Preterm Infant’s Early Crying Associated With Child’s Behavioral Problems and Parents’ Stress

WHAT’S KNOWN ON THIS SUBJECT: Preterm infants are at an increased risk of regulatory difficulties during infancy and of behavioral problems in childhood. In the full-term population, persistent crying problems that last beyond 3 months of age have been related to later behavioral problems.

WHAT THIS STUDY ADDS: Excessive crying by a preterm infant may reflect an increased risk for later behavioral problems and higher parenting stress even years later. Therefore, it is clinically relevant to assess systematically the crying behavior of preterm infants.

abstract

OBJECTIVE: To study how the early crying behavior of preterm infants at term, 6 weeks, and 5 months of corrected age is related to later behavioral problems at age 3 and 4 years and parenting stress at 2 and 4 years.

METHODS: The study group included 202 live-born, low birth weight infants (birth weight ≤1500 g) born from January 2001 through December 2006 at the Turku University Hospital, Finland. A Baby Day Diary was used to assess the preterm infants’ crying behavior at term, 6 weeks, and 5 months of corrected age. The children’s behavior was assessed using the Child Behavior Check List at 3 and 4 years old, and parenting stress was assessed by using the Parenting Stress Index when the child was 2 and 4 years old.

RESULTS: The duration and frequency of crying bouts in infancy was associated with Child Behavior Check List scores at 4 years old and to both mothers’ and fathers’ stress when the child was 2 and 4 years old.

CONCLUSIONS: Early excessive crying, especially if lasting up to 5 months of corrected age, is a clinically relevant signal in preterm infants because it may reflect infants’ regulatory problems and/or parenting stress. The crying behavior of preterm infants should be systematically inquired about at well-baby clinics.
Preterm infants are at a higher risk than term-born infants for regulatory difficulties during infancy and for behavioral problems in childhood. During infancy, 1 sign of regulatory problems is excessive crying and fussing. It has been suggested that an infant’s crying pattern is biologically based but may be modified by environmental factors, such as caregiving styles and physical holding. In test situations in previous studies, preterm infants exhibited more irritability and difficulties in negative affect and state regulation. However, in the home environment, preterm infants have been shown to be comparable to full-term infants in the duration and the frequency of crying during the first months of life.

Infants’ prolonged crying is a common concern for parents; it causes family stress and frequent help seeking. Parents of preterm infants may be even more vulnerable to an infant’s prolonged crying; they may be overly sensitive to their infant’s negative signals and may already be stressed about his or her well-being. Mothers of preterm infants illustrate more psychological distress during the first months after birth than mothers of full-term infants.

Preterm infants’ behavioral, emotional, and neurologic problems at later ages have been shown to be multietiologic and explained in part by neurologic and cognitive deficits due to prematurity and psychosocial factors. The role of the preterm infant’s regulatory competence in the development of later behavioral symptoms is still unknown. Persistent crying problems that last beyond 3 months of age have been related to later hyperactivity and other behavioral problems in the full-term population. A meta-analysis showed that full-term, healthy children with regulatory problems, including excessive crying during infancy and sleeping problems, were more likely to experience behavioral problems in childhood than children without regulatory problems. This relation was even stronger when combined with other familial problems, such as low socioeconomic status, maternal anxiety and depression, and problems in the mother-child relationship. On the basis of this meta-analysis, the authors suggested that initial deficits in regulatory competencies and the control of stimuli may be early markers for similar processes of inadequate behavior control in childhood. More studies are needed for better understanding of the early markers and risk factors of behavioral problems, especially in at-risk infants.

Given that there are no studies on early crying and later behavioral problems in preterm infants, we studied whether the duration and frequency of crying bouts at term, 6 weeks, and 5 months of corrected age were associated with (1) parent-reported behavioral problems when the child was 3 and 4 years old and/or (2) parenting stress related to the child when the child was 2 and 4 years old.

METHODS

Subjects and Procedure

This prospective study was part of a regional, multidisciplinary, follow-up study (Development and Functioning Outcome of Very Low Birth Weight Infants From Infancy to School Age; the PIPARI Study). The Ethical Committee of the Hospital District of Southwest Finland approved the study protocol. Parents gave informed consent after receiving written and oral information.

The subjects were born at the Turku University Hospital, Finland, between January 2001 and December 2006; 259 families of very low birth weight preterm children (birth weight ≤1500 g) were invited to participate in the study. From the 259 invited families, 8 declined to participate, and 40 infants died during the neonatal period. Among the remaining 213 families, 10 were excluded. Of these, 5 infants lived outside the catchment area of the hospital, 3 had severe congenital syndromes, and the parents of 2 infants were excluded because of language problems. The characteristics of the study participants are presented in Table 1.

Neonatal background data were collected prospectively from medical records. The parents were asked for parental background data when the child was born and when child was 2 years’ corrected age. The brain pathology was defined based on the cranial ultrasound examinations, which were obtained for all preterm infants. The infants were categorized into the 3 groups according to pathologic brain-imaging findings: (1) normal, (2) minor brain pathology, and (3) major brain pathology. Children’s cognitive development was measured using Bayley Scales II at 2 years’ corrected age. Infant medical records and family characteristics are presented in Table 1.

Diaries of crying behavior were obtained for the 202 preterm infants. Only 1 diary was not obtained because of the infant’s medical condition. Of the 202 families, Child Behavior Check List (CBCL) scores were obtained from 138 families when the child was 3 years old and from 117 families when the child was 4 years old. The Parenting Stress Index (PSI) questionnaire was completed by 125 mothers and 111 fathers when the child was 2 years old and by 137 mothers and 108 fathers at 4 years old. In 80% of the participating families, both parents completed the questionnaire. A dropout analysis was performed between those families who returned ≥1 CBCL or PSI questionnaire (n = 180) and those who did not return any of the questionnaires (n = 22). These 2 groups were compared according to background characteristics (Table 1) and crying behavior (Table 2).

Preterm infants of nonresponding families cried more at 5 months’ corrected age, and they had a lower mental development score at 2 years than
preterm infants of nonresponders. No other differences were found between nonresponders and responders.

Crying behavior of the preterm infants was assessed at term, 6 weeks, and 5 months’ corrected age using the Baby Day Diary. This well-validated method tracks 5 categories of infant behavior: fussing, crying, sleeping, awake content, and feeding. In the data analysis, the combined crying and fussing behavior was assessed in 2 dimensions, the duration and the frequency of crying bouts, which were calculated as a mean for a day. Descriptive values of the infant’s crying behavior are shown separately in the participants and in the nonparticipants in Table 2. The parents (or a nurse in case of hospitalization) kept the diary for 3 days. The diary entries were to be completed on days the children were not ill or receiving vaccinations.

TABLE 2 Descriptive Values of the Crying Variables and a Group Comparison Between Participants and Nonparticipants

<table>
<thead>
<tr>
<th></th>
<th>Participants (n = 180)</th>
<th>Nonparticipants (n = 23)</th>
<th>Participants (n = 180)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Duration of crying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At term</td>
<td>136.4</td>
<td>82.1</td>
<td>137.1</td>
</tr>
<tr>
<td>At 6 wk</td>
<td>126.1</td>
<td>70.3</td>
<td>135.7</td>
</tr>
<tr>
<td>At 5 mo</td>
<td>77.28*</td>
<td>45.9*</td>
<td>111.4*</td>
</tr>
<tr>
<td>Frequency of crying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At term</td>
<td>9.8</td>
<td>5.8</td>
<td>8.2</td>
</tr>
<tr>
<td>At 6 wk</td>
<td>10.6</td>
<td>6.6</td>
<td>9.2</td>
</tr>
<tr>
<td>At 5 mo</td>
<td>7.8</td>
<td>5.6</td>
<td>6.9</td>
</tr>
</tbody>
</table>

* P < .05, x² = 4.24.
as continuous measures. The CBCL descriptive values of the study population have been reported in detail elsewhere. Only 10 infants (7.1%) had a total score >90 percentile. The questionnaires were sent by mail 2 weeks before the planned assessment point. The parents completed the questionnaire based on the child’s behavior during the past 2 months. At the 3-year assessment, 64% of CBCL questionnaires were completed by mothers, 6% of questionnaires were completed by fathers, and 30% of questionnaires were completed jointly by both mothers and fathers. At the 4-year assessment, 72% of CBCL questionnaires were completed by mothers only, 6% of questionnaires were completed by fathers, and 21% of questionnaires were completed jointly by both mothers and fathers. Data included only opposite-gender parents.

Parenting stress related to the child’s behavior and temperament was assessed using the PSI when the child was 2 and 4 years old. The questionnaire included 120 items. The PSI consisted of a child domain (6 subscales), a parent domain (7 subscales), and life stress evaluation. Only the total score of the child’s domains was used in the analysis of the association between crying and parental stress. The total score of parents’ domains was used as a control variable in the analysis of the association between crying and child’s behavior. The assessments were used as a continuous measure. The descriptive values of the PSI in this population have been reported in detail elsewhere. The questionnaires were sent by mail 2 weeks before the planned assessment point to all fathers and mothers, including parents living in separate households. In 80% of participating families, both parents completed the questionnaire.

Statistics

The associations between background variables and nonparticipation were studied using the $\chi^2$ test or Fisher’s exact test in nominal variables, the $\chi^2$ test for trend in ordinal variables, and logistic regression in continuous variables. The associations of the duration and frequency of crying to childhood behavioral problems and to parenting stress were analyzed using a mixed, repeated-measures analysis using the SAS MIXED procedure with compound symmetry covariance structure. Unstandardized regression coefficients are presented in tables. The essential medical factors of the infant and family characteristics were controlled to help explain the relationship between early crying and later behavior and parenting stress. Controlled variables included the child’s brain pathology found by neonatal ultrasound, gestational age, small for gestational age status, and the duration of mechanical respiratory support, as well as the parents’ educational level, single parenthood, and parents’ previous mental health issues. In addition, the association between early crying and a child’s behavior was analyzed by controlling maternal stress (ie, the total score of parents’ domain by using PSI).

The correlations between crying variables were studied by using the Pearson correlation coefficient. The data were analyzed by using SAS for Windows, version 9.2 (SAS Institute, Cary, NC). Differences were considered statistically significant if the $P$ value was $\leq .05$.

RESULTS

Potentially confounding infant factors (gender, gestational age, small for gestational age status, length of the respiratory treatment, and brain pathology) were not associated with any of the CBCL or PSI subscales. The potentially confounding family factors (parents’ education, family structure, or mother’s previous mental health problems) also were not associated with the CBCL or PSI subscales. However, parental stress (the total score of parent’s domains in PSI) was significantly associated with every subscale of CBCL and with the total score of child’s domain in PSI. Furthermore, married mothers reported less child-related stress (PSI) than unmarried mothers.

The duration of crying at 6 weeks’ and 5 months’ corrected age was associated with both the externalizing and internalizing symptoms and with the total score of behavioral symptoms at age 4 years. Furthermore, the frequency of crying bouts at 6 weeks’ and 5 months’ of corrected age was associated with the externalizing symptoms and with the total score of behavioral symptoms but not with the internalizing symptoms at 4 years old. There were no statistically significant associations between the duration of crying at 6 weeks and at 5 months and the total score of behavioral symptoms at 3 years, although $P$ values were $<.10$. Furthermore, the frequency of crying was not significantly associated at 5 months with externalizing symptoms or with the total score of behavioral symptoms at 3 years, although $P$ values were $<.10$.

The frequency of crying bouts at all age points and the duration of crying bouts at term and 5 months’ corrected age associated with mothers’ stress when the child was 2 years old. In addition, the duration of crying at all age points and the frequency of crying bouts at term were associated with mother’s stress when the child was 4 years old. An association was also found between infants’ crying and fathers’ stress, but it was not as strong as the association for mothers. The duration of crying at term and at 6 weeks’ corrected age and the frequency of crying bouts at term age were associated with the father’s stress related to the child’s behavior and temperament at 4 years old. In addition, the duration of crying at 6 weeks was associated with a father’s stress at 2 years. The associations of
crying to childhood behavior and parental stress are presented in Tables 3 and 4. Diagnostic plots indicated that the effect of crying on the later behavior seems to be approximately linear across the entire range.

The duration of crying at term correlated with the duration of crying at 6 weeks ($r = 0.51, P < .0001$) and at 5 months ($r = 0.26, P < .0001$). The duration of crying at 6 weeks correlated with the duration of crying at 5 months of corrected age ($0.42, P < .0001$). Furthermore, the frequency of crying at term correlated with the frequency of crying at 6 weeks ($r = 0.71, P < .0001$) and at 5 months ($r = 0.51, P < .0001$). The frequency of crying at 6 weeks correlated with the frequency of crying at 5 months of corrected age (0.75, $P < .0001$).

**TABLE 3** Associations Between Crying Behavior Measures and Child’s Behavior Analyzed by Repeated Measures

<table>
<thead>
<tr>
<th>Child’s Behavior</th>
<th>Duration of Crying (min/d)</th>
<th>Frequency of Crying Bouts (bouts/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Term, E (SE)</td>
<td>6 Wk, E (SE)</td>
</tr>
<tr>
<td>CBCL total at 3</td>
<td>0.20 (0.15)</td>
<td>0.35 (0.21)$^a$</td>
</tr>
<tr>
<td>CBCL total at 4</td>
<td>0.21 (0.19)</td>
<td>0.72 (0.22)$^{**}$</td>
</tr>
<tr>
<td>CBCL internal at 3</td>
<td>0.08 (0.06)</td>
<td>0.08 (0.07)</td>
</tr>
<tr>
<td>CBCL internal at 4</td>
<td>0.09 (0.06)</td>
<td>0.22 (0.08)$^{**}$</td>
</tr>
<tr>
<td>CBCL external at 3</td>
<td>0.05 (0.08)</td>
<td>0.16 (0.09)$^a$</td>
</tr>
<tr>
<td>CBCL external at 4</td>
<td>0.07 (0.07)</td>
<td>0.29 (0.09)$^{**}$</td>
</tr>
</tbody>
</table>

 Analyses were controlled for the child’s brain pathology, gestational age, birth weight, small for gestational age status, and duration of mechanical respiratory support or by the parents’ educational level, single parenthood, parents’ previous mental health problems, and maternal stress. E, the unstandardized regression coefficient describes how much the CBCL/PSI score is estimated to increase if the duration of crying is increased to 10 min or if the frequency of crying is increased to 1 bout.

**DISCUSSION**

The current study demonstrates that longer duration and higher frequency of crying bouts in preterm infants were associated with a higher prevalence of parent-reported behavioral symptoms and higher parental stress for mothers and fathers when the child was at preschool age. The relation of infant crying to childhood behavior and parenting stress was adjusted for several infants’ medical factors, the parents’ socioeconomic circumstances, and parent mental health factors. Association was stronger at 5 months and at 6 weeks corrected age than at term. The frequency and the duration of crying correlated strongly among the 3 time points. Our results suggest that persistent crying reported at 5 months’ corrected age is related to the later parent-reported behavioral problems. Our findings also suggest that infants’ early regulatory problems are more related to externalizing symptoms than to internalizing symptoms. However, it is possible that the internalizing symptoms are more difficult to recognize as potential externalizing symptoms at preschool age. Our findings are consistent with the studies of full-term infants who cried excessively beyond the first 3 months and exhibited a higher prevalence of externalizing behavioral problems and more family distress.13-25-27 Our findings support the suggestion that ineffective regulatory competences may be an early precursor of the less effective regulation of behavior later in childhood.26 This may be even more evident in preterm infants because of biological vulnerability.

The possible explanations for preschool behavioral problems that occur after excessive infant crying might be biological, psychosocial, or both. Combined with preterm birth, prolonged crying may complicate the development of attachment between a preterm infant and the parents, potentially causing behavioral problems at a later age. Crying is a vital capability for a newborn infant, but when an infant cries often and for long periods, the parents are understandably concerned and stressed when they do not receive positive

**TABLE 4** Associations Between Crying Behavior Measures and Parent’s Child-Related Stress Analyzed by Repeated Measures

<table>
<thead>
<tr>
<th>Child’s Behavior: PSI Child Score</th>
<th>Duration of Crying (min/d)</th>
<th>Frequency of Crying Bouts (bouts/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Term, E (SE)</td>
<td>6 Wk, E (SE)</td>
</tr>
<tr>
<td>Father’s report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At age 2</td>
<td>0.42 (0.27)</td>
<td>0.56 (0.26)$^*$</td>
</tr>
<tr>
<td>At age 4</td>
<td>0.66 (0.25)$^{**}$</td>
<td>0.94 (0.28)$^{**}$</td>
</tr>
<tr>
<td>Mother’s report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At age 2</td>
<td>0.76 (0.22)$^{**}$</td>
<td>0.83 (0.28)</td>
</tr>
<tr>
<td>At age 4</td>
<td>0.82 (0.22)$^{***}$</td>
<td>1.02 (0.26)$^{***}$</td>
</tr>
</tbody>
</table>

 Analyses were controlled for the child’s brain pathology, gestational age, birth weight, small for gestational age status, and duration of mechanical respiratory support or by the parents’ educational level or single parenthood and for the parents’ previous mental health problems. E, the unstandardized regression coefficient describes how much the CBCL/PSI score is estimated to increase if the duration of crying is increased to 10 min or if the frequency of crying is increased to 1 bout. 

* $P < .05$. 
** $P < .01$. 
*** $P < .001$. 

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feedback for their soothing efforts, which may diminish their sensitivity and response to infants’ regulatory needs. Preterm birth and the related concerns for the health of the child challenge parents and increase their risk for stress, depression, and anxiety. It has been previously indicated that prolonged crying in preterm infants, but not in full-term infants, is associated with less maternal emotional involvement and communication, suggesting that the mothers of preterm infants are more vulnerable to the impact of prolonged crying. Furthermore, our findings indicated a strong association between maternal stress and parent-reported behavioral problems. This result suggests that parental stress may have a mediating role between crying and behavior. However, the association was also discovered when the effect of maternal stress was controlled. The association between crying and behavior might also reflect some underlying neurologic issues or other physical components, which were not controlled in the current study. On the other hand, even in early infancy, crying problems may reflect parenting problems. In full-term infants, the relation between excessive early crying and later behavioral problems is strongest in families with multiple problems. These possible explanations for the association between early crying and later behavioral and parenting problems are not mutually exclusive but can act simultaneously.

Assessing infants’ crying and children’s behavior with parental reports is susceptible to reporting bias. Hyde et al. found an association between maternal-reported dysregulation at 6 months and maternal-reported behavior problems but not with youths’ self-reported problems, suggesting that a mother’s psychological well-being and social factors partly explain those associations. However, in the current study, the relation between crying and a child’s behavior was adjusted for the parent’s mental health factors. Furthermore, both parents completed the questionnaires at preschool age, and nurses partially filled out the crying diary. Using several reporters diminishes the effect of the reporting bias and increases the data’s credibility. Another limitation of this study was the lack of a control group of full-term infants. Therefore, this study does not indicate whether the relation between crying and behavior also exists in full-term infants. The third limitation of this study is the incomplete follow-up. Preterm infants of the nonresponding families cried more at 5 months than in the responding families, which is in line with a previous study showing more behavioral problems in the sample of dropouts. Therefore, we had a limited opportunity to assess the role of extremes in crying duration.

CONCLUSIONS
Our study showed that regulatory problems in early infancy are associated with parent-reported preschool behavioral problems and parenting stress. Biological vulnerability combined with the extraordinary parenting challenge created by preterm birth may contribute to the strong association between infant crying and later parent-reported behavioral problems. In the clinical context, excessive crying reported at 5 months may be a sign of an infant’s regulatory and/or parenting problems. Accordingly, it is clinically relevant to inquire systematically about the crying behavior of preterm infants at well-baby clinics. For families reporting increased infant crying, targeted treatment and preventive interventions should be developed to enhance preterm infants’ regulatory capacity and to reduce parental stress.

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