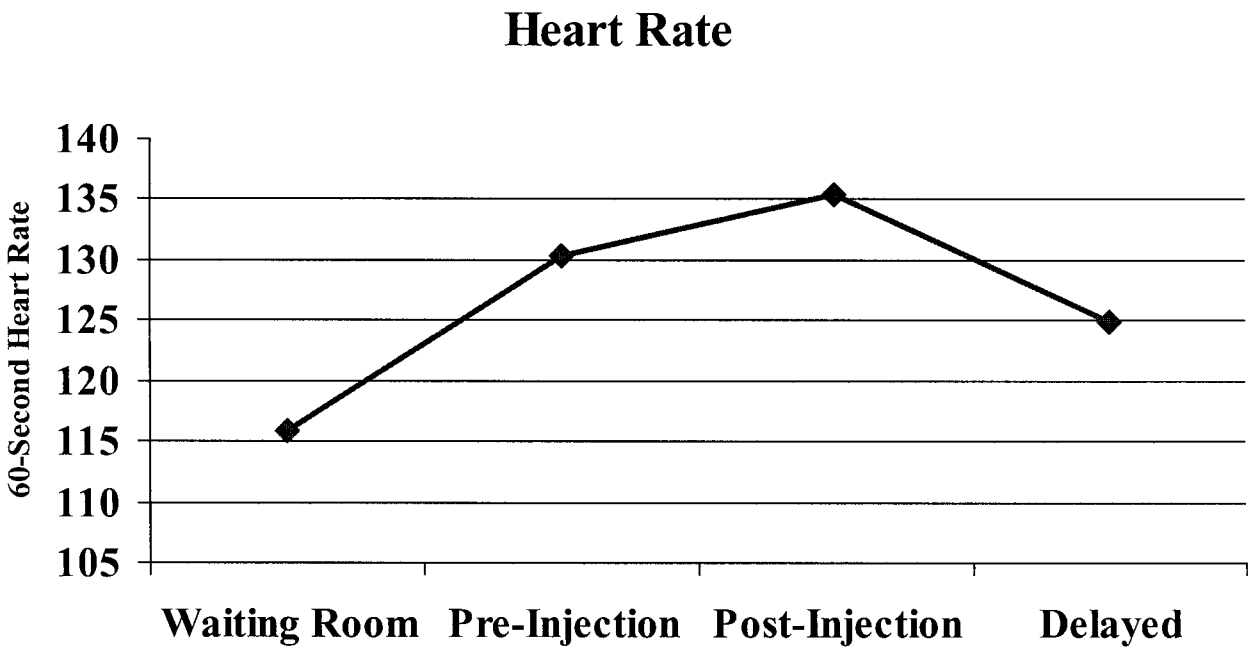

Fig. 2. Sixty-second heart rate across procedural phases.

The finding that parents' ratings of infant distress and pain were significantly higher than nurses' deserves some attention. Similar results have been found with older children (Manne et al., 1992; Schneider & LoBiondo-Wood, 1992). Perhaps parents, who are extremely familiar with their infants, are more aware of subtle, child-specific indicators of infant distress and pain than the nurses might be. It also is likely that parents are comparing their infant's distress to their infant's typical behavior, whereas nurses compare the infant's distress to the distress levels of other infants during the immunization procedure. Another possibility is that parents, being more personally invested in the well-being of their infant, are more sensitive to potential indicators of infant pain and distress than are nurses and consequently perceive greater pain and distress than do nurses who may be more removed and objective. Regardless of the explanation, these findings are valuable to health care professionals. The discordant perceptions of the medical staff and parents might contribute to parent anxiety during their children's procedures. In addition, infant distress management interventions might vary depending on whether medical professionals rely on parents or nurses evaluation of the infants' state.

According to our observational and physiological measures, infant distress varied by phase of injection. Although not surprising, it is important to note that the injection phase was the most distressing aspect of the procedure. Also notable is the finding that infant distress did not immediately dissipate after the procedure, suggesting that the time following the injection might be distressing for the child too. Consequently, we recommend that infant distress management interventions focus on not only the time of injection, but also the time following injection. One interesting direction for future research would be to examine a longer recovery period, possibly by adding phases to the MBPS or other measures beyond those used in this study.

Although there are a number of valuable findings, limitations should be acknowledged. Data were collected from only one rural health clinic. Thus, in light of the sparse infant pain assessment literature, generalization of these findings should be done with caution. Future studies might include multiple health clinics in both rural and urban settings to extend these results. Similarly, this study only evaluated immunizations, whereas examination of heel sticks and other infant procedures might result in different conclusions.

In conclusion, this study provides additional evidence that infant procedural distress can be quantified in several ways. Given the lack of correlations across measures and significant differences between parent and nurse perceptions in our study, we urge health care researchers to adopt a multimethod assessment

approach in their studies of infant procedural distress. Once greater knowledge of infant procedural distress is achieved, we will be in a better position to develop and test interventions to decrease infant procedural distress. For now, it is high time that we commit ourselves to understanding infants' procedural distress, despite what infants cannot tell us.

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