Scientific Research Publishing

Open Journal of Pediatrics, 2025, 15(4), 476-492
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Development and Evaluation on Reliability and Validity of the Screening Scale of Language and Related Developmental Disorders in Preschool Children

Ling Liu[1*], Zetao Chen[1*], Jiajian Yan[2], Mi Zeng[1], Xueqin Chen[1], Lihui Huang[1], Jianliang Lu[3#], Qin Li[4#], Zhiwei Mou[3#]

[1]Department of Rehabilitation Medicine, The Fifth Affiliated Hospital of Jinan University, Heyuan, China
[2]Department of Rehabilitation Medicine, The First Affiliated Hospital of Jinan University, Guangzhou, China
[3]Department of Rehabilitation, Guangzhou Red Cross Hospital of Jinan University, Guangzhou, China
[4]Department of Rehabilitation Medicine, The Tenth Affiliated Hospital of Southern Medical University, Dongguan, China
Email: #liuling190929@126.com

How to cite this paper: Liu, L., Chen, Z.T., Yan, J.J., Zeng, M., Chen, X.Q., Huang, L.H., Lu, J.L., Li, Q. and Mou, Z.W. (2025) Development and Evaluation on Reliability and Validity of the Screening Scale of Language and Related Developmental Disorders in Preschool Children. *Open Journal of Pediatrics*, **15**, 476-492.
https://doi.org/10.4236/ojped.2025.154046

Received: May 9, 2025
Accepted: June 22, 2025
Published: June 25, 2025

Abstract

Objective: To develop a screening scale for language and related developmental disorders in 4- to 5-year-old preschool children in China, and to evaluate its reliability and validity, thereby providing a rapid and effective tool for the early detection of language-related disorders and early rehabilitation support. **Methods:** Based on the "Developmental Checklist for Preschool Children," the scale for the 4- to 5-year-old stage was simplified, transformed, and revised. Through two rounds of expert scoring and revision using the Delphi method, the initial version of the scale was established. From January 2023 to October 2023, 4- to 5-year-old children visiting the First Affiliated Hospital of Jinan University and the Fifth Affiliated Hospital of Jinan University were selected as research participants and tested in two phases: pre-testing and formal testing. The final version of the scale was determined, and its reliability and validity were assessed. **Results:** The screening scale for preschool children's language and related developmental disorders comprises two main dimensions: overall development and language communication ability. The language communication ability dimension includes six sub-dimensions—language expression, language comprehension, language naming, language repetition, articulation ability, and social behavior—and consists of a total of 16 items. The Cronbach's α coefficient and Guttman split-half reliability coefficient for the

*Co-first authors.
#Co-corresponding authors.

4- to 5-year-old stage scale were 0.88 and 0.82, respectively. The I-CVI of the scale ranged from 0.71 to 1.00, while the S-CVI was 0.94. The Spearman correlation coefficients between each factor ranged from 0.01 to 0.96, and the Spearman correlation coefficients between each factor and the total scale ranged from 0.43 to 0.82. **Conclusion:** The screening scale for preschool children's language and developmental disorders demonstrates excellent reliability and validity and can serve as an effective auxiliary tool for the early screening of language and related developmental disorders in 4- to 5-year-old preschool children in China.

Keywords

Preschool Children, Language Delay, Developmental Disorders, Screening Scale, Reliability and Validity

1. Introduction

Against the backdrop of a continuously rising aging population proportion, a declining "youthful" population share, and a persistently low total fertility rate, China introduced the three-child policy on May 31, 2021, as a proactive response to these demographic trends. In September of the same year, the "China Children Development Outline (2021-2030)" was officially released. In its "Children and Health" section, it explicitly states that the systematic management rate and health management rate for children under 7 years old should exceed 90%, with an emphasis on promoting disability screening for children aged 0 - 6 years, particularly focusing on five types of disabilities [1]-[3]. This clearly reflects China's high regard for and urgent need to screen developmental disorders in children under 6 years old. Not only in China but globally, over 50 million children under 5 years old are affected by developmental disorders, and this number is increasing [4] [5]. In the United States, the incidence of developmental disorders in children is approximately 15% [6], while in the United Kingdom, the prevalence of intellectual disabilities among children under 5 years old reaches 2.7%, and the incidence of global developmental delay in preschool children ranges from 1% to 3% [7]. Indeed, both domestic and international research advocate for a monitoring model involving regular screening, assessment, and re-assessment of children's development across their growth stages [8]-[11]. The level of language and speech development serves as an effective initial indicator for evaluating children's overall development and cognitive abilities [12]-[14]. Among them, preschool children (4-5 years old) are in a critical transitional phase from infancy to school age, which plays a pivotal role in shaping an individual's future learning and development. Studies indicate that the prevalence of language development delay in preschool children can reach 5% to 8%, and if untreated, 40% to 60% of cases may persist into school age, thereby increasing the risk of cognitive, reading and writing, be-

havioral, and mental health issues [15]-[18]. Early detection and active intervention can significantly minimize the adverse effects of language and related developmental abnormalities on children [19]-[21]. Consequently, conducting early screening and monitoring of language and related developmental disorders in preschool children in China is both pressing and highly significant.

However, in the current school preparation phase in China, most kindergartens, teachers, and parents tend to emphasize educational approaches focused on knowledge accumulation. They rely solely on simple interviews and conversations to understand children's basic situations, failing to conduct comprehensive and objective evaluations of children's actual developmental deficiencies and related abilities. At present, the number of self-developed child development scales in China is limited, especially lacking effective tools for screening child related development from a language perspective. Most of the scales currently used in China were introduced and revised from abroad, but these scales have significant differences from the language and cultural background and children's development characteristics in China, and have not been updated in a timely manner to meet the needs of the times. In addition, most of the existing scales require high levels of professional diagnostic expertise, have low operational efficiency, and are time-consuming, making it difficult to meet the demands of nationwide census and screening. Therefore, this study aims to provide an auxiliary tool for the pre-kindergarten screening of preschool children in China. Building upon the "Developmental Checklist for Preschool Children," a "Screening Scale for Language and Related Developmental Disorders in Preschool Children (Aged 4 - 5)" will be developed. The development of this scale will facilitate children's adaptation to school life after enrollment, minimize the risk of missing optimal intervention and treatment opportunities, and offer support for the early intervention of related developmental disorders.

2. Method

2.1. Establishment of the Research Team

The research group comprises nine members: a deputy chief physician from the rehabilitation department, a deputy chief nurse from the nursing department, a head nurse from the rehabilitation department, a senior physical rehabilitation therapist, a speech rehabilitation therapist, a head nurse from the imaging department, a head nurse from the health examination center, a head nurse from the obstetrics and gynecology department, and a postgraduate in rehabilitation specializing in scale development. The primary responsibilities of the group members include reviewing and analyzing relevant literature, simplifying and revising the scale, selecting experts for consultation, designing and distributing questionnaires, collecting responses, organizing and analyzing expert feedback, and ultimately developing the "Screening Scale for Language and Related Developmental Disorders in Preschool Children (Aged 4 - 5 Years)." Additionally, the group ensures the completion of reliability and validity assessments for the scale.

2.2. Scale Development

This research scale is primarily targeted at children aged 4 to 5 years and has been revised and optimized based on the corresponding age-specific scale of the "Preschool Children Development Checklist." This research scale comprises two primary dimensions: overall development and language communication ability. Specifically, the overall development dimension encompasses five sub-dimensions, namely gross motor skills, fine motor skills, language ability, adaptive ability, and social interaction ability. Meanwhile, the language communication ability dimension includes six sub-dimensions, specifically language expression, language comprehension, language naming, language repetition, articulation ability, and social behavior. Each of these dimensions is defined as an individual factor, resulting in a total of 11 factors. The research process is outlined as follows: First, official authorization for the original scale of the "Preschool Children Development Checklist" was obtained from the official website. The original scale was then downloaded, and the portion corresponding to the 4-to-5-year-old stage was selected as the basis for this study. Subsequently, the scale was revised through the following steps: conversion of traditional Chinese characters into simplified Chinese characters, cultural adaptation and content revision, specialized discussion and expert review, and establishment of the initial version of the scale.

2.3. Expert Consultation

Four professors specializing in child development from top-tier hospitals, one psychology expert, and one special education doctoral researcher were selected to form an expert panel. The experts were briefed on the purpose and significance of this research, as well as the specific requirements for revising the scale. Subsequently, the expert panel members independently completed two rounds of scoring and questionnaire completion using the Delphi method without any communication among them. A 4-point scoring system was used to evaluate the relevance of each item and its related dimensions: "not relevant" (1 point), "somewhat relevant" (2 points), "moderately relevant" (3 points), and "highly relevant" (4 points). Higher scores indicated stronger relevance. Simultaneously, the experts assessed and reviewed the linguistic and cultural adaptability, as well as the clarity of the scale. Based on the expert opinions, the initial version of the "Screening Scale for Language-related Developmental Disorders in Children" (for the 4-5-year-old preschool stage) was developed, and its content validity was evaluated. The scoring results from each expert panel member were statistically analyzed, and the content validity index (CVI) [22] was calculated. Specifically, the ratio of experts who scored 3 or 4 for each item to the total number of experts represented the item-level content validity index (I-CVI); the average of all I-CVIs reflected the scale-level content validity index (S-CVI). When I-CVI > 0.78 and S-CVI > 0.90, it indicated that the scale had good content validity.

In the first round of expert scoring and review, significant disputes arose regarding the screening targets and examples in the language dimension. To better

align the scale with the language development characteristics of Chinese children, the researchers integrated various modification suggestions from the experts, further enhancing the scale's operability and functionality, and resubmitted it for expert review. The results of the second round of expert scoring demonstrated that the scale exhibited good content validity, with the I-CVI ranging from 0.71 to 1.00 and the S-CVI at 0.94.

2.4. Pre-Survey

Convenience sampling was employed in this study. Between January 2023 and March 2023, children aged 4 to 5 years who visited the Rehabilitation Department of Shenzhen River People's Hospital in Heyuan City, Guangdong Province, and the First Affiliated Hospital of Jinan University in Guangzhou City were recruited as research participants. The sample size determination was guided by the principles of social survey methodology: a sample consisting of 30 or more units is typically classified as a large sample, whereas fewer than 30 units constitutes a small sample. Given the exploratory nature of this study, a total of 30 children within the 4-to-5-year-old age group were included as the research sample. Inclusion criteria: 1) Children aged 4 to 5 years; 2) Full-term infants at birth, with no history of genetic or congenital abnormalities, no history of brain-related diseases such as brain edema or hypoxia, and no significant family medical history or other relevant conditions; 3) Family members provided written informed consent and actively participated in the investigation. Exclusion criteria: 1) Presence of hearing impairment; 2) Presence of oral deformities; 3) Inability to complete the assessment due to various reasons; 4) History of trauma.

2.4.1. Item Purification Analysis and Research of the Scale

In the scale for children aged 4 to 5 years, all 16 items exhibited correlation coefficients with their respective factors greater than 0.30. Therefore, all items were retained. The final version of the "Screening Scale for Language and Related Developmental Disorders in Preschool Children Aged 4 to 5 Years," which comprises 11 factors, was subsequently established. For further details, see Table 1.

Table 1. Spearman correlation coefficients between items and factors in the scale for the 4-5-year-old stage.

Factors	Entries	Correlation coefficient
Factor 1		
Gross movement	T1	0.58
	T2	0.72
	T3	0.88
	T4	0.89

Continued

Factor 3		
Language ability	T6	0.84
	T7	0.69
	T8	0.81
	T9	0.82
	T10	0.68
	T11	0.69
	T12	0.68
	T15	0.59
	T16	0.78
Factors 4		
Adaptability	T7	0.52
	T8	0.61
	T9	0.78
	T10	0.50
	T14	0.86
Factor 5		
Social skills	T6	0.69
	T13	0.72
	T14	0.81
Factors 6		
Language expression	T6	0.86
	T9	0.72
	T10	0.83
	T11	0.83
	T15	0.73
Factor 7		
Language comprehension	T6	0.82
	T7	0.72
	T8	0.86
	T9	0.91
	T10	0.72
	T11	0.74

Continued

Factor 10		
Articulation ability	T12	0.88
	T16	0.86
Factors 11		
Social behavior	T6	0.67
	T7	0.74
	T8	0.72
	T9	0.62
	T10	0.67
	T13	0.52
	T14	0.74

Note: Factors 2 (fine motor skills), 8 (naming), and 9 (repetition) each consist of a single item, making it impossible to conduct Cronbach's alpha coefficient and correlation coefficient analyses. Consequently, these factors are not included in the table.

2.4.2. Item and Factor Distribution in the Final Version of the Scale (Table 2)

Table 2. Content of items and factor distribution for the 4-5-year-old stage scale I.

Item comtent	Factor number
T1: You can easily squat and stand up without holding onto something.	1
T2: Alternate steps up stairs without holding onto railings or walls, one step at a time	1
T3: Can run (abnormal posture or frequent falls do not count as passing)	1
T4: Be able to jump with alternate feet off the ground (Both feet must be off the ground at the same time and then on the ground at the same time; if there is obvious asymmetry in strength and abnormal movement occurs, it does not pass)	1
T5: (Actual operation) Can imitate a "cross" (pass if the straight line is basically not broken)	2
T6★: Usually be able to have a continuous question-and-answer conversation with someone, use short sentences of 4-5words, and answer the relevant content	3, 5, 6, 7, 11
T7★: (Actual operation) Be able to name a color, (ask in sequence with color cards "Which one is red? Yellow? Blue? Green?" It can also be replaced with the color of a specific object to ask, such as "Which one is red for an apple?" Yellow banana? Blue ocean? Green grass?" Ask all of them and then repeat the round from the beginning. You must point to the right color twice to avoid the child guessing correctly by pointing.)	3, 4, 7, 11
T8★: (Practical operation) Be able to understand two spatial relation words (First guide the child to look at the cow head and four birds in the picture, then ask in sequence which bird is above the cow? Below? Front? Back? Point to two passes)	3, 4, 7, 11

Continued

T9★: (Practical Operation) Please repeat the following sentence: "The brother wants a tricycle." (The adult reads the sentence aloud, and the child repeats it verbatim. If the child makes four or more errors in the repetition, the task is considered not passed.)	3, 4, 6, 7, 9, 11
T10★: (Practical Operation) The child must accurately describe the functions of at least four objects. (The examiner sequentially points to images of a cup, shoes, scissors, and a pen, asking, "What is this object used for?" If the child fails to respond correctly on the first attempt, one prompt may be provided, such as, "A cup is used for drinking water." No additional prompts will be given thereafter. Successfully identifying the functions of four objects constitutes passing the test.)	3, 4, 6, 7, 11
T11★: (Practical Operation) The child must demonstrate the ability to count up to 5 sequentially and accurately. (During the counting task on the picture, the examiner should ask the child: "How many black dots are there in this image?" The child is required to point to each dot with their finger while counting aloud simultaneously. To pass the test, the child must exhibit a one-to-one correspondence between pointing and verbal counting for the first five dots and count up to 5 without any errors.)	3, 6, 7
T12★: Speech is frequently unintelligible and necessitates repetition or interpretation by a caregiver for comprehension.	3, 10
T13★: The individual frequently engages in self-talk or repeatedly describes topics of interest in a manner akin to a tape recorder, without considering the responses or reactions of others.	5, 11
T14★: Exhibiting notable differences in the group due to any of the following behavioral challenges: 1) an inability to remain seated during class, frequently moving about or leaving the classroom without authorization; 2) recurrent disputes, opposition, or conflicts with classmates or teachers, resulting in social isolation or exclusion; 3) a tendency to play alone and a lack of initiative in forming friendships; 4) difficulty matching peers' progress when completing tasks or participating in activities, often necessitating additional support from others.	4, 5, 11
T15★: Be able to correctly name at least five shapes (pictures: elephant, banana, schoolbag, stool, car, clothes)	3, 6, 8
T16★: When answering questions 5, 8 and 9, speak clearly.	3, 10

Note: Questions T6 to T16 are marked with "★", which is part of the language communication ability dimension.

2.5. Formal Survey

2.5.1. Sampling Methods and Sample Size

Convenience sampling was employed in this study. Between April 2023 and October 2023, a total of 210 preschool children aged 4 to 5 years were recruited as research participants from the Rehabilitation Department of Shenhe People's Hospital in Heyuan City, Guangdong Province, the First Affiliated Hospital of Jinan University in Guangzhou City, and the Guangzhou Red Cross Hospital. The inclusion and exclusion criteria were identical to those used in the pilot survey. According to established guidelines for scale quality testing, the sample size should ideally be 5 to 10 times the number of items on the scale [23]. Additionally, considering potential data loss or invalid responses during the scale recovery process, the sample size may be expanded by 10% to 20% of the original plan. In this study, 202 valid cases were ultimately obtained, which satisfied the minimum requirement for sample size.

2.5.2. Evaluators

The assessors were randomly selected from the staff of the children's language disorder center at the research site and underwent centralized training on the use of the "Screening Scale for Language-Related Developmental Disorders in Children". The training content was derived from the instructions provided in the original scale's user manual. Assessors were deemed qualified only after achieving a consistency rate of 95% or higher during the trial testing phase. During the training, the video case teaching method was employed, and assessors were required to strictly adhere to the standardized assessment instructions. Furthermore, prior to the assessment, the parents of the participating children were thoroughly informed about the significance and objectives of the study, and they signed an informed consent form.

2.5.3 Research Tools

1) The initial version of the "Screening Scale for Language and Related Developmental Disorders in 4-5-Year-Old Preschool Children" was developed, featuring a structure largely consistent with that of the original "Developmental Checklist for Preschool Children".

2) Based on the original scale, a self-developed "Basic Information Form for Children, Families, and Form Fillers" was utilized to systematically collect essential information about children, families, and form fillers.

2.5.4. Data Collection and Organization

The research center staff strictly adhered to the standardized instructions for assessment, employing a one-on-one evaluation approach. Assessors marked "Yes" or "No" based on whether the children's performance aligned with the item descriptions. Given that the items were framed in both positive and negative terms, one of the options ("Yes" or "No") was shaded. Selecting the non-shaded option indicated normal performance. Scoring was conducted based on correctly answered items, and scores for the overall development ability dimension and the language communication ability dimension were subsequently calculated. A convenience sampling method was used to select 4-5-year-old children for evaluation, with the accuracy and completeness of the returned scales being verified item by item. Following the assessment, a dual-review and data entry process was implemented to exclude unqualified scales. Finally, the collected scale data were entered into Excel for statistical analysis and processing.

2.6. Statistical Methods

The data in the database were analyzed using SPSS 26 (Chinese version). A P value of less than 0.05 was considered statistically significant. Reliability and validity analyses were performed on the scale developed in this study. Specifically, Cronbach's α coefficient was employed to evaluate the internal consistency reliability of the scale; the content validity index (CVI) was calculated to assess the content validity; and the structural validity was examined based on the discrimi-

nation among sub-dimensions.

3. Results

3.1. Scale Reliability Results

Internal Consistency Reliability

1) Cronbach's Alpha Coefficient

The Cronbach's Alpha coefficient for the scale targeting the 4-5-year-old group is 0.88, indicating a high level of internal consistency. Furthermore, removing any single item does not lead to a significant change in the Cronbach's Alpha coefficient, suggesting that all 16 items in the scale exhibit good discriminatory power (Table 3).

Table 3. Effects of each item on the Cronbach's alpha coefficient of the total scale for the 4-5-year-old group (n = 202).

Items	The Cronbach a coefficient after the entry is removed
T1	0.87
T2	0.88
T3	0.86
T4	0.87
T5	0.86
T6	0.89
T7	0.86
T8	0.86
T9	0.87
T10	0.86
T11	0.87
T12	0.88
T13	0.87
T14	0.87
T15	0.89
T16	0.88

2) Split-half reliability

The split-half reliability results for the 4-5-year-old stage scale are presented in Table 4. As shown in the table, the correlation coefficient between the two halves of the scale is 0.71, indicating a strong correlation between them. Additionally, the Guttman split-half reliability coefficient is 0.82, demonstrating that the scale exhibits satisfactory split-half reliability.

Table 4. Results of the split-half reliability test for the 4-5-year-old stage scale (n = 202).

Cronbach a coefficient	Part 1	Value	0.82
		Number of entries	8[a]
	Part 2	Value	0.79
		Number of entries	8[b]
	Total entries		16
The correlation coefficient of the two parts			0.71
Spearman-Brown coefficient			0.82
Guttman half-fold coefficient			0.82

Note: [a]Entries include Tl, T2, T3, T4, T5, T6, T7, T8; [b]Entries include T9, T10, T11, T12, T13, T14, T15, T16.

3) Inter-Rater Reliability and Test-retest Reliability

This study utilized the Spearman rank correlation analysis to evaluate the consistency of scores provided by two independent raters (inter-rater reliability) and the consistency of scores obtained at two distinct time points (test-retest reliability) across the overall development dimension and the language communication ability dimension. Based on established criteria for correlation analysis, a correlation coefficient of 0.8 or higher indicates an extremely strong correlation, 0.6 to 0.8 indicates a strong correlation, 0.4 to 0.6 indicates a moderate correlation, 0.2 to 0.4 indicates a weak correlation, and below 0.2 indicates a negligible or no correlation [24].

1) Inter-Rater Reliability

In the Spearman rank correlation analysis conducted on the overall development dimension and language communication ability dimension of the scale for this age group, the correlation coefficients were all greater than 0.8, with P values less than 0.01. These results indicate a high level of consistency in ratings among raters, thereby demonstrating strong inter-rater reliability. For detailed findings, please refer to **Table 5**.

Table 5. Summary of inter-rater reliability results for the 4- to 5-year-old scale ($\overline{X} \pm S$, n = 20).

	Rater 1 score	Rater 2 score	Spearman correlation coefficient
Overall development dimension	13.15 ± 1.486	13 ± 1.382	0.865**
Dimension of language communication ability	4.6 ± 0.92	4.6 ± 0.878	0.874**

Note: **denotes P < 0.01, and *denotes P < 0.05, both indicating statistically significant correlations.

2) Test-Retest Reliability

In the test-retest correlation analysis for the overall development dimension of the scale in this age group, the Spearman rank correlation coefficient was 0.656 ($P < 0.01$), indicating a strong level of stability. In contrast, for the language communication ability dimension, the Spearman rank correlation coefficient was 0.530 ($P < 0.05$), reflecting moderate stability. Overall, the test-retest reliability of the scale for children aged 4 to 5 years was satisfactory. For detailed results, please refer to Table 6.

Table 6. Summary of retest reliability results for the 4- to 5-year-old scale ($\overline{X} \pm S$, n = 18).

	Initial test score	Re-test score	Spearman correlation coefficient
Overall development dimension	12.94 ± 2.473	13.56 ± 1.679	0.656**
Dimension of language communication ability	4.61 ± 0.968	4.79 ± 0.456	0.530*

Note: **indicates $P < 0.01$, *indicates $P < 0.05$, both representing significant correlations.

3.2. Scale Validity Results

3.2.1. Content Validity

Seven experts (five specializing in child development and two in education) were invited to participate in the Delphi method expert scoring process in this study. A 4-point scoring system was employed to evaluate the correlation between each item of the scale and its corresponding dimension, with "not related," "not very related," "relatively related," and "very related" scored as 1, 2, 3, and 4 points, respectively. Higher scores indicate stronger correlations. According to the criteria for assessing content validity, an I-CVI > 0.78 and an S-CVI > 0.90 suggest that the scale demonstrates good content validity. In this study, the I-CVI values for the scale targeting the 4-5-year-old group ranged from 0.71 to 1.00, while the S-CVI value was 0.94, confirming that the scale exhibits strong content validity.

3.2.2. Structural Validity

According to factor analysis theory, the items within a scale should exhibit moderate correlations. In this study, we analyzed the correlations between the items and dimensions of the "Screening Scale for Language and Related Developmental Disorders in Preschool Children," as well as the interdimensional correlations. The results of the analysis for the 4-5-year-old group revealed that the Spearman correlation coefficients among the factors ranged from 0.01 to 0.96, while the Spearman correlation coefficients between each factor and the total scale ranged from 0.43 to 0.82 ($P < 0.01$). These findings demonstrate that the factors within the scale are moderately correlated with one another and significantly associated with the total scale, thus confirming the scale's good structural validity. For detailed findings, please refer to Table 7.

Table 7. Correlation analysis matrix of the scale with various factors and among factors for children aged 4 - 5 years (n = 202).

Factor name	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Total score
Factor 1	1.00											
Factor 2	0.42**	1.00										
Factor 3	0.35**	0.09	1.00									
Factor 4	0.56**	0.01	0.42**	1.00								
Factor 5	0.42**	0.04	0.61**	0.85**	1.00							
Factor 6	0.48**	0.18*	0.78**	0.25**	0.53**	1.00						
Factor 7	0.46**	0.14	0.81**	0.78**	0.52**	0.91**	1.00					
Factor 8	0.58**	0.25**	0.48**	0.28**	0.44*	0.58**	0.55**	1.00				
Factor 9	0.35**	0.16*	0.62**	0.51**	0.62**	0.35**	0.33**	0.47**	1.00			
Factor 10	0.47**	0.14	0.76**	0.18*	0.44**	0.66**	0.67**	0.58**	0.39**	1.00		
Factor 11	0.45**	0.07	0.63**	0.88**	0.96**	0.54**	0.54**	0.43**	0.62**	0.42**	1.00	
Total score	0.45**	0.56**	0.82**	0.56**	0.68**	0.67**	0.67**	0.43**	0.48**	0.62**	0.78**	1.00

Note: 1) The data in the table represent Spearman correlation coefficients, with **denoting $P < 0.01$ and *denoting $P < 0.05$, both indicating statistically significant correlations. 2) Factors 2 (Fine Motor Skills), 8 (Naming), and 9 (Repetition) each consist of only one item, making it impossible to conduct Cronbach's α coefficient or inter-item correlation analyses; hence, they are excluded from the table.

4. Conclusions

4.1. The Scientific Validity of the Screening Scale for Language and Related Developmental Disorders in Preschool Children

Reliability serves as a critical indicator for assessing the reliability of research scales, reflecting the consistency of measurement results. Internal consistency is one of the most commonly used approaches to evaluate reliability, typically represented by Cronbach's α coefficient. The value range of Cronbach's α coefficient spans from 0 to 1. Generally, it is considered that a scale should achieve a Cronbach's α coefficient of at least 0.6 to be deemed acceptable; when the coefficient falls between 0.7 and 0.8, it indicates relatively high reliability; and when the coefficient lies between 0.8 and 0.9, it signifies very high reliability. Split-half reliability is a method for evaluating reliability by dividing the measurement data of participants into two halves and calculating the correlation coefficient between the two parts. In this study, the scale was analyzed using a front-back item split approach. Despite the items of the gross motor and fine motor dimensions being primarily concentrated in the first half of the scale, the split-half reliability demonstrated a satisfactory level. Generally, the more items a scale contains, the higher its Cronbach's α coefficient may be, thereby enhancing internal consistency. In this study, the reliability of the scale for the 4- to 5-year-old group was exception-

ally strong.

Validity serves as a critical indicator for assessing the effectiveness of research scales, reflecting the extent to which measurement results align with the intended content. Content validity primarily evaluates the appropriateness and consistency of scale items in representing the target constructs. In this study, the scale was developed based on prior research findings related to children's language and development, with revisions made using the "Developmental Checklist for Preschool Children" as a foundation. During the initial revision, pretesting, and formal testing phases, the research team conducted multiple in-depth discussions and invited an expert panel to perform several rounds of scoring and revision through the Delphi method. This process ensured that the content validity index of the scale reached a satisfactory level, thereby demonstrating the robust content validity of the scale. Structural validity refers to the extent to which scale items effectively reflect the theoretical constructs they are designed to measure, emphasizing the consistency between the measurement tool and the underlying theoretical framework. In this study, the "Developmental Checklist for Preschool Children" served as a blueprint. Experts from fields such as child rehabilitation, child health care, psychology, and special education were invited to classify and refine the original scale, resulting in the creation of the "Screening Scale for Language and Related Developmental Disorders in Preschool Children." Throughout the research process, the scale underwent repeated refinement using item purification analysis methods and was further optimized through multiple rounds of expert discussion and evaluation. Based on the structural validity analysis results, the correlations between items and factors, as well as among the factors themselves, exhibited strong consistency, confirming the high structural validity of the scale.

In conclusion, the development process of the scale in this study was rigorous and systematic, demonstrating excellent reliability and validity. The scale thus possesses significant scientific and practical value.

4.2. Practical Significance of the Research Scale

The development of a comprehensive assessment tool for developmental disorders tailored to Chinese children holds significant importance. However, currently, there is a notable absence of auxiliary assessment tools and standardized rehabilitation monitoring mechanisms designed for screening language and related developmental disorders among children nationwide in China. Most scales currently used in China are imported from abroad. While these scales target developmental disorders, they may not fully align with the developmental characteristics of Chinese children. Additionally, existing scales often require lengthy testing times, making it difficult for most children to cooperate effectively, thus failing to meet the timeliness requirements of many pediatric diagnostic and treatment institutions. Furthermore, some developmental scales used in China have not been updated or revised in accordance with contemporary advancements, which inevitably compromises the reliability and stability of their test results.

This research scale is characterized by its operational convenience and ease of implementation, significantly enhancing the screening efficiency of evaluators while optimizing the allocation of medical resources. It also facilitates the advancement of national census services for children's developmental disorders. The excellent reliability and validity of this scale confirm its high feasibility. By enabling phased assessments as children grow older, the scale enhances public awareness of developmental disorders in children, promotes early screening combined with health education, reduces the risk of children missing optimal intervention and treatment opportunities, achieves timely intervention for specific disorder points, effectively lowers the incidence and disability rates of language and related developmental disorders in children, and assists children in better adapting to learning and life after entering school.

5. Summary

The screening scale for language and related developmental disorders in preschool children developed in this study is both scientifically rigorous and practically applicable, serving as an auxiliary tool for the assessment of 4- to 5-year-old preschool children in China. This scale adopts a novel linguistic perspective, comprehensively evaluating and screening various functional domains relevant to children's development, with broad coverage. It effectively raises awareness among parents and relevant professionals regarding children's developmental disorders, thereby facilitating the healthy development of children's functional domains and providing a foundation for early intervention in related developmental disorders. However, as an initial exploration of a language-related developmental disorder assessment tool, while this study's scale has largely achieved its predetermined research objectives, certain limitations remain. For instance, constrained by factors such as research time, resource availability, and economic conditions, the sample coverage is relatively restricted. In the future, multi-regional and large-sample studies could be conducted to further enhance the representativeness and generalizability of the scale. Additionally, continuous refinement and revision of the scale items will be necessary in subsequent stages to progressively improve its accuracy and applicability.

Acknowledgements

This research was supported by the Guangdong Medical Science and Technology Research Foundation of China (Grant No. A2022534), Guangdong Medical Science and Technology Research Foundation of China (Grant No. A2023353), Administration of Traditional Chinese Medicine of Guangdong Province (Grant No. 20242015). Specialized Strategy for Scientific and Technological Innovation of Guangdong Province (Grant No. Medical Research and Tackling Key Problems 004), Scientific and Technological Planning Project of Guangzhou City (Grant No. 2024B03J1341) and Government-Enterprise Joint Programs of Natural Science Foundation of Guangdong Province (Grant No. 2021A1515220049).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Sina Teach Yukon (2021) The State Council Issued the Notice on the Outline of Children's Development in China (2021-2030). https://edu.sina.com.cn/zxx/2021-09-27/doc-iktzqtyt8356258.shtml

[2] Xiao, J.L. (2022) Development and Reliability and Validity Analysis of a Screening Scale for Language and Related Developmental Disorders in Infancy. Master's Thesis, Jinan University.

[3] (2018) Expert Consensus on the Etiological Diagnosis Strategy for Intellectual Disability or Global Developmental Delay in Children. *Chinese Medical Information Bulletin*, No. 23, 11.

[4] Li, Q. (2021) Development and Reliability and Validity Evaluation of a Screening Scale for Language and Related Developmental Disorders in Children. Master's Thesis, Jinan University.

[5] Olusanya, B.O., Davis, A.C., Wertlieb, D., Boo, N., Nair, M.K.C., Halpern, R., *et al.* (2018) Developmental Disabilities among Children Younger than 5 Years in 195 Countries and Territories, 1990-2016: A Systematic Analysis for the Global Burden of Disease Study 2016. *The Lancet Global Health*, **6**, e1100-e1121. https://doi.org/10.1016/s2214-109x(18)30309-7

[6] Vitrikas, K., Savard, D. and Bucaj, M. (2017) Developmental Delay: When and How to Screen. *American Family Physician*, **96**, 36-43.

[7] Vasudevan, P. and Suri, M. (2017) A Clinical Approach to Developmental Delay and Intellectual Disability. *Clinical Medicine*, **17**, 558-561. https://doi.org/10.7861/clinmedicine.17-6-558

[8] Catino, E., Di Trani, M., Giovannone, F., Manti, F., Nunziata, L., Piccari, F., *et al.* (2017) Screening for Developmental Disorders in 3- and 4-Year-Old Italian Children: A Preliminary Study. *Frontiers in Pediatrics*, **5**, Article 181. https://doi.org/10.3389/fped.2017.00181

[9] Nelson, H.D., Nygren, P., Walker, M. and Panoscha, R. (2006) Screening for Speech and Language Delay in Preschool Children: Systematic Evidence Review for the US Preventive Services Task Force. *Pediatrics*, **117**, e298-e319. https://doi.org/10.1542/peds.2005-1467

[10] Huo, J.P., Wu, M.P., Wang, Q.T., *et al.* (2004) Evaluation of the Effect of Regular Developmental Monitoring and Early Intervention on Infant Intelligence Development. *Chinese General Practice*, **7**, 4.

[11] Zhang, T.E., Dai, Y. and Wu, A.M. (2021) The Impact of Regular Developmental Monitoring and Early Intervention on the Intelligence Development of Normal Newborns and High-Risk Infants. *Chinese Journal of Maternal and Child Health*, **36**, 4.

[12] Nelson, H.D., Nygren, P., Walker, M. and Panoscha, R. (2006) Screening for Speech and Language Delay in Preschool Children: Systematic Evidence Review for the US Preventive Services Task Force. *Pediatrics*, **117**, e298-e319. https://doi.org/10.1542/peds.2005-1467

[13] Mou, Z., Chen, Z., Yang, J. and Xu, L. (2018) Acoustic Properties of Vowel Production in Mandarin-Speaking Patients with Post-Stroke Dysarthria. *Scientific Reports*, **8**, Article No. 14188. https://doi.org/10.1038/s41598-018-32429-8

[14] Liu, X.M. (2021) Clinical Thinking Framework for Comprehensive Assessment and Differential Diagnosis of Language Development Delay, Language Disorders and Related Developmental Disorders. *Chinese Journal of Pediatrics*, **59**, 901-904.

[15] Mou, Z., Teng, W., Ouyang, H., Chen, Y., Liu, Y., Jiang, C., *et al*. (2019) Quantitative Analysis of Vowel Production in Cerebral Palsy Children with Dysarthria. *Journal of Clinical Neuroscience*, **66**, 77-82. https://doi.org/10.1016/j.jocn.2019.05.020

[16] Xu, J., Xu, Y.L., Mu, Z.W., Lu, J.L. and Jiang, C.Y. (2019) Study on the Pathological Acoustic Characteristics of Vowels in Common Dysarthria. *Journal of Rehabilitation*, **29**, 67-72.

[17] Mou, Z., Ye, W., Chang, C. and Mao, Y. (2020) The Application Analysis of Neural Network Techniques on Lexical Tone Rehabilitation of Mandarin-Speaking Patients with Post-Stroke Dysarthria. *IEEE Access*, **8**, 90709-90717. https://doi.org/10.1109/access.2020.2994069

[18] Zhou, A.P., Zheng, S.H., Lin, X., *et al*. (2020) Causes and Influencing Factors of Delayed Language Development in Children in Wenling Area. *Chinese Journal of Maternal and Child Health*, **35**, 2234-2237.

[19] Lake, A. and Chan, M. (2015) Putting Science into Practice for Early Child Development. *The Lancet*, **385**, 1816-1817. https://doi.org/10.1016/s0140-6736(14)61680-9

[20] Barger, B., Rice, C., Wolf, R. and Roach, A. (2018) Better Together: Developmental Screening and Monitoring Best Identify Children Who Need Early Intervention. *Disability and Health Journal*, **11**, 420-426. https://doi.org/10.1016/j.dhjo.2018.01.002

[21] Li, X.J. (2018) Pediatric Rehabilitation. People's Medical Publishing House, 150-202.

[22] Shi, J.C. and Mo, X.K. (2012) Application of Content Validity Index in Scale Development. *Journal of Central South University*: *Medical Edition*, **37**, 152-156.

[23] Zhang, W.T. and Dong, W. (2013) Advanced Tutorial on Statistical Analysis in SPSS. 2nd Edition, Higher Education Press, 366-374.

[24] Wu, S. (2019) SPSS Practical Application and Statistical Thinking. Tsinghua University Press, 232-344.