RESEARCH

Bridging the gap: family resilience as a mediator between parental psychological resilience and care competence in premature infant transitions

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Abstract

Background High levels of parental infant care competence could facilitate the transition of preterm infants from hospital to home and reduce their readmission rate and emergency visits after discharge. Researchers have confirmed psychological resilience and family resilience were excellent psychological resources that played important roles in the development of parental infant care competence. However, the interaction between these three variables in the parents of preterm infants remains unclear and requires further validation. This study aimed to explore the association between parental psychological resilience and premature infant care competence and the mediating role of family resilience on this relationship.

Methods A multi-center cross-sectional study recruited a convenience sample of 381 parents of premature infants across four public hospitals in East China between November 2022 and December 2023. Research instruments included Connor-Davidson Resilience Scale, Family Hardiness Index, and Premature Infant Care Competency Scale. Structure equation modeling (SEM) were used to detect mediating effect of family resilience, while controlling for covariates.

Results The average score of parental premature infant care competence was 134.02 points. Differences in levels of premature infant care competence were found across parental gender, education levels and pre-existing diseases. The results of SEM showed a direct relationship between the mentioned three covariates and transitional parental premature infant care competence, but not with family resilience. SEM also revealed psychological resilience as a significant predictor of transitional parental care competence, exerting both direct effects ($\beta = 0.318$, $P < 0.001$, 95%CI: [0.166, 0.464]) and indirect effects ($\beta = 0.111$, $P = 0.001$, 95%CI: [0.049, 0.183]) mediated through family resilience.

Conclusions The findings suggested higher psychological resilience related to better family resilience which can provide supportive environment, thus contributing to increased parental premature infant care competence. Future

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researchers could pay more attention to the early resilience assessment of parents and family resilience improvements based on the formation of therapeutic alliance with the entire family system of preterm babies.

Keywords Premature infant, Parents, Family care, Resilience, Cross-sectional survey

Introduction

A preterm infant is defined as a child born before 37 weeks of gestation or 259 days from the first day of the mother's last menstrual period [1, 2]. Recent global estimates indicate that approximately 13.4 million infants are born preterm annually, accounting for over 10% of all births [3]. Specifically, in China, the preterm birth rate has gradually risen to 7–10% with a marked increase in very preterm births, currently ranking the country fourth globally in annual preterm infant births [1, 4, 5]. Compared to full-term infants, preterm neonates face elevated risks of health complications due to organ immaturity, potentially prolonging their hospitalization in the neonatal intensive care unit (NICU). Nevertheless, advances in neonatal care and treatment protocols, combined with optimized allocation of medical resources, have enabled earlier discharge for many preterm infants [6, 7]. Paradoxically, this trend has raised the bar for the level of post-discharge care required from parents of these vulnerable newborns.

Since families no longer have access to the specialized monitoring systems available in the NICU for continuous vital sign tracking, and clinical support is not immediately accessible, the transition from the NICU to the home environment becomes a critical phase during which parents assume full responsibility for their preterm infants [8, 9]. During this period, parents' caregiving competence directly impacts the long-term physical, cognitive and socio-emotional development of these preterm infants [10]. Consequently, acquiring skills conducive to enabling parents to independently care for fragile preterm infants at home (e.g., administering medication and performing cardiopulmonary resuscitation) is pivotal [9]. However, practical challenges often diverge from idealized expectations. Even routine care tasks labeled as 'safe or low-risk' by clinicians may provoke overwhelming parental stress. Furthermore, parents face multifaceted challenges stemming from unexpected preterm birth, maternal-neonatal separation and infants' compromised health conditions. Post-discharge complexities—such as frequent follow-up visits, recurrent hospitalizations, and rigorous growth monitoring—compound these difficulties, significantly hindering parents' ability to function as competent primary caregivers [11, 12]. Thus, accurate evaluation of parents' caregiving competence for their preterm infants is crucial during the transitional period.

Background

Parental care competence for preterm infants during transition is rooted in four core components: adequate knowledge and skills in neonatal care, sensitivity to infants' needs, problem-solving abilities, and a sense of parental responsibility [13]. High parental care competence promotes successful transition of preterm infants from hospital to home, significantly reducing post-discharge readmission rates and emergency department visits [6, 14]. In addition, enhanced parental competence may mitigate developmental disparities between vulnerable preterm infants and their full-term counterparts [15]. However, most parents lack the practical competence required to meet the multifaceted care demands of preterm infants. Prior research has indicated that 66.3% of families of very preterm infants reported at least one error in homecare practices or healthcare management during the NICU-to-home transition, with common errors including missed appointments, medication mismanagement, feeding inaccuracies and equipment misuse, all of which heighten the risks of adverse outcomes [16]. Therefore, it is crucial to identify factors influencing parental care competence for preterm infants and elucidate their underlying mechanisms.

Factors such as maternal age, marital status, and parity have been shown to affect parental infant care competence [17, 18]. However, while most studies have focused on the adverse effects of anxiety, depression and other negative emotional states on parental care competence, the emerging field of positive psychology has begun to highlight the significant contributions of positive psychological attributes. For example, parental self-efficacy and psychological resilience are increasingly recognized as important roles in the development of parental care competence [17, 19].

Resilience, a positive psychological resource, refers to the ability to adaptively bounce back, cope with adversity and maintain well-being in challenging contexts. Rossman observed that mothers of very low birth weight infants demonstrated resilience in specific contexts by mobilizing resources to actively mitigate mental health challenges linked to preterm birth [20]. Furthermore, parental resilience was correlated with clinically significant outcomes, including reduced psychological distress and improved collaboration with the healthcare providers [21]. Enhancing parental psychological resilience may reduce mental health risks while improving their quality of life and health-related behaviors. Higher parental resilience is associated with greater self-confidence, stronger

perceived caregiving competence, enhanced sense of control, and reduced parenting stress [22]. These findings suggest that resilience-building interventions could play a pivotal role in supporting parents during the transitional period. However, limited research has systematically examined how psychological resilience influences parental care competence for preterm infants during the transition from NICU to home.

The birth and caregiving of a preterm infant constitute significant life events for families. Family resilience, derived from the conceptual framework of psychological resilience, refers to the adaptive process through which families navigate adversities such as neonatal crises [23]. During crisis management for preterm infants, this protective element fosters supportive environments. Empirical studies demonstrated that caring for extremely low birth weight infants enhanced their familial cohesion and mobilized social networks which include their relatives and friends [12, 24]. Moreover, researchers has highlighted the hidden impact of familial resilience on the long-term developmental outcomes in preterm-born children [25]. With Chinese cultural contexts, where Confucian values emphasize kinship networks and collectivism, thus family resilience as a positive variable merits greater scholarly attention.

Previous research has identified that parental care competence for preterm infants, as a component of distal patterns of response in Transitions Theory, serves as a crucial yet understudied post-discharge outcome indicator [6, 26]. Given the paucity of research elucidating the development of parental care competence during the NICU-to-home transition, particularly extant literature has predominantly focused on individual psychology in parental adaptation [27, 28], this study shifts focus to the family level, concentrating an unexplored area in preterm care literature by integrating family resilience—a dimension previously overlooked [25]. Thus, we examined the dynamic interplay between the psychological resilience, family resilience and transitional parental care competence for preterm infants using the Patterson's Family Adjustment and Adaptation Response Model (FAAR). According to the FAAR model, the psychosocial resources (e.g., psychological resilience), as components of family capabilities, facilitate familial adjustment and adaptation to stressors like preterm birth, thereby strengthening family resilience [23, 29]. In other words, psychological resilience somewhat serves as a protective factor for family resilience [23, 29]. As Feng [30] has demonstrated that psychological resilience significantly influenced family resilience since family member's adaptive capacities, including emotional regulation, communication efficacy, and problem-solving skills, all strengthened the family system's collective resilience. Thus, we hypothesize that family resilience mediates the relationship between psychological resilience and parental care competence for premature infants. This hypothesis also aligns with the evidence linking higher psychological resilience, family resilience and functioning to better parental care competence [18, 22, 31]. The proposed mediation model is illustrated in Fig. 1.

This exploratory study aimed to identify mechanisms for improving parental care competence for preterm infants in transition by examining a hypothesized model linking psychological resilience, family resilience, and parental care competence. The findings provide a foundation for developing evidence-based support frameworks.

Methods
Aims
This study aimed to explore the relationship between parents' psychological resilience and premature infant care competence, as well as the mediating effect of family resilience in this relationship among parents of premature infants from four public hospitals in East China.
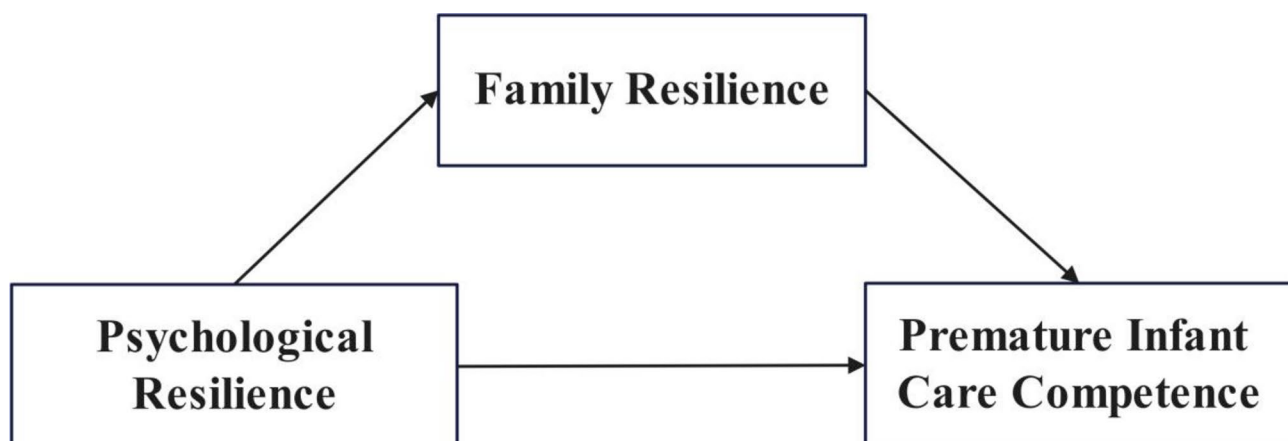

Fig. 1 Hypothesized mediation model

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Study design

A descriptive, cross-sectional, and multi-center design was conducted in the study. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional study was used to report the results [32] (see File Supplementary 1).

Data collection

Participants were recruited using convenience sampling between November 2022 and December 2023 in the high-risk pediatric outpatient from four public hospitals in East China: two tertiary-care hospitals in Shanghai and two secondary-care hospitals in Jiangxi and Zhejiang Province respectively. Team leader of this study (corresponding author) initially clarified the research objectives and significance to the heads of nursing department in the four participating hospitals and obtained their permission. Subsequently, the head nurses of the NICU in the four hospitals were informed to trained one or two nurse coordinators with the same standard for the subsequent data collection.

Before data were collected, the research aims and process were explained to the parents of preterm infants who visited the high-risk pediatric outpatient for early follow-up (within three months of discharge) by the trained nurse coordinator. Parents were then invited to independently complete the pen-and-paper surveys in the outpatient waiting room, which took about ten minutes. Once completed, the questionnaire would be retrieved promptly and checked for any missing information, and all participants were provided with gifts as compensation for the time taken to participate the study. A total of 400 parents of preterm babies were recruited to complete the questionnaire, nineteen declined because of health issues or a lack of interest. Thus, 381 participants completed the entire and valid questionnaire, with a response rate of 95.25%.

Participants and sample

Parents meeting the following criteria were eligible to participate: (1) over 18 years, (2) parents of premature infants who were less than 37 weeks gestational age at birth and (3) had been hospitalized in the NICU for more than one week, (4) able to communicate in Chinese. Exclusion criteria were: (1) refuse to participate in the study and/or (2) parents who once requested discharge from neonatal ward against medical advice or (3) whose infant had been diagnosed with a chromosomal anomaly, congenital disease or neural tube condition.

The sample size had to be above 200 or 20 times the number of parameters (20*6) to provide sufficient statistical power in path analysis [33]. Therefore, the sample size of 381 in this study met this requirement.

Measures

Infant and parent social-demographic characteristics

An enrolment form was used to collect the following information: (a) infant demographic characteristics (e.g. gestational age at birth and gender); (b) parent demographic characteristics (e.g. age and gender) and sociological characteristics (e.g. education level and income per month).

Connor-davidson resilience scale (CD-RISC)

The CD-RISC is a 25-item self-report tool for measuring the psychological resilience [34]. It covers three dimensions: tenacity (items 2, 3, 4, 6), strength (items 1, 5, 7, 8, 9, 10, 24, 25) and optimism (items 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23). Items are scored on a 5-point Likert scale ranging from 0 (not true at all) to 4 (true nearly all the time). The total score varies from 0 to 100. A higher score indicates a higher level of psychological resilience. It has been verified that the Chinese version of CD-RISC is effective and reliable for Chinese people [35]. In the current study, Cronbach's alpha for the scale was 0.931.

Family hardiness index (FHI)

The FHI, as one part of the Family Index of Regenerativity and Adaptation-General developed by [36], was adopted to assess family resilience. It comprises 20 items and is rated on a 4-point Likert scale from 1 (strongly disagree) to 4 (strongly agree) with nine items scored reversely (items 1, 2, 3, 8, 10, 14, 16, 19 and 20). The subscales of FHI include control, commitment and challenge. Possible points for the total scale range from 20 to 80 and higher scores indicate stronger family resilience. The Chinese version of FHI has good reliability and validity among the parents of hospitalized children [37]. The Cronbach's alpha of the scale in this study was 0.878.

Premature infant care competency scale (PICCS)

The PICCS, developed by Zhao [27], was adopted to measure premature infant care competence of parents in transition. It consists of 35 items clustered into four factors: care knowledge, care attitude, care skills and social support. Each item is assessed on a 5-point Likert scale from 1 (master nothing at all) to 5 (master completely). The total score varies from 35 to 175, and higher scores indicate greater premature infant care competence. The PICCS has high internal consistency (Cronbach's alpha of 0.955), great test-retest reliability (0.889) and excellent scale level content validity index (S-CVI of 0.975) in the Chinese population [27]. In this study, Cronbach's alpha for the scale was 0.966.

Data analysis

IBM SPSS V.27.0 and Amos V.26.0 for Windows were used for all statistical tests. The participants' sociodemographic characteristics and the related variables were examined by descriptive statistics of frequencies, percentages, means and standard deviations. Then, the bivariate analyses were conducted. Pearson correlation analysis was used to evaluate the relationship among the main study variables.

We followed Hayes' guidelines for mediation analysis with covariates [38], putting demographic variables significantly related to the parental premature infant care competence into the model as covariates (i.e., parental gender, education levels and pre-existing diseases). Structural equation modeling (SEM) was performed via AMOS to validate the model fit, which could provide superior control over confounders in the paths of mediation model. The model fit was evaluated with the following indices: the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), the Normed Fit Index (NFI), the Goodness of Fit Index (GFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). For the CFI, IFI, NFI and GFI, values greater than 0.90 or 0.95 indicate an acceptable or good fit. For RMSEA and SRMR, a value of less than 0.08 is suggested as the criterion for an acceptable fit. To refine the mediation effect, the bootstrap resampling was performed 5000 times, and a 95% confidence interval excluding zero was considered statistically significant at $P < 0.05$.

Results

Common method bias test

Given that the variables were all measured by a self-report scale, we needed to examine the potential for common method bias. First, common method bias had previously been reduced by the anonymous completion of the survey, time restrictions and separate link delivery. Harman's one-factor test was used to test for common method bias. The results revealed 14 factors with eigenvalues greater than one. The unrotated first factor explained 27.24% of the total variation, which was less than 40% of the critical criterion [39]. Therefore, serious common method bias was not present in this study.

Descriptive statistics for characteristics of preterm parents and infants

Table 1 illustrates sociodemographic characteristics of preterm parents and infants. A total of 381 participants, including 329 (86.35%) mothers and 52 (13.65%) fathers, were involved in this study. The mean age of parents was 28.64 (standard deviation [SD] = 5.75). More than half of the participants had a degree of technical secondary school or below (55.64%), had no pre-existing diseases (87.40%) and were married (95.28%). Among their preterm infants, the majority were moderate to late preterm (88.98%), benefited from medical insurance (74.28%), were not the first child (51.44%) and were single births (94.75%).

Differences in premature infant care competence by sociodemographic characteristics

We found that premature infant care competence of mothers was greater compared with fathers (t = 2.71, $P = 0.007$). Parents with pre-existing diseases exhibited higher levels of care competence for premature infants compared to those without such conditions (t = 3.26, $P = 0.001$). The parental premature infant care competence also differed across different education levels (F = 9.41, $P < 0.001$). A post hoc test (Dunnett) showed that premature infant care competence was lower among parents with technical secondary school or below (vs. senior high school, $P = 0.012$; vs. bachelor degree or above, $P < 0.001$). We did not find any variations in parental premature infant care competence across different infants' sociodemographic characteristics. Based on the findings above, we included this three variables as covariates in the mediation models. Detailed results for all study variables are displayed in Table 1.

Levels of psychological resilience, family resilience, and premature infant care competence of parents

All scores of the variables were normally distributed. Parents rated their premature infant care competence with an overall score of 134.02 (16.99) out of a total possible 175.00. All mean scores across all four dimensions of the premature infant care competence of parents were above the item average score of 3.5. The total psychological resilience score was 63.85 (12.46) out of a total possible 100.00. The total family resilience score was 58.37 (7.28) out of a total possible 100.00. More details are showed in Table 2.

Correlations between psychological resilience, family resilience, and premature infant care competence of parents

The results of correlational analyses among parents' psychological resilience, family resilience, and premature infant care competence were presented in Table 3. Total and subscale scores of psychological resilience were positively correlated with family resilience ($r = 0.41$ to 0.52, $P < 0.01$), and positively correlated with parental premature infant care competence ($r = 0.21$ to 0.37, $P < 0.01$). Family resilience and its three dimensions were positively correlated with parental premature infant care competence ($r = 0.16$ to 0.33, $P < 0.01$).

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Table 1 Parents' and infants' sociodemographic characteristics and influence on premature infant care competence of parents in transition (N = 381)

Variables	N (%)/M (SD)	Premature infant care competence M (SD)	t / F	P	Post hoc test (Dunnett[a])
Parent characteristics					
Gender			2.71[**]	0.007	
Male	52 (13.65%)	128.13 (17.61)			
Female	329 (86.35%)	134.95 (16.73)			
Age (years old)	28.64 (5.75)				
Advanced maternal age (n = 329)			0.33	0.74	
Yes (≥ 35)	44 (13.37%)	135.73 (15.12)			
No (18–34)	285 (86.63%)	134.82 (16.99)			
Education level			9.41[**]	< 0.001	1 < 2[$] 1 < 3[**]
1. Technical secondary school or below	212 (55.64%)	130.72 (14.96)			
2. Senior high school	43 (11.29%)	138.42 (16.81)			
3. Bachelor degree or above	126 (33.07%)	138.06 (19.06)			
Monthly household income (Chinese Yuan)			0.06	0.616	
< 3000	42 (11.02%)	135.48 (13.29)			
3000–4999	183 (48.03%)	133.38 (16.60)			
5000–9999	101 (26.51%)	133.29 (18.53)			
≥ 10,000	55 (14.44%)	136.36 (17.98)			
Marital status			0.61	0.539	
Married	363 (95.28%)	134.13 (16.97)			
Cohabiting	18 (4.72%)	131.61 (17.79)			
Parents with pre-existing diseases			3.26[**]	0.001	
Yes	48 (12.60%)	141.40 (14.91)			
No	333 (87.40%)	132.95 (17.03)			
Infant characteristics					
Multiple birth			0.74	0.460	
Yes (twins)	20 (5.25%)	136.75 (12.42)			
No	361 (94.75%)	133.86 (17.21)			
Gender (single birth, n = 361)			0.66	0.511	
Male	197 (54.57%)	133.32 (16.51)			
Female	164 (45.43%)	134.52 (18.04)			
Gestation age at birth			1.18	0.319	
less than 28 weeks	12 (3.15%)	140.75 (13.75)			
28 to less than 32 weeks	30 (7.87%)	136.00 (19.22)			
32 to less than 34 weeks	49 (12.86%)	131.33 (19.24)			
34 to less than 37 weeks	290 (76.12%)	133.99 (16.44)			
First child			0.42	0.678	
Yes	185 (48.56%)	133.64 (18.00)			
No	196 (51.44%)	134.37 (16.02)			
Medical expenses payment			0.82	0.440	
Self-paying	74 (19.42%)	135.66 (19.30)			
Medical insurance for residents	283 (74.28%)	133.87 (16.36)			
Other ways	24 (6.30%)	130.67 (16.87)			

Abbreviations: M, mean; SD, standard deviation

[a]: The first group (technical secondary school or below) was set as the control category

[**]$P < 0.01$; [$]$P = 0.012$

Table 2 Scores of psychological resilience, family resilience, and premature infant care competence of parents in transition (N = 381)

Variables	Items (*n*)	Total scores M (SD)	Item mean scores M (SD)	Cronbach's alpha
Family resilience total (FHI)	20	58.37 (7.28)	2.92 (0.36)	0.878
Control	6	16.21 (3.04)	2.70 (0.51)	
Commitment	9	27.66 (3.21)	3.07 (0.36)	
Challenge	5	14.49 (2.19)	2.90 (0.44)	
Psychological Resilience total (CD-RISC)	25	63.85 (12.46)	2.55 (0.50)	0.931
Optimism	4	9.97 (2.32)	2.49 (0.58)	
Strength	8	21.82 (4.68)	2.73 (0.59)	
Tenacity	13	32.06 (6.62)	2.47 (0.51)	
Premature infant care competence (PICCS)	35	134.02 (16.99)	3.83 (0.49)	0.966
Care knowledge	13	47.71 (7.11)	3.67 (0.55)	
Care attitude	8	32.33 (4.45)	4.04 (0.56)	
Care skill	11	41.89 (6.32)	3.81 (0.57)	
Social support	3	12.08 (1.69)	4.03 (0.56)	

Abbreviations: M, mean; SD, standard deviation; FHI, Chinese version of Family Hardiness Index; CD-RISC, 25-item Chinese version of Connor-Davidson Resilience Scale; PICCS, Premature Infant Care Competency Scale

Mediation effect analyses

The mediation model for parental premature infant care competence is presented in Fig. 2. This model provided a good fit for the analyzed data (Comparative Fit Index = 1.00, Incremental Fit Index = 1.00, Normed Fit Index = 1.00, Goodness of Fit Index = 1.00, root mean square error of approximation = 0.00, and standardized root mean square residual = 0.00). The coefficients (b) and standardized coefficients (β) of all the paths in this conceptual model can be found in Table 4.

There was a direct relationship between the three covariates and parental premature infant care competence (parental gender: β = 0.226, *P* < 0.001; education level: β = 0.139, *P* = 0.005; pre-existing diseases: β = -0.169, *P* < 0.001), but not with family resilience (parental gender: β = 0.022, *P* = 0.624; education level: β = 0.091, *P* = 0.058; pre-existing diseases: β = -0.017, *P* = 0.704). These results revealed that preterm infants' mothers and parents with pre-existing diseases or greater education level were directly associated with better premature infant care competence. Additionally, better psychological resilience was directly associated with higher levels of family resilience (β = 0.483, *P* < 0.001), and subsequently, higher levels of family resilience were associated with better premature infant care competence (β = 0.168, *P* = 0.002). This consequence showed an indirect relationship between psychological resilience and parental care competence through the mediator of family resilience (β = 0.111, *P* = 0.001), which was displayed in Table 5.

Discussion

This study aimed to elucidate potential pathways for improving transitional parental care competence for preterm infants by testing a hypothesized model. Structural equation modeling (SEM) results demonstrated that psychological resilience was a significant predictor of parental care competence during the transition period, exerting both direct and indirect effects mediated through family resilience.

In this research, the self-reported average score of parental care competence for preterm infants was 134.02 points, indicating a moderately high level. This result contradicted the high unplanned readmission rates of preterm infants in China [40]. This discrepancy may stem from the predominance of moderate-to-late preterm infants in our sample, whose parents faced fewer complex care demands (e.g., apnea monitoring and tube feeding) compared to those of extremely preterm infants [41]. The existing researches have examined demographic variables (e.g., maternal marital status and parity) as significant predictors of parental care competence [17]. Extending the context to preterm infant care, our mediation analysis identified three covariates (parental gender, educational level, and pre-existing diseases) directly associated with parental transitional care competence for preterm infants. These findings offer novel insights for optimizing NICU-to-home transition practices and parental education. **(1) Addressing Gendered Disparities in Care Competence** (evidenced by maternal advantage in care competence): Clinical staff should implement differentiated care competence-building interventions based on the 'gender difference'. Specifically, the interventions should prioritize maternal caregiving proficiency enhancement (e.g., neonatal cue interpretation) while ensuring paternal basic caring skills acquisition through error-reduction training (e.g., feeding methods optimization). **(2) Implementing Tiered Educational Programs**: Tailoring educational interventions stratified by parental education levels should be effective. For caregivers with limited literacy, clinical workers can utilize simplified training materials with visual-enhanced instructional methods (e.g., pictorial guides and video

Table 3 Correlations (*r*) between psychological resilience, family resilience, and premature infant care competence of parents in transition (*N* = 381)

	1	2	3	4	5	6	7	8	9	10	11	12
1.FHI												
2.FHI-Control	0.824**											
3.FHI-Commitment	0.881**	0.507**										
4.FHI-Challenge	0.890**	0.611**	0.760**									
5.Resilience	0.510**	0.292**	0.550**	0.485**								
6.R-Optimism	0.414**	0.169**	0.485**	0.430**	0.769**							
7.R-Strength	0.517**	0.303**	0.547**	0.496**	0.931**	0.660**						
8.R-Tenacity	0.450**	0.277**	0.478**	0.411**	0.954**	0.630**	0.813**					
9.PICCS	0.303**	0.163**	0.309**	0.328**	0.322**	0.208**	0.370**	0.272**				
10.PICCS-Care knowledge	0.260**	0.120*	0.278**	0.290**	0.286**	0.195**	0.329**	0.238**	0.906**			
11.PICCS-Care attitude	0.219**	0.133**	0.219**	0.223**	0.150**	0.089	0.181**	0.123*	0.755**	0.495**		
12.PICCS-Care skill	0.327**	0.177**	0.335**	0.350**	0.373**	0.234**	0.421**	0.322**	0.943**	0.811**	0.627**	
13.PICCS-Social support	0.151*	0.115*	0.106*	0.185**	0.247**	0.165**	0.288**	0.204**	0.729**	0.568**	0.534**	0.677**

Abbreviations: FHI, Family Hardiness Index; R, Resilience; PICCS, Premature Infant Care Competency Scale
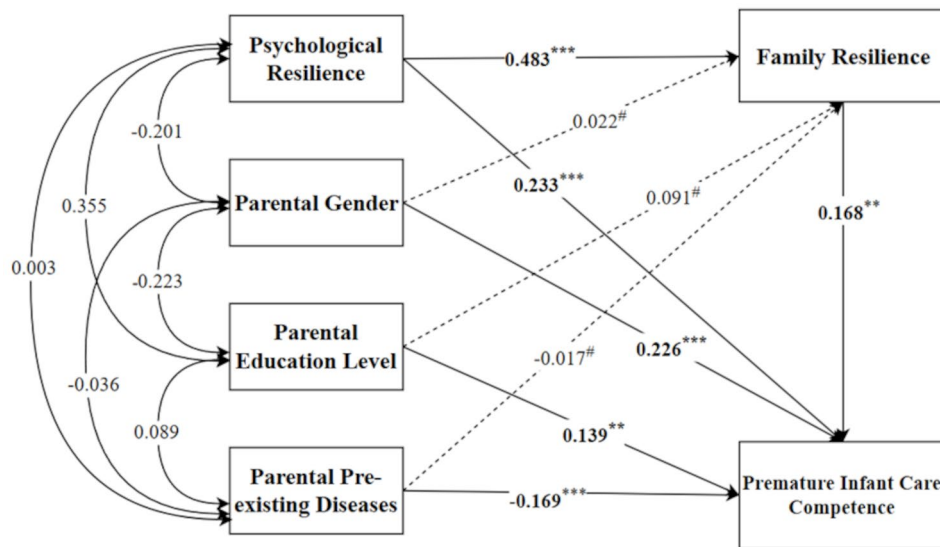
*$P < 0.05$　**$P < 0.01$

Fig. 2 Structural equation modeling of parental premature infant care competence
→standardized regression coefficients, significant. ⇢standardized regression coefficients, non-significant. ↔ correlation coefficients. #$P > 0.05$; **$P < 0.01$; ***$P < 0.001$

Table 4 Parameter estimates of all paths in the mediation model (N = 381)

Structural paths	Unstandardized coefficients (b)	SE	C.R.	P	Standardized coefficients (β)
Psychological resilience⇒Family resilience	0.282	0.028	10.179	< 0.001	0.483
Parental gender⇒Family resilience	0.472	0.962	0.490	0.624	0.022
Parental education level⇒Family resilience	0.670	0.353	1.898	0.058	0.091
Parental pre-existing diseases⇒Family resilience	-0.367	0.966	-0.380	0.704	-0.017
Family resilience⇒Premature infant care competence	0.392	0.124	3.160	0.002	0.168
Psychological resilience⇒Premature infant care competence	0.318	0.076	4.202	< 0.001	0.233
Parental gender⇒Premature infant care competence	11.152	2.330	4.786	< 0.001	0.226
Parental education level⇒Premature infant care competence	2.400	0.858	2.798	0.005	0.139
Parental pre-existing diseases⇒Premature infant care competence	-8.632	2.339	-3.690	< 0.001	-0.169

Abbreviations: C.R., critical ratios; SE, standard error

Table 5 Mediating effect of family resilience on the relationship between psychological resilience and premature infant care competence of parents in transition (N = 381)

Effect path	Estimate	Bootstrap 95%CI	P
Indirect effect: psychological resilience → family resilience → care competence	0.111	[0.049, 0.183]	0.001
Direct effect: psychological resilience → care competence	0.318	[0.166, 0.464]	< 0.001
Total effect	0.429	[0.304, 0.553]	< 0.001

Abbreviations: CI, confidence interval

demonstrations). Building on this tiered teaching approach, multimodal delivery systems integrating home visits and mobile health (e.g., short message service-based mentoring and video coaching) are proposed, which can effectively bridge the NICU-to-home care transitions, bolster premature infant care competence of those educationally disadvantaged parents and mitigate caregiver distress [42]. **(3) Enhancing Health Literacy through Contextualized Interventions**: Parents with pre-existing diseases demonstrated higher care competence, suggesting their medical experiences may augment health literacy — the capacity to acquire, process and apply health information in making informed decisions for preterm infants [43]. Current interventions overemphasize procedural knowledge dissemination [44, 45], yet passive approaches rarely drive behavioral change. Effective health literacy initiatives for preterm infants' parents should include stratifying supports for

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low-health-literacy groups, embedding contextual adaptability through participatory design, and prioritizing interactive, social and critical skills-building over didactic instruction. This competence-centered paradigm shift could catalyze sustainable behavioral modifications of needed parents.

Parental Resilience as a Catalyst for Preterm Infant Care Competence

Parental psychological resilience was identified as a significant predictor of transitional care competence for preterm infants, underscoring the critical role of resilience improvement. This finding aligns with prior evidence indicating that resilient caregivers enhanced infant developmental outcomes through responsive care practices [28]. To optimize psychological resilience in parents of preterm parents, multilevel intervention strategies are recommended. **(1) Individual-Level Interventions**: Integrate resilience-building programs (e.g., benefit finding exercises and specific mindfulness training) with mobile health applications to ensure the post-NICU care continuity [21]. Embed psychoeducation modules (e.g., cognitive reframing exercises and skill-building resources) into preterm infants discharge planning. Strengthen parental commitment to parenting goals by enhancing negative emotion tolerance and stress-coping capacities (e.g., calmness and decisiveness) [46]. **(2) Policy-Level Interventions**: Adopting the lens of Social Determinants of Health (SDOH) Resilience [47, 48], policymakers should prioritize implementing means-tested medical subsidies to redress systemic healthcare allocation disparities, thereby addressing structural inequities in medical resource distribution through social policy reforms. Concurrently, integrate SDOH resilience view into public health agendas and foster cross-sectoral collaboration (e.g., healthcare, social security and housing departments) to support preterm infant care. Furthermore, our findings regarding the association between sociodemographic predictors and care competence highlight the need for further research to elucidate the social determinants underlying SDOH resilience in preterm infant care contexts. Clinical healthcare providers should also routinely assess parental resilience and tailor customized support according to distinct psychological adaptation patterns.

Strengthening family resilience: a dual-focused approach for preterm infant care transition

The mediation effect of family resilience emphasizes the necessity of developing relevant interventions targeting familial dynamics, particularly given suboptimal engagement of family systems in current practices [44, 49]. Family-centred care (FCC), as a strategic entry point, potentially operationalizes family resilience by positioning parents as collaborative partners in clinical decision-making over peripheral observers, and incorporates nursing-led skill-building interventions (e.g., diaper changing and syringe feeding) for parents to facilitate their care competence [9, 50]. To break post-discharge adversities, comprehensive care models should be developed to integrate family support services addressing health-related social needs (e.g., housing and income) with immediate caregiving guidance during clinic visits [9]. Furthermore, follow-up visits should evolve from infant-focused surveillance to family-centred ecosystems, prioritizing parental mental health and resource access equally. This dual focus enhances family well-being. Since family resilience hinges on the interplay between internal and external supports [11, 51], internal strategies should expand FCC interventions to engage extended family members and siblings of preterm infants through role-playing workshops, thereby clarifying caregiving roles and mitigating intra-family conflicts. This also involves facilitating role adaptation and mobilizing family strengths (e.g., intergenerational caregiving traditions) via secure digital platforms that link family journals to external community resources. Externally, nurse-coordinated initiatives should integrate comprehensive partnerships through peer support groups jointly facilitated by neonatal specialists and experienced parents, which contribute to reciprocal knowledge exchange. This synergy strengthens social capital that enhances internal capacity-building efforts [46] — for instance, workshop-acquired conflict resolution techniques can be effectively consolidated through peer mentoring relationships. This multidimensional ecosystem ultimately fosters resilience co-evolution through recursive feedback between family and community systems.

As a supplement, the methodological constraints inherent to the cross-sectional study designs limit our ability to capture temporal dynamics in the evolution of parental resilience resources and care capacity. To address this, future investigations should employ longitudinal cohort studies incorporating developmental trajectory modeling. Such designs would enable precise characterization of transitional phases in parental adaptive capacities and caregiving proficiency. Furthermore, randomized controlled trials adopting multiphase and multidimensional resilience-enhancing strategies are warranted to assess the efficacy of targeted interventions at infants' critical developmental junctures and contribute to identify the optimal intervention window.

Limitations

There are certain inherent limitations in our study. First, the data collection was confined to the eastern region of China, specifically four public hospitals, limiting the findings' applicability on a boarder scale. To enhance the

generalizability and validate the identified relationships' direction and magnitude, future studies should encompass a wider demographic across China using larger sample sizes. Additional limitations are related to the study methods utilized. Self-report surveys were used in this study, and as with all self-reported surveys, participants' responses may not accurately reflect their true experiences. Finally, this study was cross-sectional in nature, it had no way to track the trajectories of the main variables, thus longitudinal researches and explicit inquiry would be needed to better verify the observed findings in the future.

Conclusions

To ensure patient safety, it is critical to enhance premature infant care competence. This study was the first to explore the mediating role of family resilience between psychological resilience and premature infant care competence of Chinese parents in transition. The family resilience were positively influenced by psychological resilience, and subsequently influenced premature infant care competence of parents. Therefore, we suggested that clinicians should pay more attention to the early resilience assessment of parents and family resilience improvements based on the formation of therapeutic alliance with the entire family system of preterm babies, which would finally help them better cope with the crises caused by prematurity.

Implications for practice

This study highlights the heterogeneity in care competence and psychological resilience of preterm parents, underlining the importance of understanding the diverse needs of families with preterm infants. Consequently, researchers should focus on developing hopeful health literacy interventions and multidimensional support networks based on the different latent profiles of parents' psychological resilience in order to improve their emotional regulation ability and health literacy, ultimately promoting their independence in caring for own infants. In addition, building strong family resilience demands strengthening both internal and external support systems of the family. The care strategies should involve the whole family as far as possible, including fathers and other family members, with accurate recognition of the crucial role of external social supports in fostering family resilience and improving care outcomes. All of these requires health professionals to have enough skills to identify and meet these needs, thereby consolidating family resilience in a comprehensive way.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40359-025-02797-8.

Supplementary Material 1

Data availability
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was obtained from the Ethics Review Committee of Children's Hospital of Shanghai(2022R110-E01). All methods were performed by the Declaration of Helsinki. Prior to the study, we obtained the informed consent of all participating parents. Data were kept confidential and processed anonymously.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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