ORIGINAL RESEARCH PAPER

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# COMPARISON BETWEEN AGES AND STAGES QUESTIONNAIRE-3 AND TRIVANDRUM DEVELOPMENT SCREENING CHARTS AS A SCREENING TOOL FOR DEVELOPMENT DELAY

**KEY WORDS:** Developmental delay, ASQ-3, TDSC, cross-sectional study, neurodevelopmental screening.

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**ABSTRACT**

**Background:** Developmental delay in children is a critical concern globally, impacting long-term outcomes and imposing significant economic burdens. Early identification and intervention are crucial for mitigating adverse effects. **Objective:** This study aims to compare the effectiveness of two developmental screening tools, the Ages and Stages Questionnaire-3 (ASQ-3) and the Trivandrum Development Screening Charts (TDSC), in identifying developmental delays in children aged 2 to 60 months. **Methods:** A cross-sectional study was conducted at MGM Medical College, Aurangabad, from September 2022 to January 2023, involving 220 children. Informed consent was obtained from parents or guardians. Two pediatricians screened each child using TDSC and ASQ-3, respectively. Data was analysed using SPSS software, with descriptive statistics, kappa statistics, and Cronbach's alpha to assess agreement and reliability. **Results:** The mean age of participants was 25.02 months and 44.5% (98/220) were female. ASQ identified 68.6% of children with developmental delays, while TDSC identified 42.3%. The highest developmental delays were observed in the 13-18 months (67.74%) and 25-36 months (63.27%) age groups. Time taken for complete assessment by ASQ-3 was 20-25 minutes and by TDSC was 5-7 minutes. Moderate agreement was found between ASQ-3 and TDSC (Kappa = 0.407). Internal consistency for ASQ delay domains ranged from moderate to good (Cronbach's alpha 0.434 to 0.667). **Conclusion:** The study demonstrates that ASQ-3 identified a higher percentage of developmental delays compared to TDSC, with moderate agreement between the two tools. These findings highlight the importance of using multiple screening tools for early identification of developmental delays, ensuring timely intervention and support for affected children.

## INTRODUCTION

The World Health Organization (WHO) estimates that in 2019, 317 million children and young people were at risk of not reaching their developmental potential due to factors such as poverty, malnutrition, and limited access to healthcare and early education.[1] Developmental delays pose a substantial economic burden on families and societies. Children who received early intervention services had significantly better developmental scores highlighting the importance of developmental screening in primary care settings, particularly for preschool children.[2,3,4]

There are many Indian and international developmental screening tools available for assessment of developmental delay and disabilities like Baroda Developmental screening Test (BDST), Trivandrum Developmental Screening Chart (TDSC), ICMR Psychosocial developmental screening Test, Denver Developmental Screening Test II, Bayley Infant Neuro-developmental Screen (BINS), Parents Evaluation of Developmental Status (PEDS), Ages and stages questionnaire (ASQ), Developmental Profile II/ III and others. The psychometric performance of the western-developed instruments is strong, but they are not well suited for use in Indian setting due to their high costs, time commitment for training, and need for adaption.

Among these ASQ-3 is a commonly used questionnaire-based screening tool. According to an Indian study the overall sensitivity of ASQ-3 in detecting developmental delay is 83.3% and specificity is 75.4% with a negative predictive value of 84.6%.[5] A potential problem faced while using ASQ-3 is that it is based on the idea that the parent knows his or her child best. It is also time- consuming.

TDSC (0–6 y) is a easy to use Indian screening test. It was validated against Denver Developmental Screening Test (DDST) as the 'Reference Standard', the sensitivity and specificity of TDSC (0–6 y) was found to be 84.62 % (95 % CI: 71.92–93.12) and 90.8 % (95 % CI: 88.97–92.43) respectively with a Negative Predictive Value of 99.23 % (95 % CI: 98.48–99.67) and $LR_{(negative)}$ of 0.17 (95 % CI: 0.09–0.32). This test is only a screening test and is not suitable to diagnose developmental age and specific disability.[6]

This study aims to compare the agreement between ASQ-3 and TDSC Charts in identifying developmental delay across different developmental domains.

## MATERIALS AND METHOD

This cross-sectional study data was conducted at the child developmental clinic at MGM Medical College, Aurangabad, India, from September 2022 to January 2023.

Children aged 2 to 60 months, referred for suspected developmental delay were enrolled. Of these, children who were critically ill, not accompanied by reliable informants or under psychopharmacology therapy & anticonvulsants were excluded. Assuming a 15% proportion of positive ratings (developmental delay) by the two scales, 220 cases were required to estimate expected kappa k of 0.6, with a precision of 0.15 and 95% confidence level.[7,8]

Two trained pediatricians screened each child using TDSC

and ASQ-3 respectively. Ages and Stages Questionnaire-3 (ASQ-3) was developed by Dr. Jane Squires and Dr. Diane Bricker at the University of Oregon. It consists of questionnaires designed for different age groups, from 1 month to 5 years. It is a parent-reported initial developmental screening tool with 21 intervals, each with 30 items in five areas: communication, problem solving, gross motor, fine motor, personal social, and problem solving for children ages 2 to 66 months.

Trivandrum Development Screening Chart (TDSC) was developed by Dr. P. Nirmala and Dr. M. S. Bhat. It is a set of growth and developmental charts designed for children from birth to 6 years. The tool includes age-specific charts for motor skills, language, personal-social skills, and adaptive behaviour.

Data was entered into a master sheet in MS Excel and analysed using SPSS software. Categorical variables were summarized using frequency and percentages, while quantitative variables were summarized as mean, median, standard deviation, and interquartile range. Agreement between ASQ-3 and TDSC was assessed using kappa statistics, and Cronbach's alpha evaluated the internal validity of ASQ-3. Informed consent was obtained from parents or guardians. Ethical permission was obtained from institutional ethical committee on 29th June, 2023, number: MGM-ECRHS/2023/117

## RESULTS

In this study, a total of 220 children underwent screening for developmental delay using two tests, namely the Ages and Stages Questionnaire (ASQ) and the Trivandrum Development Screening Charts (TDSC).

The children had a mean age of 25.02 months (SD = 17.73). Of the 220 participants, 122 (55.5%) were male. The ASQ scale indicated that 151 children (68.6%) had developmental delay, while the TDSC identified 93 children (42.3%) with developmental delay.

Frequency of developmental delay was assessed across various components of the ASQ scale. The results revealed that 74 children (33.6%) exhibited delay in the Gross Motor component, 101 children (45.9%) showed delay in the Fine Motor component, 66 children (30%) displayed delay in the Communication component, 104 children (47.3%) demonstrated delay in the Psycho-social component, and 74 children (33.6%) exhibited delay in the Problem-Solving component.

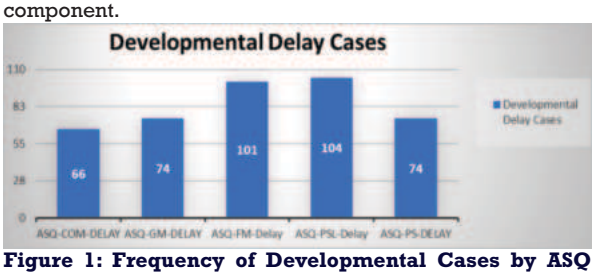


**Figure 1: Frequency of Developmental Cases by ASQ Scale**

A percentage agreement, Cohen's Kappa, and McNemar test were conducted to evaluate the agreement between the Ages and Stages Questionnaire (ASQ) and the Trivandrum Developmental Screening Chart (TDSC) for identifying developmental delays in children. Out of 220 children screened, 126 were classified as not delayed by the TDSC, of which 64 were also classified as not delayed by the ASQ, and 62 were classified as delayed. Among the 94 children identified as delayed by the TDSC, 89 were also classified as delayed by the ASQ, while 5 were classified as not delayed. The two screening tools had an overall agreement of 69.5%, indicating that the two tools classified 69.5% of the subjects similarly as either delayed or not delayed.

Cohen's Kappa demonstrated a moderate level of agreement between the two tools ($\kappa = 0.42$, SE = 0.05, 95% CI [0.33, 0.51], $p < .001$), suggesting that while there is some overlap in the identification of developmental delays, discrepancies exist between the two screening tools. The McNemar test indicated a statistically significant difference in the classifications of delay between the ASQ and TDSC ($\chi^2 = 48.5$, df = 1, $p < .001$), with the ASQ identifying more children as delayed than the TDSC. These results indicate that while the two tools show moderate agreement, they are not fully interchangeable, and the ASQ tends to identify a higher proportion of developmental delays compared to the TDSC.

**Table 1: TDSC vs ASQ Delay: Observed Frequencies and Percentages**

| TDSC-Delay | | ASQ-Delay | | Total |
|---|---|---|---|---|
| | | No | Yes | |
| No | Observed | 64 | 62 | 126 |
| | % within row | 50.8% | 49.2% | 100.0% |
| Yes | Observed | 5 | 89 | 94 |
| | % within row | 5.3% | 94.7% | 100.0% |
| Total | Observed | 69 | 151 | 220 |
| | % within row | 31.4% | 68.6% | 100.0% |

## DISCUSSION

Developmental delay is a global concern, affecting approximately 10-15% of children under the age of five, according to the World Health Organization (WHO).[9] Our study found that developmental delay was identified in 68.6% of children using the ASQ-3 and in 42.3% of children using the TDSC. These findings are in line with previous studies, such as one by Nair et al. (2013), which found a higher detection rate of developmental delay when using parent-reported tools compared to clinician-administered ones.[10]

Developmental screening tools are necessary for identifying children who may require further investigation and possible intervention. They serve as an initial step in pinpointing potential issues. An effective screening tool should be brief, valid, reliable, standardized, and include all developmental areas. In our study, the ASQ-3, a parent-reported tool, and the TDSC, a clinician-administered tool, were used. Previous studies, such as those examining the agreement between the ASQ and other tools like the Developmental Assessment Scale for Indian Infants (DASII) and the Battelle Developmental Inventory, have consistently shown high sensitivity and good agreement between the ASQ and other developmental measures. For example, the ASQ demonstrated 83.3% sensitivity and 75.4% specificity when validated against DASII, highlighting its effectiveness in identifying developmental delays.[8] Similar findings have been reported in studies comparing the ASQ to the Pediatric Developmental Impression (PDI), which showed an 81.8% agreement, and to the Bayley Scales of Infant Development (BSID-II), where the ASQ had 100% sensitivity and 87% specificity for children under 24 months.[11,12]

The time efficiency of TDSC (5-7 minutes compared to 20-25 minutes for ASQ-3) may make it a more feasible option in busy clinical settings, particularly in resource-limited environments. The study also highlighted domain-specific findings, where ASQ-3 identified the highest delays in the fine motor (45.9%) and personal-social (47.3%) domains. This suggests that these areas may require particular attention and targeted interventions.

The moderate agreement found between ASQ-3 and TDSC (kappa = 0.42) suggests that while these tools align, they are not entirely interchangeable. A Thai study (2104) found similar fair to moderate agreement between ASQ and other screening tools like the Denver Developmental Screening Test II (DDST II).[13] In our study, the McNemar test indicated

statistically significant differences in discordant cases between ASQ-3 and TDSC, with the ASQ identifying more children as delayed than the TDSC. These results indicate that while the two tools show moderate agreement, they are not fully interchangeable, and the ASQ tends to identify a higher proportion of developmental delays compared to the TDSC.

A study was done in 2020 in Chhatisgarh, India to evaluate developmental delay in different age groups using TDSC and to compare DDST II and TDSC in the 0–3 years age group. Comparison was made between the findings of 400 children who were assessed from birth to three years old. It was found that 98.93% specificity and 66.66% sensitivity was achieved by TDSC when screening for developmental delays. The results showed that the TDSC had a positive predictive value of 100.00% and a negative predictive value of 97.20%.[14]

The highest prevalence of developmental delay in our study was observed in the age group of 13 to 18 months (67.74%), followed by 25 to 36 months (63.27%). The age group with the lowest percentage of developmental delay was 0 to 6 months (50.00%). The results indicate that developmental delays are present across various age groups, emphasizing the importance of early screening and intervention to support children's developmental progress. The gender distribution indicates a relatively balanced representation of male and female participants, which enhances the study's generalizability and ensures that findings can be more broadly applicable to both genders.

Overall, the study's findings suggest that although requiring more time, ASQ-3 is a better tool than TDSC for identifying developmental delays in young children.

Limitation of our study is the reliance on parent-reported data for ASQ-3, which may introduce bias due to subjective reporting. Studies such as those by Shevell et al. (2014) have noted that parental bias can affect the accuracy of developmental screening tools.[15] No standard test like DASII was used to validate the 2 screening tests. Additionally, the study was conducted in a single center, which may limit the generalizability of the findings to other populations.

Though TDSC cannot replace ASQ-3, addition of language evaluation scale Trivandrum (LEST) may improve its performance. In future we can plan multi-centric, large sample size studies using LEST with TDSC to increase its sensitivity.

## SUMMARY AND CONCLUSION

The present study compared the Ages and Stages Questionnaire-3 (ASQ-3) and Trivandrum Development Screening (TDSC) Charts as screening tools for developmental delay in children aged 2 months to 60 months. The results indicated that both ASQ-3 and TDSC are effective in identifying developmental delays in young children. ASQ-3 identified higher percentage of developmental delays, while TDSC also showed moderate agreement with ASQ-3. The study found varying prevalence of developmental delay across different domains, with Fine Motor and Problem-Solving domains showing the highest percentage of developmental delay cases. The age-wise distribution of developmental delay cases revealed a higher prevalence in the 13 to 18 months age group.

## REFERENCES


1. WHO. "New Report Highlights Neglected Health Needs of Children with Developmental Disabilities." Www.who.int, 15 Sept. 2023, www.who.int/news/item/15-09-2023-new-reports-highlights-neglected-health-needs-of-children-with-developmental-disabilities.
2. Bailey, D. B., Jr, Hebbeler, K., Scarborough, A., Spiker, D., & Mallik, S. (2004). First experiences with early intervention: a national perspective. Paediatrics, 113(4), 887–896. https://doi.org/10.1542/peds.113.4.887
3. Sheldrick, R. C., & Perrin, E. C. (2013). Evidence-based milestones for surveillance of cognitive, language, and motor development. Academic paediatrics, 13(6), 577–586. https://doi.org/10.1016/j.acap.2013.07.001
4. Center on the Developing Child at Harvard University. (2007). "The Science of Early Childhood Development." Retrieved from: https://developingchild.harvard.edu/resources/the-science-of-early-childhood-development/
5. Juneja, M., Mohanty, M., Jain, R., & Ramji, S. (2012). Ages and Stages Questionnaire as a screening tool for developmental delay in Indian children. Indian paediatrics, 49(6), 457–461. https://doi.org/10.1007/s13312-012-0074-9
6. Nair, M. K., Nair, G. S., George, B., Suma, N., Neethu, C., Leena, M. L., & Russell, P. S. (2013). Development and validation of Trivandrum Development Screening Chart for children aged 0-6 years [TDSC (0-6)]. Indian journal of paediatrics, 80 Suppl 2, S248–S255. https://doi.org/10.1007/s12098-013-1144-2
7. Sharma, N., Masood, J., Singh, S. N., Ahmad, N., Mishra, P., Singh, S., & Bhattacharya, S. (2019). Assessment of risk factors for developmental delays among children in a rural community of North India: A cross-sectional study. Journal of education and health promotion, 8, 112. https://doi.org/10.4103/jehp.jehp_405_18
8. Arifin, W. N. (2024). Sample size calculator (web). Retrieved from http://wnarifin.github.io
9. World Health Organization. Early childhood development and disability: A discussion paper. Geneva: World Health Organization; 2012.
10. Nair, M. K., George, B., Padmamohan, J., Sunitha, R. M., Resmi, V. R., Prasanna, G. L., & Leena, M. L. (2009). Developmental delay and disability among under--5 children in a rural ICDS block. Indian paediatrics, 46 Suppl, s75–s78.
11. Hix-Small, H., Marks, K., Squires, J., & Nickel, R. (2007). Impact of implementing developmental screening at 12 and 24 months in a pediatric practice. Paediatrics, 120(2), 381–389. https://doi.org/10.1542/peds.2006-3583
12. Gollenberg, A. L., Lynch, C. D., Jackson, L. W., McGuinness, B. M., & Msall, M. E. (2010). Concurrent validity of the parent-completed Ages and Stages Questionnaires, 2nd Ed. with the Bayley Scales of Infant Development II in a low-risk sample. Child: care, health and development, 36(4), 485–490. https://doi.org/10.1111/j.1365-2214.2009.01041.x
13. Srinithiwat, B., & Ularntinon, S. (2014). Concurrent validity of the Ages & Stages Questionnaires, Third Edition, Thai-version (ASQ-3 Thai) with the Denver Developmental Screening Test II (DDST-II) in developmental screening of 18, 24, and 30 months old children at Queen Sirikit National Institute of Child Health. Journal of the Medical Association of Thailand = Chotmaihet thangphaet, 97 Suppl 6, S6–S13.
14. Dewangan, M., & Sharma, P. (2020). Comparison of Trivandrum developmental screening charts against the standard Denver development screening test in children between 0-3 years. International Journal of Contemporary Paediatrics, 7, 2142.
15. Shevell, M. I., Majnemer, A., Rosenbaum, P., & Abrahamowicz, M. (2001). Profile of referrals for early childhood developmental delay to ambulatory subspecialty clinics. Journal of child neurology, 16(9), 645–650. https://doi.org/10.1177/088307380101600904