

Original Research Article

Comparison of Trivandrum developmental screening charts against the standard Denver development screening test in children between 0-3 years

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ABSTRACT

Background: To compare of DDST II and TDSC in the age group of 0-3 years and to assess developmental delay at various age groups using TDSC.

Methods: 400 children were tested in their performance in the two tests since birth till 3 year of and their results were compared.

Results: TDSC has sensitivity of 66.66% and specificity of 98.93% in screening for developmental delays. Positive predictive value for TDSC came out to be 100.00% and Negative predictive value for TDSC came out to be 97.20 %. Prevalence rate of developmental delay was 11.25%.

Conclusions: Denver II test was concluded to be more sensitive test and TDSC as a more specific test.

Keywords: Development, TDSC, Delay

INTRODUCTION

The term developmental delay in a child is used when development lags behind established normal ranges for his or her age in areas of motor, cognitive, language, behavioural, emotional, or social development. Global developmental delay is defined as a delay in two or more developmental domains.¹ In India, sources have found prevalence of 1.5-2.5% of developmental delay in children less than 2 years of age.^{2,3} Early identification of developmental delay is important to prevent onward progression to disability family problem, peer problem, and school failure. In order to improve the identification of children with developmental delays early intervention can be provided in a timely manner, and a significant emphasis must be placed on the routine use of developmental screening. The Denver developmental screening test (DDST) is to help healthcare providers to detect developmental problems in young children. The

tests cover four general functions; personal social, fine motor adaptive, language, and gross motor. DDST II is an update of the Denver developmental screening test use by the physician, teacher and other childhood professional to monitor the development of children between birth and six years of age.⁴ Trivandrum developmental screening chart (TDSC) is a simple development screening test designed and validated at the child development centre, Thiruvananthapuram.⁵ This can be applied to children 0-3 years of age. The objectives of our study are to compare of DDST II and TDSC in the age group of 0-3 years and to assess developmental delay at various age groups using TDSC.

METHODS

This is a cross sectional study of infants from birth to 3 years conducted in the department of pediatrics, Chandulal Chandrakar memorial medical college, Durg, with effect from September 2017 to July 2019.

Inclusion criteria was all healthy babies up to one year of age, who visited Well baby clinic for immunization, feeding advice and for routine checkup were included. Any child with congenital malformation, dysmorphic child, history of perinatal asphyxia, sepsis, RDS, low birth weight, preterm babies and baby of a diabetic mother were excluded from the study.

The total sample size N (number of positive cases for developmental delay) was calculated using formula mentioned below:

$$N = (Z \text{ score})2SD \times (1 - SD)/(\text{margin of error})^2$$

Where confidence level was 95%, Z score=1.96, SD (standard deviation) was taken as 0.5 and a margin of error was taken as $\pm 5\%$. The sample size was calculated as approximately 400.

The study tools used in this study were the TDSC and DDST II. In Trivandrum development screening chart, there are 27 test items in the chart, carefully chosen after repeated trial and error. The age range of each test item is taken from the norms given in the Bayley scales of infant development. The left hand side of each horizontal dark line represented age at which 97% of the children passed the item in the Baroda sample. A vertical line is drawn or a pencil kept vertically, at the chronological age of the child being tested. If the child failed to achieve any item that falls on the left side of the vertical line, the child was considered to have a developmental delay (any obvious asymmetry is also considered abnormal). The Trivandrum developmental screening chart is a simple test which does not require a developmental kit. A pen and a bunch of keys are the only objects required. It can be administered by Anganwadi workers or any person with minimal training. The DDST II utilizes the materials are red yarn pom-pom (approximately 4" diameter), raisins, rattle with narrow handle, 10.1-inch square colored wooden blocks, small, clear glass bottle with a 5/8 inch opening, small bell, tennis ball, red pencil, small plastic doll with feeding bottle, plastic cup with handle and blank paper. The test

form has each of the items arranged within one of four sectors; personal-social, fine motor-adaptive, language, and gross motor. Age scales across the top and bottom of the test form depict ages in months and years from birth to 6 years.

The neurodevelopmental assessment was done in all children. It includes a detailed history with emphasis on pregnancy, delivery, neonatal period and course of development. Each child was subjected to a complete general and systemic examination including anthropometry. A milestone of every child was assessed on TDSC and DDST II. All subjects were screened with both TDSC and DDST II simultaneously by two separate persons to prevent observer bias. Data was analyzed using statistical functions available in Microsoft excel and SPSS (version 21.0 SPSS, USA). Sensitivity, specificity, positive predictive value, negative predictive value and prevalence rate were calculated.

RESULTS

400 cases were selected randomly from birth to 3 years of age who attended the Well baby clinic, department of pediatrics and the observations were made. Distribution of cases in the three age groups according to sex is shown in (Table 1). There is a predominance of male over female, with M: F of 1:0.92. In 0-12 months of 136 children 53.67% were male and 46.32% are female. In 12-24 months of children 50.79% males and 49.2% females out of 126. In 25-36 months there were 51.44% males and 48.55% females out of 138 children.

Table 1: Distribution of children in to three age groups according to sex.

| Age group (months) | Males N (%) | Females N (%) | Total |
|--------------------|-------------|---------------|-------|
| 0-12 | 73 (53.67) | 63 (46.32) | 136 |
| 12-24 | 64 (50.79) | 62 (49.20) | 126 |
| 25-36 | 71 (51.44) | 67 (48.55) | 138 |
| Total | 208 (52) | 192 (48) | 400 |

Table 2: Distribution of children detected normal and abnormal in the two developmental screening tests according to three age groups.

| Age group (months) | DSST II N (%) | | TDSC N (%) | | Total |
|--------------------|---------------|------------|-------------|-----------|-------|
| | Normal | Abnormal | Normal | Abnormal | |
| 0-12 | 120 (88.23) | 16 (11.76) | 123 (90.44) | 13 (9.55) | 136 |
| 12-24 | 112 (88.88) | 14 (11.11) | 115 (91.26) | 11 (8.73) | 126 |
| 25-36 | 123 (89.13) | 15 (10.86) | 127 (92.02) | 11 (7.97) | 138 |
| Total | 355 (88.75) | 45 (11.25) | 365 (91.25) | 35 (8.75) | 400 |

Normal and abnormal children according to age groups with both test DDST II and TDSC are shown in (Table 2). In 0-12 months of age 88.33% were normal and 11.76% were abnormal with DDST II whereas with TDSC 90.44% were normal and 9.55% were abnormal. In

13-24 months of age 88.88% were normal and 11.11% were abnormal with DDST II whereas with TDSC 91.26% were normal and 8.73% were abnormal. In 25-36 months of age 89.13% were normal and 10.86% were abnormal with DDST II whereas with TDSC 92.02%

were normal and 7.97% were abnormal. Overall 88.75% were normal and 11.25% were abnormal with DDST II whereas with TDSC 91.25% were normal and 8.75% were abnormal. There were increase in normality and decrease in abnormality as age advances.

TDSC has sensitivity of 66.66% and specificity of 98.93% in screening for developmental delays. Positive predictive value for TDSC came out to be 100.00% and negative predictive value for TDSC came out to be 97.20%. Prevalence rate of developmental delay was 11.25%. As the age advances the sensitivity falls from 81.25% to 73.33% and specificity remains same. The

positive predictive value remains same but negative predictive value falls from 97.56% to 96.85%.

Table 3: Cross tabulation of TDSC (0-3 years) against DDST II.

| TDSC | Abnormal | Normal | Total TDSC |
|-------------------|----------|----------|------------|
| Abnormal | 35 (TP) | 0 (FP) | 35 |
| Normal | 10 (FN) | 355 (TN) | 365 |
| Total DDST | 45 | 355 | 400 |

Table 4: Results of cross tabulation of TDSC (0-3 years) against DDST II.

| Test criteria | Formula | Calculations | Result |
|----------------------------------|---------------------------|---------------|----------|
| Sensitivity | TP/(TP+FN) | (35/45)×100 | 77.77 % |
| Specificity | TN/(TN+FP) | (355/355)×100 | 100.00 % |
| Positive predictive value | TP/(TP+FP) | (35/35)×100 | 100.00 % |
| Negative predictive value | TN/(TN+FN) | (355/365)×100 | 97.26 % |
| Prevalence rate | No. of cases/total sample | (45/400)×100 | 11.25 % |

Table 5: Results of cross tabulation of TDSC against DDST II according to three age groups.

| Criteria | Age groups | | |
|--------------------------------------|-------------|--------------|--------------|
| | 0-12 months | 13-24 months | 25-36 months |
| Sensitivity (%) | 81.25 | 78.57 | 73.33 |
| Specificity (%) | 100 | 100 | 100 |
| Positive predictive value (%) | 100 | 100 | 100 |
| Negative predictive value (%) | 97.56 | 97.39 | 96.85 |
| Prevalence rate (%) | 11.76 | 11.11 | 10.86 |

DISCUSSION

Ideally a screening test should be one with high sensitivity and specificity. It must be cheap, simple and time saving. Some of the children screened as delay in test might not be delayed when screened with the standard test. This type of error is called false positive or type 1 error. On other hand some are not delayed in screening test but are actually delayed with standard test. This type of error is false negative or type 2 error. Early detection is effective in preventing or minimizing the effects of potentially handicapping disorders.

DDST II and the TDSC were used as a screening tool to detect developmentally abnormal infants. The abnormality detection rate in Denver II was 11.76%, 11.11% and 10.86% in the age group of 0-12 months, 13-24 months, and 25-36 months respectively. While TDSC had detected 9.55%, 8.73% and 7.97% in the age group of 0-12 months, 13-24 months and 25-36 months respectively. Hence, in each of four age groups Denver II had declared higher number of children as abnormal when compared to the TDSC. A similar pattern of detecting higher number of abnormal children by Denver

II when compared to TDSC was observed even as the child grew.

Presence study having overall sensitivity of 77.77% and specificity of 100% with positive predictive value of 100% and negative predictive value of 97.26%. Validation of TDSC against DDST, using sample populations from a Kerala coastal village and babies attending well baby clinic of SAT hospital showed a sensitivity of 66.7% and a specificity of 78.8% with positive predictive value of 100% and negative predictive value 99.2-99.5%.⁹ Kannur et al shows sensitivity of 83.33% and specificity of 91.4% with positive predictive value of 38.4% and negative predictive value of 98.8%. The prevalence of developmental delay in our study was found to be 11.25% in children from 0 to 3 years using TDSC.⁸ Prevalence of developmental delay ranges from 3.5% to 10% of the general population in various studies.¹⁰⁻¹⁴

Denver developmental screening test was the most widely used screening tool up to six years of age, because of its ease of administration. However this test underwent a major revision and lead to development of modified

Denver development test or DDST II. The need to revise The DDST was felt because of difficulty in administering and scoring some test items, certain test items were inappropriate for various subgroups (such as ethnic groups, sexes, maternal educational levels, and places of residence). Hence, the modified Denver development test (DDST II) consisting of 125 items was devised, while the original DDST consisted of only 105 items.

TDSC is a simple development screening test designed and validated at the child development centre, Thiruvananthapuram. It is being used in the at risk baby clinic. It is a simple chart containing 27 items easily can be used by Anganwadi worker, ANM, nurse and paramedical staff in 10 min at low cost. It takes only 5-7 minutes to administer this test.

CONCLUSION

The results of developmental screening of an infant in the two different tests DDST II and TDSC are significantly different. Denver II test was a more sensitive test and TDSC was more specific test (specificity=100%). DDST suffers from over screening and TDSC suffers from under screening. Results of Denver II might not be reproducible if repeated on the same infant after a period of time, while results of TDSC are reproducible. Both of these test after detecting a child as abnormal require further detailed assessment. TDSC is a simple and convenient screening tool, for identifying children of developmental delay in the community in the age group 0-3 years. This screening test helps grassroots level health worker to identify early developmental delay and necessary intervention. This test is not suitable to diagnose developmental age and specific disability.

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