Influence of Fathers' Early Parenting on the Development of Children Born Very Preterm and Full Term

Grace E. McMahon, BPsych(Hons)[1,2], Megan M. Spencer-Smith, PhD[1,2], Carmen C. Pace, PhD[2,3,4,5], Alicia J. Spittle, PhD[2,6,7], Paulina Stedall, BPsych(Hons)[1,2], Kate Richardson, BA(Hons)[1,2], Jeanie L.Y. Cheong, MD[2,7,8], Lex W. Doyle, MD[2,5,7,8], Peter J. Anderson, PhD[1,2], and Karli Treyvaud, DPsych[2,5,7,9]

Objectives To examine factors associated with fathers' early parenting behaviors (including very preterm [VPT] birth, familial social risk, child sex, and child medical risk), and the relationship between fathers' early parenting behaviors and later child development.

Study design Participants were 81 VPT (born <30 weeks of gestation) and 39 full-term father-child dyads. Parenting behaviors (sensitivity, structuring, nonintrusiveness, nonhostility) were assessed at 12 months of corrected age using the Emotional Availability Scales, with scores ranging from 1 (low) to 7 (high). At 24 months of corrected age, child cognitive, language, motor, and social-emotional development were assessed. Results are presented as (regression coefficients; 95% CIs).

Results There was little evidence that VPT birth, familial social risk, or child medical risk were associated with fathers' parenting behaviors. Fathers of girls tended to be more sensitive (0.42; 0.18, 0.65), less intrusive (0.36; 0.04, 0.70), and less hostile (0.26; 0.01, 0.50) compared with fathers of boys. Higher structuring was associated with more optimal cognitive (3.29; 1.25, 5.34), and language development (4.69; 2.26, 7.14). Higher sensitivity was associated with more optimal language development 3.35 (0.95, 5.75), and more intrusive behavior was associated with more externalizing symptoms (-1.68; -3.06, -0.31).

Conclusions Early parenting did not differ between fathers with VPT and full-term children, but fathers' parenting did vary according to child sex. Fathers' early parenting was associated with future neurodevelopment, reinforcing the need to support fathers' parenting, and include fathers in early intervention programs. *(J Pediatr 2019;205:195-201).*

Children born very preterm (VPT; <32 weeks of gestation) are at high risk of neurodevelopmental difficulties across childhood,[1-3] and there is increasing interest in the role of parenting behaviors as a potential protective factor for their development.[4-8] In particular, highly sensitive parenting[9] by mothers is associated with more optimal developmental outcomes for VPT children,[4-8,10] whereas higher levels of parental negative affect[5,11] and intrusive behaviors[5] are associated with poorer outcomes.

In contrast to mothers, limited research has examined fathers' parenting of preterm children. Recent studies have reported minimal differences in parenting between fathers of VPT and full-term children,[12,13] but others have reported more optimal[14] or poorer parenting[15] in fathers of preterm children. Surprisingly, the influence of fathers' parenting behaviors on child development has not yet been extensively examined in contemporary VPT cohorts, despite evidence of the important and often independent influence of fathers on child development in the general population.[16-21] Furthermore, it is important to examine how fathers' parenting, and the association between fathers' parenting and child development, may vary according to factors such as child sex, family social risk, and child medical status. For example, in the general population, the influence of fathers' parenting on early child outcomes has been reported to be stronger for boys.[16]

This study aimed to compare parenting behaviors in fathers of VPT and full-term 12-month-olds, and to examine the influences of social risk, child sex, and medical risk on parenting; and examine the associations between fathers' parenting at 12 months of corrected age and child development at 24 months of corrected age, and the potential influence of child sex. Based on recent

EAS	Emotional Availability Scales
VPT	Very preterm

From the [1]Monash Institute of Cognitive and Clinical Neurosciences and School of Psychological Sciences, Monash University; [2]Victorian Infant Brain Studies, Murdoch Children's Research Institute; [3]Department of Adolescent Medicine, Royal Children's Hospital; [4]Developmental Disability and Rehabilitation Research, Murdoch Children's Research Institute; [5]Department of Paediatrics; [6]Department of Physiotherapy, University of Melbourne; [7]Newborn Research, Royal Women's Hospital; [8]Department of Obstetrics and Gynaecology, University of Melbourne; and [9]Department of Psychology and Counseling, La Trobe University, Melbourne, Australia

Supported by National Health and Medical Research Council (Center for Research Excellence in Newborn Medicine 1060733; project grants 1024516, 1028822; Career Development Fellowship 1108714 [to A.S.]; Senior Research Fellowship 1081288 [to P.A.]; Career Development Fellowship 1141354 [to J.C.]). Murdoch Children's Research Institute is supported by Victorian Government's Operational Infrastructure Support Program. Funders had no involvements in study design; collection, analysis or interpretation of data; writing this article; or the decision to submit the article for publication. The authors declare no conflicts of interest.

https://doi.org10.1016/j.jpeds.2018.09.073

research,[12,13,17-19] we expected that there would be no differences in parenting behaviors between fathers of VPT and full-term children, and between fathers of lower and higher social risk. We expected that higher levels of paternal sensitivity and structuring would be associated with more optimal outcomes for VPT and full-term children, and higher levels of intrusiveness and hostility would be associated with less optimal outcomes. Other analyses were considered exploratory.

Methods

Participants were part of the broader Victorian Infant Brain Study 2 cohort, a prospective longitudinal cohort of 149 VPT children born at <30 weeks of gestation (143 survivors) and a comparison group of 151 children born full-term (≥37 weeks of gestation or weighing ≥2500 g) recruited at birth from the Royal Women's Hospital, Melbourne, Australia between January 2011 and May 2014.[22] Children with congenital abnormalities known to affect neurodevelopment or from non-English speaking households were excluded, the latter because of a requirement for English to complete questionnaires. Full-term children were excluded if they required admission to the neonatal intensive or special care nursery. The study was approved by the ethics committees of the Royal Women's Hospital and the Royal Children's Hospital, and written informed consent was obtained from the parents of all children. At 12 and 24 months of corrected age, fathers and children attended follow-up assessments described below. Children did not participate in an intervention as part of this study but had access to intervention services in the community as per usual.

Of the 143 VPT children, 4 were not assessed at 12 months of corrected age (nonattendance, geographic distance). Fathers of 56 VPT children did not attend the appointment, and videos of the 12-month observational assessments were lost for 2 children. Videos were available for 81 father-VPT child dyads (including 17 sets of twins and 1 set of triplets) representing 57% of potential father-child dyads based on participating children. Of the 151 full-term children recruited, 10 were not assessed at 12 months, 100 fathers did not attend their child's appointment, and 2 videos of the 12-month observational assessment were lost, resulting in video observational data for 39 father-full-term child dyads (26% of potential father-child dyads based on participating families). Father's participation at the 12-month assessment was optional as the primary focus was on the mother's parenting, explaining the large number of fathers who did not attend.

Measures

Social Risk. At birth, primary caregivers completed the Social Risk Index,[23] a questionnaire used to estimate family social risk based on 6 factors: family structure, education of primary caregiver, occupation of primary caregiver, employment status of the primary income earner, language spoken at home, and maternal age at birth. Each variable was rated on a 3-point scale (0 = low, 1 = intermediate, 2 = high). A social risk score was generated by summing the factors (range 0 to 12), with scores categorized as lower (<2) or higher (≥2) social risk.

Medical Risk. Perinatal medical data were collected from medical records (**Table I**). Level of medical risk (higher or lower) was calculated for VPT children only. Higher medical risk was based on the presence of at least 1 of the following conditions known to influence VPT child development[2,24]: proven necrotizing enterocolitis, moderate-severe white matter brain abnormalities on brain magnetic resonance imaging performed at term-equivalent age (scored by an established scoring method for newborn infants[25]), sepsis, bronchopulmonary dysplasia, or treatment with postnatal corticosteroids.

Fathers' Parenting Behaviors. Fathers' parenting behaviors were assessed using the Emotional Availability Scales (EAS) Fourth edition.[26] At 12 months of corrected age, father-child dyads were videotaped during a 15-minute semistructured play session comprising 3 phases: free play with a variety of age appropriate toys (10 minutes), pack-up (1 minute), and play with a puzzle chosen to challenge the child (4 minutes). Fathers were asked to interact with their child as they normally would and knew they were being video recorded.

The sessions were later scored by 3 trained and accredited coders to assess 4 domains of parent behavior: sensitivity (warmth and emotional connectedness to the child), structuring (adequately guiding/scaffolding the child's play), nonintrusiveness (no overprotection/over-directiveness), and nonhostility (lack of abrasive, impatient, or antagonistic interaction). In addition to the 4 parenting domains, the EAS also has 2 child domains (child responsiveness and child involvement), that were not used for the current study given its specific focus on parenting and the parent's role in the relationship. Each EAS domain was scored on a 7-point Likert scale, with a potential range of 1 (low) to 7 (high). One score for each EAS domain was given for each father after coders had watched all 3 phases of the interaction. A set of 5 father-child interactions were randomly selected and rescored by the 3 coders to calculate intrarater reliability, with the Cronbach α ranging from .78 to .99 for all coders. Inter-rater reliability across all the coders was checked for a further 10 interactions, with averaged Cronbach α ranging from .80 to .92 between all coders. As such, intra- and inter-rater reliability were deemed acceptable.[27] The EAS is reliable and valid.[28]

Child Development. At 24 months of corrected age, cognitive, language, and motor development were assessed using the Bayley Scales of Infant and Toddler Development-Third Edition.[29]

Social-emotional development was assessed using the Infant Toddler Social and Emotional Assessment.[30] Primary caregivers rated several aspects of their child's behavior on a 3-point Likert rating scale (0 = not true/rarely, 1 = somewhat true/sometimes, 2 = very true/often, "no opportunity" available for some items). Age- and sex-specific t scores (mean = 50, SD = 10, range 25-80) were calculated for the following 4 domains: externalizing behaviors, internalizing behaviors, dysregulation, and social-emotional competence. The Infant Toddler Social and Emotional Assessment has good criterion validity, internal consistency and test-reliability.[31]

Table I. Characteristics of participants and nonparticipants

Characteristics	Study participants (with father-child interaction data)		Nonparticipants (no father-child interaction data)	
	VPT (n = 81)	Full-term (n = 39)	VPT (n = 62)	Full-term (n = 112)
Gestational age (wk), M (SD)	27.4 (1.3)	39.4 (1.3)	27.1 (1.6)	39.4 (1.2)
Birth weight (g), M (SD)	1041 (266)	3437 (335)	1017 (252)	3526 (468)
Female, n (%)	42 (52)	19 (49)	30 (48)	56 (50)
Singleton, n (%)	41 (51)	39 (100)	39 (63)	110 (98)
Sepsis and/or necrotizing enterocolitis, n (%)	34 (42)	—	34 (55)	—
Postnatal corticosteroids, n (%)	6 (7)	—	10 (16)	—
Bronchopulmonary dysplasia, n (%)	21 (23)	—	22 (35)	—
Moderate-severe white matter abnormality, n (%)*	3 (4)	—	3 (7)	—
Higher medical risk, n (%)	30 (37)	—	31 (50)	—
Higher social risk, n (%)*	26 (43)	7 (18)	24 (52)	28 (29)
Family structure, (%; living with 2 parents: parents shared custody: single parent)	99:1:0	100:0:0	94:2:4	95:5:0
Occupation of main income earner, (%; full-time: part-time: unemployed)	40:49:11	57:37:6	37:42:21	44:49:7
Father's age at birth of child, M (SD)*	35.1 (7.0)	36.7 (5.8)	34.2 (5.4)	35.6 (5.1)
Bayley-III Cognitive Composite Scale, M (SD)*	104.3 (12.5)	107.9 (14.4)	100.4 (13.5)	111.2 (12.8)
Bayley-III Language Composite Scale, M (SD)*	106.46 (17.18)	112.03 (16.77)	99.22 (17.90)	113.96 (14.56)
Bayley-III Motor Composite Scale, M (SD)*	107.68 (15.35)	112.56 (13.95)	100.33 (16.02)	112.55 (14.09)
ITSEA Internalizing Score, M (SD)*	45.07 (11.37)	48.47 (11.14)	49.79 (12.27)	43.89 (8.19)
ITSEA Externalizing Score, M (SD)*	49.60 (7.09)	47.94 (6.22)	51.38 (11.84)	46.82 (8.35)
ITSEA Dysregulation Score, M (SD)*	47.45 (11.32)	46.28 (11.92)	49.40 (14.61)	43.43 (10.85)
ITSEA Social-emotional Competence Score, M (SD)*	46.78 (10.59)	52.56 (7.81)	46.11 (13.96)	54.73 (6.49)

Bayley-III, Bayley Scales of Infant and Toddler Development-Third Edition; *Higher medical risk*, at least 1 of sepsis, proven necrotizing enterocolitis, bronchopulmonary dysplasia, moderate-severe white matter brain abnormalities, or postnatal corticosteroids; *ITSEA*, Infant Toddler Social and Emotional Assessment; *M*, mean.
*Some group sizes differ because of missing data.

Statistical Analyses

Data were analyzed using Stata v 14 (StataCorp, College Station, Texas). For aim 1, separate linear regressions for each parenting domain were fitted to examine whether child birth group (VPT, full-term), social risk category (higher, lower), and child sex (male, female) were associated with fathers' parenting behaviors (sensitivity, structuring, nonintrusiveness, nonhostility) at 12 months of corrected age. All predictors were included in each of the 4 equations. In the VPT group only, child medical risk (higher, lower) was examined as a predictor of parenting behaviors at 12 months corrected age, adjusted for social risk and child sex. For aim 2, linear regression models examined the associations between fathers' parenting behaviors at 12 months and child developmental outcomes (cognitive, language, motor, internalizing behaviors, externalizing behaviors, dysregulation, social-emotional competence) at 24 months, adjusted for social risk and birth group, with an interaction term between parenting and child sex also included. Regression models were fitted using generalized estimating equations with an exchangeable correlation structure and robust SEs to allow for correlations between twins/triplets in the study.[32,33] Given the multiple comparisons performed for the second aim, false discovery rate procedures[34] were applied using a false discovery rate of 0.25 to regression analyses examining parenting and child development (aim 2). Interpretation of results overall focused on consistency of results and effect sizes.[35]

Results

Characteristics of study participants and nonparticipants are presented in **Table I**. Fathers who completed the father-child interaction were slightly less likely to have children of higher medical risk (37% vs 50%, respectively) and to be of a higher social risk (43% vs 52% within the VPT group and 18% vs 29% within the full-term group, respectively) than those who did not complete the father-child interaction. There were no significant differences on child developmental outcomes for fathers who did or did not complete the interaction overall. Within VPT and full-term groups, the VPT children of fathers who completed the interaction had higher language and motor scores, and fewer internalizing symptoms (all $P < .05$), compared with children of VPT fathers who did not complete the interaction. The full-term children of fathers who completed the interaction had more internalizing symptoms compared with full-term children of fathers who did not complete the interaction ($P < .05$). Within the study sample, the VPT group were more likely to be classified as higher social risk compared with the full-term group (43% vs 18%, respectively).

Fathers' Parenting Behaviors

Birth group and social risk category were not associated with fathers' parenting behaviors at 12 months (**Table II**) and scores across all parenting behaviors were similar for fathers of VPT and full-term children. In contrast, child sex was associated with fathers' parenting, with fathers of girls demonstrating more sensitivity, more structuring (trend only), less intrusiveness, and less hostility, than fathers of boys (**Table II**).

Within the VPT group, there was no evidence that higher child medical risk was associated with sensitivity (regression coefficient 0.12, 95% CI −0.35, 0.59), structuring (regression coefficient −0.13, 95% CI −0.05, 0.75), nonintrusiveness

Table II. Relationships between VPT birth, social risk, child sex, and fathers' early parenting behaviors

Predictors	Sensitivity*	Structuring*	Nonintrusiveness†	Nonhostility†
Birth groups				
VPT (n = 81), M (SD)	4.35 (1.08)	4.24 (1.20)	4.63 (0.97)	5.84 (0.68)
Full-term (n = 39), M (SD)	4.56 (1.10)	4.44 (1.01)	4.82 (0.90)	5.69 (0.73)
Adjusted regression coefficient (95% CI)	−0.28 (−0.72, 0.17)	−0.30 (−0.75, 0.15)	−0.17 (−0.56, 0.21)	0.10 (−0.18, 0.37)
Family social risk				
Lower (n = 78), M (SD)	4.44 (1.08)	4.27 (1.09)	4.79 (0.90)	5.75 (0.64)
Higher (n = 38), M (SD)	4.43 (1.12)	4.42 (1.30)	4.51 (1.03)	5.89 (0.82)
Adjusted regression coefficient (95% CI)	0.06 (−0.40, 0.52)	0.13 (−0.38, 0.65)	−0.19 (−0.60, 0.23)	0.16 (−0.14, 0.47)
Child sex				
Male (n = 59), M (SD)	4.22 (1.11)	4.08 (1.12)	4.49 (0.94)	5.68 (0.75)
Female (n = 61), M (SD)	4.61 (1.03)	4.52 (1.09)	4.89 (0.92)	5.91 (0.64)
Adjusted regression coefficient (95% CI)	0.42 (0.18, 0.65)	0.19 (−0.16, 0.54)	0.36 (0.04, 0.70)	0.26 (0.01, 0.50)

Coefficients have been adjusted for other factors included in regression equations (VPT, social risk, child sex).
Range of possible scores 0-7.
*Higher scores represent more sensitivity and more structuring.
†Higher scores represent less intrusiveness and less hostility.

(regression coefficient 0.26, 95% CI −0.09, 0.62), or nonhostility (regression coefficient −0.17, 95% CI −0.43, 0.09).

Fathers' Early Parenting Behaviors and Later Child Development

After controlling for familial social risk, sex, and VPT birth, there was evidence that higher levels of fathers' sensitivity at 12 months was predictive of higher child language development at 24 months; higher levels of structuring parenting at 12 months was predictive of higher child cognitive development and language development at 24 months; and higher levels of nonintrusiveness (less intrusive) at 12 months was also associated with lower child externalizing symptoms at 24 months (**Figure** and **Table III**). Applying the false-discovery rate procedure did not change these results. There was no evidence for interactions between parenting and child sex on child developmental outcomes.

Discussion

The current study found that fathers of 12-month-old VPT and full-term children exhibited similar parenting behaviors. Furthermore, fathers' parenting did not vary according to the family's social risk, or the child's medical risk. In contrast, fathers' parenting behaviors were associated with child sex, with fathers tending to be more sensitive, more structuring, less intrusive, and less hostile with daughters compared with sons. We also found that higher levels of fathers' sensitivity and structuring behaviors at 12 months were associated with better child language development at 24 months, over and above the

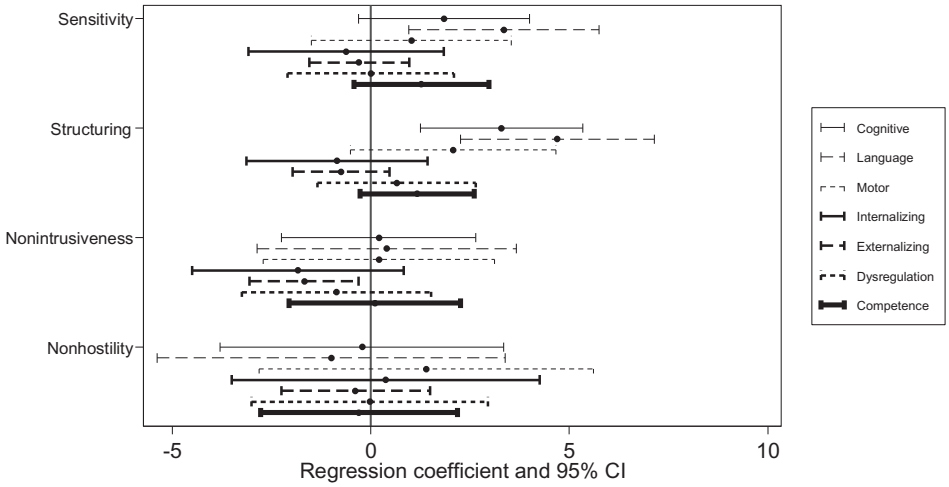

Figure. Relationships between fathers' parenting behaviors at 12 months and child development at 24 months, adjusted for social risk, birth group (VPT, full-term), and child sex. Dots represent regression coefficients and horizontal lines represent CIs. CIs crossing the vertical line at 0 are not statistically significant. Coefficients to the right of 0 represent positive associations, whereas coefficients to the left represent negative associations.

Table III. Regression coefficients (95% CI) for prediction of child development by fathers' parenting behaviors, adjusted for social risk, birth group (VPT, FT), and child sex

Developmental Domain	Sensitivity*	Structuring*	Non-intrusiveness†	Non-hostility†
Cognitive‡	1.84 (–0.31, 4.00)	**3.29 (1.25, 5.34)**	0.20 (–2.25, 2.64)	–0.22 (–3.80, 3.35)
Language§	**3.35 (0.95, 5.75)**	**4.69 (2.26, 7.14)**	0.40 (–2.87, 3.66)	–1.00 (–5.39, 3.38)
Motor¶	1.02 (–1.50, 3.54)	2.07 (–0.52, 4.66)	0.20 (–2.71, 3.11)	1.39 (–2.82, 5.61)
Internalizing**	–0.63 (–3.09, 1.84)	–0.85 (–3.14, 1.43)	–1.84 (–4.50, 0.82)	0.37 (–3.51, 4.25)
Externalizing**	–0.30 (–1.55, 0.96)	–0.75 (–1.98, 0.47)	**–1.68 (–3.06, –0.31)**	–0.39 (–2.26, 1.49)
Dysregulation**	–0.002 (–2.10, 2.09)	0.65 (–1.35, 2.64)	–0.87 (–3.25, 1.52)	–0.03 (–3.01, 2.95)
Competence**	1.27 (–0.43, 2.97)	1.16 (–0.27, 2.60)	0.10 (–2.06, 2.26)	–0.30 (–2.78, 2.18)

Bold values indicate statistical significance ($P < .05$).
*Higher scores represent more sensitivity and more structuring.
†Higher scores represent less intrusiveness and less hostility.
‡$n = 109$.
§$n = 108$.
¶$n = 105$.
**$n = 89$.
For child cognitive, language, motor, and social-emotional competence, higher scores represent more optimal outcomes, whereas for internalizing, externalizing, and dysregulation, higher scores represent more adverse outcomes.

potential influence of social risk, VPT birth, and child sex on child development. Higher levels of structuring parenting behaviors at 12 months were also associated with more optimal cognitive development at 24 months. Greater paternal intrusiveness was associated with later child externalizing behavior, but there was less evidence that fathers' early parenting was associated with later child motor development. There was no evidence for an interaction between fathers' parenting and child sex on later child development. Overall, our findings provide further support that fathers' parenting is important for child development, in both VPT and full-term children.

The similarity in parenting between fathers of VPT and full-term children is consistent with Hall et al who found a negligible impact of preterm birth on fathers' interactive behaviors when investigating stability and change in parenting behaviors across the first 2 years of the child's life.[12] Examining parenting behaviors in the same cohort as Hall et al[12] but when the child was 6 months of age, Hoffenkamp et al[13] similarly reported no significant difference in intrusiveness between fathers of VPT and full-term children, although they found that fathers of full-term children were slightly more sensitive than the fathers of VPT children. Important methodologic differences exist across studies which are likely to explain inconsistent findings, including variable sample sizes, measures used to assess parenting behaviors, and child age at assessment. Nonetheless, the current findings indicate that although VPT birth and the neonatal intensive care unit experience may influence the early attachment process for fathers of VPT children, having a VPT child does not seem to have a marked influence on their parenting behavior at 12 months.

The lack of association between social risk category and fathers' parenting behaviors in the current study is consistent with much of the previous research in the general population with fathers.[17-19] Specifically, although one of these studies found sociodemographic factors to be a strong predictor of mothers' sensitivity, they failed to find associations of this nature for fathers.[18] As such, it is possible that fathers' parenting behaviors may be less influenced by sociodemographic risk factors than mothers' parenting behaviors.[18] In saying this, however, previous findings have not been consistent, with some studies documenting associations between lower levels of paternal education and lower levels of sensitivity,[12,20] as well as higher levels of intrusive behavior[20] from fathers during interaction with their child. As such, further exploration is required, particularly given that the nature of our study sample (ie, those who opted in to participate) as well as wider study cohort was skewed toward those of lower social risk, which limits the generalizability of our findings. It is also worth noting that social risk factors (eg, family structure, employment) may change over time. It may, therefore, be beneficial for future studies to examine how the nature of these changes may affect fathers' parenting.

In the current study, child medical risk was not associated with fathers' parenting behaviors at 12 months. This contrasts with the only other study, to our knowledge, to explore this, which reported that more severe child illness was associated with decreased paternal play, interaction, and affection.[36] That study was conducted over 25 years ago, and there are likely to have been societal changes in fathers' involvement as well as well acknowledged improvements in medical care of preterm children. It is also possible that these inconsistent findings may be partly explained by differences in the gestational age of children within the study samples. Specifically, our sample comprised of only those born VPT compared with the full spectrum of prematurity, which limits the variability seen in the degree of medical risk and the generalizability of our findings to children born at older gestational ages.

Our study found an association between child sex and early parenting behaviors for fathers of VPT and full-term children, with the overall pattern of results suggesting that fathers displayed more sensitivity and structuring, and less intrusiveness and hostility toward daughters compared with sons. This pattern is largely consistent with a previous study within the general population that used the EAS to examine father-child interactions at 19 and 24 months,[37] as well as some research examining these relationships in mothers.[37,38] Although the underlying explanation for our results is likely complex,[38] the pattern of findings may be partially explained by the differential style of play typically seen between father-son

and father-daughter dyads.[39,40] Specifically, fathers of boys have previously been found to be more likely to display higher levels of physical play than fathers of girls, whereas fathers of girls are more likely to be involved in their child's imaginative play.[40] As such, the more physical and active style of play which tends to be more characteristic of father-son interactions may be interpreted to be more intrusive and hostile, and less sensitive and structured by coders.

Our study documents the importance of positive parenting behaviors of fathers, including sensitivity and structuring, for optimal developmental outcomes in a cohort including both VPT and full-term children. Specifically, our findings suggest paternal parenting that adequately guides and structures the child's play is particularly beneficial for cognitive and language development in VPT and full-term children. Indeed, these results are consistent with our previous studies highlighting the beneficial influence of sensitivity and facilitative maternal parenting behaviors on cognitive and language development of VPT children,[4,5] but extend these results to fathers. Based on these findings, interventions to promote developmental outcomes for VPT and full-term children might consider incorporating support for fathers to promptly and appropriately respond to their child's cues, and adequately guide and facilitate their child's play.

Research with mothers in the general population has reported associations between more intrusive parenting behaviors and more child externalizing behaviors across childhood,[41,42] consistent with our findings in fathers. Interestingly, 1 recent study of fathers within the general population reported findings in the opposite direction whereby children of the least intrusive fathers had an increased risk of developing externalizing behavior problems.[16] This inconsistency supports the suggestion that perhaps high as well as low levels of early intrusiveness from fathers are detrimental to children's later behavioral functioning, given that low intrusiveness may sometimes be indicative of a more withdrawn or disengaged interaction style.[16] Finding a balance between supportive and intrusive parenting may be challenging for some parents,[43] and further research is needed to better understand exactly what level of structure during play is optimal for child development.

There was no evidence for a child sex interaction within the current study, suggesting that male and female VPT and full-term children are equally susceptible to the influences of fathers' parenting behaviors on their development. This finding is consistent with some,[17] but not all,[16] previous studies of fathers within the general population, therefore, it will be important to replicate this finding in future studies.

Strengths of our study include the use of a well-validated and reliable observational measure of parenting behaviors, coded by certified researchers blinded to the child's birth and medical history. Limitations include a modest sample size of fathers, which may have reduced our ability to identify any between-group differences and interaction effects, as well as the skewed representation of fathers who opted in to participate. It is possible that the nature of the clinic-based task used may not have allowed for an accurate representation of the day-to-day parenting behaviors of many fathers, which tend to involve more physical, rough-and-tumble play.[44] Future research may benefit from observing the father-child relationship in a less structured setting that allows for more flexibility in play. Further longitudinal research is also needed to examine whether sex-based differences in fathers' parenting remain or change across childhood, as well as the potential impact on ongoing development, within both VPT and full-term populations. The role of other factors, such as the child's contribution (eg, behavior and temperament) to the fathers' parenting behaviors, as well as fathers' mental health, were not considered in the current study and are important factors for future studies to address. The role of fathers' mental health on these relationships warrants particular research attention given the higher rates of depression and anxiety symptoms reported for fathers of VPT children compared with full-term children,[45] and research suggesting that poorer paternal well-being is associated with poorer quality father-child interactions.[46,47] Although this study focused specifically on fathers parenting behaviors, it is important for future studies to look at the family system more broadly and the relative contributions of both mothers' and fathers' parenting behaviors for child development across time.

Our study suggests that fathers' early parenting behaviors have a positive influence on later developmental outcomes of VPT and full-term children. The importance of considering how the characteristics of the child, specifically sex, might influence how fathers parent in the early years was also highlighted. Targeting fathers through early intervention that supports their parenting may represent an important avenue to improve the development of VPT and full-term children. ■

We thank the Victorian Infant Brain Studies Team, particularly those who participated in recruitment and data collection, and the participating children and families.

Submitted for publication Apr 15, 2018; last revision received Aug 13, 2018; accepted Sep 28, 2018

Reprint requests: Karli Treyvaud, DPsych, Department of Psychology and Counselling, La Trobe University, Plenty Road & Kingsbury Drive, Bundoora, Victoria 3086, Australia. E-mail: k.treyvaud@latrobe.edu.au

References

1. Bhutta AT, Cleves MA, Casey PH, Cradock MM, Anand KJS. Cognitive and behavioral outcomes of school-aged children who were born preterm: a meta-analysis. JAMA 2002;288:728-37.
2. Anderson PJ, Doyle LW. Cognitive and educational deficits in children born extremely preterm. Semin Perinatol 2008;32:51-8.
3. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. Lancet 2008;371:261-9.
4. Treyvaud K, Anderson VA, Howard K, Bear M, Hunt RW, Doyle LW, et al. Parenting behavior is associated with the early neurobehavioral development of very preterm children. Pediatrics 2009;123:555-61.
5. Treyvaud K, Doyle LW, Lee KJ, Ure A, Inder TE, Hunt RW, et al. Parenting behavior at 2 years predicts school-age performance at 7 years in very preterm children. J Child Psychol Psychiatry 2016;57:814-21.
6. Cusson RM. Factors influencing language development in preterm infants. J Obstet Gynecol Neonatal Nurs 2003;32:402-9.

7. Landry SH, Smith KE, Miller-Loncar CL, Swank PR. Predicting cognitive-language and social growth curves from early maternal behaviors in children at varying degrees of biological risk. Dev Psychol 1997;33:1040-53.
8. Landry SH, Smith KE, Swank PR, Assel MA, Vellet S. Does early responsive parenting have a special importance for children's development or is consistency across early childhood necessary? Dev Psychol 2001;37:387-403.
9. Ainsworth MDB, Bell SM, Stayton DJ. Infant-mother attachment and social development: Socialization as a product of reciprocal responsiveness to signals. In: Richards MPM, ed. The integration of a child into a social world. Cambridge (United Kingdom): Cambridge University Press; 1974. p. 99-135.
10. Lowe J, Erickson SJ, MacLean P, Duvall SW, Ohls RK, Duncan AF. Associations between maternal scaffolding and executive functioning in 3 and 4 year olds born very low birth weight and normal birth weight. Early Hum Dev 2014;90:587-93.
11. Shah PE, Robbins N, Coelho RB, Poehlmann J. The paradox of prematurity: the behavioral vulnerability of late preterm infants and the cognitive susceptibility of very preterm infants at 36 months post-term. Infant Behav Dev 2013;36:50-62.
12. Hall RAS, Hoffenkamp HN, Tooten A, Braeken J, Vingerhoets AJ, van Bakel HJ. The quality of parent–infant interaction in the first 2 years after full-term and preterm birth. Parent Sci Pract 2015;15:247-68.
13. Hoffenkamp HN, Braeken J, Hall RAS, Tooten A, Vingerhoets AJ, van Bakel HJA. Parenting in complex conditions: does preterm birth provide a context for the development of less optimal parental behavior? J Pediatr Psychol 2015;40:559-71.
14. Harrison MJ. A comparison of parental interactions with term and preterm infants. Res Nurs Health 1990;13:173-9.
15. Harrison MJ, Magill-Evans J. Mother and father interactions over the first year with term and preterm infants. Res Nurs Health 1996;19:451-9.
16. Ramchandani PG, Domoney J, Sethna V, Psychogiou L, Vlachos H, Murray L. Do early father–infant interactions predict the onset of externalizing behaviors in young children? Findings from a longitudinal cohort study. J Child Psychol Psychiatry 2013;54:56-64.
17. Sethna V, Perry E, Domoney J, Iles J, Psychogiou L, Rowbotham NEL, et al. Father-child interactions at 3 months and 24 months: contributions to children's cognitive development at 24 months. Infant Ment Health J 2017;38:378-90.
18. Malmberg LE, Lewis S, West A, Murray E, Sylva K, Stein A. The influence of mothers' and fathers' sensitivity in the first year of life on children's cognitive outcomes at 18 and 36 months. Child Care Health Dev 2016;42:1-7.
19. Shannon JD, Tamis-LeMonda CS, London K, Cabrera N. Beyond rough and tumble: low-income fathers' interactions and children's cognitive development at 24 months. Parent Sci Pract 2002;2:77-104.
20. Tamis-LeMonda CS, Shannon JD, Cabrera NJ, Lamb ME. Fathers and mothers at play with their 2- and 3-year-olds: contributions to language and cognitive development. Child Dev 2004;75:1806-20.
21. Sarkadi A, Kristiansson R, Oberklaid F, Bremberg S. Fathers' involvement and children's developmental outcomes: a systematic review of longitudinal studies. Acta Paediatr 2008;97:153-8.
22. Spittle AJ, Thompson DK, Brown NC, Treyvaud K, Cheong JLY, Lee KJ, et al. Neurobehavior between birth and 40 weeks' gestation in infants born < 30 weeks' gestation and parental psychological well-being: predictors of brain development and child outcomes. BMC Pediatr 2014;14:111.
23. Roberts G, Howard K, Spittle AJ, Brown NC, Anderson PJ, Doyle LW. Rates of early intervention services in very preterm children with developmental disabilities at age 2 years. J Paediatr Child Health 2008;44:276-80.
24. Hack M, Fanaroff AA. Outcomes of children of extremely low birthweight and gestational age in the 1990's. Early Hum Dev 1999;53:193-218.
25. Kidokoro H, Neil JJ, Inder TE. New MR imaging assessment tool to define brain abnormalities in very preterm infants at term. AJNR Am J Neuroradiol 2013;34:2208-14.
26. Biringen Z. The Emotional Availability (EA) scales, infancy/early childhood version (child age: 0-5 years). 4th ed. Colorado: 2008. www.emotionalavailability.com. Accessed May 19, 2016.
27. Aspland H, Gardner F. Observational measures of parent-child interaction: An introductory review. Child Adolesc Ment Health 2003;8:136-43.
28. Biringen Z, Derscheid D, Vliegen N, Closson L, Easterbrooks MA. Emotional availability (EA): theoretical background, empirical research using the EA Scales, and clinical applications. Dev Rev 2014;34:114-67.
29. Bayley N. Bayley scales of infant and toddler development. 3rd ed. San Antonio (TX): Harcourt Assessment; 2006.
30. Carter AS, Briggs-Gowan MJ. The Infant-Toddler Social and Emotional Assessment (ITSEA). San Antonio (TX): Harcourt Assessment; 2006.
31. Carter AS, Briggs-Gowan MJ, Jones SM, Little TD. The Infant–Toddler Social and Emotional Assessment (ITSEA): factor structure, reliability, and validity. J Abnorm Child Psychol 2003;31:495-514.
32. Carlin JB, Gurrin LC, Sterne JAC, Morley R, Dwyer T. Regression models for twin studies: a critical review. Int J Epidemiol 2005;34:1089-99.
33. Hanley JA, Negassa A, Edwardes MD, Forrester JE. Statistical analysis of correlated data using generalized estimating equations: an orientation. Am J Epidemiol 2003;157:364-75.
34. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Ser B 1995;57:289-300.
35. Sterne JA, Smith DG. Shifting the evidence—what's wrong with significance tests? BMJ 2001;322:226-31.
36. Levy-Shiff R, Mogilner MB. Mothers' and fathers' interactions with their preterm infants during the initial period at home. J Reprod Infant Psychol 1989;7:25-37.
37. Lovas GS. Gender and patterns of emotional availability in mother-toddler and father-toddler dyads. Infant Ment Health J 2005;26:327-53.
38. Bornstein MH, Putnick DL, Heslington M, Gini M, Suwalsky JTD, Venuti P, et al. Mother-child emotional availability in ecological perspective: three countries, two regions, two genders. Dev Psychol 2008;44:666-80.
39. Jacklin CN, DiPietro JA, Maccoby EE. Sex-typing behavior and sex-typing pressure in child/parent interaction. Arch Sex Behav 1984;13:413-25.
40. Lindsey EW, Mize J, Pettit GS. Differential play patterns of mothers and fathers of sons and daughters: implications for children's gender role development. Sex Roles 1997;37:643-61.
41. Urbain-Gauthier N, Wendland J. Mother–child interactions in young children with excessive physical aggression and in typically developing young children. Clin Child Psychol Psychiatry 2017;22:467-82.
42. Joussemet M, Vitaro F, Barker ED, Côté S, Zoccolillo M, Nagin DS, et al. Controlling parenting and physical aggression during elementary school. Child Dev 2008;79:411-25.
43. Eiser C, Eiser JR, Mayhew AG, Gibson AT. Parenting the premature infant: balancing vulnerability and quality of life. J Child Psychol Psychiatry 2005;46:1169-77.
44. Paquette D. Theorizing the father-child relationship: mechanisms and developmental outcomes. Hum Dev 2004;47:193-219.
45. Pace CC, Spittle AJ, Molesworth CM, Lee KJ, Northam EA, Cheong JLY, et al. Evolution of depression and anxiety symptoms in parents of very preterm infants during the newborn period. JAMA Pediatr 2016;170:863-70.
46. Zelkowitz P, Bardin C, Papageorgiou A. Anxiety affects the relationship between parents and their very low birth weight infants. Infant Ment Health J 2007;28:296-313.
47. Paulson JF, Dauber S, Leiferman JA. Individual and combined effects of postpartum depression in mothers and fathers on parenting behavior. Pediatrics 2006;118:659-68.