Low parental tolerance for infant crying: an underlying factor in infant sleep problems?

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SUMMARY

Parenting behaviours play a major role in the evolution of infant sleep. Sleep problems in infancy have been associated with excessive parental involvement at night-time, and with shorter delays in response to infant night wakings and signalling. Infant crying and sleep problems are linked, yet little is known about the impact of parental responses to crying on infant sleep patterns. This study examined the hypothesis that lower parental tolerance for crying is associated with infant sleep problems. We studied 144 married couples divided into three groups: parents of infants suffering from night-waking problems (i.e. the clinical group), parents of infants without sleep problems and childless couples. Crying tolerance was assessed using questionnaires, audio recordings of crying infants and using a novel paradigm, in which participants were shown a video of a crying infant and asked when they would intervene. Parents in the clinical group demonstrated shorter intervention delays in the crying infant clip (group effect: $P < 0.0001$), and tended to attribute more distress to the crying infants compared to parents in both control groups ($P < 0.05$). Additionally, women demonstrated lower tolerance for infant crying on most measures compared to men. Our results suggest that parents of sleep-disturbed infants appear to have lower tolerance for infant crying, which may be a predisposition underlying their excessive involvement in soothing their infants to sleep which may lead to the development of sleep problems. These preliminary findings should be explored further to assess their clinical validity and utility.

INTRODUCTION

The infant cry is one of the most powerful signals in the human repertoire. It conveys a sense of distress or urgent need and activates parental caring behaviours and protection (Bell and Ainsworth, 1972; Bowlby, 1969; Murray, 1979). The human brain is highly reactive to infant cry signals. Studies have documented strong and pervasive activation of brain areas, including subcortical regions for motivation and cortical areas for social cognition in response to infant crying (De Pisapia *et al.*, 2013; Sander *et al.*, 2007; Seifritz *et al.*, 2003; Swain, 2011). Significant physiological arousal and endocrine involvement have been documented in adults' responses to infant crying (Del Vecchio *et al.*, 2009; Groh and Roisman, 2009; Riem *et al.*, 2011; Stallings *et al.*, 2001).

Multiple factors have been associated with different levels of cognitive or behavioural reactivity to infant crying, including the acoustic features of the cry (Out *et al.*, 2010b; Soltis, 2004), gender (Boukydis and Burgess, 1982) and parenting experience (Boukydis and Burgess, 1982; Out *et al.*, 2010a). For instance, women are more likely than men to respond to infant crying and to intervene (Boukydis and Burgess, 1982). The literature on the role of infant crying and parental cry reactivity underscores the importance of understanding the impact of these factors on child development. Surprisingly, research in this area is relatively scarce.

Crying and sleep problems are very prevalent during infancy, and are often considered to be related phenomena (Smart and Hiscock, 2007; St James-Roberts and Peachey, 2011). Parents play a major role in the evolution of infant sleep (Sadeh and Anders, 1993; Sadeh *et al.*, 2010; Touchette *et al.*, 2009). The most established link between parenting and infant sleep is between parental bedtime interactions and sleep quality. In a longitudinal study, longer delay in parental responses to infant night wakings and signalling (e.g. crying) at 3 months predicted relatively high night-time self-soothing abilities at 12 months of age (Burnham *et al.*, 2002). Moreover, parents who are more active in soothing their infant to sleep are more likely to have infants with difficulty falling asleep and fragmented sleep (Sadeh *et al.*, 2007, 2010; Tikotzky and Sadeh, 2009; Touchette *et al.*, 2009). For instance, a longitudinal study during the first year of life demonstrated that mothers who strongly tended to interpret infant awakenings and crying during the night as a sign of distress that requires immediate intervention (as opposed to reducing responsiveness and promoting self-soothing) were more likely to use more active soothing interventions during the night, and their infants were more likely to experience more fragmented sleep (Tikotzky and Sadeh, 2009). These studies suggest that parental difficulty in coping with infant protest and crying plays a major role in the development of infant self-soothing abilities and sleep patterns. Accordingly, most behavioural interventions for infant sleep problems target parental bedtime behaviours in an attempt to reduce parental excessive involvement and night-time soothing behaviours. These interventions are very efficient in improving infant sleep (Mindell *et al.*, 2006), and they often involve coping with infant crying at night ('controlled crying') (Hiscock and Wake, 2002).

The goal of the present study was to expand the knowledge on parental sensitivity and reactivity to infant crying and to examine the hypothesis that lower tolerance for infant crying is associated with infant sleep problems. To accomplish this goal, we compared a group of parents with sleep-disturbed infants to two control samples (control parents with infants without sleep problems and childless married controls) using multiple methods to assess cry tolerance. Furthermore, we aimed to assess the role of parent gender, parenting experience (adults with or without parenting experience—therefore, we included the childless married couples group) and noise sensitivity (considering the acoustic stress associated with crying) in parental tolerance and reactivity to infant crying. We hypothesized that parents from the clinical sample would show lower tolerance to infant crying than parents from the control groups, and that women would show lower tolerance in comparison to men.

METHOD

The study was approved by the Tel Aviv University Ethics Committee and the Helsinki Committee of the Tel Aviv Medical Center. Signed informed consent was obtained from all of the participants.

One-hundred and forty-four married couples participated in this study. They were divided into three distinct groups: (1) the clinical sample that included 93 couples who sought help for their infant night-wakings problems; (2) 31 couples of parents of infants recruited as controls with no reported infant sleep problems and (3) 20 childless married couples. Infants and toddlers in both groups of parents were aged less 2 years. The clinical sample was recruited by advertisements and media reports on a study offering clinical interventions for infant sleep problems. The two control samples were recruited using advertisement on parenting websites and other related media channels.

All participants first completed a demographic information questionnaire, the Infant Sleep Vignette Interpretation Scale (ISVIS) and the Noise Sensitivity Scale (NSS). Each participant was then tested separately to assess his or her responses to infant crying using two procedures: the Ratings of Infant Crying Audio Segments (RICAS) followed by the Intervention Delay to Infant Crying Video (IDICV).

The ISVIS is a questionnaire designed to assess parental cognitions related to infant sleep difficulties (Sadeh *et al.*, 2007; Tikotzky and Sadeh, 2009). It comprises 14 hypothetical case descriptions of infants presenting sleep difficulties (e.g. having difficulties falling asleep or resuming sleep independently). After each description responders are asked to rate their agreement with three different assertions reflecting possible interpretations of the sleep problem using a six-point Likert type scale (from 'highly disagree' to 'highly agree'). In the present study we analysed only one subscale addressing the infant distress interpretation. This scale relates to assertions that represent beliefs that infants experience distress or anxiety upon awakening, and parents should therefore directly help or soothe them at night. These assertions are likely to be associated with difficulty tolerating crying and employing active interventions during the night (Sadeh *et al.*, 2007; Tikotzky and Sadeh, 2009).

The NSS is a 20-item scale assessing sensitivity to environmental noise and other auditory stimuli in different contexts (e.g. 'I get annoyed when my neighbours are noisy', 'Even music that I normally like will bother me if I am trying to concentrate') (Dornic and Ekehammar, 1990; Weinstein, 1978). Each item is rated on a six-point Likert type scale. Early validation studies have shown that high noise sensitivity predicts difficulties in adjusting to environmental noise and lower academic achievements (Weinstein, 1978) and is associated with lower extraversion (Dornic and Ekehammar, 1990). In the present study, the internal reliability of the scale (Cronbach's alpha) was 0.87.

The RICAS procedure was inspired by the work of Zeifman (2003). During this procedure participants were presented with 10 30-s audio recordings of infant crying in varying intensities and tones, using a headset adjusted to an average of 80 db. Following each recording participants rated their responses on six 10-point Likert-like scales (10 being the

highest agreement), including the following statements: (1) it was difficult to tolerate the sound of this crying voice; (2) it is difficult for me to hear a baby crying like this; (3) this crying baby is in distress; (4) this crying voice sounds penetrating and irritating; (5) this crying voice sounds spoiled or manipulative (reverse scored); and (6) this crying voice sounds urgent and alarming. Internal reliability of each scale across items was acceptable (0.91, 0.90, 0.77, 0.82, 0.79 and 0.77 for scales one to six, respectively). Items on each scale were averaged across the 10 stimuli to create six scale scores.

For data reduction purposes, the ratings on these six scales were subjected to factor analysis with varimax rotations. Two significant underlying factors emerged from this analysis: factor 1 (eigenvalue = 3.16) was highly loaded on scales 1 (loading = 0.92), 2 (0.92) and 4 (0.89) and was therefore labelled as the level of difficulty listening to infant crying; and factor 2 (eigenvalue = 1.34), which was loaded on scales 3 (0.75), 5 (−0.80) and 6 0.60), and was labelled as the attributed distress level to the infant crying. These two standardized factor scores were used in later analyses.

The IDICV procedure also was inspired by the work of Zeifman (2003) on adult responses to infant distress. The procedure is based on a presentation of a 2-min video clip of a 6-month-old baby playing on a carpet who then starts crying (after 10 s), with a gradual increase in crying intensity and visual distress signs. Prior to watching the video, a written cover story was presented to the participants: 'The following video is of a very demanding baby. His parents are trying to ignore some of his crying to allow him to calm down by himself. Please look at the video and decide when you feel it is absolutely necessary to intervene.' The purpose of the cover story was to create a standardized description of the situation and to increase motivation to tolerate the crying and delay the response. The intervention delay (in seconds) was used as the outcome measure for this procedure.

Data analysis

To test our hypotheses we used general linear mixed models based on the Proc Mixed procedure (Littell *et al.*, 2006; Verbeke and Molenberghs, 2000) from the SAS version 9.3 statistical package (SAS, 2011). Proc Mixed was used to examine factors explaining the five cry-related variables. Group (clinical parents, control parents and childless control couples) and gender (male/female) were independent variables included as categorical fixed effects. The couple's ID number was used as a random variable; gender was considered as a repeated variable to account for potential interdependence of the measures between partners within couples. Restricted maximum likelihood was used as the variance components estimation method. Covariance structure type was selected after comparison of different structures using the Akaike's information criterion (Akaike, 1974). *Post-hoc* differences between groups were based on the differences between least-squares means of the Mixed procedures. Due to significant skewness of the variable IDICV, it was log-transformed for all statistical analyses.

Regression analysis was used to assess multivariate prediction of the IDICV. To allow sufficient power for this analysis we applied multiple imputations to complete missing data using the SAS procedure MI (SAS Inc.) with the Markov chain Monte Carlo method (Schafer, 1997; Schafer and Graham, 2002). The imputations were computed following Little's test for missing data that confirmed that the missing data are missing at complete random (Little, 1988). The multiple regression analysis for the imputed data was conducted using the SAS procedure MIANALYZE (SAS Inc.), based on multiple imputation theory (Rubin, 1987). The numbers of participants (*n*) with data on the relevant variables are described in Table 1.

Table 1 Means, standard deviations and correlations of gender, age, education (years), delay to intervention to the crying video, sense of difficulty hearing the crying audio recordings, attributed infant distress to the crying audio recordings, distress interpretation on the ISVIS and noise sensitivity

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Gender	–							
2. Age	0.27***	–						
3. Education	−0.08	0.09	–					
4. Intervention delay to video	0.21**	−0.06	−0.03	–				
5. Crying audio—difficult	−0.08	0.07	0.06	−0.11	–			
6. Crying audio—distress	−0.22**	0.02	0.18*	−0.22**	0.23	–		
7. ISVIS distress interpretation	−0.12	0.04	0.10	−0.30***	0.10	0.24**	–	
8. Noise sensitivity	−0.19*	0.06*	0.11	−0.11	0.19*	−0.03	0.09	–
Mean	–	32.63	16.16	44.37	0.00	0.00	3.80	3.74
SD	–	4.27	2.20	20.38	1.00	1.00	0.62	0.77
n	288	288	277	285	259	259	248	251

Correlations with gender represent point-biserial correlations. Females = 0, males = 1. ISVIS, Infant Sleep Vignette Interpretation Scale; SD, standard deviation.
*$P < 0.05$, **$P < 0.001$, ***$P < 0.0001$.

RESULTS

Group comparisons of background variables revealed significant age differences. Fathers [mean = 32.61, standard error (SE) = 0.39] were significantly older than the mothers (mean = 30.58, SE = 0.39, $F = 40.84$, $P < 0.001$). Parents in the clinical group (mean = 33.59, SE = 0.37) were significantly older than those in parents control group (mean = 31.76, SE = 0.64) and from the childless couples (mean = 29.45, SE = 0.79, $F = 12.42$, $P < 0.001$). Because of these differences, age was controlled for in all relevant analyses. There were no significant differences in infant age between the clinical (mean = 12.09 months, SD = 3.10) and the parents control group (mean = 12.40 months, SD = 6.76). No other group differences were found on demographic variables.

Table 1 presents the means and SDs of the main measures of the study and the correlations between these measures. These correlations demonstrate shared variability of some of the sensitivity and tolerance for infant cry measures as manifested by the significant correlations of the intervention delay on the IDICV, the distress attributions on the RICAS and the distress interpretation on the ISVIS.

Intervention delay to the infant crying video

Significant gender ($F = 8.19$, $P < 0.005$) and group ($F = 9.51$, $P < 0.0001$) fixed effects were found (see Fig. 1a, with data presented before log-transformation). Women responded faster than men on this task. The clinical group had significantly shorter delays in comparison to the control parents ($t = 1.99$, $P < 0.05$) and to the childless controls ($t = 4.21$, $P < 0.0001$). The control parents had significantly shorter delays than the childless controls ($t = 2.20$, $P < 0.05$). There were no significant group × gender interaction or age effects.

Response to the infant crying audio recordings (RICAS)

No significant effects were found with regard to the factor of rated difficulty to cope with the sound of the infant crying. However, with regard to the factor of distress attributed to the crying infant, significant gender ($F = 21.03$, $P < 0.0001$) and group ($F = 3.20$, $P < 0.05$) fixed effects were found (Fig. 1b). Women tended to interpret the infant crying sounds as indicating that the baby was distressed and demanding at a higher level compared to men. Parents in the clinical group

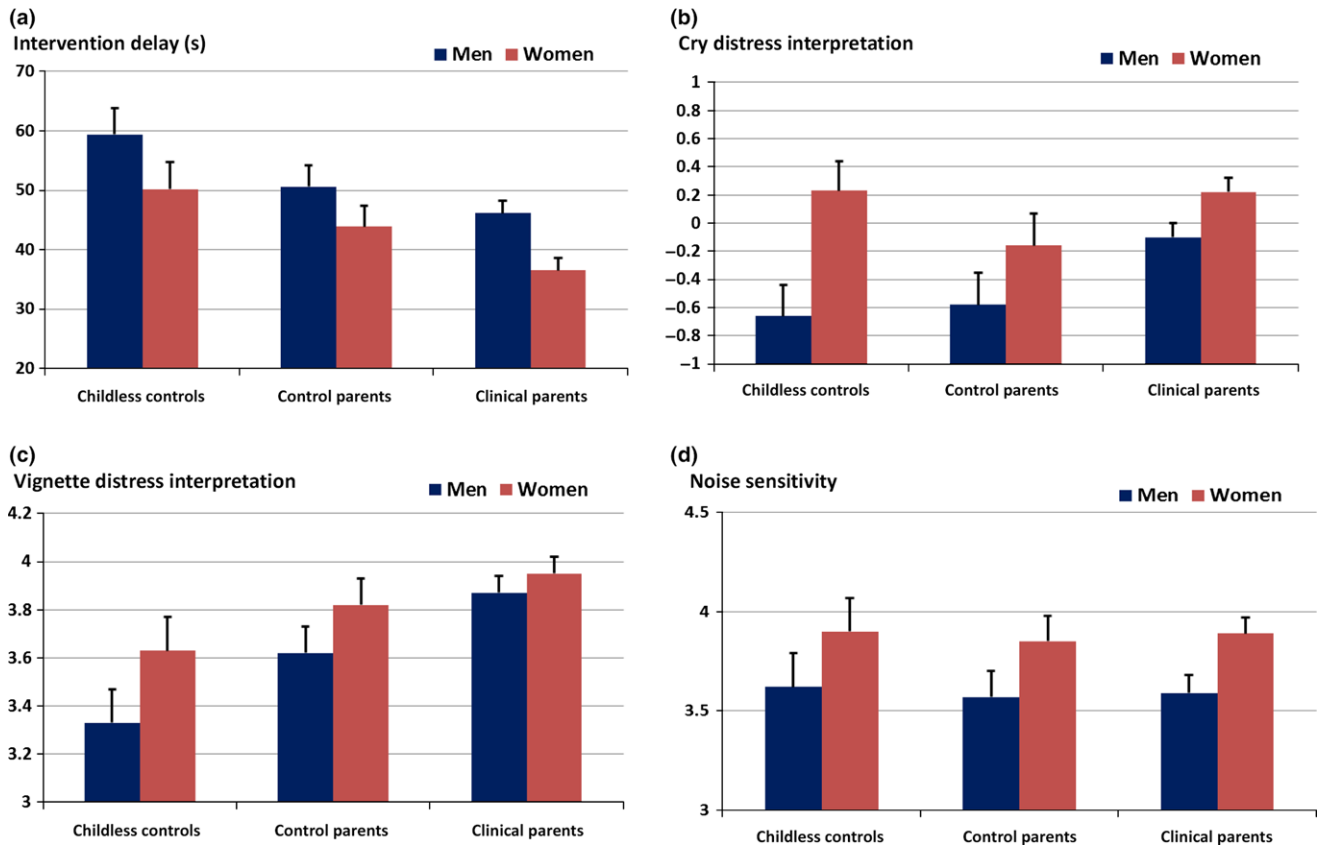

Figure 1. Group and gender comparisons on the main cry-related variables (means and standard errors). (a) Delay to intervention on the crying baby video; (b) attributed distress level to auditory crying stimuli; (c) level of attributed distress to vignettes of infant crying and protesting during the night; (d) reported noise sensitivity.

rated higher distress levels in comparison to the control parents ($t = 2.19$, $P < 0.05$), but there was no significant difference between the clinical group and the childless controls. Examination of the specific group differences revealed that there were no significant differences between the women's ratings on this scale and the only significant group differences resulted from the higher ratings of men in the clinical group in comparison to the parent control group ($t = 2.07$, $P < 0.05$) and the childless control men ($t = 2.63$, $P < 0.01$). There were no significant group × gender interaction or age effects.

Distress cognitions on the ISVIS

Significant gender ($F = 5.84$, $P < 0.05$) and group ($F = 6.93$, $P < 0.005$) fixed effects were found on the infant distress interpretation scale following the written vignettes of the ISVIS (Fig. 1c). In comparison to men, women scored higher on the distress interpretations. Parents in the clinical group scored significantly higher on this scale compared to the childless controls ($t = 3.64$, $P < 0.0005$), but the differences from the control parents were not statistically significant. There were no significant group × gender interaction or age effects.

Noise sensitivity

Gender was the only significant effect in this analysis ($F = 6.50$, $P < 0.05$). Women reported higher noise sensitivity than men (Fig. 1d).

Multivariate prediction of IDICV

Because the infant crying video is the most realistic experience of tolerance for infant crying, we assessed the multivariate prediction of the intervention delay to the video using age, gender, education, distress interpretation on the ISVIS, rated difficulty listening to the audio cry recordings, attributed distress in response to audio cry recordings, reported noise sensitivity and group (dummy coded as clinical = 1 for the clinical group or 0 for the other groups and control parents = for the control parents group and 0 for the other groups).

The results (Table 2) indicate that belonging to the clinical group, being a woman and attributing high distress levels on the ISVIS are significant predictors of shorter intervention delay.

DISCUSSION

The main goal of this study was to test the hypothesis that parents of sleep-disturbed infants have lower tolerance for infant crying using multiple assessment methods and two control groups. Our construct of cry tolerance received support from the significant correlations between some of the measures used for cry tolerance assessment (e.g. intervention delay to the video, distress attribution to the audio stimuli and distress interpretation). Overall, the results lend support to our basic hypothesis. In comparison to the two control groups, parents from the clinical group tended to respond faster to the crying infant video, suggesting a lower tolerance for infant crying under conditions encouraging delay of intervention (i.e. the cover story). This finding is in line with previous findings from a longitudinal developmental study suggesting that sleep problems in infancy are predicted by a shorter response time to infant signalling during the night (Burnham *et al.*, 2002), and with practice recommendations encouraging delay of response and increased tolerance for infant crying during the night (Mindell *et al.*, 2006). Considering that the participants responded to a video of a non-familiar infant crying during a period of daytime wakefulness, the group differences are particularly impressive. Assessing parental reactivity to a video of an infant crying in his/her crib during the night may provide additional meaningful information in future research.

Additional support for our basic hypothesis comes from the responses to the auditory stimuli. Fathers in the clinical group tended to attribute significantly more distress to the crying infants in comparison to the control fathers. Interestingly, there were no group differences related to the difficulty listening to

Table 2 Prediction of intervention delay to crying infant video

Parameter	*Estimate*	*SE*	*Lower B*	*Upper B*	t	P
Intercept	4.55	0.28	4.47	461	16.13	<0.0001
Gender (men = 1)*	0.128	0.048	0.125	0.135	2.66	0.0134
Age	−0.0037	0.0060	−0.0052	−0.0025	−0.62	0.5410
Education (years)	0.0059	0.012	−0.0015	0.0115	0.47	0.6444
Distress on ISVIS	−0.151	0.040	−0.166	−0.136	−3.73	0.0012
Cry audio difficult	−0.013	0.023	−0.020	−0.009	−0.56	0.5815
Cry audio distress	−0.051	0.027	−0.061	−0.040	−1.93	0.0674
Noise sensitivity	−0.042	0.035	−0.066	−0.023	−1.17	0.2598
Clinical group (= 1)*	−0.208	0.072	−0.210	−0.206	−2.90	0.0075
Control parents (= 1)*	−0.134	0.079	−0.147	−0.127	−1.70	0.1013

*Other options of these dummy variables were set to zero. ISVIS, Infant Sleep Vignette Interpretation Scale; SE, standard error.

the crying audio stimuli, which emphasizes the role of distress attribution rather than the stressful auditory feature. This distinction is in line with the fact that there were no group differences in the general NSS. On the ISVIS, the results reflected significant group differences with the clinical parents showing the highest distress interpretation ratings, which were significantly higher compared to the childless controls.

Our second hypothesis regarding gender differences received substantial support. In comparison to men, women intervened earlier in the crying infant video procedure, they tended to attribute more distress to the crying auditory stimuli and had higher distress interpretation on the ISVIS. These findings are in line with previous studies demonstrating increased sensitivity or lower tolerance of women to infant crying and distress signals (Boukydis and Burgess, 1982; Tikotzky and Sadeh, 2009; Wiesenfeld *et al*., 1981).

Parenting experience was also an important factor, with the childless control group showing the highest tolerance on the IDICV and the ISVIS. These results are consistent with earlier findings suggesting that adults with no parenting experience have greater tolerance to infant distress during the night (Tikotzky and Sadeh, 2009).

The multivariate analysis of the predictors of the intervention delay (IDICV, which reflects the closest approximation to real-life situations) revealed that gender (women), group (clinical) and distress interpretations (higher) were all predictors of shorter intervention delays.

Taken together, these findings provide preliminary support for the construct of parental tolerance for infant crying and to the hypothesis that individual differences in this domain may play a role in parenting with potential significant impact on child development.

It is important to note that the main limitation of our study is its correlative nature. Therefore, the associations between lower tolerance for infant crying and infant sleep problems are not indicative of causality. It could be hypothesized that infants who are more difficult (e.g. cry more, present sleep problems) may influence their parents' tolerance for crying. Additional longitudinal and clinical studies are needed to validate and establish further the role of infant cry tolerance on child development and specific disorders, and to develop tools to regulate parental tolerance for infant crying when it interferes with appropriate parenting.

In conclusion, parents of sleep-disturbed infants appear to have lower tolerance for infant crying, which may be a predisposition underlying their excessive involvement in soothing their infants to sleep and the development of sleep difficulties. The clinical value of these preliminary findings should be explored further to assess if, indeed, tolerance for infant crying plays a role in sleep and other domains of child development.

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AUTHOR CONTRIBUTIONS

AS, MJ-H, EL-K and YS contributed to the design, execution of the study, data collection and preparation of the manuscript. TFA, SC, YS, LT and MK contributed to the design of the study and manuscript preparation.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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