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Parenting style associations with sensory threshold and behaviour: a prospective cohort study in term/preterm infants

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Abstract

Aim: Early-life atypical sensory functioning and behavioural profiles are often associated with long-term developmental problems, especially in former preterm infants. We tested whether parenting style is associated with atypical sensory threshold or behavioural outcomes in preterm and term infants assessed during early childhood.

Methods: We prospectively evaluated parenting style for a cohort of term and preterm infants who had previous assessments of sensory development and behaviour. We used standardised tools to evaluate parenting style, sensory neurological threshold at one year, and internalising and externalising behavioural tendencies at two years. Covariates included gestational age, sex and maternal education.

Results: For the entire cohort ($n = 82$), children of more permissive parents were 2.7 times more likely to demonstrate abnormal sensory neurological thresholds compared to children of parents with less permissive styles (CI: 1.4–4.9). More permissive parenting scores were also associated with 2.4 times increased internalising (CI: 1.3–4.2) and 3.0 times increased externalising (CI: 1.6–5.6) tendencies. In the preterm group only, higher authoritative parenting scores were associated with fewer behavioural problems.

Conclusion: Permissive parenting is associated with worse infant sensory and behavioural outcomes. Authoritative parenting is associated with fewer behavioural problems in preterm children. Modification of parenting style may improve sensory development and behavioural outcomes.

Keywords

Behavioural and learning problems; Neurodevelopment; Parenting; Preterm children

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section at the end of the article:

Introduction

Many former preterm infants demonstrate subsequent neurodevelopmental impairment (1). Although the prevalence and extent of disability are strongly influenced by gestational age and illness severity, the interplay between environmental factors and developmental capacity to react to sensory experiences also contribute to a child's outcome (Fig. 1) (1–3). For both term and preterm children, construction of sensory systems is foundational for early learning: atypical sensory processing characteristics, such as hypersensitivity, are associated with subsequent aberrant neurodevelopment in children (2–6).

As a critical environmental factor, caregiver behaviour, defined by measures of parenting style constructs, is also associated with developmental outcomes, such as cognition, in children of all gestational ages (7–11). Additionally, supportive experiences parents provide to children, such as breastfeeding or skin-to-skin care, can modulate the development of somatosensory processing (3). However, parenting style has not yet been studied in relation to sensory development in early childhood. Similarly, although associations exist between specific parenting characteristics, such as parental warmth, and behavioural outcomes in children, associations between each aspect of parenting style and subsequent behavioural outcomes is not fully understood (7,8). In addition, the influence of parenting on construction of sensory systems and behavioural tendencies must account for immaturity at birth, as children born preterm are more likely to demonstrate abnormal sensory and behavioural outcomes than term infants (1,12,13).

Our objective was to examine associations of parenting style with concurrent child behavioural outcomes and with a previous assessment of sensory reactivity in preterm and term infants (Fig. 1). This framework was possible because parenting style remains stable throughout early childhood and parenting characteristics between a given parent and child remain stable in the absence of high quality parenting interventions (9,10). Based upon associations between the parenting constructs described above and child cognitive development, we hypothesised that an authoritative parenting style, characterised by a combination of high parental responsivity and high expectations or 'demanding-ness', would be associated with more positive behavioural outcomes and a higher level of sensory functioning earlier in infancy. We further hypothesised that these associations would be stronger for the preterm than term children given the increased risk of neurodevelopmental impairment in former preterm infants and previously established role of parenting in this context (7,8).

METHODS

Study population

We studied a secondary cohort derived from term and relatively healthy preterm infants recruited from the new-born nursery and the neonatal intensive care unit for an NIH-funded study on multisensory processing (1 K23 HD074736–01A1; 01/14–01/1). The Vanderbilt University Medical Center Institutional Review Board (IRB) approved both the original study and secondary use of the cohort. Inclusion criteria were term infants 37 weeks

gestation and preterm infants <37 weeks gestation at birth. Exclusion criteria were grade III or IV intraventricular hemorrhage, periventricular leukomalacia and presence of inflammatory conditions such as necrotizing enterocolitis, severe bronchopulmonary dysplasia or culture-documented sepsis.

The primary caregiver completed the Infant/Toddler Sensory Profile (ITSP) at 12–15 months corrected age and the Child Behavior Checklist (CBCL) at 24–27 months corrected age during the original study (14,15). A trained therapist assisted primary caregivers as needed to complete the assessments (3). The original study team obtained demographic data from both the medical record and the parents. In accordance with IRB regulations, all data were stored in a secure Research Electronic Data Capture (REDCap) encrypted server (16).

The ITSP has the best psychometric properties among similar behavioural assessments in infancy (17) and consists of a 48-item questionnaire that assesses how often the child responds to different sensory experiences in the home environment (15). A key variable derived from this instrument is the infant's neurological threshold (tendency to respond to sensory stimuli). The neurological threshold was considered atypical if it was lower or higher than the standard range for age band established for the ITSP. Neurological threshold is considered low when minimal sensory input causes a system to respond and high when substantial stimulation is required to elicit a response (15). Because preterm infants are often atypical in their responses but neither consistently high nor low (12), and because our sample size was limited, we analysed neuro-logical threshold as a binary variable of typical or atypical.

Continuous raw scores were obtained for internalising and externalising tendencies on the CBCL and were calculated according to the Achenbach System of Empirically Based Assessment (ASEBA) manual and analysed as continuous variables (14). Internalising tendencies include anxiety, depression, withdrawn and somatic complaints; externalising tendencies include rule-breaking and aggressive behaviours. CBCL scores range 0–72 for internalising and 0–48 for externalising, with higher scores indicating more of a tendency towards those behaviours.

A single investigator (MLN) prospectively administered the Parenting Styles and Dimensions Questionnaire (PSDQ) to caregivers of infants in the cohort with completed ITSP or CBCL records at 27–47 months. The 32-item PSDQ is based on Baumrind's typology of parenting (18,19) and demonstrates acceptable psychometric properties (20–22). The PSDQ quantifies parenting style (authoritative, authoritarian and permissive) for each parent, based upon the parent's degree of responsivity and demandingness. Parents can demonstrate more or less sensitivity in their interactions with their child (responsivity). In addition, parental expectations of their child's development (demandingness) can range from nonexistent to excessive (11,19). Authoritative parenting is both highly responsive and highly demanding, whereas authoritarian parenting is highly demanding but less responsive. In contrast, permissive parenting is highly responsive but less demanding. Of note, the PSDQ does not address parenting that is low on both responsivity and demandingness; this style is characterised as 'uninvolved' or 'neglectful' and was not part of Baumrind's original typology (18,19). The PSDQ provides an independent, continuous score for each parenting

style with larger numbers indicating increased usage by the parent (22). Scale scores were analysed as three continuous variables. PSDQ scores range for authoritative 15–75, authoritarian 12–60 and permissive 5–25. Each parent received a score for each of the three styles. Only 12% of the families in our study participated in a parenting programme, and none participated in those with interventions associated with improved outcomes.

Analysis

In this study, parenting style was considered as a continuous exposure. Although the characterisation of parenting style using the PDSQ occurred at the same time as one of the outcomes, previous research supports that parenting style itself is present since birth and remains constant and thus could not be considered an outcome (9,10). This was in contrast to sensory processing threshold or behavioural tendencies which develop through the interplay of environmental factors and baseline characteristics such as immaturity at birth and sex. After multiple imputation to account for missing data, we used proportional odds ordinal logistic regression to estimate the association of infant neurological threshold with PSDQ score while controlling for gestational age at birth. Since infant neurological threshold is a binary variable, and only 17 subjects were atypical, we fit separate models with neurological threshold as the outcome and authoritarian, authoritative or permissive parenting as the predictor of interest. Adjusted models were controlled for gestational age. Adjustment for more covariates was not supported by the sample size and number of events.

We used proportional odds ordinal logistic regression to estimate the association of infant internalising and externalising tendencies with PSDQ scores. Since internalising and externalising scores were continuous variables, we included the three PSDQ scores (authoritarian, authoritative and permissive) in the same model. Adjusted models accounted for two other covariates of gestational age at birth and infant sex. As 98% of the mothers in our cohort graduated from high school, we were unable to adjust for maternal education. We did not adjust for birthweight since gestational age and birthweight are highly correlated variables ($R = 0.94$). All data were analysed using R version 3.3.3 (<https://www.rproject.org/>). (See Supporting information for more details).

RESULTS

Our secondary cohort consisted of 82 infants, including 42 preterm, for whom we collected parenting data. Study cohort characteristics are seen in Table 1. We obtained ITSP and PSDQ data for 78/82 (95%) of study participants and CBCL and PSDQ data for 76/82 of participants (93%) (Fig. 2). The median age of PSDQ collection was 33 months. No significant differences existed between the groups lost and retained to follow-up, with four infants missing in the ITSP group and six in the CBCL group. We used multiple imputation to account for missing data.

Parenting style and neurological threshold

Permissive parenting was associated with an atypical sensory threshold in children at one year. In analyses adjusted for gestational age, a 5-point increase in parent permissive score was associated with 2.7-fold increased odds of an abnormal neurological threshold [95%

confidence interval (CI): 1.4–4.9]. Associations between authoritarian and authoritative parenting and neurological thresholds were not significant. An association between permissive parenting and atypical child sensory threshold was found in both in preterm and term groups, odds ratios (OR) of 2.4 (CI: 1.1–5.4) and 3.0 (CI: 1.2–7.6), respectively (Fig. 3).

Parenting style and behavioural outcomes

Permissive parenting was associated with more atypical behavioural tendencies at two years. In analyses adjusted for both gestational age at birth and infant sex, a 5-point increase in the permissive score of parents was associated with 2.4-fold (CI: 1.3–4.2) increased odds of a higher internalising score and 3-fold (CI: 1.6–5.6) increased odds of a higher externalising score. Authoritarian and authoritative parenting styles were not associated with atypical behavioural tendencies for the entire cohort (Fig. 4).

Parenting style, child internalising tendencies and prematurity

In single group analyses, the association between permissive parenting of preterm infants and internalising tendencies did not reach statistical significance (OR 1.9, CI: 1.0–3.8), in contrast to the term group (OR 4.7, CI: 1.7–12.9). Additional statistical analysis using a Wald test failed to demonstrate a significant difference between the preterm and term groups for these associations.

In preterm-born infants, a 10-point increase in parental authoritative score was associated with 2.4-fold decreased odds of internalising tendencies (CI: 0.2–0.8). This association was not found in the term group.

Parenting style, child externalising tendencies and prematurity

Preterm and term infants with permissive parents were more likely to demonstrate externalising tendencies at two years. For the preterm group alone, a 10-point increase in parental authoritative score was also associated with 2.4fold decreased odds of externalising tendencies (CI: 0.2–0.9) (Fig. 5). No significant associations were demonstrated with authoritarian parenting for any group.

DISCUSSION

Our report is the first to characterise the association between parenting style and infant sensory neurological threshold. We report for the first time the association between parenting styles characterised by high responsivity and high expectations with early sensory development and behavioural outcomes in former preterm infants. Our study also contributes to a small but growing body of literature on the associations of parenting style with child behaviour in former preterm children. We found that children of permissive parents were more likely to display atypical neurological thresholds in infancy and more internalising and externalising tendencies in early childhood.

We found that parenting style is associated with subsequent development. Permissive parenting reflects low demandingness and high responsivity. Demandingness indicates that

the parent has developmentally appropriate expectations of the child, indicating a parenting style that aims to determine the ‘just-right’ challenge for their child. This dynamic concept means ensuring that expectations of the child’s tasks are suitably matched with their skill level and that they change as their performance changes overtime (23). Responsivity reflects parental sensitivity to a child’s cues and that the parent provides a balanced mix of pressure and support in interactions with the child. In contrast to authoritative and authoritarian parents, permissive parents demonstrate low demandingness. Our finding of worse behavioural tendencies in children whose parents have lower than appropriate developmental expectations of them is consistent with studies of the ‘vulnerable child’, parents of children with medical problems more often perceive them as frail, and these children display poorer emotional adjustment (24). In former preterm children, higher parental perception of child vulnerability has been correlated with lower adaptive development, even after controlling for indicators of medical vulnerability (25). In fact, in former preterm children without indicators of continued medical vulnerability, the associations between parental perception of child vulnerability and lower child adaptive development display the strongest correlations (25).

Permissive parenting and child sensory development

We found no published reports of associations of permissive parenting with infant sensory thresholds. However, other populations of children at risk for aberrant sensory development, such as those with autism spectrum disorders (ASD), provide some insight on possible interactions between parenting, sensory thresholds and behavioural tendencies (5,26,27). In children with ASD, sensory processing outcomes and behavioural outcomes are closely related (5,6). Furthermore, parenting style is associated with developmental outcomes in these children. For example, a randomised controlled trial of an intervention to modify parenting style in parents of children with ASD resulted in decreased permissive parenting tendencies and improved behavioural outcomes in their children (27). Although detailed sensory processing outcomes were not specifically assessed in that study, these two outcomes appear closely associated (5,6). Children with sensory processing difficulties also benefit from parental scaffolding, which is lacking in permissive parenting style. The National Center for Clinical Infant Programs (NCCIP) specifically recommends parental scaffolding to promote optimal exploration of sensory environment in children with sensory processing difficulties (26). Our findings are therefore consistent with reports of interactions between permissive parenting, sensory thresholds and behavioural outcomes.

Early sensory experiences shape neural connections and brain networks, which are the foundation for later higher order functions such as behavioural responses (3). Thus, the association between permissive parenting and abnormal sensory neurological threshold in the home environment may be a critical component in the pathway for behaviour problems at two years of age in children of permissive parents. However, the mechanistic underpinnings of these associations need further elucidation.

Term versus preterm group

We analysed the preterm and term groups separately to ensure that the associations found in the entire cohort between permissive parenting and increased abnormal sensory threshold and increased internalising and externalising behaviours applied to the term and preterm

infant groups individually. With one notable exception, findings for term and preterm groups individually were consistent with those of the entire cohort. Authoritative parenting, which is both highly demanding and highly responsive, was associated with improved behavioural outcomes in former preterm children. However, this effect was seen only in the preterm group, but not in the term group or the entire cohort. In one report, preterm-born children of authoritative mothers had improved neurodevelopmental outcomes (28). However, ours is the first study to suggest that authoritative parenting style is associated with better neurodevelopment in preterm, but not term infants, a finding consistent with the differential susceptibility model studied in other groups of preterm and term infants (10,29).

Parental demandingness and preterm infants

The association of authoritative parenting with fewer negative behavioural tendencies in the preterm group combined with worse behavioural tendencies in children of permissive parents suggests that preterm children would benefit from parental expectations that are neither too high nor too low for the child. Although increased parental responsiveness has been associated with improved behavioural outcomes in former preterm infants (7,8), few studies have examined the associations between parental expectations of the child with behavioural outcomes. Interventions such as the Parent-Baby Interaction Program and Creating Opportunities for Parent Empowerment, among others, have focused on improving parental responsiveness to help optimise neurodevelopment in former preterm infants (30,31). However, these interventions address only one component of the optimal approach. Although lower parental demandingness, as seen in permissive style, is associated with worse behavioural tendencies in both term and preterm children, higher parental demandingness, as reflected in authoritative style, is associated with improved behavioural outcomes only in preterm children. Thus, parents of former preterm infants may benefit from additional training and support to achieve high demandingness, as defining and adjusting developmental expectations may be difficult in infants at risk for highly variable delay types and severity (1).

Future directions

While authoritative, authoritarian and permissive parenting styles are defined by degree of responsiveness and demandingness, other parenting constructs including parental structure, intrusiveness and synchrony are also critical (7,8,11). Future studies that examine the interactions between these parenting constructs and their associations with neurodevelopment in former preterm infants will inform our understanding of these dynamics and, ultimately, guide interventions. For example, we may find that organisation within a dyadic relationship enhances parent–child synchrony and that enhanced synchrony improves parental responsiveness or demandingness. We need to further examine which of these individual and combined parenting constructs are most critical for child outcomes.

Limitations

Our study has several limitations. Multiyear follow-up studies, such as ours, are time and resource intensive, thus dictating a small cohort. The wide confidence intervals for our subgroup analyses make effect sizes difficult to interpret. Our attrition was low, however,

and our sample size sufficient to demonstrate associations while controlling for gestational age at birth and infant sex.

Maternal education is an important influence on cognitive and behavioural development (32). Since nearly all (98%) of the mothers in our cohort graduated from high school, maternal education was not a useful covariate in our study. Thus, our findings may not be generalisable to children of mothers with lower levels of educational attainment. Although parenting style is an independent correlate with outcomes while accounting for medical and social factors (8), further studies are needed to characterise the relationships between maternal education, parenting style, and child sensory and behavioural outcomes.

Parent–child dynamics are dyadic, and our study considered parenting but not infant contributions. Parenting style, however, has been demonstrated to depend intrinsically more on the parent and less upon the child (8), thus informing our methodological framework of using parenting style as the independent variable. Additionally, though the literature supports stability of parent style over time (9,10), stable parenting style for each individual parent–child dyad or for each individual parenting characteristic is impossible to demonstrate. Finally, parenting is a more complicated and multidimensional concept than a single questionnaire can measure, even one that is multifactorial and psychometrically sound (20–22).

CONCLUSION

In term and preterm infants, we have shown that permissive parenting is associated with more atypical sensory and behavioural outcomes. Children with these characteristics are more likely to demonstrate anxiety, depression, aggression or attentional difficulties in later childhood and adulthood (33,34). Furthermore, authoritative parenting was associated with improved outcomes in the preterm group, suggesting directions for future parenting interventions beyond responsivity training.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

ASD	Autism spectrum disorders
ASEBA	Achenbach System of Empirically Based Assessment
CBCL	Child Behavior Checklist

CI	Confidence interval
IRB	Institutional Review Board
ITSP	Infant/Toddler Sensory Profile
NCCIP	National Center for Clinical Infant Programs
OR	Odds ratio
PSDQ	Parenting Styles and Dimensions Questionnaire
REDCap	Research Electronic Data Capture

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Key notes

- In this prospective cohort study, permissive parenting, which is highly responsive but not demanding, is associated with worse infant sensory and behavioural outcomes in term and preterm children.
- Authoritative parenting, which is both responsive and demanding, is associated with fewer behavioural problems in preterm children.
- Interventions that promote parental demandingness, in addition to responsivity, may improve outcomes in term and preterm children.

Figure 1.

Progression and influences on infant neurodevelopment (modified from Maitre review of Neurorehabilitation) (4). The neonatal brain at birth is immature and is influenced by prenatal, birth and postnatal events. Development of the sensory system, one of the first systems to develop, is influenced by both brain maturation and experience, and in turn influences behaviour. Although parenting is a key environmental factor in infants, associations between parenting and sensory systems and behavioural outcomes are not well studied.

Figure 2.

Study population. Subjects were derived from a cohort of preterm and term infants whose parents completed the Parenting Styles and Dimensions Questionnaire (PSDQ). Multiple imputation was used to account for missing data. Results for both ITSP and CBCL were available in 73 infants. CBCL = Child Behavior Checklist; ITSP = Infant/Toddler Sensory Profile.

Figure 3.

Odds ratios with 95% confidence intervals for associations between each parenting style and abnormal neurological threshold for the entire cohort and in group analysis by term or preterm status. The adjusted analysis accounts for gestational age at birth. Permissive parenting is associated with abnormal neurological thresholds in all groups.

Figure 4.

Associations between parenting style and internalising (A) and externalising (B) tendencies at two years corrected age for the cohort. Odds ratios and 95% confidence intervals are adjusted for gestational age and sex. Permissive parenting (high responsivity/low demandingness style) is associated with increased internalising and externalising scores.

Figure 5.

Odds ratios (triangles) with 95% confidence intervals (lines) for associations between parenting styles and internalising (A,B) and externalising (C,D) tendencies for single groups [preterm (A,C), term (B,D)]. Panels E and F show the odds ratios (OR) and 95% confidence intervals (CI) for associations between permissive (E) and authoritative (F) parenting and atypical sensory neurological threshold and internalising and externalising behaviours in children. Since no significant associations were found between authoritarian parenting and outcomes, these data were not included. CIs not crossing one are statistically significant with p -values $<0.05^*$ on odds ordinal logistic regression analysis. More authoritative parenting is associated with fewer internalising and externalising behaviours in preterm children. More permissive parenting is associated with more internalising behaviours in term children and more externalising behaviours in term and preterm children.

Table 1

Study population characteristics and scores for the entire cohort (A) and by term and preterm groups (B)

A.			
	n		
Gestational age at birth, weeks, median (IQR)	82	36 (31, 39)	
Female, n (%)		44 (54)	
Preterm, n (%)		42 (51)	
Full-term, n (%)		40 (49)	
Race Black or African American, n (%)		16 (20)	
Race White or Caucasian, n (%)		64 (78)	
Race Asian, n (%)		1 (1)	
Race Other, n (%)		1 (1)	
Ethnicity Hispanic, n (%)		6 (7)	
Ethnicity Non-Hispanic, n (%)		76 (93)	
Predictors		Scores	
Parenting style score on PSDQ, median score (IQR)			
Authoritative	82	61 (56, 67)	
Authoritarian		18 (16, 21)	
Permissive		11 (8, 13)	
Outcomes		n (% atypical)	
Atypical sensory neurological threshold	78	17 (22%)	
Behavioural profile score on CBCL, median score (IQR)		Scores	
Internalising	76	23 (12, 37)	
Externalising		8 (4, 14)	
B.			
	Preterm n = 42	Term n = 40	p-value
Female, n (%)	23 (55)	21 (52)	0.84
Mother with high school graduation, n (%)	40 (95)	40 (100)	0.16
Race Black or African American, n (%)	11 (26)	5 (12)	0.22
White or Caucasian, n (%)	30 (71)	34 (85)	
Asian, n (%)	0 (0)	1 (2)	
Other, n (%)	1 (2)	0 (0)	
Ethnicity Hispanic, n (%)	3 (7)	3 (8)	0.95
Non-Hispanic, n (%)	39 (93)	37 (92)	
Parenting style score on PSDQ, median score (IQR)			
Authoritative	64 (57, 69)	59 (56, 66)	0.21
Authoritarian	18 (15, 20)	18 (16, 21)	0.35
Permissive	11 (8, 13)	10 (8, 12)	0.33
	n = 41	n = 37	

A.			
	n		
Atypical sensory neurological threshold n (%)	8 (20%)	9 (24%)	0.61
	n = 40	n = 36	
Behavioural profile score on CBCL, median score (IQR)			
	n = 40	n = 36	
Internalising	26 (12, 39)	21 (13, 33)	0.44
Externalising	8.5 (3.8, 15)	7 (4, 13)	0.77

CBCL = Child Behavior Checklist; IQR = Interquartile range (25th, 75th); PSDQ = Parenting Styles and Dimensions Questionnaire.

For all variables, higher scores indicate increased tendency to display the behaviour or use the parenting style. There are no significant differences between the term and preterm groups.