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Effect of home environment on neuropsychiatric development in preterm infants discharged from NICU at 18 months corrected age

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ABSTRACT

Background There have been numerous intervention studies focusing on the development of preterm infants, but there has been limited investigation into the home environment as a determinant of developmental outcomes in preterm infants. The aspects and extent to which the home environment affects the early (18 months corrected age) neuropsychological development of preterm infants are still unclear.

Aims This study aimed to analyse the effect of the home environment on the neuropsychiatric development of preterm infants at 18 months corrected age after discharge from the neonatal intensive care unit (NICU). It also sought to provide a basis for promoting neuropsychiatric development among preterm infants by improving the home environment.

Methods In this retrospective cross-sectional study, 275 preterm infants born between January 2019 and January 2022 were followed up for systematic management after discharge from the NICU at Shanghai Children's Hospital. The Home Nurture Environment Questionnaire was used to assess the home environment of the infants and analyse its impact on the developmental quotient (evaluated by the Gesell Developmental Scale) and the rate of developmental delays at 18 months corrected age.

Results A total of 41.454% of the infants were extremely preterm. The developmental quotient scores at 18 months corrected age were in the middle of the scale. The language domain had the highest rate of developmental delay (46.182%), followed by the adaptive domain (37.091%). Multiple logistic regression analyses showed that compared with infants in supportive home environments, infants with moderate/unsupportive home environments had significantly elevated risks of development delay: 2.162-fold for global (odds ratio (OR) 2.162, 95% confidence interval (CI) 1.274 to 3.665, p=0.004), 2.193-fold for fine motor (OR 2.193, 95% CI 1.161 to 4.140, p=0.016), 2.249-fold for language (OR 2.249, 95% CI 1.336 to 3.786, p=0.002) and 2.042-fold for personal-social (OR 2.042, 95% CI 1.149 to 3.628, p=0.015).

Conclusions A supportive home environment is a crucial protective factor for the neuropsychological development of preterm infants. It is associated with higher developmental quotient scores and protects against neuropsychiatric delays. Incorporating evaluation and continuous improvement of the home environment into the management framework for preterm infants to promote optimal neurodevelopment is essential.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous research has extensively explored biological factors impacting the neuropsychiatric development of preterm infants, such as gestational age at birth and birth weight; however, there has been limited investigation of the home environment as a determinant of developmental outcomes in preterm infants, especially those with a younger gestational age and lower birth weight who are discharged from the neonatal intensive care unit.

⇒ In this study, we addressed this gap by examining the role of the home environment in preterm infant neurodevelopment, highlighting the need for comprehensive assessments beyond biological risk factors.

INTRODUCTION

Preterm is defined as babies born alive before the completion of 37 weeks of pregnancy. The majority of preterm infants discharged from neonatal intensive care units (NICUs) are early (<31^{+6} weeks) and moderately preterm infants (32–33^{+6} weeks).[1] During the initial phases of life, younger gestational age and reduced birth weight can significantly influence perceptual, motor, communicative-linguistic abilities, attention, processing speed and memory. Preterm birth may result in cascading effects on subsequent development, placing preterm infants at an elevated risk for developmental deficits in motor, cognitive and language domains compared with their term-born counterparts. These potential long-lasting effects can persist from infancy into adulthood.[2]

A meta-analysis examining the intellectual and neuropsychological functioning of preterm infants at preschool age reveals

WHAT THIS STUDY ADDS

⇒ Our study uniquely contributes to the literature by demonstrating the significant impact of the home environment on the neuropsychiatric development of preterm infants discharged from the neonatal intensive care unit.

⇒ We found that a supportive home environment—characterised by higher emotional warmth, more opportunities for social adaptation or self-regulation, more language and cognitive stimulation and less neglect/punishment—is associated with higher developmental quotient scores and lower rates of developmental delays, particularly in the fine motor, language and personal-social domains.

⇒ These findings underscore the importance of considering environmental factors in interventions to optimise developmental outcomes in preterm infants.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings of this study have important implications for clinical practice, policy development and public health interventions targeting preterm infant populations.

⇒ By highlighting the protective effect of a supportive home environment, this study emphasises the need for early assessment and intervention strategies focusing on the home environment to promote optimal neurodevelopment.

⇒ These findings may inform the development of evidence-based interventions and policies that aim to improve long-term outcomes in preterm infants, ultimately contributing to more effective and holistic approaches to paediatric neurodevelopmental care.

that, in comparison with their term-born counterparts, preterm infants demonstrate diminished performance in intelligence quotient (IQ) mean scores, attention, memory, visuomotor integration skills and executive functions between the ages of 3 and 5 years.[3] Children born preterm at low-to-moderate risk exhibit developmental deficits in intelligence and executive function relative to healthy full-term children, persisting into school age.[4] Another meta-analysis explored the correlation between very preterm birth or very low birth weight and adult intelligence. The findings suggested that variables such as lower gestational age, reduced weight for gestational age, neonatal morbidities and lower maternal educational levels are significant risk factors linked to decreased IQ in young adults who were born very preterm or with very low birth weight.[5]

Given the irreversible impact of biological factors on the neuropsychological development of preterm infants, more studies are now focusing on protective environmental factors, specifically the home environment, to facilitate effective intervention.[6–8] The home environment encompasses factors the family provides during a child's interaction with their surroundings. This includes physical factors such as food, toys and books; objective psychosocial factors such as environmental safety and parental educational attainment and subjective psychosocial factors such as play activities and emotional expression.[7 8] A systematic review of the impact of home environment on early childhood development[9] reported that high-quality home environmental practices in the first 3 years of life effectively improve early childhood development outcomes.

Currently, there have been numerous intervention studies focusing on the development of preterm infants, but relatively few studies have focused on the home environment of very preterm and moderately preterm infants discharged from NICU.[4 8] The aspects and extent to which the home environment affects the early (18 months corrected age) neuropsychological development of premature infants are still unclear. Therefore, in this study, we aimed to investigate and analyse the home environment of preterm infants discharged from NICU and their developmental quotient (DQ) at 18 months corrected age to provide a basis for improving early interventions based on home environment factors.

METHODS

Participants

This retrospective cross-sectional study included preterm infants at 18 months corrected age (±2 months). Preterm infants born between January 2019 and January 2022 who were followed up for systematic management after discharge from the NICU in Shanghai Children's Hospital were included. The inclusion criteria of preterm infants[1] were as follows: (1) preterm infants; (2) preterm infants with suspected or confirmed brain damage (neonatal hypoxic-ischaemic encephalopathy, periventricular leukomalacia, intracranial haemorrhage, hydrocephalus, purulent meningitis and bilirubin encephalopathy); (3) preterm infants with associated chronic illnesses (bronchopulmonary dysplasia and short bowel syndrome) and (4) preterm infants requiring advanced life support (extracorporeal membrane oxygenation and continuous renal replacement therapy). The exclusion criteria were preterm infants with confirmed genetic abnormalities.

The inclusion criteria for caregivers of preterm infants were as follows: (1) the individual must be the primary caregiver of the research subject and have lived with the research subject within the past 6 months; (2) the caregiver must possess adequate literacy skills to understand and complete the survey instrument and (3) the caregiver must voluntarily participate in the study and provide written informed consent. The exclusion criteria for caregivers included (1) medical conditions such as cognitive impairments or severe mental health issues that may affect comprehension abilities and (2) participation in other studies that could potentially influence the results of this research (figure 1).

Evaluation of the growth and development of preterm infants typically involves calculating corrected age up to 2 years based on the expected delivery date. In this study, a diagnostic assessment of preterm infants at 18 months corrected age was conducted to gain early insights into their developmental progress across different domains, identify additional opportunities for follow-up and early intervention and mitigate potential gaps in evaluation owing to missed visits by 2 years of age. To minimise the

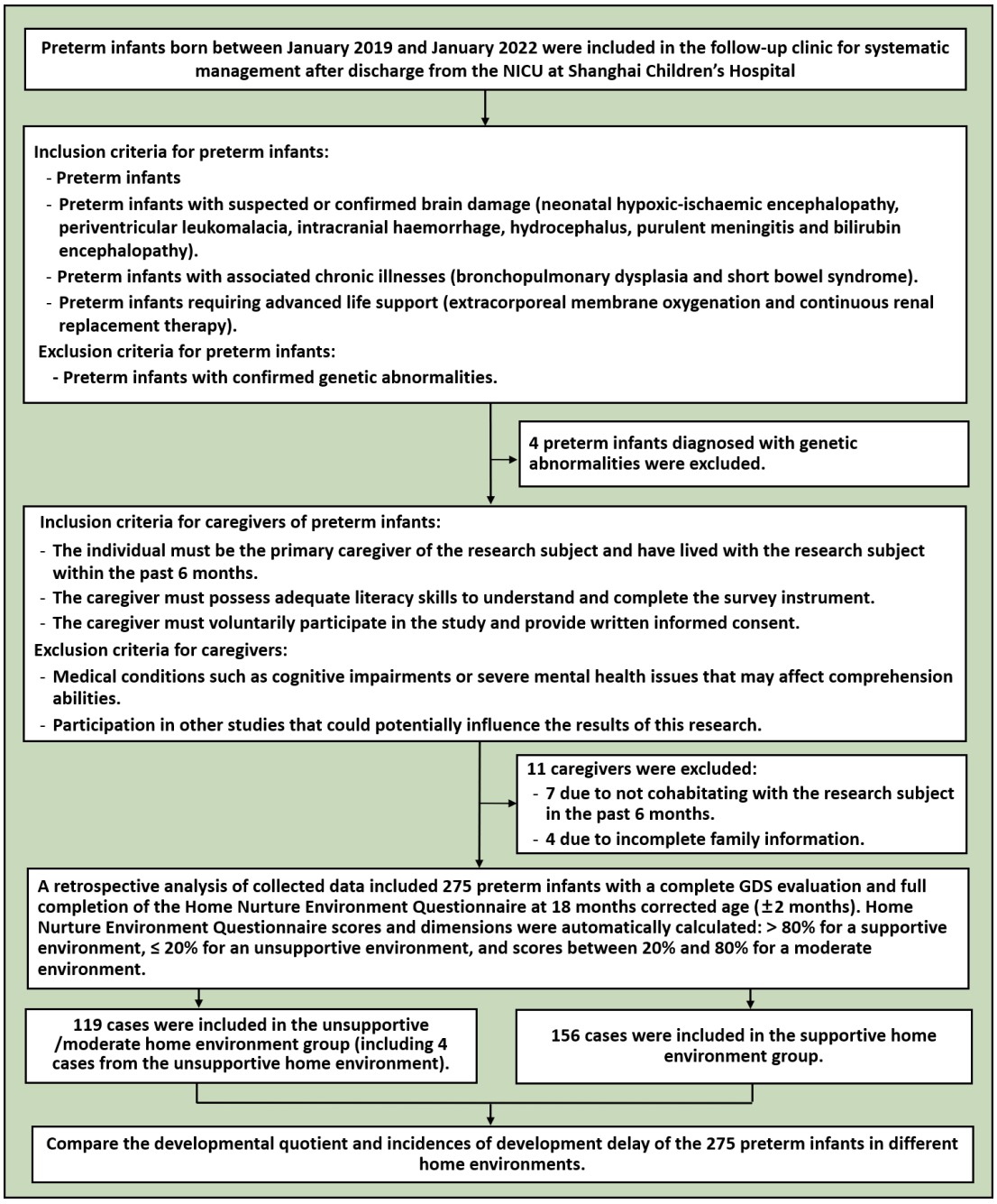

Figure 1 Flowchart of the sample selection. GDS, Gesell Developmental Scale; NICU, neonatal intensive care unit.

effect of inconsistencies in birth gestational age on the results, preterm infants were evaluated using corrected ages up to 18 months based on the expected delivery date.

Research instruments

Sociodemographic questionnaire

Parents or guardians of the infants were given a self-administered sociodemographic questionnaire on maternal history (including age, parity, gravidity and pregnancy complications), basic perinatal data of the preterm infant (including sex, gestational age at birth, birth weight, birth length and birth complications) and basic parent and family data (including age, educational attainment, occupation and history of smoking or alcohol consumption). A standardised follow-up data system was used to compile the sociodemographic data starting from the initial clinic admission of the preterm infant.

Home environment questionnaire for children aged 1–3 years

The home environment was assessed using the Home Nurture Environment Questionnaire for children aged 1–3 years, developed by He *et al*.[10] The 41-item scale assesses four dimensions in the home environment: emotional warmth/atmosphere, social adaptation/self-regulation, language/cognition and neglect/punishment. The scale is reliable, with a Cronbach's alpha coefficient of 0.930, and has a correlational validity of 0.475 with DQ standards. Questionnaire responses were entered into the

scale, which automatically calculates percentiles for both total scores and dimensions (>80% for a supportive environment, ≤20% for an unsupportive environment and in between for a moderate environment).[10]

Gesell Developmental Scale—revised Chinese version

The scale consists of five domains: gross motor, fine motor, language, adaptive and personal-social. DQs were calculated for each domain, with DQ ≥86 being normal and DQ <86 being abnormal. Abnormalities in two or more domains were considered a global developmental delay.[11]

Data collection and quality control

Technicians with extensive experience and qualifications in follow-up studies of preterm infants administered the home environment questionnaires and Gesell Developmental Scale (GDS) evaluations. All technicians involved in data collection underwent training to ensure assessments were standardised. Before participating in the study, participants were informed about the purpose of the study, the voluntariness of participation, confidentiality, duration and data retention. Home environment questionnaires were distributed to parents of preterm infants who met the inclusion criteria. If parents had any questions about the questionnaire's content, they could immediately ask the researchers to clarify and explain the issues. After the questionnaires were completed, they were collected by the researchers, who then conducted on-site quality control. Subsequently, the researchers carried out the GDS assessment on the preterm infants. After the assessment, the GDS evaluation outcomes were immediately recorded in a follow-up management information system, and the home environment questionnaire results were entered into the system for automatic scoring and classification. Only personnel involved in this study could access this information.

Statistical analysis

Data cleanup, descriptive statistics and univariate and multivariate analyses were conducted using SPSS V.26.0 and R V.4.0.2. Outliers were treated as missing data. As the rate of missing data was <10% for all variables, no interpolation was performed. Continuous data are expressed as mean (standard deviation (SD)) and counted data are expressed as frequencies and percentages. The relationship between home environment and neuropsychiatric development in preterm infants was investigated using independent sample t-test, analysis of variance and multiple logistic regression analyses. Multiple logistic regression was used to further analyse the effect of the home environment on developmental delays in preterm infants, with the home environment as the independent variable (1=moderate/unsupportive home environment, 0=supportive home environment) and developmental delays as the dependent variable (1=yes, 0=no). Model 1 was not adjusted for any variables; model 2 was adjusted for variables associated with preterm infants (sex, gestational age, weight and length at birth) and model 3 was adjusted for those who completed the home environment questionnaire and variables associated with parents (parental age, parental educational attainment, mother's pregnancy status, etc) based on model 2. P value <0.05 indicated a statistically significant difference.

RESULTS

Basic characteristics of the study population

The survey comprised 275 preterm infants at 18 months corrected age, with 145 (52.727%) males and 130 (47.273%) females. The average weight and length at birth were 1751.607 (577.292) g and 42.283 (7.588) cm, respectively. The average gestational age at birth was 31.804 (2.476) weeks. There were 114 (41.455%) extremely preterm infants born at a gestational age $\leq 31^{+6}$ weeks, 80 (29.091%) moderately preterm infants born at $32–33^{+6}$ weeks, 81 (29.455%) late preterm infants born at $34–36^{+6}$ weeks.

Basic characteristics of the parents and families of the study participants

The mean ages of the participants' fathers and mothers were 33.298 (5.346) and 31.577 (4.113) years, respectively. The educational attainment of the fathers included a bachelor's degree (52.727%), vocational/high school (25.455%), master's degree and above (10.908%), and middle school and below (10.910%). The educational attainment of the mothers was bachelor's degree (54.181%), vocational/high school (25.818%), master's degree and above (10.545%), and middle school and below (9.456%). The occupations of the fathers were company employees (34.909%), skilled workers (20.727%) and managers (18.545%), whereas those of the mothers were company employees (49.818%), full-time mother or other occupations (13.091%) and skilled workers (11.273%). The per capita monthly household income was >¥20 000, ¥10 000–¥20 000, ¥8000–¥10 000 and <¥8000 in 29.296%, 30.078%, 17.187% and 23.439% of the infants' families, respectively. The average housing area of the families was 92.124 m^2 (interquartile range (IQR) 67.681–110.752 m^2; range: 20–214 m^2), with 79.134% owning their homes and 20.876% renting or having other arrangements.

Home environment for preterm infants aged 18 months corrected age

The preterm infants' mothers completed 66.545% of the home environments questionnaires, fathers completed 28.000% of them and other care providers completed the remaining 5.455%. The results suggest that 56.727% of the study population had supportive home environments, 41.818% had moderate home environments and 1.455% had unsupportive ones. No statistically significant difference (χ^2=4.295, p=0.117) in home environments classification was observed in preterm infants with different gestational ages at birth or other related factors.

Table 1 Developmental quotient scores for preterm infants at 18 months corrected age in different home environment

Developmental domain ($\bar{X}$(S))	Total* (n=275)	Preterm infants living in supportive home environment (n=156)	Preterm infants living in moderate/ unsupportive home environment (n=119)	t†	P value
Gross motor	98.176 (11.746)	98.728 (11.706)	97.361 (11.799)	0.994	0.321
Fine motor	95.362 (15.923)	96.942 (14.356)	93.321 (17.607)	1.766	0.079
Adaptive	90.931 (14.267)	92.436 (13.876)	88.958 (14.588)	2.014	0.045‡
Language	87.633 (15.531)	91.346 (14.779)	82.765 (15.200)	4.712	<0.001§
Personal-social	92.062 (12.077)	93.795 (11.987)	89.790 (11.863)	2.757	0.006§

*The mean (SD) of the DQ scores of all preterm infants in each domain.
†Compared with preterm infants living in supportive home environments.
‡P<0.05.
§P<0.01.
DQ, developmental quotient; SD, standard deviation.

DQ scores in preterm infants at 18 months corrected age across various gestational ages and home environment

At this age, the DQ scores for gross motor, fine motor, adaptive and personal-social domains in preterm infants with varying gestational ages at birth fell within the mean range of 90–110 on the scale. There were no statistically significant differences among different gestational age groups. However, the DQ scores for the language domain were below this mean range, with statistically significant differences among different gestational age groups (F=5.693, p=0.004) (online supplemental table 1).

Given that only 1.455% of the preterm infants were living in unsupportive home environments, they were grouped with those living in moderate home environments. Compared with preterm infants living in moderate/unsupportive home environments, those living in supportive home environments scored 3.478 points higher in the adaptive domain (t=2.014, p=0.045), 8.581 points higher in the language domain (t=4.712, p<0.001) and 4.005 points higher in the personal-social domain (t=2.757, p=0.006) (table 1).

Developmental delay in preterm infants at 18 months corrected age across various gestational ages and home environment

The incidence rate of comprehensive developmental delay at 18 months corrected age is 40.364%, with a statistically significant variation observed across different birth gestational age groups (χ^2=6.389, p=0.041). In specific domains, elevated rates of developmental delay are noted in the language domain (46.182%), adaptive domain (37.091%) and personal-social domain (26.909%). Notably, there is a statistically significant difference between different birth gestational age groups in both the language domain (χ^2=6.643, p=0.036) and the personal-social domain (χ^2=10.224, p=0.006) (table 2).

Compared with preterm infants residing in moderate/unsupportive home environments, those living in supportive home conditions exhibited a significantly lower incidence of global developmental delays by 17.728% (χ^2=8.814, p=0.003). Furthermore, the incidence of fine motor development delay was 13.784% lower (χ^2=7.115, p=0.008), the incidence of language development delay

Table 2 Incidence of developmental delay in preterm infants at 18 months corrected age in different gestational ages

Developmental domain (n (%))	Total* (n=275)	Very preterm infants (–31^{+6} weeks) (n=114)	Moderately preterm infants (32–33^{+6} weeks) (n=80)	Late preterm infants (34–36^{+6} weeks) (n=81)	χ^2	P value
Global developmental delay	111 (40.364)	56 (49.123)	26 (32.500)	29 (35.802)	6.389	0.041†
Gross motor	31 (11.273)	15 (13.158)	6 (7.500)	10 (12.346)	1.637	0.441
Fine motor	64 (23.273)	31 (27.193)	16 (20.000)	17 (20.988)	1.825	0.401
Adaptive	102 (37.091)	49 (42.982)	28 (35.000)	25 (30.864)	3.192	0.203
Language	127 (46.182)	62 (54.386)	36 (45.000)	29 (35.802)	6.643	0.036†
Personal-social	74 (26.909)	42 (36.842)	14 (17.500)	18 (22.222)	10.224	0.006†

*The number and proportions of preterm infants with developmental delay in each domain.
†P<0.05.

Table 3 Incidence of developmental delays in preterm infants at 18 months corrected age in different domains and home environment

Developmental domain (n (%))	Total* (n=275)	Preterm infants living in supportive home environment (n=156)	Preterm infants living in moderate/unsupportive home environment (n=119)	χ^2†	P value
Global developmental delay	111 (40.364)	51 (32.692)	60 (50.420)	8.814	0.003‡
Gross motor	31 (11.273)	13 (8.333)	18 (15.126)	3.114	0.078
Fine motor	64 (23.273)	27 (17.308)	37 (31.092)	7.115	0.008‡
Adaptive	102 (37.091)	53 (33.974)	49 (41.176)	1.501	0.221
Language	127 (46.182)	58 (37.179)	69 (57.983)	11.755	0.001‡
Personal-social	74 (26.909)	33 (21.154)	41 (34.454)	6.071	0.014§

*The number and proportions of preterm infants with development delay in each domain.
†Compared with preterm infants living in supportive home environments.
‡P<0.01.
§P<0.05.

was 20.804% lower (χ^2=11.755, p=0.001) and the incidence of personal-social development delay was 13.300% lower (χ^2=6.071, p=0.014) among infants from supportive home environments (table 3).

Effect of home environment on the rate of developmental delay in preterm infants at 18 months corrected age

The multivariate regression analyses showed that compared with preterm infants living in supportive home environments, those living in moderate/unsupportive home environments exhibited significantly higher risks at 18 months corrected age: 2.162-fold for global developmental delay (OR 2.162, 95% CI 1.274 to 3.665, p=0.004), 2.193-fold for fine motor developmental delay (OR 2.193, 95% CI 1.161 to 4.140, p=0.016), 2.249-fold for language developmental delay (OR 2.249, 95% CI 1.336 to 3.786, p=0.002), and 2.042-fold for personal-social developmental delay (OR 2.042, 95% CI 1.149 to 3.628, p=0.015) (table 4).

DISCUSSION

Main findings

Systematic management and early intervention are crucial for assisting preterm infants discharged from NICU to achieve normal developmental levels

The participants in this study were characterised by low gestational age and low birth weight, with 41.454% being extremely preterm and an average weight of 1751.607 g. All participants underwent strict and systematic management and early intervention per relevant guidelines.[1] Research into family environments and development levels indicates that over half of the participants originated from 'supportive' family upbringing environments. The mean DQ scores in each domain at 18 months corrected age were in the middle of the scale, suggesting potential benefits from systematic management and early intervention for adequate growth and development in this population group.

Table 4 Effect of home environment on the rate of developmental delay in all domains in preterm infants at 18 months corrected age

	Model 1*			Model 2†			Model 3‡		
Developmental domain	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Global developmental delay	2.094	1.281 to 3.421	0.003§	2.052	1.246 to 3.381	0.005§	2.162	1.274 to 3.665	0.004§
Gross motor	1.960	0.919 to 4.181	0.082	1.756	0.811 to 3.803	0.153	2.010	0.879 to 4.599	0.098
Fine motor	2.185	1.223 to 3.903	0.008§	2.029	1.124 to 3.661	0.019¶	2.193	1.161 to 4.140	0.016¶
Adaptive	1.360	0.831 to 2.227	0.221	1.326	0.804 to 2.186	0.269	1.365	0.804 to 2.318	0.249
Language	2.332	1.432 to 3.798	0.001§	2.331	1.419 to 3.830	0.001§	2.249	1.336 to 3.786	0.002§
Personal-social	1.959	1.143 to 3.359	0.014¶	1.954	1.127 to 3.389	0.017¶	2.042	1.149 to 3.628	0.015¶

*Not adjusted for any variables.
†Adjusted for variables associated with preterm infants (sex, gestational age, weight and length at birth).
‡Based on model 2, adjusted for those who completed the home environment questionnaire and variables associated with parents (parental age, parental educational attainment, parental occupations, monthly household income, mother's pregnancy status).
§P<0.01
¶P<0.05.

Parents of children with medical issues or developmental risks frequently experience heightened levels of parenting stress compared with parents of typically developing children. Caregiver strain can have long-term adverse effects on both parents and their children, increasing the risk of poor mental health among caregivers, promoting inappropriate parenting behaviours and complicating the implementation of behavioural interventions for the children. Intrafamilial circumstances significantly influence the development of children's personalities and social relationships.[12] As such, globally recognised and effectively implemented child development programmes, including Head Start and the Positive Parenting Programme (Triple P), are designed to provide parenting support and enhance the home environment.[13]

Follow-up of preterm children aged 1–2 years should focus on language and speech

The study population had a high incidence of global developmental delay (40.364%), close to the findings (39.600%) of Zhang *et al*[14] but higher than that in a general population survey of infants and toddlers aged 0–24 months (2.150%).[15] Preterm factors such as preterm birth and low birth weight significantly impact speech and language development.[16] The present study also revealed a high rate of abnormal speech and language development (46.182%) in preterm infants at 18 months corrected age. Children's language development delays are associated with congenital risk factors, including pregnancy infections and congenital disabilities. Additionally, postnatal family language environments significantly influence these delays.[17] Research indicates that language development in preterm infants may be more susceptible to parental rearing behaviours compared with full-term children.[18] A recent study examined the causal effects of maternal speech exposure on white matter brain development in neonates born preterm. The study demonstrated that speech experiences during neonatal development directly contribute to the maturation of the left arcuate fasciculus, a white matter tract implicated in language.[19] Thus, early intervention should focus on language and speech development in preterm infants aged 1–2 years. Acknowledging that the expressive language skills of children aged 18 months are not fully developed is crucial. Additionally, the GDS assessment does not differentiate between receptive and expressive language skills, which may contribute to the high incidence of developmental delays observed.

A supportive home environment is a protective factor for neuropsychiatric development in preterm infants

Bronfenbrenner's ecological systems theory emphasises that a child's development depends on genetic factors and the quality of their home environment. Although genetics set the potential for a child's development, the parenting and home environment primarily determine whether this potential is actualised.[12 20]

Research on early development in preterm infants suggests that high-quality home environments characterised by sensitive parents, abundant learning opportunities, responsive caregiving and high-quality parent-child interactions contribute to the development of good language[21] and cognitive skills,[22] better emotional and behavioural regulation[23] and improved mental health even into adolescence.[24] Conversely, unsupportive home environments with fewer early learning opportunities, insufficient interactive stimulation and more punitive or neglectful parenting are associated with poorer language skills, cognitive functioning and academic performance in preterm infants.[25–27]

The findings from this study indicated that a supportive home environment contributed to higher DQ scores and lower incidences of developmental delays in preterm children at 18 months corrected age compared with a moderate/unsupportive home environment, consistent with the findings of other Chinese studies.[7 28] A supportive home environment provides more opportunities for practising social adaptation/self-regulation, enhanced language and cognitive stimulation, emotional warmth and less neglect/punishment for infants and toddlers. This family-based positive parenting model, emphasising early learning and responsive care, has been strongly associated with subcortical brain development in preterm infants[6 29] and facilitates prefrontal cortex development.[19]

The systematic management framework for preterm infants should include assessment and continuous improvement of the home environment

For preterm children aged 0–3 years, the home represents their primary and most frequent environment. Effective systematic management and early intervention services for preterm infants should integrate three key elements: home environment, health promotion and developmental interventions, with a particular focus on the importance of the home environment.[6] Early intervention for preterm infants should incorporate appropriate tools for evaluating the home environment. Based on our results, families should be provided with targeted guidance including high-quality companionship and responsive care for preterm infants, age-appropriate parent-child play with rich sensory stimulation, learning materials such as books and toys appropriate for the child's developmental stage and abilities and intentional opportunities for the children to take the initiative and play independently. In addition, the quality of life and care provided by the parents of preterm infants warrants attention, as well as the physical and mental health of the caregivers. By implementing intervention programmes such as emotional support, knowledge dissemination and active guidance for caregivers, we can help families continuously improve their home environment and promote early development in preterm infants.

Implications

The findings of this study suggested that a supportive home environment has a significant protective effect on the neuropsychiatric development of preterm infants discharged from NICU. These results provide a novel insight into the importance of home environment assessment and intervention in promoting optimal neurodevelopment, contribute to advancing knowledge in the field of paediatric neurodevelopment and give important implications for clinical practice and policy development in child healthcare.

Limitations

Ethical constraints precluded the establishment of a no-intervention control group among preterm infants discharged from NICU, which constitutes the main limitation of this research. Another noteworthy limitation of this study is the inadequate collection of factors potentially affecting neuropsychiatric development owing to survey time and field conditions. Moving forward, researchers plan to conduct longitudinal follow-up studies on the participants and integrate qualitative research techniques—including family interviews and observation records—to garner feedback from parents and caregivers regarding the interventions. This feedback will elucidate their perceptions of the interventions' impact on preterm infants' development and identify which aspects are deemed most effective or in need of enhancement, thereby fostering a more profound understanding of how the home care environment influences the developmental trajectory of preterm infants.

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Patient consent for publication Consent obtained from parent(s)/guardian(s).

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