

Psychometric Evaluation of the Teacher's Evaluation of Neurodevelopmental Delays (TEDD) Tool Among Indian Preschoolers: Reliability Analysis Using Cronbach's Alpha

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HOW TO CITE:

Sunanda Kolhe, Anand Prakash, Maxim Pereira (2026). Psychometric Evaluation of the Teacher's Evaluation of Neurodevelopmental Delays (TEDD) tool among Indian Preschoolers: Reliability analysis using Cronbach's Alpha. International Journal of Special Education, 41(19s), 525 - 544

ABSTRACT:

Background – Early detection of developmental delays in children can significantly help them realize their full potential. The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V) is currently used to identify neurodevelopmental delays among children worldwide. However, due to cultural differences, there is a pertinent need for a content-validated screening tool in the context of low- and middle-income countries, including India.

Purpose – To examine reliability and validity of the TEDD (Teacher's Evaluation of Neurodevelopmental Delays) screening tool in measuring neurodevelopmental delays among Indian preschool children aged 3 years to 6 years. The TEDD tool was developed to be administered by preschool teachers or early childhood educators. It can be used as a focused screening tool or a mass-level screening tool. The items were developed in accordance with the theoretical framework, aligning with the criteria and definitions of neurodevelopmental disorders outlined in the DSM-V, and were subsequently integrated with the developmental milestones described in the International Classification of Diseases, 10th version (ICD-10) AND Early Childhood Care and Education (ECCE)/New York City Early Education Centre (NYCE) framework. The items were then worded in behavioral terms.

Methodology – The TEDD was administered by preschool teachers. A total of 381 preschoolers participated in the study. There were 96 items spread across five domains, namely, Cognitive, Sensory Motor, Social-Emotional, Language Speech and Communication and Daily Living, which measure Neuro

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developmental milestones. Exploratory factor analysis (EFA) and confirmatory composite analysis were used to establish the structural validity of the TEDD. The reliability of the instrument was evaluated using Cronbach's alpha and composite reliability scores. To determine its validity, both convergent and discriminant validity assessments were conducted. The structural validity of the TEDD scale was assessed using exploratory factor analysis (EFA) followed by confirmatory composite analysis (CCA). The study sample consisted of 381 preschool children aged 3-6 years, recruited from 6 preschools in Bangalore. Reliability was evaluated using Cronbach's alpha and composite reliability scores, with values ≥ 0.70 considered acceptable. Convergent validity was assessed through average variance extracted ($AVE > 0.50$), and discriminant validity was evaluated using the Fornell-Larcker criterion. All analyses were performed using SPSS-24, with a significance level set at $p < 0.05$.

Results – The EFA and CFA results confirmed the measurement structure of the TEDD tool. Cronbach's alpha analyses indicated high internal consistency for the TEDD. Discriminant validity was established, which revealed that the TEDD accurately measures neurodevelopment delays in preschool children.

Conclusion – The TEDD is a valid and reliable instrument for assessing neurodevelopmental delays in Indian preschoolers across five key developmental domains.

Implications – The TEDD has significant implications for educational and clinical settings. The TEDD has proven to be a culturally sensitive tool for early childhood educators as well as practitioners and researchers to assess and support the process of early identification and diagnosis of neurodevelopmental disorders in children aged 3 years to 6 years.

Keywords: TEDD, Neurodevelopmental delays, Teachers, Preschool children, Evaluation tool, India

Introduction Background

Neurodevelopment involves the dynamic interaction of genetic, brain, cognitive, emotional, and behavioral processes across the lifespan. Disruptions from genetic or environmental risks can lead to neurodevelopmental disorders and impairments (Boivin et al., 2015). Neurodevelopmental delays (NDDs) affect infants and young children, causing delays in skill development. While descriptions of NDDs vary, they all indicate delays in one or more areas compared with typical development. These delays result from

abnormal development of the central nervous system, occurring anytime from utero to approximately five years of age. Atypical neurodevelopment can impact a single area (e.g., language) or multiple areas (e.g., motor, language, or cognitive) (Villagomez et al., 2019).

The term "early childhood" refers to the time period beginning with fetal development and ending with the age of eight years. (Block et al., 2013). Early childhood is a phase that is incredibly significant and crucial since early experiences establish the foundation for the development and functioning of the brain over

the long term. With respect to young children, the multitude of effects that are linked with growing up with disabilities is enormous. However, this can be lessened by early identification, intervention, and support.

In regard to these children, the earlier years hold even greater significance. This is because the sooner a developmental delay or disability is recognized in a child, the more likely it is that early intervention efforts tailored to address and support the child's individual requirements will be effective. (Guralnick, M. J., 2005). Sadly, although these children are more susceptible to developmental problems, they are frequently ignored by mainstream programs and services. (UNICEF 2013) Several screening tools are available to identify developmental delays in preschool children, such as The Denver II (Frankenburg WK et al, 1992;89), Ages and Stages Questionnaire (ASQ) (Squires J et al, 1997), and Developmental Profile (DP-3) (Alpern GD, 2007). However, most of these instruments are either developed in high-income countries, lack cultural adaptation, or are not regularly updated for local contexts (Author, Year). As a result, there remains a gap in culturally relevant and locally validated tools to identify developmental delays in preschoolers. To address this gap, the present study developed the Teacher's Evaluation of Neurodevelopmental Delays (TEDD) scale to screen children at risk for neurodevelopmental disorders. Without timely early intervention, affected children and their families often face long-term challenges. Screening is vital in diagnosis, with families and schools playing key roles. Since preschool teachers interact closely with children in their early years, their involvement is essential for accurate identification of developmental delays. A screening process must be in place to guarantee that kids are found and given the assistance they require. Many nations have screening policies and processes in place because developmental screening is crucial for both healthy development and the early detection and diagnosis of delays. (American Academy of Pediatrics., 2001, 2006).

The American Academy of Pediatrics (AAP) mandates that standardized developmental screening tests be administered regularly at the 9-, 18- and 24–30-month wellness child visits. The National Association for the Education of Young Children's (NAEYC) joint position statement states that screening is not used for diagnosis, labeling, early intervention planning, or placement but rather only to decide whether to refer the child for additional evaluation (NAEYC, 2003).

Developmental screening in India

India is a popular destination for medical tourists but lags in early detection and treatment. When it comes to developmental screening in India, early developmental screening is rare rather than routine. Several key gaps exist that limit early identification and intervention for children at risk of developmental delays. No Indian-made tools specifically screen for neurodevelopmental disorders such as autism and ADHD; most focus only on developmental delays. A comprehensive tool must include criteria and milestones for these conditions. Many widely used assessments are not culturally fair and have been standardized for middle-class White children in the U.S. (Glascoe, 2008, 2010; Sparrow et al., 2005; Squires & Bricker, 2009). Without localized norms, such tools may be biased and unsuitable for minority populations. Moreover, none are standardized for paraprofessionals, such as teachers in Indian preschools. These tools are also underused due to barriers such as cost, time, complexity, and limited accessibility (Moodie et al., 2014).

This study utilizes the diagnostic criteria and diagnostic group of neurodevelopmental disorders mentioned in the DSM-5, as it includes all the important disorders categorized under this group.

Developmental screening in Indian preschools

Although developmental differences exist among children of the same age (APA, 2012), many show signs of delayed development or learning even before kindergarten (Coleman, Buysse, & Neitzel, 2006). Early screening and

intervention at the preschool stage are crucial before problems become significant. Preschools serve as key contact points and should be equipped to identify developmental delays, which they currently are not. Once screened, children can be referred to qualified professionals and early intervention centers focused on support rather than labeling. In India, primary health care providers, community health workers, and parents are involved in screening, but schoolteachers—who play a vital role—are largely excluded.

The role of teachers in screening

Teachers offer valuable insights into children's abilities, as preschool teachers observe and track progress daily. They may record videos, collect work samples, and write anecdotes, helping assess a child's overall skills, interests, and talents. Observing and recording have become essential aspects of their work. Given their training and experience, teachers hold informed perspectives on child development and should be involved in the screening process to improve its validity (Bordignon & Lam, 2004; Lamberty & Crnic, 1994; Meisels et al., 1993; Williams et al., 1989). Meisels (1993) emphasized that assessments lacking naturalistic observations may be incomplete. Structured screening enables teachers to identify learning difficulties efficiently (Satz & Fletcher, 1988). Teacher reports are often reliable, allowing comparisons within peer groups. A U.S. study reported that preschool teachers' assessments of developmental concerns aligned with parent evaluations via a standard tool (Kiing et al., 2019). In high-income countries, universal child health programs engage schools in early detection via classroom-based tools (Singh & Blanchard, 2017; Glascoe, 2010; Frankenburg et al., 1996; Mardell & Goldenberg, 2011; Harrison, 1990; Morales-Hidalgo et al., 2017). However, in developing nations such as India, challenges such as a lack of time, stigma, limited training, and the absence of teacher-friendly tools hinder early identification (Faruk, 2020; Toit et al., 2021; Mukherjee et al., 2014).

Rationale of the study

Given the importance of early identification, teachers need a quick and easy screening tool to refer children for further evaluation or provide timely support before issues escalate. This study introduces the Teacher's Evaluation of Developmental Delays (TEDD), a DSM-5-based questionnaire designed to screen for neurodevelopmental delays in preschool settings and evaluate its psychometric properties. The TEDD was developed on the basis of prior research emphasizing the need for early, systematic screening of developmental domains.

Established tools such as the Vineland Adaptive Behavior Scales, ASQ-3, Denver II, DP-3, PEDS, and M-CHAT effectively assess motor, cognitive, linguistic, and socioemotional development (Moodie et al., 2014; Squires & Bricker, 2009). However, these are often culturally misaligned, costly, training intensive, or lack comprehensive domain coverage, limiting their use in India (Halli et al., 2021; Abdoola et al., 2023; Sheel et al., 2023).

In low-resource contexts such as India, screening tools must be culturally relevant, affordable, and easy to administer. Many existing instruments detect only gross delays and have not been standardized for Indian populations. Most available tools are Western adaptations, limiting their applicability in local settings owing to scoring and interpretive constraints (Rispoli et al., 2022; Sheel et al., 2023).

This study presents the TEDD as a culturally appropriate, low-cost, easy-to-administer tool for use by preschool teachers. It includes developmentally relevant behavioral items, enables parental input, and covers all major developmental domains. This study aimed to develop and validate the Teacher's Evaluation of Developmental Delays for Indian preschoolers aged 3–6 years.

Materials & Methods

Study Design and Setting

This mixed-method study was conducted in seven private preschools across Bangalore, India, between September 2022 and February

2023. Schools were recruited through snowball sampling, with informed consent obtained from principals and verbal consent from parents. The study included 381 children aged 36–72 months, representing both typically developing profiles and children with neurodevelopmental concerns or confirmed diagnoses.

Participants were enrolled in regular private schools with comparable socioeconomic backgrounds. The TEDD tool was administered across three age-based forms: Form A (36–48 months, $n=123$), Form B (49–60 months, $n=134$), and Form C (61–72 months, $n=124$). Of the total sample, 62 children (16.3%) were identified with developmental concerns, either referred jointly by teachers and parents or with confirmed clinical diagnoses. The inclusion of both typical and atypical profiles enabled assessment of the tool's reliability, validity, sensitivity, and specificity.

Participants and Sampling

The study included **381 children aged 36–72 months** enrolled in seven private preschools in Bangalore, India. Of the total sample, **178 (46.7%) were girls** and **203 (53.3%) were boys**. Children were distributed across three age-based TEDD forms: Form A (36–48 months, $n=123$), Form B (49–60 months, $n=134$), and Form C (61–72 months, $n=124$).

A **non-probabilistic sampling strategy** was adopted. Both typically developing children and those with developmental concerns were included to minimize bias and enhance the tool's applicability. Developmental concerns were identified in **62 children (16.3%)**, of whom 39 were referred jointly by teachers and parents and 23 had confirmed diagnoses or were undergoing therapies such as speech, occupational, or behavioral interventions. This inclusion of atypical profiles also enabled evaluation of the TEDD's sensitivity and specificity.

Instrument Development

The Teacher's Evaluation of Neurodevelopmental Delays (TEDD) was developed to identify neurodevelopmental concerns in preschool children aged 36–72

months. An initial pool of 273 items was generated using DSM-5 diagnostic criteria, ICD-10 developmental milestones, and the ECCE/NYCE frameworks. Items were refined using the modified Delphi technique and cognitive interviewing, resulting in a final set of 96 items across five domains: cognitive, sensory-motor, social-emotional, language, speech and communication, and daily living.

The final tool comprised three age-specific forms: Form A (36–48 months, 29 items), Form B (49–60 months, 33 items), and Form C (61–72 months, 34 items). Each form contained both positive (expected) and negative (deviant) behavioral statements, along with a parent-report section. Designed for administration by preschool teachers familiar with the child, the TEDD captures observable behaviors in a culturally relevant and developmentally appropriate manner.

Instrument:

Brief description of the TEDD for the field study

The TEDD consists of three separate forms pertaining to three separate age groups: Form A (36–48 months), Form B (49–60 months), and Form C (61–72 months). From a pool of 273 items, 96 items were retained via the modified Delphi technique (Kolhe, S., Prakash, A., & Pereira, M., 2024) and the cognitive interviewing method. These items cover five domains: Cognitive (CG), Sensory Motor (SM), Social-Emotional (SE), Language Speech and Communication (LSC) and Daily Living (DL). Form A consists of 29 items, Form B consists of 33 items, and Form C consists of 34 items. The first page of the form enlists the Form Name (A, B or C), captures demographic information about the child, school and screening details, and lists instructions to administer the tool. All the forms have some positive statement items and some negative statement items. The positive statement items are the behaviors, skills or milestones expected to be achieved at that age. The negative statement items are the expected behaviors or skills not achieved or observed or deviated behaviors usually not observed in

normal healthy children. The form also consists of an overall section to elicit information about the child from the parent. (See Annexure for complete Forms A, B and C, which were used for the pilot study.)

Overall aims and objectives

To test the feasibility of the TEDD by field testing the tool on a larger sample and to assess the psychometric properties and validity of the TEDD.

Setting and Subjects

Participants:

Private preschools in Bangalore were selected via non probabilistic sampling. The sample included children aged 36 to 72 months with typically developing profiles, children diagnosed with neurodevelopmental delays or disabilities, and those receiving interventions such as speech, occupational, behavioral, or applied behavior analysis (ABA) therapy. For children

with confirmed diagnoses, parents were asked to provide a written diagnostic report from a qualified professional or verify whether the diagnosis had been communicated verbally. When written reports were available, they were reviewed with parental consent; in the absence of documentation, this was duly noted.

Rationale for Sampling

The inclusion of both typically and atypically developing children minimized potential researcher bias and ensured the screening tool's applicability across diverse developmental profiles. The atypical group also provided baseline data to establish the TEDD receiver operating characteristic (ROC) curve, sensitivity, and specificity. All the children were enrolled in regular schools. Some were receiving special education or remedial services on the basis of developmental concerns raised by teachers or parents.

Table 1
Sample Descriptive statistics (N=381)

Age Group (In Months)	Gender		Total number of children (N)
	Female(n)	Male (n)	
36-48	61	62	123
49-60	55	79	134
61-72	62	62	124
Total (N)	178	203	381

Table 2
Descriptive Statistics For Form A, B, and C

	N	Minimum	Maximum	Mean	Standard Deviation
Age (Form A)	123	2.917	4.065	3.526	.311
Age (Form B)	134	3.312	5.073	4.464	.323
Age (Form C)	124	4.975	6.682	5.522	.322

Sample Characteristics

A total of 381 children were enrolled from seven private preschools in Bangalore located in Whitefield, Bellandur, JP Nagar, and Akshaya Nagar. The annual school fees ranged from INR 45,000--60,000, suggesting relative socioeconomic homogeneity on the basis of parental income. As the per capita income across these areas was also similar, income-

related confounding variables were not controlled. Among the total sample, 178 (46.71%) were girls, and 203 (53.28%) were boys. In terms of age, 123 children (32.28%) were in Form A (36–48 months), 134 (35.17%) were in Form B (49–60 months), and 124 (32.54%) were in Form C (61–72 months). Developmental concerns were identified in 62 children (16.27%); among them, 39 (62.90%)

were referred by both teachers and parents, whereas 23 (37.09%) had confirmed diagnoses or were receiving therapies such as speech

therapy, applied behavior analysis, occupational therapy, or play therapy.

Table 3

Descriptive details of Atypical children

S. No	Form Number	Referral Based on	No of Children
Total Number of children Referred by Teacher, Parent and Doctors			
1.	Form A	Teacher and Parent	5
	Form A	Doctors and Therapists (Diagnosis Received or undertaking therapy)	6
Total Number of children Referred by Teacher, Parent and Doctors			11
2	Form B	Teacher and Parent	15
	Form B	Doctors and Therapists (Diagnosis Received or undertaking therapy)	7
Total Number of children Referred by Teacher, Parent and Doctors			22
3	Form C	Teacher and Parent	19
	Form C	Doctors and Therapists (Diagnosis Received or undertaking therapy)	10
Total Number of children referred by Teachers, Parents and Therapists			29
Total Number of Atypical Children Referred			62

Sampling Strategy

The sampling strategy was bifurcated into two sets. First, the qualitative research part involved finalizing the dimensions of the NDD tool and deriving the scale items used to measure each first-order construct. In this section, we contacted the key informants for convenience. A questionnaire-based survey was subsequently used to collect data for the quantitative analysis. In this stage, we used a nonrandom sampling technique on the basis of judgment.

Research Design

Mixed method model involving quantitative and qualitative methods.

Inclusion criteria

1. Private Preschools in Bangalore, India.
2. The child must be between 36 months and 72 months of age.
3. Children are assumed to have optimally healthy development.
4. Optimally nourished children.
5. The child must be enrolled as a full-time student in the preschool.

6. The teacher who responded to the form must be familiar with the child for at least 60+ school weeks or 2+ school months.
7. The teacher must have personally interacted with the child almost daily.
8. The teacher must have a working knowledge of English.
9. Children with diagnosed neurodevelopmental/developmental delays and disabilities.
10. Children undertaking speech therapy, occupational therapy or behavior therapy.

Exclusion criteria

1. Government Preschools in Bangalore, India.
2. Children with known serious medical conditions or congenital defects as confirmed by the school. (The admission form filled out by the parent during the child's admission served as the basis for this information.)
3. Children with gross physical defects.
4. History of premature birth
5. Children younger than 36 months and older than 72 months were included.
6. If the teacher responded that the form is not familiar with the child for a period of at least 60+ school weeks or 2+ school months.

7. The teacher has not personally interacted with the child daily.
8. The teacher does not have working knowledge of English.

Ethical considerations

The purpose of the study was explained to each school principal during in-person visits, and informed consent was obtained. During parent–teacher meetings, principals conveyed this information to parents, who provided verbal consent under the following conditions: (a) screening would be based on input from the class teacher, who serves as the child’s primary caregiver; (b) additional information could be obtained from other staff and parents; (c) only the class teacher would communicate with parents for clarification; (d) the researcher would not interact directly with the child without parental consent; (e) children’s identities would remain confidential, with only initials and class details used for identification; (f) data would be collected solely from teachers who regularly interacted with the child; (g) no diagnostic labels would be shared with school staff; (h) any required screening tasks would be facilitated by the teacher; (i) the researcher could observe the child from a distance for a maximum of 10 minutes; (j) teachers would maintain daily logs with dates and times of screening; and (k) only data from children known to the teacher for at least 90 working school days would be included.

Method of Data Collection

The data were collected from September 2022 until February 2023. A total of 12 preschools were approached, 7 of which agreed to be a part of the study on the basis of certain terms and conditions, as mentioned above. The schools that did not participate in the study did not reply back to the author’s request for participation. As per their consent forms, the schools that participated in the study refrained from having their names written in the final thesis document.

Selection of Schools

A snowballing sampling method was adopted for selecting the schools. The author approached nearby schools, and the schools that

agreed to be a part of the study provided references to other schools.

Scoring and Administration

Responses were scored on the basis of teacher reports or, when necessary, the child’s direct demonstration of the task. For example, if a teacher could not confirm whether a child could kick a ball independently, the child was asked to perform the task, and scoring was based on the observed performance.

Interview Procedure

The TEDD was administered through individual interviews with teachers. Prior to screening, school principals conducted an orientation in which the author introduced herself, explained the study, and described the TEDD tool. Each teacher was then briefed individually, with the researcher explaining the purpose of the study, each item on the TEDD, and the response criteria. Teachers’ questions were addressed immediately. The presence of the child was not required unless the teacher was uncertain and needed the child to demonstrate a skill.

Observation

For children identified by the principal, teacher, or parent, the author conducted a brief classroom observation (10–15 minutes) to verify concerns. Direct interaction with the child was not permitted; instead, behaviors were recorded on the TEDD response form. Informal, naturalistic observation was preferred due to its ecological validity (Booren et al., 2012) and its effectiveness in revealing developmental, social, and emotional functioning (Smidt, 2005).

Observed behaviors

- Positive engagement with the teacher (e.g., initiating and sustaining conversations, using language for varied purposes)
- Peer sociability and communication (e.g., cooperative interactions, shared affect)

- Active involvement in classroom tasks (e.g., sustained attention, following instructions)
- Peer conflict (e.g., aggression, negative affect, if any)
- General classroom conduct
- Motor behaviors (e.g., sitting, standing, walking, writing, building)
- Behavioral regulation (e.g., taking turns, waiting patiently)

Confirmation of the Diagnosis of Neurodevelopmental Disorders and Detailed Information Regarding Therapy

When the teachers or the principal mentioned the diagnosis of a specific child or any child undergoing therapy, the information was confirmed by a personal interview with the parent, teacher and the child. Most interviews

lasted for approximately one hour. The details about the diagnosis, assessments undertaken, history of present illness (HOPA), details of the centers where the child was receiving therapy, type of therapy, month and year of starting therapy, and frequency and duration of the sessions were also noted. Sometimes, the respective therapist was also consulted about the treatment and progress of the child. According to the parents, the professionals involved in providing the diagnosis to the parents were mostly one or more of the following:

- Developmental Pediatricians
- Pediatrician
- Licensed Clinical Psychologists
- Licensed Speech, Language and Behavior Therapist
- Pediatric Neurologist
- Child and adolescent psychiatrist.

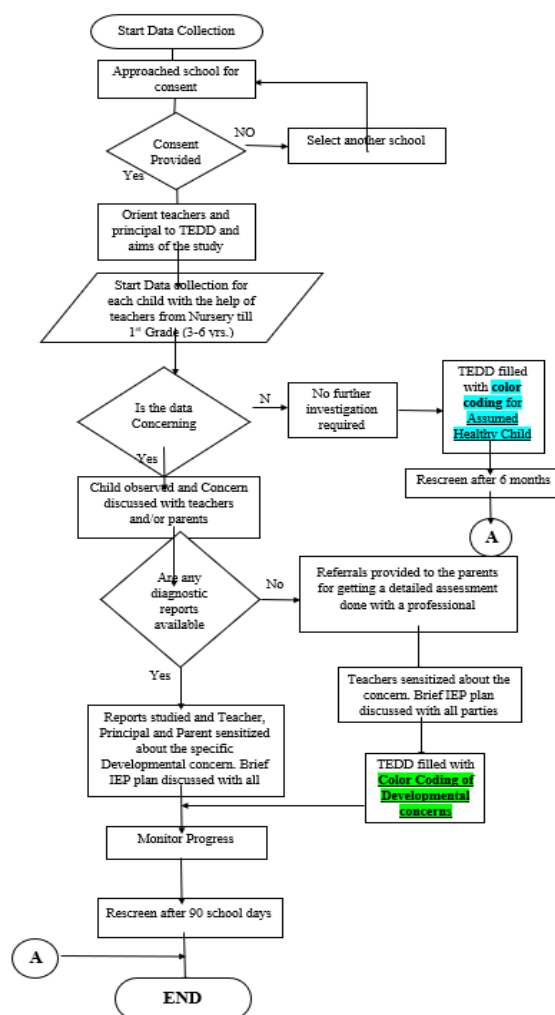


Figure 1: Flowchart for Data Collection

Reliability and validity

An evaluation tool is considered reliable when it consistently yields the same results under similar conditions with comparable subjects. The method of assessing reliability depends on the type of tool used. Although reliability is necessary for validity, it is not sufficient on its own (Downing, 2003). Without reliability, valid interpretation of results is not possible, and sufficient evidence must support score validity before practical application.

Validity refers to the extent to which an instrument accurately measures the intended construct. It is not an inherent feature of the tool but is based on how it is used in a specific context and population (American Psychological Association [APA], American Educational Research Association [AERA], & National Council on Measurement in Education [NCME], 1985). For research findings to be credible, assessment tools must be both valid and reliable.

Various methods are used to assess reliability (Cook & Beckman, 2006), with their relevance depending on the instrument type (Downing, 2004). Internal consistency, which reflects the degree of correlation among test items, is the most frequently reported metric and can be

assessed with a single administration. The low internal consistency suggests that the tool may measure multiple constructs.

Internal consistency reliability: Cronbach's alpha

Reliability testing is essential to ensure the consistency and stability of research instruments (Sekaran, 2009). Cronbach's alpha is a commonly used and straightforward method for assessing reliability (Churchill, 1979), although it assumes that all items have equal reliability and loadings on the construct (Hair et al., 2014). To address this limitation, the present study employs composite reliability, which accounts for varying outer loadings across items. Nevertheless, Cronbach's alpha was also used to evaluate the internal consistency of Forms A, B, and C. Introduced by Cronbach (1951), this coefficient measures internal consistency by examining interitem correlations, with values closer to 1 indicating higher reliability. Applicable to both dichotomous and continuous data, it is a generalization of the Kuder–Richardson formula and assumes that all items assess a single construct (Bland & Altman, 1997). The interpretation of the alpha values for the Likert scale items followed established guidelines (Thorndike, 1994; Bland & Altman, 1997; DeVellis, 2003).

Table 4
Criteria for interpreting Cronbach's Alpha Values

Cronbach's Alpha(α) Values	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Table 34 shows the Cronbach's alpha values for all five domains for Forms A, B and C. For all five domains in Form A, Form B and Form C,

the criterion for **Cronbach's alpha** is satisfied with the interpretation of values ranging from good to **excellent**.

Table 5
Reliability Statistics: Cronbach Alpha Values- Form A, B, and C

Domains	Cronbach Alpha Values	Interpretation
FORM A		
Cognitive	.852	Good
Sensory-Motor	.864	Good
Social-Emotional	.786	Acceptable
Language, Speech and Communication	.958	Excellent
Daily Living	.750	Acceptable
FORM B		
Cognitive	.886	Good
Sensory-Motor	.759	Acceptable
Social-Emotional	.761	Acceptable
Language, Speech and Communication	.885	Good
Daily Living	.792	Acceptable
FORM C		
Cognitive	.916	Excellent
Sensory-Motor	.797	Acceptable
Social-Emotional	.806	Good
Language, Speech and Communication	.913	Excellent
Daily Living	.879	Good

Composite reliability (CR)

Composite reliability assesses the internal consistency and reliability of a construct (Hair et al., 2014), with values ranging from 0 to 1. Higher values indicate greater dependability. Scores between 0.60 and 0.70 are acceptable, whereas values below 0.60 indicate poor internal consistency. Table 35 presents the composite reliability and average variance extracted scores for Forms A, B, and C.

Convergent Validity

Average Variance Extracted (AVE)

When items relating to the same construct show a strong positive correlation, they demonstrate convergent validity. Items associated with a specific construct are expected to converge, indicating that they should exhibit substantial shared variance (Hair et al., 2014). This research suggests assessing the outer loadings of the items and the average variance extracted (AVE) as methods for evaluating convergent validity. Hair et al. (2014) suggested

the use of average variance extracted (AVE) to establish convergent validity. In addition to other methods, construct validity can also be determined by analyzing convergent validity. The concept of convergent validity highlights the importance of internal consistency among indicators that gauge the same construct (Bagozzi, 1981). Consequently, researchers have relied on reliability metrics as a key criterion for evaluating convergent validity for over forty years. (Fornell & Larcker, 1981). Many studies use the (Fornell & Larcker, 1981) criterion for assessing convergent validity (for example, Yu et al., 2021; (Zahoor et al., 2022)). Fornell and Larcker (1981) define convergent validity as the situation where a latent construct accounts for at least 50% of the variance in its associated indicators. They recommend using the average variance extracted (AVE) as a measure to reflect the mean proportion of variance that a construct explains in its indicators compared to the total variance of those indicators.. According to Hair et al. (2017) and (Fornell & Larcker, 1981), a latent concept is considered to have convergent

validity if the average variance extracted (AVE) value is greater than 0.5 (Hair et al., 2013, 2017; (Fornell & Larcker, 1981)

Discriminant validity of the 1st-order construct

Discriminant validity refers to the extent to which constructs are distinct and not highly correlated. In research involving latent variables, its assessment is essential to avoid multicollinearity and ensure accurate model interpretation. Fornell and Larcker (1981) proposed a widely used method, where the square root of the average variance extracted (AVE) for each construct should exceed its correlations with other constructs. This confirms that a construct explains more variance in its indicators than in others. Table 36 presents the Fornell–Larcker values for the first-order constructs.

Common Method Bias

Common method variance (CMV) and common method bias (CMB) can substantially affect the reliability and validity of research findings. Although often used interchangeably, CMV refers to systematic error arising from a shared measurement method (Podsakoff et al., 2003; Richardson et al., 2009), whereas CMB

occurs when this variance distorts correlations among variables (Jakobsen & Jensen, 2015; Richardson et al., 2009). This study refers to the issue as CMB for simplicity. Widely recognized as a concern in behavioral research, discussions about its impact have persisted for over four decades (Campbell & Fiske, 1959). As a primary source of measurement error, CMB threatens the validity of results by offering alternative explanations for the observed relationships between constructs.

Harman's single-factor test

Harman's single-factor test is frequently utilized to identify the presence of common method variance or bias (Fuller et al., 2016; Podsakoff et al., 2003). The premise is that significant common method bias will manifest as either a single dominant factor or one overarching factor that accounts for most of the covariance among the measured variables. This test involves conducting either exploratory or confirmatory factor analysis. In exploratory analysis, if a single unrotated factor explains over 50% of the total variance, it suggests the existence of common method bias (Fuller et al., 2016). Similarly, a comparable approach is used in confirmatory analysis (Podsakoff et al., 2003).

Table 6

AVE and CR scores for Form A

Construct	AVE	CR
Cognitive (C)	0.668	0.909
Sensory Motor (SM)	0.721	0.928
Social-Emotional (SE)	0.630	0.872
Language, Speech and Communication (LSC)	0.858	0.968
Daily Living and Adaptive (DL)	0.826	0.905
NDD (2 ND order construct)	0.639	0.898

As shown in the table above, when the AVE > 0.5, convergent validity is satisfactory (Hair et al., 2014), and composite reliability scores are

>0.85 (CR >0.85); hence, composite reliability is also satisfactory (Hair et al., 2014).

Table 7

Values for Fornell- Larcker Criterion for Discriminant Validity of 1st Order Constructs for Form A

	Cognitive (C)	Sensory Motor (SM)	Social- Emotional (SE)	Language, Speech and Communication (LSC)	Daily Living and Adaptive (DL)
Cognitive (C)	0.817				
Sensory Motor (SM)	0.468	0.849			
Social-Emotional (SE)	0.681	0.618	0.794		
Language, Speech and Communication (LSC)	0.651	0.362	0.615	0.926	
Daily Living and Adaptive (DL)	0.011	0.148	0.266	0.185	0.909

*Diagonal values (In Bold) represent the square root of the Average Variance Extracted

As explained above, for discriminant validity to be established, the square root of the average variance extracted should be greater than the correlation values of the corresponding rows and columns of the correlation matrix. Therefore, in Form A, discriminant validity was found to be achieved according to the Fornell–Larcker criterion.

Common Method Bias Form A

Common method bias is not an issue according to Harman's single factor test (Podsakoff et al., 2003). The single factor accounts for **36.17%**, which is less than 50%. Hence, common method bias is not a concern for Form A.

Table 8

AVE and CR scores Form B

Construct	AVE	CR
Cognitive (C)	0.562	0.910
Sensory Motor (SM)	0.551	0.876
Social-Emotional (SE)	0.494	0.801
Language, Speech and Communication (LSC)	0.694	0.918
Daily Living and Adaptive (DL)	0.714	0.833
NDD (2 ND order construct)	0.610	0.886

As shown in the table above, when the AVE > 0.5, convergent validity is satisfied (Hair et al., 2014). The composite reliability score is >0.85

(CR >0.85); hence, composite reliability is also satisfactory (Hair et al., 2014).

Table 9

Values for Fornell- Larcker Criterion for Discriminant Validity of 1st Order Constructs for Form B

	Cognitive (C)	Sensory Motor (SM)	Social-Emotional (SE)	Language, Speech and Communication (LSC)	Daily Living and Adaptive (DL)
Cognitive (C)	0.750				
Sensory Motor (SM)	0.370	0.742			
Social-Emotional (SE)	0.631	0.637	0.703		
Language, Speech and Communication (LSC)	0.684	0.408	0.634	0.833	
Daily Living and Adaptive (DL)	0.325	0.638	0.557	0.205	0.845

*Diagonal values (In Bold) represent the square root of the Average Variance Extracted

As explained above, for discriminant validity to be established, the square root of the average variance extracted should be greater than the correlation values of the corresponding rows and columns of the correlation matrix. Therefore, in Form B, we achieved discriminant validity.

Common Method Bias Form B

Common Method Bias is not an issue according to Harman's Single Factor Test (Insert citation). The single factor accounts for **35.442%**, which is less than 50%. Hence, common method bias is not a concern for Form B.

Table 10

AVE and CR scores for Form C

Construct	AVE	CR
Cognitive (C)	0.574	0.930
Sensory Motor (SM)	0.524	0.867
Social-Emotional (SE)	0.571	0.868
Language, Speech and Communication (LSC)	0.768	0.943
Daily Living and Adaptive (DL)	0.756	0.925
NDD (2 ND order construct)	0.735	0.933

As shown in the table above, when the AVE > 0.5, convergent validity is satisfactory

(Hair et al., 2014), and composite reliability scores are >0.85 ($CR >0.85$); hence, composite

reliability is also satisfactory (Hair et al., 2014).

Table 11

Values for Fornell- Larcker Criterion for Discriminant Validity of 1st Order Constructs for Form C

	Cognitive (C)	Sensory Motor (SM)	Social- Emotional (SE)	Language, and Communication (LSC)	Speech	Daily Living and Adaptive (DL)
Cognitive (C)	0.758					
Sensory Motor (SM)	0.682	0.724				
Social-Emotional (SE)	0.694	0.628	0.756			
Language, Speech and Communication (LSC)	0.691	0.678	0.727	0.876		
Daily Living and Adaptive (DL)	0.590	0.776	0.661	0.660		0.869

*Diagonal values (In Bold) represent the square root of Average Variance Extracted

As explained above, for discriminant validity to be established, the square root of the average variance extracted should be greater than the correlation values of the corresponding rows and columns of the correlation matrix. Therefore, in Form C, we achieved discriminant validity.

Common Method Bias Form C

Common Method Bias is not an issue according to Harman's single factor test (insert citation).

The single factor accounts for **43.836%**, which is less than 50%. Hence, common method bias is not a concern for Form C.

Correlation Matrix

The following is the correlation matrix for the formed factors. Since this is a multiple-construct tool, the interconstruct correlation is significant in this case. This indicates that all the dimensions of the NDD are related to each other.

Table 12

Correlation Matrix for Form A

		C	SM	SE	LSC	DLA
C	Pearson Correlation	1	.468**	.681**	.651**	.011
	Sig. (2-tailed)		.000	.000	.000	.901
	N	123	123	123	123	123
SM	Pearson Correlation	.468**	1	.618**	.362**	.146
	Sig. (2-tailed)	.000		.000	.000	.108

	N	123	123	123	123	123
SE	Pearson Correlation	.681**	.618**	1	.615**	.226*
	Sig. (2-tailed)	.000	.000		.000	.012
	N	123	123	123	123	123
LSC	Pearson Correlation	.651**	.362**	.615**	1	.185*
	Sig. (2-tailed)	.000	.000	.000		.040
	N	123	123	123	123	123
DLA	Pearson Correlation	.011	.146	.226*	.185*	1
	Sig. (2-tailed)	.901	.108	.012	.040	
	N	123	123	123	123	123

*. Correlation is significant at the 0.05 level (2-tailed).

The figures in Table 41 show that all the interconstruct correlations were significant at the $p < 0.5$ level. The exceptions were Daily Living and Adaptive and Cognitive Domains.

Table 13
Correlation Matrix for Form B

		C	SM	SE	LSC	DLA
C	Pearson Correlation	1	.286**	.623**	.701**	.309**
	Sig. (2-tailed)		.001	.000	.000	.000
	N	134	134	134	134	134
SM	Pearson Correlation	.286**	1	.655**	.323**	.722**
	Sig. (2-tailed)	.001		.000	.000	.000
	N	134	134	134	134	134
SE	Pearson Correlation	.623**	.655**	1	.640**	.597**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	134	134	134	134	134
LSC	Pearson Correlation	.701**	.323**	.640**	1	.212*
	Sig. (2-tailed)	.000	.000	.000		.014
	N	134	134	134	134	134
DLA	Pearson Correlation	.309**	.722**	.597**	.212*	1
	Sig. (2-tailed)	.000	.000	.000	.014	
	N	134	134	134	134	134

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The figures in Table 42 show that all the interconstruct correlations were significant at the $p < 0.5$ level. The exceptions were the Daily

Living and Adaptive and Cognitive Domains, which were significantly related at $p < 0.1$.

Table 14
Correlation Matrix for Form B

		C	SM	SE	LSC	DLA
C	Pearson Correlation	1	.651**	.704**	.693**	.581**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	124	124	124	124	124
SM	Pearson Correlation	.651**	1	.580**	.639**	.724**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	124	124	124	124	124
SE	Pearson Correlation	.704**	.580**	1	.785**	.666**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	124	124	124	124	124
LSC	Pearson Correlation	.693**	.639**	.785**	1	.657**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	124	124	124	124	124
DLA	Pearson Correlation	.581**	.724**	.666**	.657**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	124	124	124	124	124

** . Correlation is significant at the 0.01 level (2-tailed).

The figures in Table 43 show that all the interconstruct correlations were found to be significant at the $p < 0.5$ level. The exceptions were the Daily Living and Adaptive and Cognitive Domains, which were significantly related at $p < 0.1$.

Results

Results

The primary objective of this study was to validate the Teacher's Evaluation of Developmental Delays (TEDD) tool for use in screening for neurodevelopmental delays in Indian preschool children. The results are presented below, addressing reliability and validity.

Reliability

Internal consistency was assessed via Cronbach's alpha. For Form A, Cronbach's alpha values

ranged from .750 to .958 across the five domains (cognitive, sensory-motor, social-emotional, language speech and communication, and daily living), indicating acceptable to excellent internal consistency. The alpha values of Form B ranged from .759 to .886, and those of Form C ranged from .797 to .916, which also demonstrated acceptable to excellent internal consistency within each domain. (See Table 5 for detailed Cronbach's alpha values for each domain and form).

Validity

- **Convergent Validity.** Convergent validity was evaluated via average variance extracted (AVE). For Form A, all the constructs demonstrated AVE values exceeding 0.5 (see Table 6), indicating adequate convergent validity. Similarly, the AVE values for Forms B (Table 8) and C (Table 10) were also above the 0.5

threshold for most constructs, supporting convergent validity.

- **Discriminant validity.** Discriminant validity was assessed via the Fornell–Larcker criterion. For Form A (Table 7), the square root of the AVE for each construct was greater than its correlations with other constructs, indicating adequate discriminant validity. The results for Form B are shown in Table 9, and those for Form C are shown in Table 11.

- **Common Method Bias.** Harman's single-factor test was conducted to assess the presence of common method bias. The single factor accounted for 36.17% of the variance in Form A, 35.442% in Form B and 43.836% in Form C, which is below the 50% threshold, suggesting that common method bias is not a significant concern in this study.

Inte-construct Correlations

Inter-construct correlations were significant in all dimensions of NDD, which are related to each other. Table 12 Correlation matrix for Form A, Table 13 Correlation matrix for Form B and Table 14 Correlation matrix for Form C

Discussion and Conclusion

The principal objective of this study was to validate the TEDD tool to evaluate its efficacy in screening neurodevelopment delays in Indian preschoolers. According to the results of the research, the Teacher's Evaluation of Developmental Delays (TEDD) screening tool demonstrates robust, reliable and satisfactory levels of construct validity, convergent validity and internal consistency. This tool can be used to evaluate the onset of neurodevelopmental delay in preschool children in India.

Acknowledgement

The authors would like to acknowledge the author's Guide and Co-Guide's Prof Anand

Prakash and Prof Maxim Pereira for their guidance and support in completing this study as per the protocols. The author would also like to extend a big thank you to their statistician

Prof Shivan Patel, without whose expertise and knowledge this study would have not been

completed in the most scientific manner.

Limitations

Few limitations should be considered when interpreting the findings of this study. First, the sample was drawn from private preschools in Bangalore, India, via non probabilistic sampling. This limits the generalizability of the findings to other populations or educational settings, particularly those in lower socioeconomic strata or different cultural contexts. While the study aimed to include a diverse range of children, potential selection bias related to parental awareness and access to private preschools cannot be ruled out.

Second, the study relied on teacher reports for data collection. While teachers offer valuable insights into children's development, their assessments may be subject to individual biases or variations in their understanding and application of the TEDD tool. Although efforts have been made to provide clear instructions and address teacher questions, the reliance on subjective ratings introduces a potential source of error. Future studies should consider incorporating multiple data sources, such as direct observations or parental input, to increase the robustness of the findings.

Third, the study focused primarily on the psychometric properties of the TEDD. Future research is needed to examine the sensitivity and specificity of the TEDD in identifying children at risk for neurodevelopmental disorders compared with clinical diagnoses. Longitudinal studies are also warranted to assess the predictive validity of the TEDD and its impact on early intervention outcomes.

Implications

Despite these limitations, this study has important implications for the field of early childhood development in India and similar contexts. The TEDD has promising psychometric properties as a culturally relevant screening tool for neurodevelopmental delays in preschool settings. Its feasibility for

administration by preschool teachers makes it a potentially valuable tool for early identification, particularly in settings where access to specialized professionals is limited.

The findings suggest that the TEDD can be integrated into existing preschool programs to facilitate early detection and referral for further evaluation and intervention. This may contribute to improved outcomes for children with neurodevelopmental disorders by enabling timely access to support services.

Furthermore, the study highlights the need for culturally appropriate assessment tools that are sensitive to the unique needs and characteristics of Indian children. The development and validation of the TEDD represents a step toward addressing this gap and promoting

equitable access to early intervention services for all children.

Future research should focus on expanding the use of the TEDD in diverse settings, evaluating its effectiveness in improving child outcomes, and exploring its potential for integration with other screening and assessment tools. The results of this study support the use of the TEDD in educational and clinical settings and support the early identification and diagnosis of neurodevelopmental disorders in children aged 3 years to 6 years.

Declaration of interest statement

We confirm to adhering in principle to the Conflict of Interest policy recommended by the

International Committee of Medical Journal Editors (ICMJE)

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