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Development



Crying behaviour

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Synthesis

How important is it?

Crying is an important means of communication available to babies during early infancy – that is from birth to three months of age. At this stage in their development, infants are almost entirely dependent on caregivers to meet their needs. Consequently, infant crying can assume an important role in ensuring the survival, health and development of the child.

Increased crying among healthy infants in the Western world is now recognized in all infants in the first few weeks of life. This includes crying for prolonged periods of time for no discernable reason, a characteristic almost unique to the first few months of life. In fact, it isn't unusual for a normal infant to cry from one to five hours daily, with a peak during the first two months of life.

In less than 5% of these infants is there ever evidence of organic disease to help explain increased crying behaviour. Furthermore, prolonged crying takes place despite excellent parental care. Fortunately, after the age of five months, the increased prolonged periods of inconsolable crying decrease, crying becomes more intentional, and is more related to events in the environment.

However, persistent crying, especially when associated with sleeping and feeding problems that continue beyond four months, often in the context of multiple parental psychosocial risk factors, can be a predictor of poor infant social and emotional development.

What do we know?

All infants cry, but most of the crying is unexplained. The explanations often attributed to infant crying include pain, hunger, anger and boredom. Unexplained increased excessive crying within the first three months of life that occurs in otherwise healthy infants is often labelled "infant colic." Depending on how it is defined, colic is said to affect about 10 to 20% of babies at this age. One salient characteristic is that it tends to follow a pattern of increasing for the first two months of life, peaking at about six weeks, and usually lessening by the fourth or fifth month of age. However, this pattern is true of all infants, whether their crying is considered "excessive" or not, and is now recognized as the "normal crying curve." During this period, intense crying

bouts can occur with no apparent reason, are difficult to soothe, and often last 35 to 40 minutes on average or as long as a couple of hours. They usually occur in the late afternoon or evening.

Infants whose fussiness persists throughout infancy, or whose increased fussiness gets worse after the first four months, are often said to have a difficult temperament. Crying related to infant colic can be hard to distinguish from crying related to difficult temperament. The major difference is that in colic, the crying bouts lessen with time, while in infants with temperamental difficulties, the increased fussing lasts throughout infancy, and even beyond. Though crying due to difficult temperament can sometimes be modified, difficult temperament is often stable across the life span, constitutionally based and heritable.

Positive consequences:

Excessive crying through the first months of life can cause frustration and stress within the family. Nevertheless, there are positive consequences associated with crying behaviour. One such consequence is that crying allows infants to build close relationships to those who most reliably respond to their needs. In this way, crying may be central to the formation of an emotional bond or “attachment” with a particular caregiver(s).

Negative consequences:

Many studies on colicky infants have shown convincingly that there are no negative long-term outcomes for the infants. Most parents show no negative consequences, but lack of confidence in caregiving abilities persists in some, and they are more likely to consider their infants “vulnerable.” However, infants with difficult temperament are more likely to experience long-term differences. Infants who are fussy and difficult to soothe are more likely to be at increased risk for preschool problem behaviour, adolescent adjustment difficulties, or aggressive behaviour and attention difficulties.

The mother’s interpretation of crying behaviour may be affected by maternal depression. When they occur together, maternal depression and colic or excessive crying may affect parent-infant interactions, relationships and even child outcomes. Maternal depression adversely influences some aspects of infant development and behaviour. This applies particularly to difficulties with soothing, irritability and crying behaviour.

High-pitched or hyperphonated crying may be due to a wide range of neurobehavioral insults, including brain damage, malnutrition, asphyxia, prenatal maternal drug use, prematurity and low birth weight. High-pitched crying in infants who have prenatal risk factors may elicit caregiver responses that either improve or worsen the infant's risk condition. In homes with less responsive parents, infants may show lower IQ scores, more withdrawn temperaments and poorer quality interactions with their mothers.

The most extreme consequences for an inconsolably crying infant are neglect and outright abuse, especially Shaken Baby Syndrome, which sometimes results in brain damage or even death.

What can be done?

The meaning of early increased, excessive or colic crying in infancy has evolved from a belief that it is abnormal or indicative of disease/dysfunction to the realization that this increased crying is a normal part of human infant development. Clinicians should be aware of the importance of crying to parents, how frustrating it can be and how it may be affecting their relationship with their infants.

When helping parents with infants who cry excessively, we should assure them that most infants who cry a great deal are healthy, and that the unpredictable, inconsolable crying usually stops spontaneously after the first few weeks. Interventions that are aimed at consoling crying infants are only partially successful, and do not reduce the inconsolable crying bouts. It is also important to recognize that variations in the sound of the cry itself may affect the reaction of the caregiver. We should be especially sensitive to caregivers experiencing depression or other condition(s) that can alter their perceptual set.

Public health information and interventions should be rigorously evaluated before being recommended as techniques for managing infant crying. Attempts should be made to create cost-effective and efficient services to meet the needs of families with young infants.

Reduction of Shaken Baby Syndrome:

Shaken Baby Syndrome is an extreme response to infant crying. Reduction in the incidence of this syndrome may be attained by public health education programs delivered early, perhaps even before the infant is born, in an effort to increase parents' understanding of normal crying, its patterns in infancy, and how the frustration that is experienced can lead to inappropriate

shaking or abuse.

Crying Behaviour and its Impact on Psychosocial Child Development

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Introduction

All infants cry and all cry for a reason. Indeed, the attributions applied to early infant crying range from pain to anger to boredom.[1] In the first months of life, crying is particularly salient as infants have relatively few effective methods of communicating their needs and states. Developmentally, crying in early infancy is distinguished by its temporal qualities. Several studies have demonstrated that infants typically show an increase in their crying across the first three months, with a peak at around 6 to 8 weeks of age.[2] Importantly, crying decreases significantly around 3 to 4 months of age, coinciding with important developmental changes in affect, non-negative vocalizations and motor behaviour. As crying is considered a normal communicative signal,[3] developmental outcomes for children who cry within the normal range are not of concern. However, some infants exceed the typical pattern of crying, such as those who cry long, hard and inconsolably during the first three months or those who cry/fuss frequently beyond 3 to 4 months of age. It is these infants who are often believed to be “at risk” for developmental problems.

Subject

Unexplained, excessive or persistent crying in the first three months of life that occurs in an otherwise healthy infant is labelled “infant colic.”[4] Colic can be found in approximately 10% of the population. The causes of colic are quite diverse and can be categorized as residing either in the infant or the parent-infant dyad. Only 5 to 10% of infants who cry excessively, however, are believed to suffer from some organic disease.[5] A recent set of papers reviewing the evidence on the source of infant colic concluded that those infants who present with excessive crying and other symptoms of ill-health such as failure to thrive, vomiting, and diarrhea should be distinguished from infant colic and treated accordingly.[6] For healthy infants, however, there is a growing consensus among researchers that infant colic is a developmental phenomenon

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involving individual differences in reactivity and regulatory function.[7,8]

Shorter bouts of crying and fussiness that are more frequent and persist beyond 3 months of age are believed to be temperamentally based. Infants who possess these caracteristics are termed either difficult, irritable, or negatively reactive. Temperament describes constitutionally-based and heritable individual differences in reactivity and regulation.[9] Although temperament can be modified, it is considerably stable across the life span.[10-13] And, because high negative reactivity represents an extreme case, it has been found to demonstrate significant continuity.[14]

Problem

The intense crying and inconsolability of an excessively crying or fussy infant creates a host of parental reactions and concerns about the behavioural development of the infant. Because negatively reactive temperament is relatively stable, it is proposed to have implications for more adverse, persistent outcomes than the transitory condition of colic. Nevertheless, this does not preclude colic's effect on the family environment nor its long-term outcome.

Key Research Question

Whether infants cry intensely for a few months or fuss frequently for the first year of life, a systems approach to development would suggest that the impact of extremes in crying on the infants' immediate environment may have negative consequences for the dynamics of the parent-child relationship, which in turn would have implications for the child's psychosocial development. Thus, researchers have asked: Is the effect of early infant crying on later development direct, or is it indirect through interactions with the child's early social partners?

Recent Research

Outcomes for infant colic. Longitudinal observations and parent ratings show that infants with colic may continue to be more negatively reactive shortly after the colic has resolved;[15-19] however, long-term assessments of their temperament have revealed few differences.[15-20] Interestingly, this early difference in reactivity may be due to a delay in the development of regulatory strategies.[17] Most longitudinal research report few long-term effects of infant colic. In two studies, mothers reported more negative emotional behaviour in their preschool-aged children who formerly had colic, although there were no differences in all other reported behaviour problems when compared to infants who did not have colic.[20,21] Finally, several studies

have also examined mental development in infants with colic and likewise have demonstrated no effect of colic.[15,16,20,22] In one study, although differences on the Bayley MDI were revealed at six months, both groups were within the normal range, and no differences were found at 12 months of age.[23]

As might be expected, the impact of infant colic is felt more by the parents, particularly mothers who have the burden of caring for the excessively crying child. Mothers reported more symptoms of psychological distress[24,25] and low self-efficacy.[26,27] And, although mothers report more depressive symptoms at the time their infants are experiencing colic,[28,29] research on maternal depression 3 months after the remittance of infant colic is mixed.[30,31] The distress mothers of colic infants report may arise out of their difficulties in soothing their infants as well as within their everyday dyadic interactions.[32] The few studies to date that have examined the long-term consequences of having a colicky child, however, indicate that there are no negative outcomes for parent behaviour and, importantly, for the parent-child relationship. In two separate studies, [15,16] mothers of colic and non-colic infants were observed to be alike in maternal sensitivity shortly after the colic resolved. These results may explain why infant who developed colic were on the parent-child relationship have been found. Infants who developed colic were no more likely to be insecurely attached than infants who did not have colic.[26]

Outcomes for negatively reactive temperament. As with the research on the developmental effects of infants with colic, findings with regard to negatively reactive temperament and persistent crying (excessive crying that persists beyond the colic period) suggest that it influences more than the infant. The psychosocial outcome receiving the most attention from researchers is problem behaviour, with most studies finding perceived negative reactivity in infancy to predict problem behaviour in childhood[33,34] and adolescent.[35] Specifically, infants prone to high levels of fear, frustration, and sadness, as well as difficulty recovering from such distress, were found to be at increased risk for internalizing and externalizing problem behaviours according to parental and/or teacher report. Two things are important to note about these findings: (1) not every negatively reactive infant expressed behavioural problems later in life; and (2) both temperament and problem behaviours were, in most studies, rated by parents, raising the issue of respondent bias.

Research has also shown that infant negative reactivity may have immediate and long-term effects on parenting. Concurrent associations have been found between parents-reported infant negative emotionality and negative parenting, but only in studies of low socioeconomic status or

minority families.[36] This pattern of findings suggests that, within the context of sociodemographic risk, negatively reactive infants may tax parental capacity for appropriate responsiveness to infant needs. Longitudinal findings highlight the bidirectional nature of such processes. In one study, observed infant negativity predicted declines in supportive parenting by toddlerhood, while harsh parenting during infancy predicted increased toddler negativity.[37] Similarly, another study found that maternal relationship stress was associated with concurrent infant negativity, which predicted slower emotion regulatory development across infancy, which in turn predicted negative parenting in toddlerhood.[38]

The interactive effect of infant temperament and parent behaviour on child development has been explained by the "differential susceptibility model,"[39,40] which proposes that highly reactive infants are more sensitive than their peers to both negative and positive environmental influences. In support of this model, multiple studies have shown the association between infant negative reactivity and later psychosocial outcomes such as problem behaviour and self-regulation to be moderated by parental behaviour, so that highly reactive children fare better than others when they experience optimal parenting but worse than others when they experience negative parenting.[41-46] Further support is found in studies indicating that interventions targeting parental attitudes and/or behaviours are particularly effective for children with a history of negative reactive temperament.[47,49]

Conclusions and Implications

Aside from clear and diagnosable medical conditions, parents' primary complaint to clinicians during the infancy period is that of excessive fussing and crying, generally that which cannot be soothed or tolerated. There are, however, important distinctions to be made about crying in infancy: (a) Crying in early infancy increases over the first two months of life and then decreases thereafter. Thus, excessive crying may be mis-attributed if the developmental course of crying is not understood; (b) Crying in excess of the normative rate during the first three months of life is categorized as colic. Colic is a transient condition that ends around the third to fourth month of an infant's life and appears to have few consequences for the child; (c) Crying and/or frequent fussing is a characteristic of negatively reactive temperament but can be distinguished from colic in several ways; colic is not a stable phenomenon and it manifests itself as intense crying bouts of long duration, whereas negative reactivity is stable and characterized by frequent bouts of fussiness. Finally, because of the persistence of negative reactivity for some infants more adverse outcomes are likely, particularly if the parental environment is non-supportive. It

appears that this form of temperament may tax parents, leading to stressful interactions and negative perceptions. At the extreme, crying may lead to child maltreatment and/or shaken baby syndrome.[50,51] Clinicians receiving complaints of excessive crying and fussing in infants should be aware of these distinctions and use appropriate measures to validate parental assessments.

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Impact of the Cry of the Infant at Risk on Psychosocial Development

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Introduction

Infant crying is exceptional among early behaviours for its central role in the survival, health and development of the child. The sound of crying is comprised of a myriad of temporal and acoustic characteristics that serve as a biological siren, a signal that alerts and motivates the caregiver to attend to the infant's needs. The perceived meaning of, and response to, this biological siren varies as a function of the specific combination of acoustic properties that comprise the cry. For example, cries with a faster repetition rate, shorter individual cry expirations and pauses and a higher fundamental frequency (basic pitch) may elicit more urgent caregiver responses to an infant than other cries with other acoustic characteristics. For this reason, the sound of infant crying plays an important role in the development of infants who are at risk for poor psychosocial outcomes due to prenatal and other conditions that adversely affect neurobehavioral organization. These infants often have distinctive, unusually high-pitched cry sounds that are particularly salient to caregivers and may contribute to the infant's future developmental course by eliciting responses that either ameliorate or exacerbate the infant's risk condition. The nature of responses to hyperphonated (high-pitched) cries depends on individual differences among caregivers and the perceptual set they bring to caregiver-infant interactions.

Subject

High-pitched (hyperphonated) cry sounds are characteristic of infants who suffer from a wide range of neurobehavioural insults,[1,2] including brain damage,[3,4] malnutrition,[5] asphyxia[6,7] and maternal use during pregnancy of drugs ranging from heroin,[8] methadone[9] and cocaine[10] to marijuana, cigarettes and alcohol.[11,12] Preterm and low birth weight infants,[13] as well as seemingly healthy full-term, full birth weight infants[14] who suffer a subtle but common form of prenatal malnutrition,[15,16] also frequently emit hyperphonated cry sounds. Whereas typical cries may range in fundamental frequency (basic pitch) from 400 to 650 Hz, hyperphonated cries are defined by a

qualitative break in the cry sound to a fundamental frequency above 1,000 Hz that may range to 2,000 Hz and more.

Problem

Within a developmental model that focuses on the bidirectional effects of infants and caregivers on each other's behaviour and development, the demand characteristics of the infant's cry sound, and the way it is responded to, may play an important role in infant development. As the exceptionally high-pitched quality of the cry sound of the infant at risk is the most distressing and obvious acoustic characteristic to caregivers of both genders and across cultures, we must ask what the functional significance of this particular cry sound is for both infant and caregiver.

Research Context

In analogue laboratory settings, experimental[17,18] and correlational[19,20] methods have been used to examine how specific temporal and acoustic characteristics of infant crying affect adults' perceptual responses. Naturalistic observations[21] and longitudinal designs[22,23,24] have also been used to explore how higher-pitched cry sounds affect caregiver responses and longer-term infant psychosocial development.

Key Research Questions

The key research questions focus on how and in what way this particularly salient, high-pitched cry sound affects caregivers' perceptual and behavioural responses. These questions have required not only an examination of differences in infant cry sounds, but also an examination of the basis for individual differences in caregivers' interpretations of, and responses to, these different cry sounds.

Recent Research Results

Whereas research originally sought to find whether cries elicited by discrete eliciting conditions could be perceptually differentiated,[4,25] more recent research has centered on cries as representing a continuum of sounds.[26,17] A model emphasizing a "synchrony of arousal" between infants and caregivers describes how increases or decreases in infant arousal produce corresponding changes in the temporal and acoustic characteristics of infant crying that then typically produce corresponding increases or decreases in the perceived arousal and motivation of the caregiver.[27] For example, as the infant becomes increasingly hungry and aroused, cries

become more rapid and increasingly higher-pitched, resulting in increasingly higher-perceived arousal in the caregiver. In this way, the cry sound mediates a symbiosis between the conditions that result in infant crying and the caregiver's responses to the infant.

Reflecting a special condition of infant arousal, the high-pitched hyperphonated cry of the infant at risk elicits significantly stronger perceptual and physiological reactions than typical infant cries. Across cultures,[14,28] hyperphonated cries are perceived to be more irritating, aversive, arousing and "sick" sounding than typical cries and to elicit more immediate responses that include holding and cuddling.[29] Several studies indicate that there are at least two distinct dimensions underlying the perceptions of hyperphonated cries — one in which the infant sounds "sick" and requires ameliorative care and one in which the cry is perceived as unusually aversive.[14,30] A higher cry pitch has been directly related to these particular perceptions.[30]

The presence of at least two dimensions underlying the perceptions of infant cry sounds underscores the importance of considering how the same cry sound may have different meanings to caregivers, depending on the listener's emotional set. Whereas some caregivers show heart rate decelerations to hyperphonated cries, indicative of attentive responses to an infant who sounds "sick," other caregivers show unusually high heart rate accelerations characteristic of inattentive, defensive responses to aversive sounds.[28] These different response patterns may provide the basis for important differences in caregiver-infant interactions. For example, the heightened heart rate response has been found in women at high risk for physical child abuse, even before they have children of their own.[31] In fact, parents who abuse their infants have heightened heart rates to infant cries[32] and indicate that hyperphonated cries are similar to the sounds of the cries of their own abused infants.[33] Other research has begun to explore other caregiver characteristics that may provide the basis for differential responsivity to higher-pitched cries. In contrast to the typical response of increased arousal to higher-pitched cry sounds, adolescent mothers,[34] women suffering from depression[35] and women who use cocaine during pregnancy[36] perceive cries of increasing pitch as being less arousing and less worthy of immediate care.

These differences in caregiver responsivity to infants with higher-pitched and hyperphonated cry sounds have been shown to be related to the infant's subsequent psychosocial development. In a longitudinal study, infants who typically have hyperphonated cries were randomly assigned to caregiving environments varying in how responsive they were to infant behaviour. In less responsive homes, infants had increasingly lower IQ scores over time, more withdrawn

temperaments and less quality interactions with their mothers (including physical neglect) through at least three years of age than similar infants who had a more responsive caregiving environment.[22,23] Other work has similarly shown that mothers who better understood the meaning of their preterm infants' cries had infants who later showed higher Bayley mental scores and language development scores at 18 months.[24]

Conclusion

The psychosocial development pathway of the infant at risk will reflect the combined effects of the infant's altered neurobehavioural organization, the resulting behavioural repertoire of the infant, and how individual caregivers respond to the infant. As part of this behavioural repertoire, the hyperphonated cry of the infant at risk is a two-edged sword. So aversive are the physical properties of high-pitched infant crying that caregivers will often try to do whatever is necessary to try to stop the noxious sound. In most cases, these attempts will provide the kinds of auditory, visual, vestibular and tactile-kinesthetic forms of stimulation that promote infant development. This process may be accentuated when caregivers respond with attentive, more immediate ameliorative care to an infant they think sounds "sick." In some cases, however, caregivers may respond to the aversive quality of the cry with unusually heightened arousal that provides that basis for "defensive" reactions, actions that are physically detrimental to the infant's well-being and/or emotional and physical withdrawal of the mother from the infant over time. When a mother suffers from depression, for example, her emotional condition may make her even less able to respond to the crying infant as the needs of that infant increase. In extreme cases, her response patterns may include an increased risk for physical child abuse and/or neglect. These divergent response patterns and effects on several aspects of the infant's psychosocial development have been supported in longitudinal studies.

Implications

An important implication of the above research is that infant crying should not be viewed as a singularly defined behaviour that affects caregivers in a uniform manner. Cries vary widely in their perceptual salience and meaning to caregivers. Another implication is that the same cry sound may have very different perceptual salience and meaning based on the characteristics of the caregiver. It is this combination of cry sounds and adults' characteristics that determines the effects of infant crying on responses of the caregiver and thus on the infant's psychosocial development. These issues also have implications for understanding the impact of other

conditions, such as infant colic[37] or difficult temperament,[38] in which the cry of the infant has been shown to have higher-pitched components. When helping parents of infants with excessive crying cope with the stresses of the infant's behaviour, we should be cognizant of possible differences in the cry sound and how these cry sounds may have different salience for different caregivers, especially those suffering from depression or other conditions that alter the caregiver's perceptual set.

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Crying Behaviour and Its Importance for Psychosocial Development in Children

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Introduction

For generations, parents have experienced the stress and frustration of increased, inconsolable crying in their infants in the first three to five months of life. In its most extreme manifestations, this increased crying has been considered a clinical problem, often referred to as "colic."[1] The most extreme and dangerous consequence for the infant is abuse or neglect, and especially the specific form of abuse referred to as "shaken baby syndrome."[2] Many of the properties of crying are unique to the first few months,[3] and therefore generate their own particular problems. Later in the first year of life, the amount of crying is much reduced. However, more stable individual differences between infants appear. Those infants who tend to be more reactive and to respond negatively (by crying) can be completely normal, but they are often thought of clinically as having a "difficult temperament." If the crying is associated with difficulties feeding and sleeping, they are often thought of in clinical terms as having behavioural regulation problems ("regulatory disorder").[4] While the vast majority of these crying behaviours are not associated with disease or pathology, the meaning of the crying behaviour for the infants' caregivers ("perceptual set")[5] is usually a determinant of its psychosocial consequences for the infant. Although many questions remain, research findings have changed our understanding of the nature and significance of this early behaviour.

Zeskind[5] has focused on the normal and abnormal acoustic properties of cries, and Stifter[6] has focused on the differences between "colic" and "difficult temperament." In this paper, I will focus on our new understanding of normal infant crying (including colic) in the first few months of life.

Subject

There are six properties of crying that have been shown to be typical of, and probably unique to, the first months of life in otherwise normal infants.[3,7-9]

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1. The overall amount of crying per day (fussing, crying and inconsolable crying combined) tends to increase week by week, peaking some time during the second month, and then receding to more stable and lower levels by the fourth or fifth month of age.[9-11] This is sometimes referred to as the "normal crying curve."[12]
2. Many of the crying bouts are unexpected and unpredictable, starting and stopping for no apparent reason, unrelated to feeding or wet diapers, and unrelated to anything that is going on in the environment.
3. These crying bouts are resistant to soothing, or inconsolable.
4. The infant appears to be in pain, even when it is not.
5. The crying bouts are longer at this age than at any other time, lasting 35 to 40 minutes on average, and sometimes lasting one to two hours.
6. The crying tends to cluster in the late afternoon and evening.[7,10,11]

Each of these properties separately, but especially all together, can be remarkably frustrating for any caregiver.

The properties of crying prior to five months are probably more a reflection of the infant's behavioural state than of any purposive signalling that the infant is doing.[13,14] After the first five months, crying becomes more "intentional" in the sense that it is more context-specific, more incorporated with other signalling systems (such as gazing and pointing),[15] and more "reactive" in nature.[12] However, there are a few infants whose high early crying never wanes,[16-18] as well as those who have lower amounts of crying during the early "peak" period, but cry at levels after five months of age equivalent to those of infants who have "colic" earlier.[19,20] In those infants in whom the amount or the rate of crying is high ("difficult infants"), the crying can be a very negative signal, and very unsatisfying and frustrating to caregivers.[6]

Problem

The clinical significance of crying is largely a function of how the crying behaviour is perceived and responded to by the caregiver. While the meaning of crying can vary on the basis of cultural belief systems, a number of findings are relevant to how crying is generally understood by caregivers. The challenge is to transmit these findings to caregivers in intelligible ways to prevent negative consequences due to crying behaviour.

Research Context

While clinical studies remain important, crying research has moved beyond unidisciplinary studies to embrace findings from developmental psychology, biological and cultural anthropology, psychobiology, and neurobiology (among others), and to include both experimental and naturalistic observational studies in ecologically valid settings to provide a more complete understanding of the nature and function of early crying behaviour.[13,21-23] Furthermore, the parallel study of both the clinical manifestations and the normative properties of early crying has led to a reconceptualization of the significance of early increased "excessive" crying and "colic." The argument is that early increased crying (including most cases of so-called "colic") is a manifestation of normal behavioural development rather than indicative of abnormalities (or "something wrong") in either the infants or their caregivers.[7] There are also a small number of infants who may have abnormal cries or who are also sick or have something wrong. However, the vast majority (over 95%) of infants with increased crying and colic are normal infants with normal behavioural development.

Key Research Questions

The key research questions are directed at the following quandary: if early increased crying in the first few months of life is not indicative of something wrong, how does one account for the primary properties of crying that are so frustrating to parents without invoking abnormal processes? Answers to this question have required the integration of empirical evidence from a number of usually disparate disciplines. The following is a brief summary of an expanding literature.[7,22,23]

Recent Research Results

Although variable, most clinical definitions of colic incorporate three primary qualitative dimensions:[8] (1) there is an age-dependent crying pattern, such that the overall amount of fussing and crying per day tends to increase from the second week of life, peaks during the second month of life, and then decreases to lower more constant amounts by the fourth or fifth month of life; (2) there are a number of associated behaviours, the most common and notable of which are that some of the bouts of crying are very prolonged and unsoothable, and that the infant looks as if it is in pain (has a "pain facies"); and (3) the crying bouts are "paroxysmal," meaning that they start and stop without warning and with no clear relationship to anything

(including caregiver soothing efforts) that goes on in the environment. The most common quantitative definition is “Wessel’s rule of 3s,” which states that infants can be considered to have colic if they cry or fuss for more than three hours a day for more than three days a week for more than three weeks.[7,24] Critical to understanding early infant crying is that there is (a) a very large variability from infant to infant in the amounts of crying, with about 25% of infants crying more than 3.5 hours/day and 25% crying less than 1.75 hours at the peak,[10,11] and (b) a continuous spectrum of amounts of crying from a little to a lot, with no specific “border” between normal and abnormal (or “colicky”) amounts of crying.

A number of lines of interdisciplinary research have contributed to the evidence that the primary properties of early increased crying, including “colic,” are manifestations of normal behavioural development. With regard to the “crying curve,” some of this evidence is the following:

1. The basic pattern of increased peaking and then decreasing crying has been replicated in almost all Western societies in which it has been studied, with few variations.[9-11, 24-30] Furthermore, there has been little change within societies over the last 30 years, indicating a lack of secular trends.[10,11,31,32]
2. There is a similar pattern and timing of crying in a number of cultures with radically different caretaking styles.[25,33,34] The most well documented is the crying pattern in the !Kung San hunter-gatherers, who are in constant contact with their infants, breastfeed four times an hour, and respond to virtually all frets and whimpers. Although they do everything that should be soothing, the pattern of early increasing and then decreasing crying is strongly present in these infants as well.[33]
3. Similar “distress curves” have been found in all mammalian species in whom it has been looked for, including guinea pigs,[35] rat pups,[36] chimpanzees,[37] and Rhesus macaques,[38] suggesting that this distress pattern is not unique to human infants.
4. In infants born prematurely by about eight weeks, the distress curve is at six weeks corrected age, indicating that this pattern is not due to postnatal experience, but rather a maturational developmental phenomenon.[39]

Furthermore, it is now clear that all kinds of crying (i.e. fussing, crying and inconsolable crying) is prolonged, that this prolongation occurs only in the first few months, and that inconsolable crying is almost unique to the first few months of life.[3,40] The “unpredictability” of the crying, and of the caregiver’s ability or inability to soothe the infant is most likely due to the facts that (1)

the infant cry in the first few months is a reflection of the organization of its behavioural states (crying, awake alert, sleeping), rather than an intentional "signal,"[14] (2) that behavioural state changes occur in "steps" rather than due to increases or decreases in arousal[7,41] and (3) infants are resistant to behavioural state change unless they are in a transitional phase in which they are "ready" to change state.[7] Finally, there is now good evidence that the proportion of infants that have evidence of organic disease to explain their crying is less than 5%.[8,42,43] In the absence of other compromise, infants with "colic" have as good an outcome as infants without "colic."[44]

While the evidence that early increased crying and colic is part of normal infant development is reasonably compelling, it remains a challenge to understand why it is normal behaviour, given its ability to frustrate caregivers. This has resulted in interesting work on the positive (or "survival") value of early increased crying in terms of the evolutionary history of humans, and possibly other species. This includes evidence for its role in ensuring sufficient nutrition, closeness to primary caregivers as protection against predators, and the early formation of attachment relationships.[22,45,46] As with most evolutionarily influenced behaviours, whether a particular behaviour functions to provide positive or negative outcomes for an individual depends on the context in which it is expressed. Increasing isolation due to short maternity leaves, nuclear rather than extended families, and separated living arrangements increases the stress on mothers.

Conclusions

In the last 30 years, the accumulation of new interdisciplinary evidence about the properties, time course, and outcome of early crying, including the clinical manifestations of "colic," has changed our understanding of this increased crying from a behaviour that was considered abnormal or indicative of disease or dysfunction in the infant, its parents, or both to a behaviour that is part and parcel of normal human infant development. This also implies that the socio-emotional consequences of this crying are largely a function of how caregivers interpret and respond to the crying. These responses may have longer- term effects both in terms of how they treat the infant, on the one hand, and whether they consider that they are poor parents if they cannot soothe their infant or handle the crying, on the other.[5,6,40,47-54] However, in the absence of other compromises in the infant or its environment, the outcome for infants with early increased crying or colic is good.

Implications

A previously underappreciated consequence of understanding the properties of early crying, that they are a normal part of infant behavioural development in all infants, and the potential they have for frustrating caregivers, whether or not their infants have “colic,” is that these properties of crying can be the trigger for a tragically serious consequence referred to variously as Shaken Baby Syndrome (SBS), abusive head trauma, or inflicted childhood neurotrauma.[2] SBS is a form of non-accidental head injury with or without impact, resulting from violent shaking, that presents with a (probably) unique set of injuries, including acute encephalopathy with subdural hemorrhages, cerebral edema, retinal hemorrhages and fractures. About 25% of clinically diagnosed cases die, and about 80% of survivors have lifelong neurological damage, including blindness, cerebral palsy, learning disabilities and behavioural problems.[55]

New evidence has shown that the age-specific incidence curve of Shaken Baby Syndrome has the same onset and shape as the normal crying curve, while the peak incidence occurs at about 12 weeks of age rather than at six weeks, when crying is at its peak.[32] This apparent “delay” in peak incidence may be because 35 to 50% of diagnosed shaken baby cases have evidence for prior shaking or abuse, implying that the shaking episode that brings them to clinical attention is simply the last in a series of such incidents.[32,56,57]

On the positive side, the increasing appreciation of the crying-Shaken Baby Syndrome relationship has opened the possibility that Shaken Baby Syndrome may be reduced by universal educational programs delivered early to new parents to increase understanding about the normality of crying, its ability to frustrate caregivers, and the fact that shaking in response to crying causes serious brain injury and death.[58] To this end, the National Center on Shaken Baby Syndrome has created intervention booklets and DVD/videos designed to encourage the widest distribution possible to health-care facilities and the general public, called ***The Period of PURPLE Crying.***™ Each letter in the word PURPLE refers to one of the six properties of normal crying that are typical in the first few months of life (**P** for crying peak; **U** for the unexpected timing of prolonged crying bouts; **R** for resistance to soothing; **P** for a pain-like face even when they are not in pain; **L** for long crying bouts, and **E** for evening clustering of crying). Caregivers are encouraged to take three action steps to reduce the likelihood of shaking their infants: (1) increase their contact, carry, walk and talk responses that will help reduce crying, although not stop it altogether; (2) if the crying becomes too frustrating, it’s OK to walk away, put their baby in a crib for a few minutes, and calm themselves; and (3) never shake or hurt their baby. In short, the intervention takes advantage of new knowledge about early infant crying, and applies

it in the service of reducing the incidence of a catastrophic but preventable outcome. Randomized controlled trials of the efficacy of such interventions in changing knowledge, attitudes and behaviour of new parents are currently in progress, in anticipation of the possible incorporation of such materials in prevention programs across the country if they are demonstrated to be useful.

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Crying Behaviour and Its Impact on Psychosocial Child Development: Comment on Stifter, and Zeskind

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Introduction

Crying is the primary means of communication available to young infants during a stage of development when they are almost completely dependent on others to meet their needs. Because crying typically elicits care, crying and soothing sequences provide a highly motivated context in which the infant associates the primary caregiver with a rewarding transition from emotional distress to calmness. For this reason, perhaps, infants typically become emotionally attached to the individual who has most reliably responded to their crying, and crying is, in turn, viewed as central to forming a bond to a particular caregiver.[1] There is tremendous variability, however, in the quality and quantity of early infant crying and in the nature of parental responses to it. Normal infants cry anywhere from one to over two and three-quarter hours per day in the first six weeks of life,[2] and parental responses range from highly indulgent to neglectful and even abusive.[3] The authors of the papers in this section address some of the factors that contribute to the variability in infant crying behaviour and parental response patterns.

Research and Conclusions

Stifter's paper focuses on the differences between colic and difficult temperament and delineates their developmental trajectories. Colic, defined as excessive and persistent crying in the first three months of life in otherwise healthy infants, is a transient condition that typically resolves by four months and has been shown to have few, if any, long-term consequences. In contrast, difficult temperament, defined as frequent fussiness and difficulty being soothed, extends beyond four months, shows some continuity throughout childhood, and is correlated with several long-term negative outcomes. Another distinction between colic and difficult temperament is in the quality of the crying itself. In colic, crying is more intense and of longer duration; in difficult temperament, crying and fussing are more frequent than normal, but not necessarily more

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intense.

Both colic and difficult temperament may have negative consequences for an infant directly or indirectly, through negative parental reactions to excessive crying and the strained parent-child interactions that ensue. Although there is ample evidence that colic is psychologically stressful for parents in the short term, the parent-infant relationship appears to repair soon after colic disappears. In contrast, infants labelled as having difficult temperament show numerous deficits in childhood and adolescence, including most notably attention, behaviour and school problems. The fact that early interventions targeting parental sensitivity and responsiveness buffer some of these negative consequences suggests that the long-term effects of difficult temperament may be mediated by the strain it places on parent-child relationships.

Zeskind's paper focuses on the acoustic features of cries and personal characteristics of adults that influence crying's salience to listeners and its effectiveness at garnering aid. In particular, the hyperphonated or high-pitched crying characteristic of some infants with congenital conditions and illnesses is associated with the perception that crying is urgent and requires immediate attention. Compared to the cries of normal infants, the high-pitched cries of at-risk infants are rated as more "sick sounding" and aversive. In normal infants, high-pitched crying is reserved for the most distressing injuries, such as the invasive portion of circumcision.[4] Parents respond to high-pitched crying with increased autonomic arousal and appropriately swift interventions in what Zeskind aptly refers to as a "synchrony of arousal." When crying is consistently high-pitched because of an underlying condition rather than injury, it is likely to be irritating to caregivers. One of the consequences is that infants who are already at increased risk for suboptimal development may be at increased risk for hostile parental responses to crying that could further exacerbate their compromised condition.[5]

Listener characteristics also influence perceptions of and reactions to crying. Compared to non-abusers, parents who abuse their own children evidence heightened arousal and aversion in laboratory tests of physiological and emotional reactions to high-pitched cries. Yet depressed teenaged and cocaine-addicted mothers perceive high-pitched cries as less arousing and worthy of urgent response than normal mothers do, possibly indicating a failure to discriminate among cries of different intensity and to understand their comparative meanings. The author argues that responsiveness to infant behaviour, including sensitivity to crying, may underlie differences in infant outcomes, particularly in at-risk infants.

Zeskind's paper highlights the dynamic interplay of cry and listener characteristics that results in patterns of response. One limitation of this approach may be its focus on one acoustic feature, fundamental frequency (i.e. basic pitch), to the relative exclusion of other acoustic and contextual variables. To the extent that pitch is a disturbed feature in the cries of impaired infants who are at risk for developmental problems, Zeskind's focus is more than understandable. However, this focus may obscure other features such as the duration of cries, or contextual variables such as the time since the last feed, which contribute to the timing and nature of responses.[6-7] Others and I have argued that, whereas large variations in pitch indicate compromised neurological status,[3] other features of crying and its context are typically used to gauge infant distress in normal, healthy infants under more usual circumstances.[8]

Implications for Policy and Services

Stifter's paper will help clinicians distinguish between infant colic and difficult temperament. Awareness on their part of differences between these two conditions and their relative risks has practical implications for providing optimal support and guiding decisions about follow-up care. In the case of colic, for example, parental concerns may be assuaged by reassurance about the transient nature of the problem. Parents of children with difficult temperaments, on the other hand, could be given support to help them cope with this more enduring condition, potentially preventing or mitigating some of the long-term adverse effects caused by the strain on parent-child relationships.

Clinicians could utilize Zeskind's findings to identify infant health problems and to train caregivers to be more sensitive to infant distress signals. Certainly, infants with unusual or high-pitched cries ought to be evaluated for medical problems. Clinicians should discuss the taxing nature of unusually high-pitched cries with parents and offer appropriate support. In addition, parental characteristics associated with reduced sensitivity to infant distress, e.g. depression or a history of abusing, should factor into clinicians' assessments of risk and need for supplemental support in any caregiving arrangement.

Both papers focus on pathological rather than normal conditions of development. It is worth noting that, in the normal course of events, crying functions to bring a parent and child into close proximity in an emotionally charged and unusually rewarding situation. In most cases, a crying infant is soothed and the precipitating pain, hunger or discomfort relieved. The discomfort that a caregiver feels in response to the irritating sound of crying is alleviated as well, and he or she is

rewarded with a quiet, often alert and happy child. Thus, in the course of psychosocial development, crying provides an ideal context for a parent and child to learn about each other and form an emotional bond.

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Effective Services for Managing Infant Crying Disorders and Their Impact on the Psychological and Behavioural Development of Young Children

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Introduction

The sound of a baby's cry can provide information about his or her condition and nervous system integrity. However, the chief clinical concern has been with the amount or duration of infant crying, rather than its sound. In particular, prolonged unexplained infant crying is one of the earliest, most common, and most perplexing challenges for parents and the professionals who support them.[1] Three questions often arise which provide the focus for this article:

1. What is causing the crying?
2. What should parents do about it?
3. What does it mean for the future — does it foretell a difficult or disturbed child?

Subject

Parents report that some 12–20% of apparently healthy 1–3 month-old infants in Western societies cry for long periods for no apparent reason.[2] This crying often worries these parents.[2] Because crying at older ages is much rarer and not as well understood, we will focus on crying during early infancy and its consequences, with some attention to crying in later infancy and childhood.

Problems

There are several reasons for seeking an evidence-based approach to unexplained crying in early infancy:

1. It distresses many parents, who view it as a sign that something is wrong with their baby and employ a variety of dubious remedies. Parents want proven advice.

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2. Popular books give parents conflicting advice about how to manage infant crying, thereby compounding the problem.[3]
3. Some physicians attribute unexplained infant crying to reflux of stomach contents into the throat (Gastroesophageal reflux; GOR or GER) and treat this with medication, despite evidence that infant regurgitation is normal, reflux and crying are not related, and treatments for reflux are not effective in reducing crying.[4,5]
4. Because parents often seek professional help, the problem is costly for health services.[6] Cost-effective services for crying should conserve resources.
5. Parents who misinterpret their baby's crying as a sign of hunger may stop breast-feeding prematurely, or over-feed the baby.[7,8] The crying can also trigger parental distress and depression.[9,10] More rarely, exasperated parents shake or otherwise harm their crying baby, sometimes resulting in infant brain damage or death.[11] Preventive strategies are needed.
6. In some cases, adverse long-term parent–child relationships and child outcomes develop.[12] There is a need to understand the various outcomes and how to distinguish and help high-risk cases.

Recent Evidence

Unexplained crying in early infancy has traditionally been viewed as an infant problem attributable to gastro-intestinal disturbance, and often referred to as "infant colic." Research has gradually qualified this view.[13]

Several studies have found evidence of untypical amounts of particular bacteria in the digestive systems of some babies who cry a lot – a finding which appears consistent with the notion of colic and gastro-intestinal disorder.[14,15] Some initial studies found, too, that feeding the babies particular probiotic ('friendly') bacteria seemed to reduce their crying. However, the largest and most rigorous study of probiotic supplements failed to find any benefits[16] and a review of the overall evidence concluded that adding probiotic bacteria to young babies' diet is not recommended.[17] It remains feasible that gut bacteria are involved in some cases, but we don't understand why this happens or how to distinguish them. This is an area for continuing research but not yet for clinical practice.

Likewise, although it is generally agreed that food intolerance, particularly involving cow's milk, can give rise to infant crying, this is probably rare and there are no tests that identify such cases

accurately. Diagnosis has to be based on a trial, for instance eliminating products containing cow's milk from a breast-feeding mother's diet, or substituting an extensive protein hydrolysate formula if infants are formula fed.[4,5,18] However, elimination of dairy products from the maternal diet may be challenging to achieve and there are no data to confirm how many mothers can comply. Changes to infants' diets can cause adverse reactions, so that any such changes need to be monitored by a qualified professional.[18] Many infants with initial cow's milk sensitivity will tolerate cow's milk protein from 1–3 years of age, so that such infants should be reviewed at intervals until tolerance is developed.[18]

In sum, although it is generally agreed that digestive and other organic disturbances can give rise to infant crying, such disturbances are rare, occurring in about 1 in 100 infants overall, and about 5-10% of cases where parents seek professional help.[19,20] The evidence also challenges other long-standing assumptions, such as the belief that the crying signals underlying pain.[21] Instead, the feature that disturbs parents most is the 'unsoothable' nature of the crying, and parents' attendant experience of losing control.[22,23] In particular, the long unsoothable crying bouts which occur in the first five months of infancy and then stop by themselves are the main source of parents' frustration and are more important than the overall amount of crying.[24] Several studies have found a crying peak in normal infants at around 4-6 weeks of age[2] and normal infants share many of the features of clinically referred cases. This suggests that, rather than being unwell, many referred infants are simply at the extreme of the norm for such behaviour. As a result, the search for causes has widened beyond the gut to include studies of the neuro-developmental changes that normally take place during early infancy.[25]

Prolonged crying in early infancy can occur in spite of excellent parental care[26] and does not usually predict long-term problems.[27] Indeed, the findings suggest that this crying is usually an acute, self-resolving phenomenon. Interventions geared towards reducing crying by changing Western parents' care methods have not produced reliable results.[28] Parenting which involves more holding and carrying, and greater responsiveness than is typical in Western societies does appear to reduce overall crying durations, but does not prevent the unsoothable crying bouts in early infancy which worry parents.[29] In the absence of infant organic disturbance, interventions targeting infant crying appear to be of questionable worth.

Because parental concern about crying is the presenting clinical complaint, it is important to recognize the parental, as well as infant, component of this problem. This involves distinguishing between 'prolonged crying' (which refers to crying duration) and 'excessive crying', (which

refers to a parent's concern that a baby is crying too much and is a sign that something is wrong with a baby).[4,5] Infant crying that persists is stressful for most parents, but there is evidence that parental vulnerabilities increase both its impact on parents and the likelihood of the adverse outcomes listed above, such as parental depression, infant maltreatment, and long-term problems with child development. This evidence bridges the traditionally distinct areas of paediatrics (with its focus on infant crying) and adult wellbeing and mental health. In an important step forward, guidelines for clinicians have begun to recommend the need to assess parental circumstances, coping and wellbeing, as well as infant crying.[4,5]

Raising awareness and asking all parents to sign contracts not to shake babies produced significant reductions of Shaken Baby Syndrome (SBS) cases in a multi-centre trial[30] and other studies since have produced encouraging findings.[31,32] Recent programmes have widened their focus beyond SBS to include supporting parental knowledge and coping more generally.[33,34] It is too early to know whether programmes of this type will be cost-effective in general health services, but the evidence is promising.[31]

Most infants who cry a lot in early infancy do not have concurrent or later sleeping or feeding problems: the problems appear to be largely distinct.[35] However, the much rarer combination of persistent crying, sleeping, and feeding problems beyond 4 months of age and parental psychosocial risks has been found to predict adverse psychological and social development in later childhood.[36,37] Such infants have more extensive disturbances, and probably differ in etiology, from cases in which unexplained crying alone occurs solely in the first 4 months. The findings imply that infants over 4 months of age who both cry a lot and have multiple problems are at risk for developing long-term psychological and behavioural disturbances. The outcomes of irritable newborns from socio-economically disadvantaged families were improved by enhancing mother–infant interactions after 6 months of age in a carefully controlled study.[38] This finding is promising, but not yet translatable into cost-effective services.

Key Questions for Further Research

Questions for continuing research include the following:

1. How should practitioners identify and manage cases with an organic etiology? On current understanding, most young babies who cry a lot are in good health, but a minority (perhaps 5-10% of cases seen by clinicians) have an organic disturbance. Protocols for identifying

and treating organic cases have been published,[4,5,39] but need to be evaluated in practice.

2. The distinction between “organic” cases, cases where parents are vulnerable, and low-risk cases depends on accurate assessment. Here too expert protocols have been proposed,[4,5,39] but need to be evaluated in everyday use.
3. Attempts to show whether infants who cry a lot are in pain have not found that is the case.[21] Moreover, a careful review concluded that young infants’ cries are ‘graded signals’ which convey the degree of their distress, but do not distinguish reliably between different causes, such as hunger versus pain.[40] Although that conclusion reflects current knowledge, we lack decisive methods for assessing infant pain. If a ‘neurological signature’ for infant pain can be found and tied to particular instances of crying, that would provide a compelling reason for clinical interventions in such cases.[4]
4. How can we explain the finding that many infants who cry a great deal go on to develop normally, while some suffer psychological and behavioural problems? Age and multiple risk factors appear to be important, but we need detailed understanding of the mechanisms involved and their implications for services.
5. Perhaps surprisingly, the question of how to evaluate treatments for unexplained infant crying and colic remains largely unresolved. Many studies have targeted reductions in crying compared to a control group, which seems necessary, but there is poor agreement on how this should be measured.[41] At least one treatment study found substantially reduced crying without any improvements in caregiver-reported problems.[42] To address unexplained crying and colic as a clinical complaint, we need to understand caregivers’ perceptions of their infants. Measures of the infants’ unsoothable crying bouts, of parent reported infant well-being, and of parents’ satisfaction with interventions, need to be trialled and evaluated for general use.

Conclusions

Progress has been made in understanding infant crying and its impact on parents. Protocols for identifying and treating the small number of cases with organic disorders have been developed and need to be evaluated in practice. Most infants who cry a lot in early infancy are healthy and stop crying spontaneously. Interventions that target this crying have not proved effective. Instead, current recommendations for interventions with healthy infants focus on providing parents with information and support to manage the crying and their responses to it. Promising

initiatives exist for preventing Shaken Baby Syndrome and providing parents generally with information and support, but it is not yet clear whether these programs can be integrated cost-effectively into routine health services. Prolonged crying after 4 months of age is rare and these infants are likely to have more extensive problems and a different etiology from cases in which crying alone occurs during the first 4 months. In combination, prolonged crying after 4 months of age and parental psychosocial risk predict adverse long-term child development. The reason for the crying in such cases, for good versus poor outcomes, and the contribution of infant crying per se to such outcomes, all require clarification.

Lastly, it is worth acknowledging the overall evidence that poor long-term psychological and behavioural development is typically the product of multiple and cumulative risks in the infant and family. Practices in the field are likely to be enhanced by continuing to consider crying together with other problems and risks in the infant and family, rather than by focusing on infant crying alone.

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Post-Partum Depression and Infant Crying Behaviour

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Introduction

Excessive infant crying can be troublesome for parents and health-care providers, even though for the most part, it is quite benign for the infant.[1] However, in the context of post-partum depression (PPD), excessive crying behaviour may be problematic if it leads to a failure to elicit appropriate maternal responses. This may have substantial and lasting adverse consequences for development. Understanding the impact of infant crying in this setting and the implications for interventions that promote healthy child development services will be the focus of this article.

Subject

Understanding infant social and emotional development in the context of maternal mental illness is a timely and urgent issue. Post-partum depression is common, affecting 10 to 20% of all mothers in the first few post-partum months.[2-4] Accumulating evidence shows that maternal depression adversely influences some aspects of infant development and behaviour,[5,6] particularly difficulty soothing, irritability (i.e., altered behavioural state regulation) and crying behaviour.[7] Arguably, excessive infant crying is a signal waiting for a response. Consequently, it may be a useful target to use for interventions in mothers with depression that improves outcomes for infants and their mothers.

Problems

There are several reasons to believe that targeting infant crying behaviour may be an effective way to improve developmental outcomes among infants of depressed mothers:

- PPD may interfere with the infant’s ability to “use” the cry signal as a way to engage or communicate with its depressed mother, thereby compromising social and emotional development.

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- Limited research examining how crying characteristics of infants of depressed mothers are interpreted or understood by their mothers or how they are related to developmental outcomes.
- While reported interventions for PPD have typically improved maternal mood, interventions have been successful in effecting sustained improvement of infant developmental outcomes .[8]
- Emerging evidence suggests a potential beneficial effect of addressing infant cry as a strategy for treating maternal mood disorders. Therefor, if crying can be regarded as a meaningful “target behaviour” for intervention with depressed mothers, research needs to address how to identify it (cry), what aspect of its character is meaningful (to the mother and clinician), who should be the target of the intervention (mother and/or infant) and whether the crying infant or the mother’s processing of the signal matters (i.e., mother vs. infant).

Research Context

Infant crying duration and intensity reaches its peak during the first three months of life. All healthy low-risk infants will cry for prolonged periods for no apparent reason that is typically not associated with an identified etiology or pathology, although about 20% do this so much that they are sometimes considered to have “colic.”

Further, under these circumstances infant crying is a key signal that engages mothers and therefore may assist in the emerging social and emotional development of the infant. This three-month period also corresponds with the peak incidence of post-partum depression. What does this mean for the developing infant when the cry signal is ignored, or misinterpreted by the depressed mother?

Post-partum depression poses substantial adverse consequences for mothers and their infants via multiple direct biological (i.e., medication exposure, maternal genetic factors) and environmental (i.e., life with a depressed mother) mechanisms.[8,9] From the earliest newborn period, infants are very sensitive to the emotional states of their mothers and other caregivers.[10,11] Maternal mood and behaviour appear to compromise infant social, emotional and cognitive functioning.[11-15] As children grow, the impact of maternal mental illness appears as cognitive compromise, insecure attachment and behavioural difficulties during the preschool and school periods.[6,16-19]

Timely and appropriate maternal sensitivity to the infant's behaviour is a central component of mother-infant relationships and healthy social and emotional development.[20,21] Maternal depression may disrupt the maternal-child relationship,[22] contribute to maternal failure to respond appropriately to infant signals[23] and lead to insecure attachments.[24] A mother's failure to respond to the crying infant can have important immediate and lasting consequences for infant development.

Maternal insensitivity and emotional unavailability influences the infant's ability to develop a capacity for arousal regulation.[25] Insensitive maternal behaviour results in increased anger, distress and crying – together, these might reflect an infant's poor arousal regulation.[26] PPD also alters the capacity to regulate the reciprocal interaction between mothers and their infant via two patterns: intrusiveness and withdrawal. Depressed mothers have more negative perceptions of their infants' behaviour and are less likely to offer stimulation to their infants.[27-29] Such lessened stimulation may lead to disrupted learning during non-social learning tasks. Depression appears to lead the mother to ignore or misinterpret the infant cry signal, compounding the damage of maternal depression. In addition, in a single report, infant crying may even exacerbate or trigger maternal depression, thereby increasing developmental risk.[5]

Understanding maternal failure to respond appropriately may be a key element in developing interventions that promote healthy infant and child development in the presence of post-partum depression. However, little work has been done that describes how well mothers are able to make correct and/or avoid incorrect judgments. Thus, the question remains: Does improving maternal responses to infant crying offer an opportunity to support healthy infant development in this context?

Key Research Questions

Research needs to address the following:

1. What is the evidence that infant crying might be different in the context of post-partum depression?
2. How do depressed mothers respond to their crying infants?
3. Is excessive crying causally linked to post-partum depression?
4. What do we know about maternal perception of infant crying in this setting?

5. What implications do altered maternal sensitivity (associated with depressed mood) to infant crying have for infant and young child development? How does the absence of a meaningful/appropriate maternal response influence infant crying?
6. How can findings from the questions above be used to develop interventions that utilize infant crying behaviour to promote improved maternal mood, maternal-infant interaction and child development in general? Are there services that target crying in infants of depressed mothers that promote maternal sensitivity to crying and lead to improved early childhood social-emotional development in a setting where crying is misperceived? Should those strategies focus on infant or mother, or perhaps on both?

Recent Research Results

While soothability (i.e., ability to regulate behaviour) may be altered in infants of depressed mothers,[30] and by extension crying behaviour (duration, timing and fundamental frequency), little is known about infant crying in the context of post-partum depression. Even less is known about how to intervene in this setting to promote optimal developmental outcomes. However, in a single study, Milgrom[31] et al compared crying behaviour in infants of depressed and non-depressed mothers at three and six months. From one-week daily recordings, variations in cry patterns were similar between groups and between ages (i.e., crying peaked in the afternoon and early evening and there was a reduction in total crying per week by six months). However, infants of depressed mothers cried significantly more in total per day than infants of non-depressed mothers at three months. Interestingly, depressed mothers did not rate their infants as more difficult, suggesting that crying amount differences could not easily be explained as a function of infant temperament. By six months, maternal depression had lessened and differences between crying groups had disappeared. Milgrom speculates that this change reflected the fact that infants had learned that crying was not a useful comforting strategy, thereby leading to a reduction in this mode of communication.

Convergent evidence from studies examining other aspects of infant behaviour in this setting also suggests that infants of depressed mothers are more likely to cry more. Depressed mothers gaze less at their infants, rock less, are less active and show poorer responsiveness to their infants.[32] Infants may be more drowsy, more distressed and fussy, look less at their mothers and engage in more self-directed activity.[33]

Depression may affect maternal response via altered sensitivity to their infant's signal.[34] Schuetze and Zeskind[34] show that perception of infant crying varies with level of maternal depression: as the level of depression increases, infant crying is perceived as less urgent and sick-sounding (i.e., less aversive and less arousing). Using Signal Detection Theory, Donovan examined to what extent maternal psychosocial factors affect sensitivity to responses to infant cry. Mothers of four- to six-month-olds were asked whether they could detect differences between a standard cry and frequency variations of that cry. Mothers who were more depressed reported perceiving their infant as more difficult and were less sensitive to changes in cry frequency. Importantly, maternal sensitivity was also affected by marital happiness and conflict over work/home happiness. Moreover, a recent imaging study compared the neural response of non-depressed mothers versus depressed mothers to their own infant crying and found a reduced neural activation in the depressed mothers in regions related to emotional response and regulation.[35] Together, it appears that both the character of infant crying behaviour and maternal perception of crying differ when mothers are depressed.

Community-based early intervention programs[22] and population-based maternal screening for PPD[36] have been attempted as ways to improve developmental outcomes. To date they have yielded inconsistent results.[22] Brief home-based psychotherapeutic interventions appear to improve maternal mood and lead to a short-term improvement in mother-infant interaction. However, it remains unclear whether this leads to a sustained improvement in child development.[37–39] Some interventions aimed at improving maternal mood and marital supports have reported an effect on infant behaviour[40] but not on infant emotional development.[22,41]

Multiple lines of evidence point to relationships between excessive crying and long-term social and emotional development,[42] as well as the impact of maternal depression. In a single study, Miller and Barr[43] found a relationship between increased infant crying in the first six weeks post-partum and increasing maternal depressive symptoms. While this finding does not suggest a causal relationship between crying and maternal mood, it does highlight the importance of understanding infant crying as a possible reflection of a distressed or stressed mother-infant relationship. However, to date there has been no research reported that examines the use of infant crying in this context as an intervention to promote improved social and emotional development. Data, on the other hand, do suggest that intervention strategies could be developed.

Donovan[30] speculates that an intervention that increases maternal capacity to attend (i.e., enhanced ability to recognize relevant or meaningful aspects of their infant's behaviours) to infant crying would be beneficial. Similarly, a focus on maternal understanding of the causal attributions associated with the cry (i.e., "the baby is not crying to bother you") might lead to appropriate response to the infant.

Recently, increasing attention has turned to focusing on a search for more practical approaches to infants crying as an approach to maternal depression by offering different strategies for intervention.

For instance, randomized trials targeting infant's colic crying by treating the infant (less than 3-4 month of age) with probiotics (Lactobacillus Reuteri),[44–46] with the assumption that reducing crying time will also benefit mother's mental state, however the results are inconsistent. Although none of the groups reported on drug side effects, while Guo who tested only breastfed infants reported on significant decrease in infant crying, and decrease in depressive symptoms at one month and at two months respectively, Sung who tested both formula fed and breastfed infants reported on increase crying in the probiotic treated infants (particularly in the formula fed infants) compared to placebo with no effect on maternal depressive symptoms. Clearly, additional large randomize trials are needed to further understand the possibility of using probiotics to manage infant colic crying and which subgroup of infant could potentially profit from such intervention.

Another study has reported on a unique intervention previously shown beneficial for preterm infants, using a "breathing bear" with gentle body motion rates that can be adjusted to match infant's breathing rates to serve as a comforting, nonintrusive crib friend for the infant, and a reassuring aid for the mother.[47] As infant can use the bear at his own will, the infant can learn that he can either approach or withdraw from the bear providing him opportunity for positive reinforcement. Surprisingly, although the exposure to the breathing bear was not effective in reducing crying/fussiness (as reported by the mother) compared to use of a regular bear, mother's reports on infants' negative temperament scores, and on depression and stress levels have decreased (at 7 and 9 months – 2 months post intervention period). Novosad et al suggests that this positive effect on mothers mood might be mediated through changes in infant' self-regulation (i.e., lower negative temperament) which can potentially be associated with changes in mother infant interactions.[47]

While these reported interventions target the infant, other interventions target the mother-infant interaction[48] or the whole family (rather just the mother)[49,50] to improve parental skills by providing practical parental care techniques (such as sleeping habits and feeding) in combination with psychoeducation about the postpartum period and mindfulness techniques.[48] This set of studies have shown positive results such that maternal depression, anxiety scores[48] and baby crying times,[48,50] were reduced. However, although these intervention programs do show positive effects on both infant and mother/family, the beneficial effect was only short termed (peaking at 6 weeks of age).

Another perspective for improving maternal care was offered by the group of Young and colleges who tested the potential contribution of musical training in depressed adults to their ability to interpret infant crying in relation to changes in pitch.[51] Using auditory recordings of infants crying manipulated such that the pitch of the crying increased gradually to sound more distressed, it was shown that depressed adults with previous musical training showed higher sensitivity in discriminating distress variations in the infant crying. Although this study was not specifically tested on mothers with PPD, Young suggests that even short musical training can have a protective effect to overcome diminished sensitivity to auditory cues for distress in infant crying that mothers with PDD might have.

While most of these interventions are promising in providing relief to both mother, family and infant, none of these interventions have shown or examined long term effects on infant developmental outcomes.

Conclusions

Reviewing what is known about infant crying behaviour and post-partum depression raises more questions than it answers. Little is known about the character of crying among infants of depressed mothers. However, preliminary studies suggest that cry frequency is increased and that PPD may reduce the maternal capacity for processing infants' signals (i.e., crying), which interferes with social and emotional development. Infant crying itself may adversely influence maternal mood. Together, these findings may suggest that we might target crying behaviour for interventions that alter both infant behaviour and maternal perception of their infant's behaviour as ways to improve maternal sensitivity and infant developmental outcomes. At this point, it remains unclear whether excessive infant crying in the presence of post-partum depression is just a "window" onto a disturbed dyadic relationship and a reflection of developmental risk, or a

“door” through which we can enter and intervene to improve developmental outcomes and mental health. In this sense infant crying may also be a “signal by proxy” eliciting help for the depressed mother. Developing services that promote and/or target infant cry during the first four to six weeks may offer ways to intervene and improve the depressed mother-infant dyad.

Implications

Infant crying behaviour may be an important step towards addressing maternal mental health and developmental consequences. We need to address a number of unanswered questions. Do the quality and character of the crying behaviour in this setting matter? What is the role of maternal perceptions of crying, the effect of antidepressant medications (via prenatal exposure and breast milk), specific relationships between crying behaviour and developmental outcomes? Finally, how do contextual factors (family, social and economic variables) influence child development in this context?

Second, if crying is a meaningful “target behaviour” for intervention with depressed mothers, we need to know how to identify it, what aspect of its character is meaningful and who should be the target of the intervention: the crying infant or the mother’s processing of the signal (i.e., mother vs. infant). Recent studies have shown beneficial effects for both approaches; however most of these studies are preliminary, and showing only short term effects. Can maternal mood and developmental outcomes be improved in the long term? Clearly, additional longitudinal studies are warranted to compare between different intervention strategies on larger sample size and to follow up on infant developmental outcomes in the long term.

Ultimately, focusing on infant crying behaviour associated with maternal mental illness should not be disregarded from the context in which child development occurs. Excessive infant crying in this setting may be only a “red flag” of distress, and as such reflects key co-existent elements of the context in which it occurs, such as the role of the father, social and economic factors and the community context. Infant cry in the context of maternal mood disturbances can also be recognized as an opportunity to improve mother’s mood, which could in turn support healthy early development.

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Infant Crying Behaviour: Comments on Oberlander, and St James-Roberts

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Introduction

If an infant is crying excessively during the first months of life, the disturbance caused in the family may last well beyond the time period of the problem of crying.[1] Indeed, the considerable impact of excessive crying on family life is a testimony to the compelling force a behaviour otherwise regarded as benign. If the psychosocial resources of a family are already extenuated, an infant's crying problem can sorely try family coping capacities and prevent it from providing sensitive and consistent infant caregiving. One of the most common problems exhausting the coping capacities of families of young infants is postpartum depression. Is the crying of an infant in these families depriving the infant from optimal care? This important question is raised in a paper by Tim F. Oberlander, who points out that depression affects maternal responsiveness to the infant (and infant crying), which may affect later infant/child development. Oberlander cites convergent evidence from the literature supporting the hypothesis that infants of depressed mothers may also cry more and suggests that infant crying could be used as an opportunity to offer help to such families, with the ultimate goal of improving maternal mood and child development. What kind of help should be offered, and for whom, in the context of infant crying? This question is discussed more generally in a paper by Ian St James-Roberts. St James-Roberts points out the large gaps in our understanding of infant crying, despite expanding research on this topic, namely: We do not know what causes excessive crying (regarded as a problem in a given percentage of otherwise normal infants), what should be done about it, and whether crying predicts a poor development in some settings.

Research and Conclusions

A substantial proportion of families with young infants are affected both by infant crying (regarded as a problem) and by postpartum (and antenatal) depression. Papers on this subject have done much to raise essential questions and point out shortcomings in the literature.

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There have been three main approaches in assessing infant crying:

1. Subjective perceptions of the problem of excessive crying from caregivers
2. A more objective quantification through diary-keeping (usually by parents)
3. An analytical qualification of the acoustics of a segment of the cry sound.

Perceptions, quantifications and qualifications of crying problems may all be affected by maternal depression, and combinations thereof may affect parent–infant interaction. Subjective maternal perceptions of crying are most likely influenced by maternal psychological factors. Subjective parental perceptions of infantile "colic" and parental assessments of how much crying is too much have been found to be associated with the psychosocial risks specific to the family during pregnancy.[2,3] Moreover, parental complaints regarding excessive crying are not proportional to the amount of crying involved. The fact that an infant may cry a great deal may not concern some parents, while average levels of crying may be a real concern to other parents.[4] The amount of crying may, itself, be influenced by biological and environmental factors as described by Oberlander. These factors may also be categorized as antenatal and postnatal factors as it is possible that maternal depression affects infant crying both before and after birth. There is evidence summarized in a review by Van den Bergh[5] that maternal anxiety and stress influence fetal behaviour and later child development as the developing fetus is influenced by a maternal neural and hormonal balance. Furthermore, maternal anti-depressant medication during pregnancy has be shown to alter the acoustic quality of infant crying after birth.[6] Therefore, in addition to *post partum* depression, the role of depression and its medication during pregnancy needs to be clarified in future research.

Infant crying affects parent–infant interaction even in normal populations. Dyadic parent–infant (both father and mother) interactions were affected by higher amounts of crying during the crying period,[7] and there still were differences in family interaction one year later.[8] In another cohort, the perception of "colic" was related to fewer younger siblings three years later[9] which may indicate a significant impact of "colic" on the family. In the context of maternal depression, problem infant crying is likely to have even more consequences and in order to find ways to alleviate possible adverse effects, interventions are needed. Our starting point: We do not know enough to provide evidence-based advice to either professionals or the parents of infants who cry excessively. The fundamental questions regarding this knowledge gap are posed in the paper by St James- Roberts.

First, we need to identify those infants whose organic etiology leads them to cry. For example, as St James-Roberts clearly shows, there are major disadvantages to implementing a cow's milk elimination diet to a breastfeeding mother as it radically restricts the mother's diet or it prevents breastfeeding. Breastfeeding has been shown to have many health benefits as it is more economical for the parents and may also strengthen the mother–infant relationship, which is important to support in a context of infant crying. Even in formula-fed infants, an elimination diet with hypo-allergic milk products is much more costly than a regular formula diet. Studies about elimination diets as treatments for excessive crying suffer from selection biases: the problem has to be long-lasting and severe to meet the inclusion criteria. Without a similar wait-and-see period in clinical practice, we cannot expect similar results with a dietary intervention. It would be very helpful for pediatricians to have tests to screen those infants who would benefit from dietary interventions or other procedures targeting organic etiologies.

As most infants presenting with excessive crying are likely exhibiting normative behaviour at the high end of its range, a critical examination of (cost)-effective intervention methods regarding the majority of infants with crying problems should be carried out. Crying may be tolerated by one family, but not by another. As St James-Roberts formulates it, we should identify vulnerable parents and the ways in which such cases should be managed. Mothers suffering from depression may be one of the vulnerable groups, as also discussed by Oberlander. Conversely, excessive crying may be tolerated in a family without any consequences, but multiple or long-lasting problems may lead to later consequences. St James-Roberts suggests that infants with multiple and prolonged behavioural problems, especially in combination with psychosocial risks, may define one of the potential risk groups.

The third question raised by St James-Roberts is an important one for primary care because infant crying is such a common problem. The question is should we intervene, and if so, how, and when, in the case of a crying infant who has not undergone an organic disturbance and parental vulnerability. Many simple interventions such as increased carrying,[10] baby massage[11] or swaddling[12] have not been superior to control care in the treatment of excessive crying. As it is largely questionable if the amount or quality of crying can be affected by any intervention in cases of normal age-appropriate behaviour, interventions may be geared towards parental perceptions of crying. If crying is explained as signalling vigour, health and robustness,[13] and appropriate information is provided to this effect, parents may see the positive side to crying: their crying infant may be showing a superior ability to increase his/her food supply (by

expressing him/herself regarding hunger) and attract more interactions with caregivers compared to a quiet infant. Increased interaction may serve in the long run as a benefit for the infant. St James-Roberts et al.[14] showed that holding children a great deal and more mother–infant interaction were related to a change from high to low negativity (crying) in infants.

Implications for the Development of Research and Policy

In future research, a broader picture of crying problems could be drawn if studies measured a broader spectrum of factors. Future research could quantify 1) the magnitude of a perceived infant crying problem within the family; 2) the amount (duration and frequency) of crying; and 3) the acoustic quality of crying. How infant crying is affected by prenatal and postnatal factors such as maternal depression and the treatments used for it should also be explored. Further, it should be assessed which aspects of excessive infant crying most affect parent–infant interactions, along with the long-term consequences of excessive crying on child development in different settings. From a clinical perspective, it is crucial to formulate intervention methods that alleviate parental distress and prevent the adverse effects of crying disorder on child development in various family settings. It might be argued that the highest demand for this research concerns families with multiple risks.

In addition to the families with a depressed mother, there are other groups of families in which infant crying may be affected by biological and environmental factors and where psychosocial resources may be exhausted in advance of any problem with infant crying. Groups at risk include families of very preterm infants and substance-abusing parents. In such groups, the additional problem of infant crying may exacerbate the family situation and later affect child outcomes. Very preterm infants are born at early stages of the brain development and are exposed to psychological separation (more or less so, even today) and a radically unnatural environment compared to a physiological *in utero* environment. If environmental factors dictate infant crying at all, there should be differences in the crying behaviour of very preterm infants. Furthermore, the parent–infant relationship of this infant group is affected by several stressors, which are likely to alter parental responses to the infant and to infant crying. The unfortunate fact that preterm infants are a risk group for shaken baby syndrome may indicate different responses to infant crying in this group. The infants born to substance-abusing mothers cry more during withdrawal, and the quality of crying is high-pitched. There is a paucity of research on crying after a withdrawal period. It is questionable whether addicted mothers have the ability to be

responsive and sensitive in a consistent way towards their crying infant. It is not known whether the amount of crying continues to increase or if crying subsides without adequate responses. In all of these groups (families with maternal depression, or drug abuse or families with a very preterm infant), infant crying may serve to indicate a need for closer evaluation and as an acceptable reason for the family to comply with interventions supporting sensitive and consistent parenting.

Public health information and interventions should be studied in rigorous research settings to find evidence-based ways of managing infant crying and to help build cost-effective and efficient services for the families of young infants. The optimal timing for some information and interventions may be before the birth of an infant, and other types of interventions may be necessary for those with multiple and prolonged infant behavioural problems. Such work is vital and will serve a large group of families today and possibly in future generations.

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