Original Article

The effectiveness of therapist-led family-centered language intervention for children with language delay

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Background: China's language therapist shortage and intergenerational caregiving trends underscore the need for family-based language training, yet such interventions are underutilized and family roles undervalued. This study aims to investigate the effect of a therapist-led family-centered intervention on children with language delay.

Methods: The study comprised 134 children, comprising 59 girls and 75 boys, aged between 2 and 5 years (39.92±10.23 months) who presented with language delay. These participants were selected from the pediatric rehabilitation ward of the Second Affiliated Hospital of Army Medical University from July 2021 and July 2023. They were divided into a control group (n=70) receiving language therapy led by a language therapist, and an observation group (n=64) receiving therapist-led family-centered language intervention in conjunction with the treatment provided to the control group. Demographic characteristics were analyzed. The Gesell and Sign-significant (S-S) were used for assessments before and after the intervention.

Results: No significant demographic differences were found between the groups. Both groups demonstrated significant improvements in language development following a 3-month intervention as assessed by the Gesell assessment. The control group showed an increase from 52.97±4.79 to 65.97±3.48 (P<0.001), while the observation group improved from 53.53±4.06 to 71.98±4.51 (P<0.001). Additionally, prior to the intervention, differences were observed between the control group and the observation group in S-S assessments, particularly in symbolic form and instructional content (P=0.04 and P<0.001) as well as foundational research topics (P=0.04 and P<0.001). Following the intervention, the observation group demonstrated more significant advancements in language development compared to control group as evidenced by higher Gesell scores (18.45±5.72 *vs.* 13.00±6.16, P<0.001), S-S assessments in symbolic form and instructional content (1.11±1.55 *vs.* 0.53±1.57, P=0.03), and foundational research topics (1.42±1.88 *vs.* 0.64±2.14, P=0.02). Based on the Gesell assessment, there was a significant improvement in personal-social skills for both groups of children following intervention (all P<0.05), with the observation group demonstrating a more pronounced enhancement compared to the control group (4.73±4.07 *vs.* 2.20±3.68, P<0.001).

Conclusions: Therapist-led family-centered interventions enhance language development, with parents playing a significant role in mitigating skip-generation caregiving and fostering greater parent-child interactions.

Keywords: Children; language delay; Sign-significant relations (S-S relations); Gesell Developmental Scale (GDS); family-centered language intervention

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Introduction

Language is a crucial component in human social and behavioral interactions, serving as a cognitive manifestation of brain function and psychological processes (1). Language delay is a prevalent pediatric condition characterized by children failing to achieve the anticipated language development milestones by a specific age, thereby potentially impeding their overall developmental progress (2). The incidence of language delay in children shows variability across different research studies. Some findings suggest that the prevalence of language development delay ranges from 2% to 11% (3,4), whereas other studies estimate that approximately 15% of children experience language delay (5). While a majority of these children may exhibit catch-up in language abilities by the age of 4 years, a significant portion continues to display persistent and enduring deficiencies in learning and social skills (6,7). Research suggests that untreated language delay may continue to affect 40–60% of children, placing them at increased risk for social, emotional, behavioral, and cognitive difficulties in later life (8-10). In addition, for preschoolers with language delay, undetected hearing loss is also an issue that cannot be overlooked (11).

The initial stages of language acquisition significantly impact the neuropsychological development of children (12). Identifying and addressing language delays during this critical period can significantly mitigate the adverse effects on children's language acquisition, both in the immediate and long-lasting contexts (13,14). Research conducted by Dale *et al.* (15) indicated that a significant proportion (69%) of the variance in language development among children can be attributed to differences in the family foster care environment, highlighting the substantial influence of the familial context on early language acquisition. Moreover, research has shown that early language intervention prior to the age of 3 years can effectively reduce the immediate and lasting negative impacts of language delay (16). In China, the primary method of language rehabilitation intervention is overseen by speech therapists in rehabilitation facilities. This approach commonly involves oral-motor exercises, speech imitation, and the use of cognitive cards focusing on categories such as "animals", "fruits and vegetables", and "transportation", all of which have been found to be beneficial in enhancing the language skills of children with language delay. The language therapists in our rehabilitation ward also employ the aforementioned intervention methods. However, we have observed that this form of training often results in parents relying on therapists due to their limited understanding of language development principles and training methods. Furthermore, it fails to facilitate productive interaction and education between children and parents in authentic settings. In some instances, children may exhibit a preference for learning solely from therapists rather than their own parents. Haden *et al.* (17,18) have demonstrated that language therapists can assist parents in utilizing the child's natural environment and interests to engage in conversations that capture their attention. This approach entails the delineation of subjects, integration of the child's preferences, and acknowledgment of their communicative and investigative actions. These methods have the potential to booster the linguistic proficiency of children experiencing delays in language

Highlight box

Key findings

- Compared to children receiving only therapist-led language rehabilitation intervention, children undergoing combined therapist and family-centered language interventions demonstrate significant improvements in language comprehension, language expression skills, and social abilities.

What is known and what is new?

- Family-centered language intervention is effective in providing language therapy for children with language delays.
- This study demonstrated the effectiveness of family-centered language training, addressing the current inadequacies in speech therapists in China. This approach is applicable to various caregiving arrangements within families, with parental involvement yielding the most favorable outcomes, making it widely applicable in clinical settings.

What is the implication, and what should change now?

- Family-centered language intervention is a cost-effective and efficient method of language training.
- Family-centered language interventions can be disseminated within children's rehabilitation centers, educating parents on the feasibility and efficacy of these approaches to enhance their engagement in the process.

acquisition. Family-centered language intervention programs are recognized for their manifold advantages, such as enhancing parental perceptions of effectiveness, overall wellness, and contentment; offering proactive advice to parents to encourage their participation in childcare interventions; enhancing developmental and functional achievements in children with developmental delays and special health needs; reducing children's screen time, fostering parent-child interaction and communication, and incorporating natural environments to enhance authentic language learning experiences (19,20).

In the current Chinese context, a notable deficiency of language therapists has led to prolonged wait periods for language therapy services for children experiencing delays. Additionally, a rising inclination towards intergenerational caregiving has been observed. Therefore, in light of societal changes, parents, and even grandparents or other caregivers, should receive language training and support to facilitate the language development of their children. Nevertheless, the implementation of the family-centered language intervention approach remains limited in China, with the crucial role of family participation in language intervention for Chinese children frequently disregarded.

Thus, this study undertook a clinical trial involving children aged 2–5 years with language delays, emphasizing practical considerations and investigating the clinical outcomes of family-centered language intervention. The objective of this study is to offer theoretical rationale and empirical validation for the implementation of family-centered language intervention for children with language delays in China. We present this article in accordance with the STROBE reporting checklist (available at https://tp.amegroups.com/article/view/10.21037/tp-24-225/rc).

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics committee of the Second Affiliated Hospital of Army Medical University (No. 2023-160-01) and individual consent for this retrospective analysis was waived.

Research design and study sample

A total of 134 children, comprising 59 girls and 75 boys, aged between 2 and 5 years (39.92±10.23 months), were identified as exhibiting developmental delays. These participants were selected from the pediatric rehabilitation ward of the Second Affiliated Hospital of Army Medical University from July 2021 and July 2023. Among them, 70 children received language rehabilitation intervention led by a speech therapist as the control group, and an additional 64 children received combined interventions of the control group along with family-centered language intervention as the observation group. The demographic characteristics of the language delay children were collected, including gender, age, perinatal asphyxia, maternal prenatal condition, history of epilepsy, parents' level of education, family's monthly income, child's primary caregiver, amount of daily interaction between caregiver and child, child's daily screen time, daily time of outdoor activities for children, caregiver's screen time after returning home, close relatives with language delay, and the child's eating behavior.

Inclusion criteria: (I) meet the diagnostic criteria for language delay in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (21); (II) age between 2 to 5 years; (III) the participants' language developmental quotients (LDQs), as assessed by the Gesell assessment, needed to be less than 76; and (IV) children and their families willing to participate in the questionnaire survey and cooperate with the study procedures.

Exclusion criteria: (I) children with comorbidities such as hearing impairment (including children with conductive hearing loss resulting from otitis media with effusion), malformations of the outer, middle and/or inner ear visual impairment, cerebral palsy, syndromes, and autism spectrum disorders; (II) intervention received in other medical or educational institutions during the 3-month follow-up period; (III) children whose parents refused follow-up visits, assessments, or withdrew from the language development intervention midway; and (IV) children currently participating in other clinical trials.

Assessment and assessment tools

Prior to and following the intervention, all children involved in the study underwent both Gesell assessment and Sign-significant (S-S) assessment.

The Gesell Developmental Scale (GDS) is a commonly utilized instrument for evaluating children's developmental advancements. Created by American psychologist Arnold Gesell in the early 1900s, the GDS assesses a range of developmental domains such as gross motor skills, fine motor skills, adaptive behaviors, personal-social skills, and language development. The assessment of these domains involves the observation and measurement of

particular behaviors and skills demonstrated by children at various stages of development. In the realm of language development, Gesell focuses primarily on evaluating children's proficiency in both language expression and comprehension. For instance, when assessing the language skills of a typically developing 4-year-old child, the evaluation may encompass tasks such as identifying the uses of six objects in pictures, discerning differences in 10 pairs of pictures, defining 5 pairs of antonyms, repeating a sentence consisting of 13 words and naming three different animals. In our study, the GDS-Chinese Revised Version was utilized to evaluate neurodevelopment in children under the age of 6 years. The GDS is a well-established psychometric tool in China that provides developmental quotients (DQs) based on a child's developmental age, determined by comparing their abilities to normative developmental milestones. In each area of development, a DQ below 76 is commonly associated with developmental delays or abnormalities, 55≤ DQ ≤75 is indicative of mild language delay, 40≤ DQ ≤54 signifies moderate language delay, and 25≤ DQ ≤39 is classified as severe language developmental delay (22-26).

The S-S assessment, a diagnostic tool for language delay and developmental characteristics in children, was developed and tested by the Language Development Delay Committee of the Japan Society of Logopedics and Phoniatrics. This assessment, with a specific focus on children with language delay, was initiated in 1977 and officially published in 1980 after trials. It assesses multiple facets of language development such as comprehension, expression, basic learning abilities, and social attitudes. The results of the S-S assessment are compared to the child's actual age, and any scores falling below the expected range may indicate abnormalities or delays in the corresponding domains of language development (27). S-S is widely used in China for assessing the language development of children (28,29).

Intervention

In our study, both groups received language intervention from language therapists in the pediatric rehabilitation ward. However, children in control group led normal home lives without parental or family language intervention training, all parents or other caregivers in observation group received standardized family language intervention training. These parents' home intervention records were reviewed retrospectively in this study.

Control group: a therapist-led individualized language rehabilitation intervention was implemented, including the following approaches: (I) reading comprehension training, which included articulatory organ exercises, pronunciation exercises, and the execution of written instructions; (II) listening comprehension training, encompassing activities such as listening, executing language commands, listening to music, and listening to sentences; and (III) reading and writing training, involving tasks such as identifying cards, reading short stories, and engaging in writing exercises. In our intervention approach, "reading comprehension training" and "reading and writing training" refer to language intervention methods where we select simple picture books suitable for children's language developmental age. These picture books are primarily visual, with minimal text, allowing children to describe the content in their own words based on their understanding of the pictures. Writing involves children holding a pen, coloring, drawing, writing numbers, and practicing strokes under the guidance of a speech therapist. The training sessions were conducted for 30 minutes daily, 5 days a week, over a period of 3 months.

Observation group: received the same language rehabilitation intervention as the control group, along with family-centered language intervention. It is recommended that family-centered language training interventions are preferably attended by parents, in cases where parents are unable to participate, it is also advised to involve other caregivers who reside with the child in the intervention. The intervention plan is as follows: (I) creating a rich language environment through exposure to diverse linguistic stimuli; (II) encouraging expression to support the child in communicating their thoughts and needs; (III) the importance of patient guidance in interactions and language development with children cannot be overstated, as it is crucial for parents to demonstrate patience and refrain from exerting pressure on the child; and (IV) leveraging the child's natural inclination towards imitation, parents can effectively promote language acquisition through methods such as repetition, role-playing, and interactive reading sessions; (V) employing a system of positive reinforcement can be an effective strategy for encouraging and rewarding the child's progress in language-related skills; and (VI) by actively participating in and maintaining consistent engagement in the child's daily activities, parents can cultivate a strong parent-child bond that enhances the quality of interactions and language development. Mustonen *et al.* found that prolonged exposure to electronic screens by both caregivers and children may negatively impact children's language development (30,31). As a result, limitations on screen time were enforced during

Family training homework completion record form							
Name:	Age:	Gender:	ID:	Date of birth:			Parent of operation: Mother
Phone number:		Diagnosis: Language delay		Guidance therapist: Lisha Su			Guidance item: ST
First session of family training homework instructions (to be completed by the guiding therapist)							
Training exercise tasks				Recommended duration	Suggested frequency		Additional notes (such as timing of selection operations)
1. Expanding comprehension and expression of animal nouns (common animals)				60 minutes	Once or twice daily		Conduct activities in a stable emotional and positive state (preferably during games or playtime; parents should engage in face-to-face communication with the child; speak slowly and use simple language during training)
2. Enhancing understanding and expression of verbs (e.g., pull, take, run, eat, etc.)							
3. Say a noun + verb (e.g., "Mom is eating, brother is sleeping, etc.")							
4. Enhancing vocabulary for comprehension and expression of everyday Items (beginning with items commonly used by children)							
5. Enhancing social interaction ability							
6. Can accurately identify sizes and describe which one is larger and which one is smaller							
Family training homework completion status (to be filled out by parents)							
	Monday	Tuesday	Wednesday	Thursday	Friday	Staturday	Sunday
Completed tasks (please indicate with numbers)							
Duration and frequency of practice							
Areas of strength identified during the task							
Challenges or difficulties encountered during the task							
Assistance and support needed							

Figure 1 Family training homework completion record form. ST, speech and language therapy.

the execution of family-centered language interventions. Parents submit daily recorded videos on WeChat to the therapist to track progress, in addition to completing the Family Training Homework Completion Record Form daily (see *Figure 1*). The therapist utilizes these videos and homework records to provide feedback and guidance to the parents. The family-centered language intervention program consists of daily sessions lasting 1 hour, with weekly therapeutic guidance provided to the family based on parental feedback, over a period of 3 months.

Quality control

Quality control measures were implemented through standardized training for all developmental pediatricians, child healthcare physicians, evaluators, and language therapists involved in the study. Interviews and diagnoses of participating patients were conducted by experienced developmental pediatricians and child healthcare physicians following established protocols. Professionally trained evaluators with qualifications in relevant scale testing conducted assessments in the assessment rooms of the pediatric healthcare clinic and rehabilitation ward. Language rehabilitation intervention for both groups was administered by language therapists who had completed standardized training, with therapy sessions held in the language therapy rooms of the pediatric rehabilitation ward.

Statistical analysis

Data analysis and graphing were performed using GraphPad Prism 8 statistical software. Descriptive statistics were employed for categorical variables and presented as frequencies and percentages. To compare differences between groups, the χ^2 test was used for nonparametric data, and the Mann-Whitney *U* test was used for ordinal data. For continuous variables, the mean ± standard deviation (SD) was reported. Independent samples *t*-test was utilized

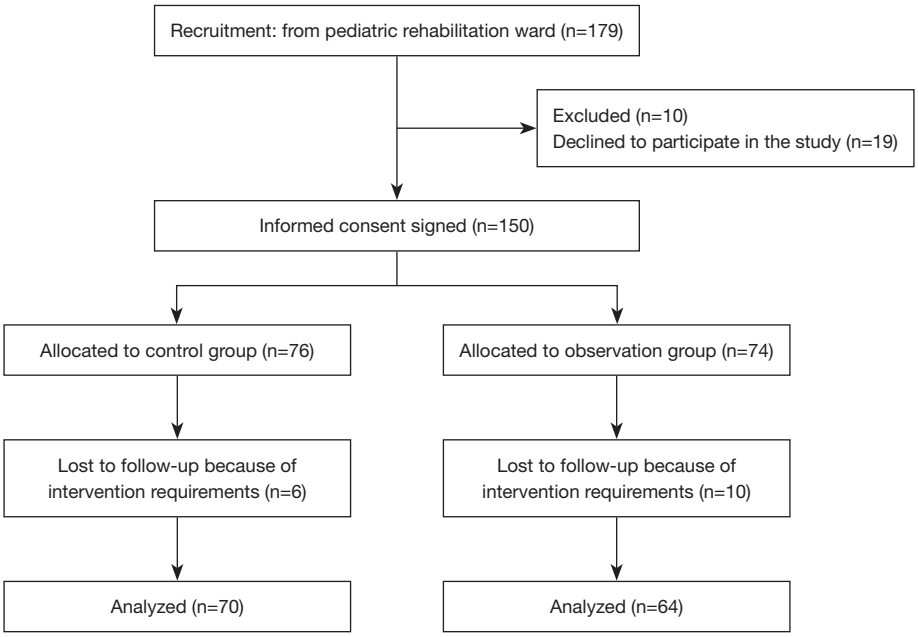

Figure 2 The flowchart of subject enrollment for the two groups of children with language delay.

for normally distributed data, while the Wilcoxon rank-sum test was used for non-normally distributed data. P<0.05 was considered statistically significant.

Results

Population characteristics of included children

The subject enrollment flowchart for the two groups of children with language delay is depicted in *Figure 2*. There were no statistically significant differences between the two groups in various demographic and health-related variables, including gender, age, history of perinatal hypoxia, history of epilepsy, primary caregiver for the child, parental age at birth, parents' education level, family's monthly income, maternal depression, dietary behaviors, daily interaction time between the caregiver and the child, daily outdoor activity time for the child, child's daily screen time, caregiver's screen time after returning home, presence of relatives with language delay, and maternal conditions during pregnancy (all P>0.05). *Table 1* provides the demographic characteristics of the two groups of language delay children. Additionally, a linear regression analysis was conducted using changes in LDQ before and after intervention as the outcome measure to examine the factors influencing language development. The results revealed that only the group factor and the baseline level of LDQ significantly affected the intervention outcomes, as detailed in *Table 2*. Similarly, there were no statistically significant differences in Gesell and S-S assessment scores between the two groups of children before the intervention (all P>0.05), as shown in *Tables 3*,*4*.

Comparison of Gesell and S-S assessment results in two groups before and after intervention

Following the intervention, based on the Gesell assessment, there was a notable enhancement in language development scores for both groups compared to pre-intervention levels, control group (52.97±4.79 to 65.97±3.48, P<0.001) and observation group (53.53±4.06 to 71.98±4.51, P<0.001) (*Figure 3A*). Additionally, the control group and the observation group exhibited statistically significant improvements in personal-social skills compared to their baseline assessments (P<0.001 and P<0.001) (*Figure 3B*). Conversely, there were no statistically significant differences observed in gross motor skills, fine motor skills, and adaptive behaviors between the two groups of children (all P>0.05) (*Figure 3C-3E*). Similarly, based on the S-S Assessment, following a 3-month intervention, it was observed that both control group and observation group exhibited significant enhancements in their language proficiency in symbolic form and instructional content (P=0.04 and P<0.001) as well

Table 1 Demographic characteristics of children at baseline

Factors	Control group (n=70)	Observation group (n=64)	P
Child sex			0.10
Female	31 (44.3)	28 (43.8)	
Male	39 (55.7)	36 (56.3)	
Child age (months)			0.10
>24 and ≤36	27 (38.6)	23 (35.9)	
>36 and ≤48	25 (35.7)	23 (35.9)	
>48 and ≤60	18 (25.7)	18 (28.1)	
Antenatal infection			0.94
No	61 (87.1)	57 (89.1)	
Yes	9 (12.9)	7 (10.9)	
Gestational hypertension			0.98
No	63 (90.0)	57 (89.1)	
Yes	7 (10.0)	7 (10.9)	
Gestational diabetes			0.13
No	61 (87.1)	47 (73.4)	
Yes	9 (12.9)	17 (26.6)	
Gestational thyroid dysfunction (hypo/hyper)			0.37
No	62 (88.6)	61 (95.3)	
Yes	8 (11.4)	3 (4.7)	
Perinatal asphyxia			0.97
No	58 (82.9)	52 (81.3)	
Yes	12 (17.1)	12 (18.8)	
Epilepsy			0.60
No	64 (91.4)	55 (85.9)	
Yes	6 (8.6)	9 (14.1)	
Close relatives with language delay			0.93
No	55 (78.6)	52 (81.3)	
Yes	15 (21.4)	12 (18.8)	
Maternal depression			0.98
No	60 (85.7)	54 (84.4)	
Yes	10 (14.3)	10 (15.6)	
Child's eating behavior			0.67
Regular diet	56 (80.0)	47 (73.4)	
Soft diet[†]	14 (20.0)	17 (26.6)	
Mothers' age at birth (years)			0.76
<35	64 (91.4)	56 (87.5)	
≥35	6 (8.6)	8 (12.5)	
Fathers' age at birth (years)			0.79
<35	55 (78.6)	47 (73.4)	
≥35	15 (21.4)	17 (26.6)	
Education of mother			0.97
Junior high school	9 (12.9)	11 (17.2)	
Senior high school	31 (44.3)	27 (42.2)	
≥ University	30 (42.9)	26 (40.6)	
Education of father			0.05
Junior high school	16 (22.9)	9 (14.1)	
Senior high school	19 (27.1)	34 (53.1)	
≥ University	35 (50.0)	21 (32.8)	
Caregiver character			0.46
Mother	17 (24.3)	8 (12.5)	
Father	7 (10.0)	3 (4.7)	
Grandparents	27 (38.6)	35 (54.7)	
Others	19 (27.1)	18 (28.1)	
Caregiver-child interaction (hours)			0.88
≤2	43 (61.4)	35 (54.7)	
>2–<4	14 (20.0)	18 (28.1)	
≥4	13 (18.6)	11 (17.2)	
Child's daily screen time (hours)			0.68
≤1	21 (30.0)	13 (20.3)	
>1–<2	22 (31.4)	27 (42.2)	
≥2	27 (38.6)	24 (37.5)	
Caregiver's screen time after returning home (hours)			0.71
≤1	5 (7.1)	7 (10.9)	
>1–<2	28 (40.0)	31 (48.4)	
≥2	37 (52.9)	26 (40.6)	
Daily time of outdoor activities for children (hours)			0.86
≤1	22 (31.4)	18 (28.1)	
>1–<2	24 (34.3)	18 (28.1)	
≥2	24 (34.3)	28 (43.8)	
Family's monthly income (RMB)			0.46
≤5,000	15 (21.4)	16 (25.0)	
>5,000–<10,000	21 (30.0)	27 (42.2)	
≥10,000	34 (48.6)	21 (32.8)	

Data are presented as n (%). [†], soft diet: a type of food that is easy to digest and has a relatively soft texture, which falls between regular diet and semi-liquid diet. Hypo, hypothyroidism; hyper, hyperthyroidism; RMB, renminbi.

Table 2 Linear regression analysis of the influence of factors on changes in LDQ before and after intervention

Factors	β	SE	2.5th percentile	97.5th percentile	T	P
Child age (months)						
>24 and ≤36	Reference					
>36 and ≤48	−0.241	0.988	−2.202	1.721	−0.244	0.81
>48 and ≤60	0.217	1.069	−1.904	2.339	0.203	0.84
Child sex						
Female	Reference					
Male	−0.618	0.921	−2.446	1.210	−0.671	0.50
Group						
Control group	Reference					
Observation group	4.718	0.911	2.909	6.527	5.176	0.00
LDQ						
55≤ DQ ≤75	Reference					
40≤ DQ ≤54	8.742	0.855	7.046	10.438	10.230	0.00
Antenatal infection						
No	Reference					
Yes	−1.866	1.302	−4.449	0.718	−1.434	0.16
Epilepsy						
No	Reference					
Yes	−0.874	1.337	−3.529	1.781	−0.653	0.52
Maternal depression						
No	Reference					
Yes	−1.777	1.178	−4.114	0.561	−1.509	0.14
Perinatal asphyxia						
No	Reference					
Yes	−0.523	1.162	−2.829	1.784	−0.450	0.65
Gestational hypertension						
No	Reference					
Yes	−1.085	1.426	−3.914	1.745	−0.761	0.45
Gestational diabetes						
No	Reference					
Yes	0.700	1.081	−1.445	2.845	0.648	0.52
Child's eating behavior						
Regular diet	Reference					
Soft diet†	0.704	1.381	−2.029	3.437	0.510	0.61
Close relatives with language delay						
No	Reference					
Yes	−0.115	1.433	−2.950	2.720	−0.081	0.94
Gestational thyroid dysfunction (hypo/hyper)						
No	Reference					
Yes	−1.401	1.566	−4.508	1.707	−0.895	0.37

Table 2 (*continued*)

Table 2 (*continued*)

Factors	β	SE	2.5th percentile	97.5th percentile	T	P
Fathers' age at birth (years)						
<35	Reference					
≥35	0.907	1.129	−1.334	3.148	0.803	0.42
Mothers' age at birth (years)						
<35	Reference					
≥35	0.247	1.464	−2.659	3.154	0.169	0.87
Caregiver character						
Mother	Reference					
Father	−1.411	1.822	−5.028	2.207	−0.774	0.44
Grandparents	0.723	1.270	−1.797	3.243	0.570	0.57
Others	−0.179	1.333	−2.824	2.468	−0.133	0.89
Caregiver child interaction (hours)						
≤2	Reference					
>2–<4	0.815	1.029	−1.227	2.857	0.792	0.43
≥4	0.793	1.175	−1.539	3.125	0.675	0.50
Caregiver's screen time after returning home						
≤1	Reference					
>1–<2	−0.980	1.596	−4.418	2.189	−0.614	0.54
≥2	−1.201	1.558	−4.293	1.891	−0.771	0.44
Child's daily screen time						
≤1	Reference					
>1–<2	1.699	1.185	−0.653	4.050	1.434	0.16
≥2	−0.336	1.206	−2.730	2.058	−0.279	0.78
Daily time of outdoor activities for children						
≤1	Reference					
>1–<2	0.761	1.127	−1.477	2.999	0.675	0.50
≥2	−0.848	1.058	−2.948	1.253	−0.801	0.43
Education of father						
Junior high school	Reference					
Senior high school	−0.518	1.146	−2.793	1.757	−0.452	0.65
≥ University	−0.645	1.127	−2.883	1.593	−0.572	0.57
Education of mother						
Junior high school	Reference					
Senior high school	0.480	1.266	−2.034	2.994	0.379	0.71
≥ University	−0.831	1.312	−3.436	1.773	−0.634	0.53
Family's monthly income (RMB)						
≤5,000	Reference					
>5,000–<10,000	2.586	1.518	−0.417	5.589	1.704	0.09
≥10,000	0.912	1.102	−1.275	3.099	0.828	0.41

†, soft diet: a type of food that is easy to digest and has a relatively soft texture, which falls between regular diet and semi-liquid diet. LDQ, language developmental quotient; SE, standard error; DQ, developmental quotient; hypo, hypothyroidism; hyper, hyperthyroidism; RMB, renminbi.

Table 3 The comparison of baseline scores between two groups for the Gesell assessment and the changes in the Gesell scores among children in the two groups throughout the intervention period

Assessment content	Control group (n=70)	Observation group (n=64)	P
Before intervention			
Gross motor	82.17±3.69	83.02±2.29	0.12
Fine motor	82.73±2.63	81.92±2.70	0.08
Adaptive behaviors	83.53±2.74	82.67±2.76	0.07
Personal-social skills	77.13±3.37	76.05±3.36	0.07
Language development	52.97±4.79	53.53±4.06	0.47
During the intervention period (change in score)			
Gross motor	0.84±1.66	0.67±2.54	0.46
Fine motor	0.71±1.58	0.64±2.10	0.22
Adaptive behaviors	0.86±2.40	0.78±2.06	0.84
Personal-social skills	2.20±3.68	4.73±4.07	<0.001
Language development	13.00±6.16	18.45±5.72	<0.001

Data are presented as mean ± SD. SD, standard deviation.

Table 4 Using S-S assessment to compare the number of participants in two groups at different language development stages before and after intervention

Observation indicators	Before intervention			Control group (n=70)			Observation group (n=64)		
	Control group (n=70)	Observation group (n=64)	P	Before intervention	After intervention	P	Before intervention	After intervention	P
Symbolic form and instructional content			0.88			0.04			<0.001
Stage 1, stage 2, stage 3–1 12 to 17 months)	16	14		16	9		14	1	
Stage 3–2 (18 to 23 months)	27	26		27	16		26	7	
Stage 4–1 (24 to 29 months)	16	13		16	25		13	26	
Stage 4–2 (30 to 41 months)	10	8		10	16		8	20	
Stage 5–1 (42 to 59 months)	1	3		1	4		3	10	
Foundational process-oriented research topic			0.99			0.04			<0.001
12 to 17 months	17	14		17	7		14	1	
18 to 20 months	25	22		25	16		22	2	
21 to 23 months	9	10		9	19		10	20	
24 to 29 months	10	8		10	14		8	14	
36 to 41 months	6	7		6	9		7	19	
42 to 59 months	3	3		3	5		3	8	

Data are presented as number.

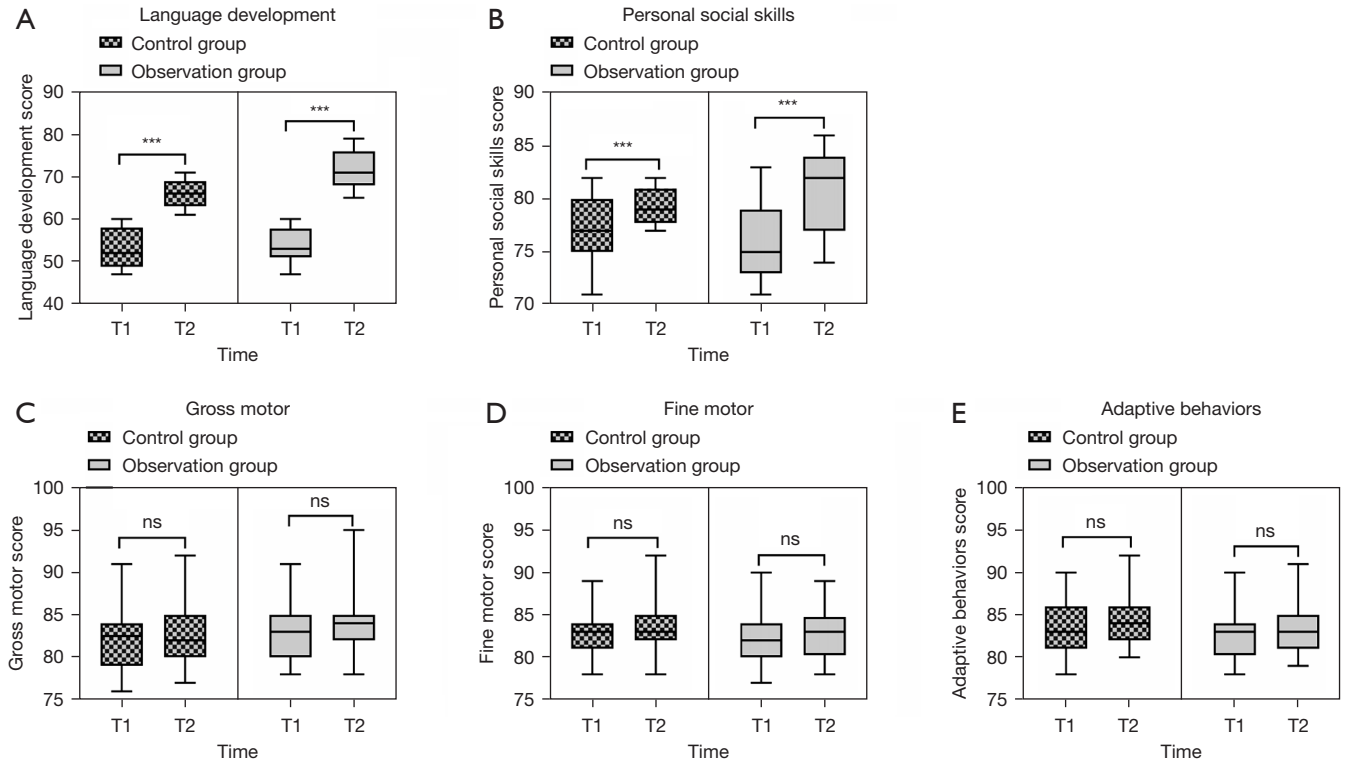

Figure 3 Comparison of Gesell assessment results in two groups before and after intervention. (A) The language development scores in the two groups of children before and after intervention. (B) The personal social skills scores in the two groups of children before and after intervention. (C) The gross motor scores in the two groups of children before and after intervention. (D) The fine motor scores in the two groups of children before and after intervention. (E) The adaptive behaviors scores in the two groups of children before and after intervention. T1: pre-intervention; T2: post-intervention at 3 months. ns, P>0.05; ***, P<0.001.

as foundational process-oriented research topics (P=0.04 and P<0.001) (*Figure 4A-4F*). The detailed data of the Gesell and S-S assessment results for both groups can be found in *Tables 4,5*.

Comparison of the changes in Gesell and S-S assessment results among children in two groups throughout the intervention period

During the intervention period, children in the observation group exhibited significantly greater improvements in language development and personal-social skills as assessed by the Gesell assessment compared to the control group (18.45±5.72 *vs.* 13.00±6.16, P<0.001) and (4.73±4.07 *vs.* 2.20±3.68, P<0.001) (*Figure 5A,5B*); however, there was no significant enhancement in gross motor skills, fine motor and adaptive behaviors for two groups (all P>0.05) (*Figure 5C-5E*). The children in the observation group exhibited a statistically significant increase in S-S assessment during the intervention period compared to the control group, as evidenced by the higher mean results (1.11±1.55 *vs.* 0.53±1.57, P=0.03) in symbolic form and instructional content, as well as in foundational process-oriented research topic (1.42±1.88 *vs.* 0.64±2.14, P=0.02) (*Figure 6A,6B*). Further details can be found in *Tables 3,6*.

Discussion

Language delay not only has a significant impact on a child's comprehension and expressive language skills, but also impairs their social adaptability. Furthermore, it substantially raises the risk of psychological and behavioral issues, such as attention deficit hyperactivity disorder, learning difficulties, and social and communication problems (32). Early detection and intervention can markedly improve the quality of life for children facing language delays. Therefore, effective early diagnosis and intervention for children experiencing language delays are

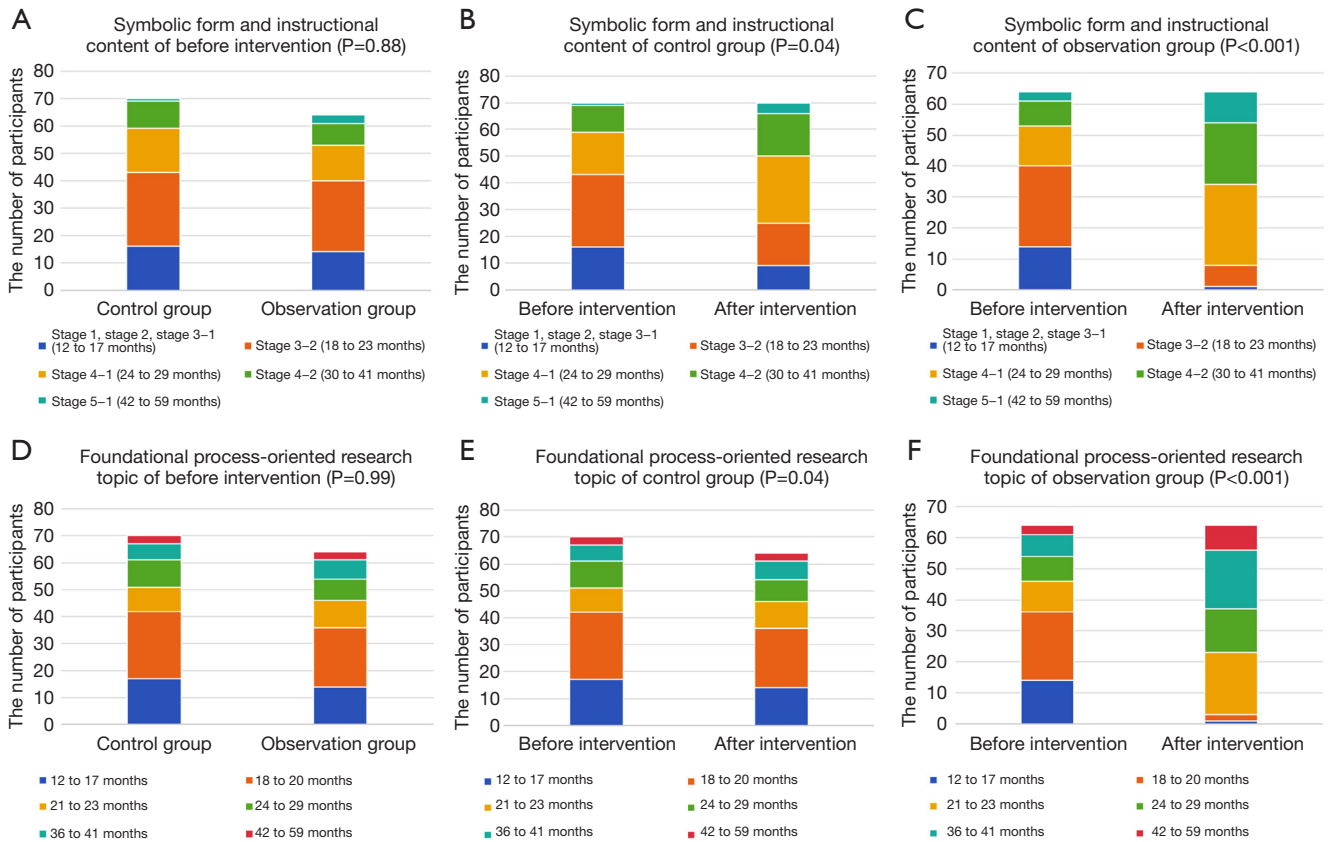

Figure 4 Comparison of S-S assessment results in two groups before and after intervention. (A) The sample size of participants exposed to symbolic form and instructional content in both groups prior to the intervention. (B) The sample size of participants exposed to symbolic form and instructional content in control group before and after intervention. (C) The sample size of participants exposed to symbolic form and instructional content in observation group before and after intervention. (D) The sample size of participants exposed to foundational process-oriented research topic in both groups prior to the intervention. (E) The sample size of participants exposed to foundational process-oriented research topic in control group before and after intervention. (F) The sample size of participants exposed to foundational process-oriented research topic in observation group before and after intervention. S-S, Sign-significant.

crucial. Our research demonstrates notable enhancements in language comprehension, expressive language skills, and personal-social abilities in children with language delays following a combined family-centered language intervention compared to those who only received therapist-led one-on-one language rehabilitation intervention. Our study holds significant clinical implications for the treatment of language delay in children. Firstly, it underscores the necessity of family-centered language interventions in enhancing the effectiveness of rehabilitation for children with language delay, as compared to therapist-led interventions alone. By integrating family members into the intervention process, this approach not only facilitates the direct application of language skills in a child's everyday life but also promotes a more natural and meaningful learning experience. Moreover, the study highlights the importance of parental involvement in language training, emphasizing its role in fostering stronger parent-child relationships, maintaining consistent treatment plans, improving the home environment, and promoting collective efforts among family members.

In our study, the observational group of children demonstrated significantly superior language expression and comprehension abilities compared to the control group. The pivotal role of parents or other caregivers as primary language instructors in influencing children's language acquisition is widely acknowledged (33). The development of children's language skills is contingent not only on inherent abilities but also on the language learning opportunities afforded during the nurturing

Table 5 Comparison of Gesell assessment scores in two groups before and after intervention

Assessment content	Before intervention	After intervention	P
Control group (n=70)			
Gross motor	82.17±3.69	83.01±3.81	0.19
Fine motor	82.73±2.63	83.44±2.81	0.13
Adaptive behaviors	83.53±2.74	84.39±2.85	0.08
Personal-social skills	77.13±3.37	79.33±1.90	<0.001
Language development	52.97±4.79	65.97±3.48	<0.001
Observation group (n=64)			
Gross motor	83.02±2.29	83.69±3.28	0.18
Fine motor	81.92±2.70	82.56±2.84	0.19
Adaptive behaviors	82.67±2.76	83.45±2.91	0.12
Personal-social skills	76.05±3.36	80.78±3.93	<0.001
Language development	53.53±4.06	71.98±4.51	<0.001

Data are presented as mean ± SD. SD, standard deviation.

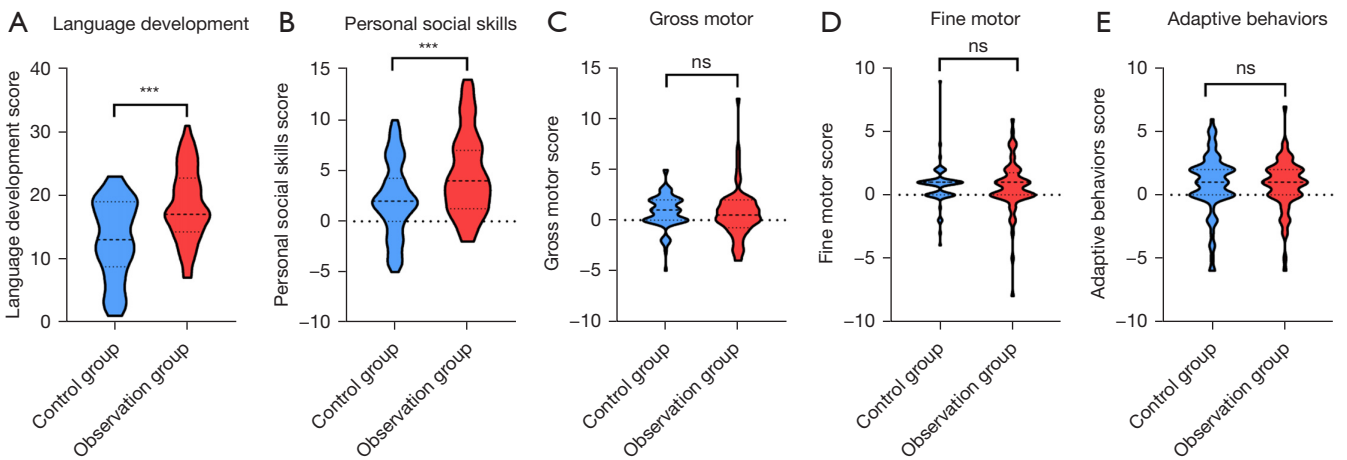

Figure 5 Comparison of the changes in Gesell assessment results among children in two groups throughout the intervention period. (A) The changes of language development scores in the two groups throughout the intervention period. (B) The changes of personal social skills scores in the two groups throughout the intervention period. (C) The changes of gross motor scores in the two groups throughout the intervention period. (D) The changes of fine motor scores in the two groups throughout the intervention period. (E) The changes of adaptive behaviors scores in the two groups during the intervention period. ns, P>0.05; ***, P<0.001. The thicker dashed lines denote the median, the finer dashed lines extending upwards and downwards represent the 95% confidence intervals.

process. Roberts *et al.* (34-36) indicated that parental involvement in language training has a substantial impact on the development of expressive and receptive vocabulary in children experiencing language delay. Additionally, their findings suggest that the efficacy of language rehabilitation programs is heightened when parents are actively engaged, surpassing the outcomes achieved through the conventional approach led solely by language therapists. The results of our study indicate that the implementation of a family-centered language intervention in natural settings, as opposed to a therapist-led approach, facilitates the direct application of language skills in a child's everyday life,

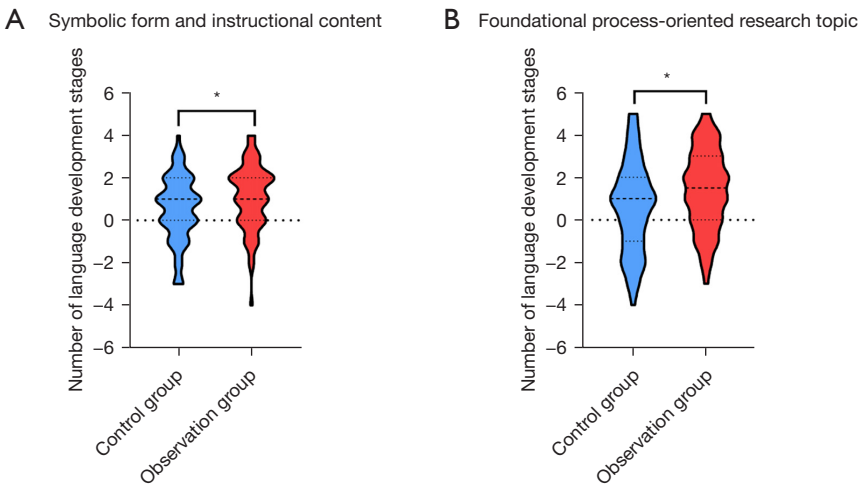

Figure 6 Comparison of the changes in S-S assessment results among children in two groups throughout the intervention period. (A) The changes of symbolic form and instructional content in the two groups throughout the intervention period. (B) The changes of foundational process-oriented research topic in the two groups throughout the intervention period. *, P<0.05. The thicker dashed lines denote the median, the finer dashed lines extending upwards and downwards represent the 95% confidence intervals. S-S, Sign-significant.

Table 6 Comparative analysis of the age-based distributional shifts in language development levels among children in two groups before and after intervention, as indicated by the S-S assessment

Observation indicators	N	Change in number	P
Symbolic form and instructional content			0.03
Control group	70	0.53±1.57	
Observation group	64	1.11±1.55	
Foundational process-oriented research topic			0.02
Control group	70	0.64±2.14	
Observation group	64	1.42±1.88	

Data are presented as mean ± SD. S-S, Sign-significant; SD, standard deviation.

thereby enhancing the naturalness and meaningfulness of the intervention. By incorporating interventions within the family environment, children are more inclined to utilize acquired language skills in real-life situations, thereby enhancing opportunities for language development. The engagement of family members fosters increased interaction and communication with the child, offering holistic support and motivation for the child's language development. Moreover, exposing children to immersive and authentic language learning opportunities during interventions lays a strong groundwork for their linguistic growth, leading to a comprehensive enhancement in their language skills.

The advent of the digital age has had a profound impact on the lives and childhood experiences of children. Research indicates that extended exposure to electronic screens and passive engagement with electronic devices in the familial setting can diminish opportunities for social interaction, emotional connection, and impede language and neurological development in children (37,38). In our research, we particularly emphasize the importance of limiting children's screen time and enhancing parent-child interaction. During the implementation of family language interventions, therapists guide parents to set daily limits on electronic device usage and ensure clear rules within the household, such as designated time slots for device use. Simultaneously, engaging in enjoyable non-electronic activities is encouraged, providing a variety of entertaining non-electronic options like outdoor activities, drawing, music, etc., to divert children's attention away from screens. Family involvement is also promoted, encouraging family members to participate in parent-child interactive activities together, fostering a positive family atmosphere that aids in children's language development and social skills.

As societal pressures increase, more and more young parents are fully immersed in their work, leading to a prominent trend of intergenerational caregiving in China. In our study, some children are raised by their parents while others are raised by grandparents, making it possible for both parents and grandparents to participate in family language training. However, compared to children raised

by parents, those raised by grandparents often lack parent-child interaction and exhibit noticeable deficiencies in language expression. Leiser *et al.* conducted a 21-month longitudinal study with a sample of 46 children, revealing that parental engagement in reading aloud and providing toys positively influences children's language development (39). Therefore, we recommend that parental involvement be maximized in family-centered language interventions. Relative to other caregivers, parental involvement offers the following prominent advantages: strengthening parent-child relationships, parents are the closest individuals in a child's life, and their involvement can enhance parent-child relationships, fostering the child's emotional development; maintaining continuity and consistency in treatment plans, parents can consistently engage in language rehabilitation training in daily life, maintaining consistent training methods and goals that help children better absorb and apply learned content; improving the home environment, parents can create more language stimuli and practice opportunities in the home environment, aiding children in enhancing their language skills more rapidly; better supervision and support for the intervention process, parents can better monitor a child's training progress, providing timely support and encouragement to enhance training effectiveness; promoting collective efforts among family members: parental involvement can inspire collective efforts among family members, establishing a supportive system beneficial to the child's recovery process.

Limitations

The present study's conclusions should be interpreted in light of various constraints. Primarily, the study's limited sample size warrants additional scrutiny of the practical implications of the favorable outcomes. To enhance comprehension of the efficacy of a family-centered language rehabilitation intervention model and alternative language intervention strategies, forthcoming research should prioritize enlarging the sample size and executing multi-center randomized controlled trials. Additionally, the participants in this study were exclusively sourced from urban locales, thereby constraining the generalizability of the family-centered language rehabilitation intervention model to rural settings. Subsequent research endeavors should strive to enlist a more diverse sample of children with language delays residing in rural areas in order to enhance comprehension of the training process in these regions and to develop family-centered language intervention models that are applicable across both urban and rural contexts. Furthermore, it is essential to acknowledge that the participants in this study were exclusively drawn from a pediatric rehabilitation ward. Consequently, the families who opted to partake in this research may have exhibited higher levels of motivation compared to the broader population, thereby potentially influencing the outcomes with a bias. Moreover, the retrospective nature of the sample collection and information gathering, particularly with regards to exposure and outcome data, introduces the possibility of recall bias. This potential bias may impact the accuracy of participants' recollections of exposures and outcomes, thus posing a threat to the validity of the study. It should be noted that, the assessment instrument employed in this study was the Gesell and S-S scale, which may not comprehensively encompass all facets of children's linguistic development. In future research, it is anticipated that the integration of the Gesell, S-S, and Griffiths Development Scales will provide a more thorough and nuanced evaluation of children's language development. Finally, longitudinal studies could help to understand the long-term effects of family-centered language interventions on children's language development and social skills.

Conclusions

Compared to children receiving only therapist-led language rehabilitation intervention, children undergoing combined therapist and family-centered language interventions demonstrate significant improvements in language comprehension, language expression skills, and social abilities. In the context of the increasing trend of intergenerational caregiving and the evolving societal landscape, it is crucial to develop evidence-based guidelines for family-centered language interventions that are adaptable to diverse family structures and caregiver roles. Training programs for parents and other caregivers could be developed to ensure they are equipped with the necessary knowledge and skills to support their children's language development effectively. Moreover, digital platforms could be explored to provide accessible and scalable family-centered language interventions, reaching a broader audience and bridging geographical barriers. In conclusion, the findings of this study lay a solid foundation for the implementation of family-centered language interventions in clinical practice, offering a promising direction for future research and development in the field of pediatric language rehabilitation.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tp.amegroups.com/article/view/10.21037/tp-24-225/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tp.amegroups.com/article/view/10.21037/tp-24-225/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the ethics committee of the Second Affiliated Hospital of Army Medical University (No. 2023-160-01) and individual consent for this retrospective analysis was waived.

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