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Concurrent validity of the Warner Initial Developmental Evaluation of Adaptive and Functional Skills (WIDEA-FS) and the Bayley Scales of Infant and Toddler Development III

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Abstract

Aim: Our objective was to determine the concurrent validity of the Warner Initial Developmental Evaluation of Adaptive and Functional Skills (WIDEA-FS), a criterion-specified questionnaire that assesses a child's adaptive skills in everyday context, and the Bayley Infant and Toddler Scales of Development, 3rd Edition (Bayley-III).

Method: In a prospective cohort study, 431 WIDEA-FS and Bayley-III assessments were completed among 341 children, aged 10-36 months corrected age, followed in a high-risk NICU follow-up clinic.

Results: WIDEA-FS scores were significantly associated with Bayley-III scores in all domains. Lower scores on the WIDEA-FS were significantly associated with increased risk of adverse developmental performance on all Bayley-III scales. The association was strongest for motor and language Bayley-III scores when tested at <30 months of age, and for cognitive Bayley-III scores when tested at ≥30 months of age.

Interpretation: The WIDEA-FS has concurrent validity with the Bayley-III test and may be a useful tool in high-risk follow-up settings.

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Keywords

NICU follow-up; neurodevelopmental outcome; WIDEA-FS; developmental delay; neonatal encephalopathy; premature infant; neurocritical care

Infants born preterm, with a history of neonatal encephalopathy, or other neurological conditions are at increased risk of adverse neurodevelopmental functioning and require close follow-up in the first years of life[1]. Early identification of children with atypical development prompts referral to targeted intervention services designed to maximize functional outcomes at the time of greatest brain plasticity[2,3]. Therefore, valid and effective screening tools are essential to promote identification of children at risk for adverse neurodevelopmental outcomes.

One of the most commonly used methods for evaluating the neurodevelopment of children under 42 months old is the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III)[4]. An experienced and reliable examiner can administer the Bayley-III in approximately one hour. The results of the Bayley-III can be used to identify children who would benefit from early intervention services. However, the extensive implementation in clinics and in research studies remains limited due to the time requirement, need for an in-person visit by a trained examiner, and associated high cost for both families and health care centers.

The Warner Initial Developmental Evaluation of Adaptive and Functional Skills (WIDEA-FS) was developed to simplify the assessment process for high risk infants aged up to 37 months[5,6]. The WIDEA-FS is a 50-item criterion-specified questionnaire designed to assess a child's adaptive skills[6] including mobility, communication, social cognitive, and self-care (e.g., feeding, drinking, diaper awareness) skills. The WIDEA-FS takes only 10-15 minutes to administer and can be conducted with either parents or individuals who have observed the child's performance during daily routines[6]. Because the WIDEA-FS can be conducted by telephone, families with children at high risk for neurodevelopmental disabilities that live in remote areas may benefit from reduced travel times and costs associated with in person follow-up visits.

The objective of the study was to determine the ability of WIDEA-FS to identify children at risk of neurodevelopmental delay or disability, which would justify additional developmental assessments or intervention services. More specifically, concurrent validity was calculated by comparing the WIDEA-FS to Bayley-III.

Method

We conducted a cross sectional study, using a sample of children consecutively enrolled in a state mandated Infant Follow-Up Program at University of California San Francisco (UCSF) Benioff Children's Hospital Intensive Care Nursery (ICN) Follow Up Program between February 2015 and June 2018.

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Participants

Children were prospectively recruited between 10-36 months adjusted age from the UCSF ICN Follow Up Program. Eligibility criteria included any of the following: preterm birth (gestational age <32 weeks), neonatal encephalopathy, persistently and severely unstable infant (prolonged hypoxia, acidemia, hypoglycemia and/or hypotension requiring pressor support, persistent pulmonary hypertension of the newborn requiring inhaled nitric oxide for >4 hours, extracorporeal membrane oxygenation) intracranial pathology, or other neurological pathology, per California Children's Services (CCS) program guidelines. Informed parental consent was obtained for each child and ethical approval for the study was granted by the University's institutional review board.

Bayley Scales of Infant and Toddler Development

Between 10-36 months corrected age, motor, language, and cognitive outcomes were assessed with the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III)[4] as part of clinical care in the ICN Follow Up Program. Standard assessments are conducted at three of four possible time points: 12, 18, 24 or 30 months depending on risk factors. The Bayley-III assesses the child's developmental level of gross and fine motor skills, receptive and expressive communication, object relatedness, memory, and concept formation[4]. The assessments were performed by either a child psychologist or a qualified pediatric nurse practitioner trained in Bayley-III assessment. The mean of each composite score of the Bayley is 100 (standard deviation 15) points. We designated children with composite scores of ≤85 as having a risk for adverse neurodevelopmental outcomes. Some children in the cohort were tested at more than one time point at a minimum of 6 months between assessments.

Warner Initial Developmental Evaluation of Adaptive and Functional Skills (WIDEA-FS)

The WIDEA-FS is a 50-item check list designed to describe the emerging functional skills in a child's mobility (9 items), communication (13 items), social cognition (11 items), and self-care (17 items) domains (Supporting information). The WIDEA-FS was designed to assess criterion-specific activities, representing a child's daily routine. The domains of the WIDEA-FS were originally created by a multi-disciplinary team with varied expertise in the daily activities of children. The choice of items was based on activities that occur on a daily basis and were developed by an interdisciplinary team of health, rehabilitation, early childhood, and psychological professionals. They were chosen based on domains considered essential activities from historic adaptive assessments including the Vineland Adaptive Behavior Scales[7], Pediatric Evaluation of Disability Inventory[8], the WeeFIM[9], the Batelle Developmental Inventory[10], and items used in early childhood assessments of motor, manipulative, communicative, and cognitive skills. The WIDEA-FS is an evaluative measure of child's performance from observation, parent, or professional report from criterion items developed using Delphi methodology[11]. The purpose of the WIDEA-FS is to describe how children with diverse developmental delays, disability, and special health care needs are progressing in independence of basic feeding, mobility, communication, and social interaction skills. The individual items were selected based on their relationship to meaningful everyday tasks that parents could easily observe or participate in with the child.

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Each item consists of an operationally defined task that is part of an everyday activity and is rated on a scale of one (never performs task) to four (always performs task). Examples of test items from each subscale include: “maintains sitting without support” (mobility), “demonstrates two-syllable babbling” (communication), “looks for an object dropped out of sight” (social cognition), and “chews solid food” (self-care). The total score ranges from 50-200 points. Once a child achieves the maximum score in each domain, one can be assured that basic skills have been achieved. The WIDEA-FS has been validated in a population of typically-developing children[12] and has been used as an outcome measure in children with Krabbe disease[13], children with prenatal exposure to ZIKA[14] virus, and in children with a history of neonatal encephalopathy[15]. In this study, the WIDEA-FS was completed either in-person or via telephone within one month of the Bayley-III assessment.

Statistical analysis

Data were analyzed with Stata, version 15 (StataCorp LLC, College Station, TX, USA). When comparing the WIDEA-FS and the Bayley-III, we compared the following domains to one another: WIDEA-FS mobility to Bayley-III motor, WIDEA-FS communication to Bayley-III language, and WIDEA-FS social cognition to Bayley-III cognitive.

In order to examine the relationships between WIDEA-FS and the Bayley-III, we used three analytic methods: Spearman’s rank correlation, a receiver operating characteristic (ROC) curve, and sensitivity and specificity analyses. First, for Spearman’s rank correlation, association between the score on the WIDEA-FS and each Bayley-III domain was analyzed. Second, the area under the receiver operating characteristic (ROC) curve was calculated, using the trapezoidal rule as a measure of the ability of the WIDEA-FS to discriminate between children with and without risk of adverse neurodevelopmental outcomes on the Bayley-III. This was done separately at the timepoints listed above, and an overall area under the ROC curve was calculated using the *somersd* package in Stata (which allows for the clustering of multiple observations per patient). Finally, for the calculation of sensitivity and specificity, a cutpoint was chosen based on maximizing the Youden’s index[16] (sensitivity+specificity −1) of the WIDEA-FS score with the Bayley-III composite scores of no more than 85 as the gold standard; 95% confidence intervals (CIs) were constructed for these estimates based on the binomial distribution. A second set of cutpoints was also calculated where applicable for instances when sensitivity was ≥ 90%.

Results

There were 431 (WIDEA-FS and Bayley-III) assessments completed among 341 children. Two children had WIDEA-FS assessments at >37 months and were excluded. This left 429 assessments among 341 children (260 with one assessment, 74 with two assessments, and 7 with three assessments; Supplementary Table 1). Demographic and clinical characteristics of the participants are listed in Table 1. Mean scores on the WIDEA-FS and Bayley-III at timepoints 10 to <18 months, 18 to <24 months, 24 to <30 months and ≥30 months are listed in Table 2. The mean Bayley-III scores fell within the average range at all tested timepoints. There was no difference in results based on the order of test administration (WIDEA-FS first compared with Bayley-III first).

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WIDEA-FS scores are associated with Bayley-III scores at multiple timepoints

The WIDEA-FS scores were significantly related to Bayley-III scores for all compared domains in at least two tested timepoints. When comparing WIDEA-FS mobility scores to Bayley-III motor scores, there was a significant association at every timepoint; the greatest association occurred at 10 to <18 months (Table 3). There were significant associations between communication scores and Bayley-III language scores at all timepoints, with the greatest association in children tested at 18 to <24 months (Table 3). When comparing the WIDEA-FS social cognition score to the Bayley-III cognitive composite score, significant associations were seen at 10 to <18 months and at ≥30 months (Table 3).

Lower WIDEA-FS scores are associated with increased risk of adverse outcome on the Bayley-III (area under the ROC curve)

The association between WIDEA-FS score subdomains and risk of adverse (≤85) Bayley-III composite scores was strongest when comparing WIDEA-FS mobility and Bayley-III motor, and WIDEA-FS communication and Bayley-III language for timepoints measured <30 months. In addition, the association between WIDEA-FS social cognition score and risk of adverse (≤85) Bayley cognitive score was strongest when tested at ≥30 months of age. (Table 3).

Sensitivity and specificity of the WIDEA-FS for Bayley-III

The sensitivities and specificities of the WIDEA-FS scores, calculated using Youden's Index, for predicting Bayley-III composite scores of ≤85 at all four timepoints, and cutpoint scores which yield at least 90% sensitivity are listed in Table 4.

Bayley-III Motor Scale: For the WIDEA-FS mobility scale, at 10 to <18 months of age, a cutpoint of 34 yielded a sensitivity of at least 90% for predicting a Bayley motor score of ≤85, however, when the WIDEA-FS mobility was tested at other ages, there was no cutpoint that provided a sensitivity of 90% (Table 4). From 24 to ≥30 months of age a cutpoint of 36 on the WIDEA-FS mobility scale yielded the best combination of specificity and sensitivity to Bayley-III motor scores.

Bayley-III Language Scale: WIDEA-FS communication cutoff scores of 30 and 48, yielded sensitivity of at least 90% in predicting Bayley-III language scores of ≤85 at 10 to <18 months and 18 to <24 months respectively (Table 4). At 24 to <30 months, a cutoff score of 52, yielded 100% sensitivity to a Bayley-III language score of ≤85. Using the Youden's index, the highest combination of sensitivity and specificity to Bayley-III language score occurred at 10 to <18 months of age.

Bayley-III Cognitive Scale: WIDEA-FS social cognition cutpoints between 40 and 44 yielded sensitivities of at least 90% in prediction of a Bayley-III cognitive score of ≤85 for the four age groups tested (Table 4). Using the Youden's index, the specificity of WIDEA-FS social cognition score was higher in each age group as compared to sensitivity for Bayley-III cognitive composite score (Table 4).

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Children who achieved the maximum WIDEA-FS mobility and communication scores had higher Bayley-III motor and language scores

Because some children achieved the maximum score for the WIDEA-FS mobility and communication scores at earlier ages than other children (Table 2), we next examined whether there were differences between mean Bayley-III scores among those children who achieved the maximum WIDEA-FS scores compared to those who didn't at the following timepoints: 18 months to < 24 months, 24 months to <30 months, and ≥ 30 months. Children who had not achieved the maximum WIDEA-FS mobility score had lower Bayley motor scores at all timepoints as compared to children who did achieve the maximum score (18-24 months: −10, 95% CI −15, −4; 24-30 months: −18, 95% CI −34, −2; ≥30 months: −12 95% CI −21, −3). In similar fashion, children who had not achieved the maximum WIDEA-FS communication score also had lower mean Bayley language composite scores at all timepoints (18-24 months: −12, 95% CI −19, −5; 24-30 months: −22, 95% CI −32, −13; ≥30 months: −12 95% CI −17, −7).

Discussion

In this prospective study of high risk infants, we demonstrated concurrent validity between the WIDEA-FS and Bayley-III by finding significant correlations between scores on the WIDEA-FS mobility, communication, and social cognition domains and the Bayley-III motor, language, and cognitive composite scores, respectively. The WIDEA-FS (mobility, communication, and social cognition domains) was also able to establish differences between children who had normal motor, language, and cognitive Bayley-III scores from those who were at risk for adverse motor, language, and cognitive outcomes (≤85). While the WIDEA-FS mobility and communication domains had good concurrent validity with the Bayley-III language and motor domains, the concurrent validity between the WIDEA-FS social cognition domain and Bayley-III cognitive domain was less robust.

The age at which greater proportions of children were able to achieve the maximum scores on the WIDEA-FS followed a typical early neurodevelopmental sequence with more children first reaching the maximum score on the mobility domain (between 18-24 months) than the communication domain (between 24-30 months), and finally the social cognition domain (≥30 months) possibly representing the emergence of executive functioning. This suggests that the domains of the WIDEA-FS may be most clinically useful at age-specific time points, which reflect the skillset of the child at that time.

We calculated sensitivities and specificities using the Youden's index at all timepoints. The WIDEA-FS was designed to measure basic functional competencies of a child and was not intended as a replacement measure of more extensive assessments which measure more complex developmental skills. However, if the goal of the clinician is to use the WIDEA-FS to screen children who will need to receive a more detailed, in person neurodevelopmental assessment, we recommend that the clinician consider using the 90% sensitive cutpoint scores (when available) to choose children who will need a full Bayley-III assessment. For the mobility domain of the WIDEA-FS, we recommend using this test between 10 to <18 months of age because there appears to be a ceiling affect after this age and there is a provided cutoff score of 34 which provides a 90% sensitivity to a Bayley-III motor score of

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≤85. For the same reasons, we recommend using the WIDEA-FS communication scale between 10 to 24 months of age with the cutoff scores of 30 at 10 to <18 months of age and 48 at 18 to <24 months of age. The social cognition domain of the Bayley may be most useful to clinicians in screening for cognitive functioning at ≥30 months of age. Clinicians using the 90% sensitive cutoff scores should be aware that many children who are recommended for more detailed evaluation may have Bayley scores >85 as maximizing sensitivity will yield a lower specificity for children who will score in the average range.

Although we present a large cohort of children at risk, our recommendations are limited by the fact that relatively few of the children included scored ≤85 on the Bayley-III, therefore our 90% sensitive cutpoint threshold may be higher than in other samples of children with lower Bayley-III scores. In addition, by calculating sensitivity and specificity at various timepoints, there are fewer assessments performed in each age grouping. Consequently, the confidence intervals are larger, especially in age groupings where few children scored ≤85 on the Bayley-III.

It is important for clinicians working with high risk infants to identify those at greatest risk for adverse neurodevelopmental outcome in order to direct intervention and study the effects of previous treatment. However, it is not always possible for families to complete Bayley-III testing, which requires a visit with a skilled tester and participation of the child. Additionally, follow up programs may need to prioritize exams based on space and practitioner availability. The WIDEA-FS is a novel way to screen children via parent interview, as it can be administered easily by a variety of professionals. The WIDEA-FS can also be used in person or over the phone and takes 15 minutes or less to complete. While there are domain-specific ceiling effects at various ages, the WIDEA-FS can detect delays in children who are not able to achieve the maximum scores (at the above age-specified timepoints), screening those children who are at highest risk of severe disability. Therefore, the WIDEA-FS can be used easily as either a part of a battery of developmental tests or when other, more extensive testing, is unavailable. This test may also be issued remotely and may be of benefit to families who have limited resources to travel to a pediatric medical center or are burdened by traveling a great distance to receive follow-up care.

The Ages and Stages Questionnaire (ASQ) has similar administration time and methods as the WIDEA-FS, and has been compared to the Bayley-III in the general and high risk populations[17–19], with moderate specificity and a lower sensitivity in identifying infants at highest risk. The WIDEA-FS and ASQ have been successfully used together[13] in order to provide a more comprehensive evaluation and to increase compliance of families in need of ongoing monitoring.

A large number of WIDEA-FS and Bayley-III assessments were completed in this study, and the majority of children tested (75%), had only one assessment included in our analysis. In order to better understand the ability of the WIDEA-FS to predict long-term neurodevelopment, it may be beneficial to compare longitudinal WIDEA-FS assessments with outcomes at school age. The WIDEA-FS, especially the self-care and social cognition domains may measure executive competencies, which are more accurately assessed later in development.

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The WIDEA-FS, which is designed to quickly measure functional independence of a young child, may be a practical alternative to repeated Bayley-III testing of children that require long-term monitoring. This study establishes concurrent validity between the WIDEA-FS mobility and communication domains with Bayley-III motor and language scales in a cohort of high-risk infants, at corrected ages 10-36 months.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References:

1. McCormick MC, Brooks-Gunn J, Buka SL, Goldman J, Yu J, Salganik M, Scott DT, Bennett FC, Kay LL, Bernbaum JC, Bauer CR, Martin C, Woods ER, Martin A, Casey PH. Early intervention in low birth weight premature infants: results at 18 years of age for the Infant Health and Development Program. Pediatrics 2006; 117: 771–80. [PubMed: 16510657]
2. Rydz D, Srour M, Oskoui M, Marget N, Shiller M, Birnbaum R, Majnemer A, Shevell MI. Screening for developmental delay in the setting of a community pediatric clinic: a prospective assessment of parent-report questionnaires. Pediatrics 2006; 118: e1178–86. [PubMed: 17015506]
3. Hix-Small H, Marks K, Squires J, Nickel R. Impact of implementing developmental screening at 12 and 24 months in a pediatric practice. Pediatrics 2007; 120: 381–9. [PubMed: 17671065]
4. Bayley N Bayley Scales of Infant and Toddler Development. San Antonio, TX: The Psychological Corporation; 2006.
5. Msall ME. Measuring functional skills in preschool children at risk for neurodevelopmental disabilities. Ment Retard Dev Disabil Res Rev 2005; 11: 263–73. [PubMed: 16161097]
6. Msall ME, Tremont MR, Ottenbacher KJ. Functional assessments of preschool children: Optimizing developmental and family supports in early intervention. Infants and Young Children 2001; 14: 46–66.
7. Sparrow SS, Cicchetti D, Balla DA. Vineland adaptive behavior scales. 1984.
8. Wright F, Boschen KA. The Pediatric Evaluation of Disability Inventory (PEDI): Validation of a new functional assessment outcome instrument. Canadian Journal of Rehabilitation 1993.
9. Msall ME, DiGaudio K, Duffy LC, LaForest S, Braun S, Granger CV. WeeFIM: normative sample of an instrument for tracking functional independence in children. Clinical pediatrics 1994; 33: 431–8. [PubMed: 7955782]
10. Newborg J, Riverside Publishing C. Battelle developmental inventory. Riverside Pub.; 2005.
11. Linstone HA, Turoff M. The delphi method. Addison-Wesley Reading, MA; 1975.
12. Park JJ. Development of a Functional Assessment Tool in Children Birth to 36 Months: Validation Study of the Warner Initial Developmental Evaluation of Adaptive and Functional Skills (Warner IDEA-FS) in Typical and Atypical Children. Chicago, IL: University of Chicago 2010.
13. Duffner PK, Granger C, Lyon N, Niewczyk P, Barczykowski A, Bauer S, Msall ME. Developmental and functional outcomes in children with a positive newborn screen for Krabbe disease: a pilot study of a phone-based interview surveillance technique. J Pediatr 2012; 161: 258–63 e1. [PubMed: 22381022]

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14. Mulkey SB, Arroyave-Wessel M, Peyton C, Bulas DI, Fourzali Y, Jiang J, Russo S, McCarter R, Msall ME, du Plessis AJ, DeBiasi RL, Cure C. Neurodevelopmental Abnormalities in Children With In Utero Zika Virus Exposure Without Congenital Zika Syndrome. JAMA Pediatr 2020.
15. Mulkey SB, Ramakrishnaiah RH, McKinstry RC, Chang T, Mathur AM, Mayock DE, Van Meurs KP, Schaefer GB, Luo C, Bai S. Erythropoietin and brain magnetic resonance imaging findings in hypoxic-ischemic encephalopathy: volume of acute brain injury and 1-year neurodevelopmental outcome. J Pediatr 2017; 186: 196–9. [PubMed: 28456387]
16. Youden WJ. Index for rating diagnostic tests. Cancer 1950; 3: 32–5. [PubMed: 15405679]
17. Veldhuizen S, Clinton J, Rodriguez C, Wade TJ, Cairney J. Concurrent validity of the Ages And Stages Questionnaires and Bayley Developmental Scales in a general population sample. Acad Pediatr 2015; 15: 231–7. [PubMed: 25224137]
18. Steenis LJ, Verhoeven M, Hessen DJ, van Baar AL. Parental and professional assessment of early child development: the ASQ-3 and the Bayley-III-NL. Early Hum Dev 2015; 91: 217–25. [PubMed: 25703316]
19. Schonhaut L, Armijo I, Schonstedt M, Alvarez J, Cordero M. Validity of the ages and stages questionnaires in term and preterm infants. Pediatrics 2013; 131: e1468–74. [PubMed: 23629619]

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What this paper adds:

- The WIDEA-FS mobility, communication, and social cognition domains are concurrently valid with the Bayley III motor, language and cognitive composite scores in high risk infants tested between 10 and 36 months of age
- The WIDEA-FS mobility and communication domains may be most clinically useful when assessed in children < 30 months of age

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Table 1.

Demographic and clinical characteristics of 341 children who received concurrent WIDEA-FS and Bayley-III testing.

	***N* = 341**
Female sex, *n* (%)	158 (46)
Gestational age at birth (in weeks), median, (*p*25, *p*75)	32, (29, 38)
Birthweight (g), median, (*p*25, *p*75)	1500, (1109, 3000)
Primary diagnosis for high-risk follow-up eligibility *n*, (%)	
Preterm birth	195 (58)
Neonatal encephalopathy	62 (18)
Unstable infant	46 (14)
Intracranial pathology	20 (6)
Other neurological pathology	18 (5)
Destination after NICU discharge *n*, (%)	
Home	315 (95)
Residential care	1 (<1)
Transfer to another hospital	15 (5)

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Table 2.

Concurrent mean Bayley-III and median WIDEA-FS scores of 341 children at four standardized follow-up time points. The timepoints represent the ages of the children when they were tested. WIDEA-FS medians are presented as raw scores.

	10 to <18 months	**18 to <24 months**	**24 to <30 months**	**30 months or older**
Number of children receiving assessment *n*, (%)	166 (40)	112 (26)	45 (11)	106 (25)
Mean Bayley-III Composite score ± SD (% with ≤ 85 score)				
Cognitive	102 ± 14 (11%)	101 ± 13 (14%)	106 ± 21 (11%)	103 ± 16 (13%)
Language	100 ± 13 (9%)	95 ± 13 (18%)	98.8 ± 19 (13%)	97±15 (18%)
Motor	94 ± 16 (28%)	98 ± 13 (15%)	98.4 ± 18 (18%)	95.6 ± 14 (17%)
WIDEA-FS raw scores, median, (*p*25, *p*75)				
Self-care (68 maximum score)	38, (34, 42)	45, (40, 50)	53, (46, 57)	58, (52, 63)
Mobility (36 max)	31, (24, 35)	36, (34, 36)	36, (35, 36)	36, (36, 36)
Communication (52 max)	34, (27, 43)	51, (38, 50)	51, (48, 52)	52, (49, 52)
Social cognition (44 max)	34, (29, 39)	39 (31, 41)	40, (37, 43)	41, (37, 43)

% with ≤ 85 score indicates the percentage of children scoring at least 1SD below the mean on the Bayley-III Composite Score

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Table 3.

Relationship between WIDEA-FS scores and adverse Bayley-III outcome (≤85; area under the ROC curve), and associations between WIDEA-FS scale scores and Bayley-III composite scores (represented by Spearman's correlations) among 341 children who received concurrent testing. The timepoints represent the ages of the children when they were tested with the WIDEA-FS and the Bayley-III.

	10 to <18 months	**18 to <24 months**	**24 to <30 months**	**30 months or older**
ROC curve area (95% CI)				
WIDEA-FS mobility and Bayley-III motor	0.82 (0.75,0.90)	0.81 (0.69,0.93)	0.91 (0.77,1.0)	0.61 (0.49,0.73)
WIDEA-FS communication and Bayley-III language	0.92 (0.85,0.98)	0.82 (0.71,0.94)	0.79 (0.61,0.98)	0.70 (0.55,0.85)
WIDEA-FS social cognition and Bayley-III cognitive	0.76 (0.64,0.89)	0.55 (0.39,0.71)	0.64 (0.36,0.91)	0.83 (0.71,0.94)
Spearman's correlations and *p*-values				
WIDEA-FS mobility and Bayley-III motor	0.59, $p<0.001$	0.40, $p<0.001$	0.41, $p<0.01$	0.27, $p<0.01$
WIDEA-FS communication and Bayley-III language	0.55, <0.001	0.66, <0.001	0.65, <0.001	0.51, <0.001
WIDEA-FS social cognition and Bayley-III cognitive	0.28, <0.001	−0.03, 0.77	0.26, 0.09	0.33, <0.001

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Table 4.

Specificity and sensitivity of WIDEA-FS in predicting Bayley-III normal versus abnormal composite scores at various cutpoints in 341 children who received concurrent WIDEA-FS and Bayley-III. The first raw score cutpoint is based on Youden's index (YI) and the second reported raw score cutpoint provides a sensitivity of at least 90% when available. 95% confidence intervals are reported for all values. The timepoints represent the ages of the children when they are tested with the WIDEA-FS and the Bayley-III.

Bayley Composite Score	**WIDEA-FS Scale**	**10 to <18 mo**		**18 to <24 mo**		**24 to <30 mo**		**≥30 mo**	
		Sp	**Se**	**Sp**	**Se**	**Sp**	**Se**	**Sp**	**Se**
Motor	Mobility	YI Cut point 25		YI cutpoint 35		YI cutpoint 36		YI cutpoint 36	
		89 (82,94)	62 (46,76)	81 (72,88)	71 (44,89)	87 (71,96)	88 (47,100)	87 (78,93)	33 (13,59)
		90% cutpoint 34							
Language	Communication	YI cutpoint 27		YI cutpoint 43		YI cutpoint 52		YI cutpoint 49	
		87 (80,92)	87 (60,98)	75 (65,83)	80 (56,94)	51 (35,68)	100 (54,100)	87 (78,93)	53 (29,76)
		90% cutpoint 30		90% cutpoint 48		90% cutpoint 52			
Cognitive	Social cognition	YI cutpoint 31		YI cutpoint 33		YI cutpoint 38		YI cutpoint 36	
		74 (67,81)	72 (47,90)	85 (77,92)	31 (11,59)	77 (61,89)	60 (15,95)	89 (81,95)	62 (32,86)
		90% cutpoint 40		90% cutpoint 44		90% cutpoint 44		90% cutpoint 42	
	Self-care	YI cutpoint 37		YI cutpoint 44		YI cutpoint 42		YI cutpoint 58	
		65 (57,73)	83 (59,96)	58 (48,68)	63 (35,85)	87 (73,96)	60 (15,95)	59 (49,70)	85 (55,98)
		90% cutpoint 49		90% cutpoint 53		90% cutpoint 60		90% cutpoint 60	

Sp = Specificity, Se=Sensitivity