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Use of Trivandrum Developmental Screening chart for Neurodevelopmental Assessment in Children upto 6 years of age with congenital heart diseases

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ABSTRACT:

INTRODUCTION: Congenital heart disease (CHD) is one of the most prevalent congenital abnormalities in children, affecting approximately 9 out of every 1000 live births. Advancements in cardiac catheterization, surgery, and intensive care have significantly reduced mortality rates in infants with complex CHD. However, these children are at a higher risk of neurodevelopmental delays, which affect their overall quality of life. This study aims to evaluate the prevalence of developmental delays in children with CHD using the Trivandrum Development Screening Chart (TDSC).

MATERIALS AND METHODOLOGY: This observational study was conducted at Vikhe Patil College, Ahmednagar, Maharashtra, in the Pediatrics Department. The study included 46 children aged 0-6 years over a period of 1 year, diagnosed with CHD based on 2D ECHO results. The children were further classified into acyanotic and cyanotic CHD. Neurodevelopmental assessment was conducted using the TDSC, with developmental delays identified based on failure to meet age-specific milestones. **RESULTS:** The gender distribution showed 52.17% males and 47.83% females. The highest incidence of CHD was observed in infants aged 7–12 months (32%), followed by children up to 6 months (26%). Ventricular septal defect (45.83%) was the most common acyanotic CHD, while Tetralogy of Fallot (40.91%) was the most prevalent cyanotic CHD. Delays in diagnosis were observed in 37.50% of acyanotic CHD cases and 59.09% of cyanotic CHD cases.

CONCLUSION: The study highlights the importance of early diagnosis and timely intervention in children with CHD to reduce the risk of neurodevelopmental delays. The TDSC proved to be an effective screening tool for identifying developmental delays, particularly in areas with limited access to specialized care. Early detection and intervention can significantly improve the long-term outcomes for children with CHD.

Keywords: Congenital heart disease (CHD), Neurodevelopmental delays, Trivandrum Development Screening Chart (TDSC), Acyanotic CHD, Cyanotic CHD, Developmental assessment

INTRODUCTION:

One of the most prevalent congenital abnormalities in children is congenital heart disease (CHD).[1] Of children, about 28% have one or more serious congenital malformations related to cardiac problems. The incidence of CHD varies between 4 and 50 per 1000 live births worldwide.[2] It was discovered that 9 out of every 1000 live babies had CHD.[3] The field of cardiac catheterization techniques, surgery, intensive care management, and medication therapy has advanced significantly in recent years, leading to a notable decrease in the mortality rates of infants with complex congenital heart disease. While these advancements have a good effect by extending the life expectancy of these children, they also have a negative neurological impact by contributing to neurodevelopmental disorders, poor academic performance, developmental delays, and difficulties with daily living activities. Due to the impact that congenital heart disease (CHD) has on a child's general development, children with CHD are more likely than normal children to experience neurodevelopmental delay.[4] These children's neurodevelopmental delay is linked to a variety of intrauterine events, surgical procedures, or developmental disorders such as shock, low perfusion, acid-base imbalances, and hypoxic episodes. Furthermore, children with cyanotic congenital heart disease have more severe adverse outcomes (CCHD)

Because of either lower blood oxygen content or decreased blood supply to the brain, congestive heart failure (CHD) impairs brain growth. The focus has shifted to improving the neurodevelopmental outcomes of CHD children in recent years due to improved survival rates brought about by advanced management approaches. This will ultimately improve the children's quality of life over the long run.[5] It is crucial that babies have routine follow-up care at a medical center that specializes in evaluating their nutritional status, developmental evaluation, and neurological examination. These children are more likely to experience malnourishment, delayed developmental milestones (Development Quotient, DQ), and decreased social quotient; these issues can be identified early on with routine follow-up.[6] Even if a child is not at risk, the American Heart Association advises routine testing from infancy through adolescence. Neurodevelopment is impacted by CHD, which will have a long-term effect on the child's overall outcome. All areas of development—gross motor, fine motor, language, cognitive, and social—are negatively impacted by CHD. When a child reaches school age, in particular, these negative neurodevelopmental outcomes manifest as poor memory, difficulty organizing tasks, lack of coordination in visuospatial tasks, slow math computation speed along with delayed language, and poor sociocommunication skills when compared to peers of the same age.[7]

Numerous studies conducted globally have revealed that children with CCHD experience a more significant neurodevelopmental delay than those with acyanotic CHD (ACHD).[8] Given the dearth of research on the neurodevelopmental state and the percentage of developmental delay in pediatric CHD patients, the current study was conducted. The study's goal was to use the Trivandrum development screening chart (TDSC) to determine the percentage of developmental delay in individuals with congestive heart failure.

MATERIAL AND METHODS:

The study is an observational research conducted over a period of one year in the Pediatrics Department at Vikhe Patil College, Ahmednagar, Maharashtra. It focused on children aged 0 to 6 years who were diagnosed with congenital heart disease (CHD). A total of 46 participants were included, and they were categorized into acyanotic congenital heart disease (ACHD) and cyanotic congenital heart disease (CCHD) based on 2D ECHO test results. Neurodevelopmental assessment was carried out using the Trivandrum Development Screening Chart (TDSC), with developmental delays identified by the failure to meet a single age-specific criterion outlined by the TDSC.

RESULTS:

The gender distribution of the study population revealed that 52.17% were male (24 individuals) and 47.83% were female (22 individuals), giving a total sample size of 46 (Table 1).

The age distribution varied across the study. The highest proportion of children was found in the 7–12-month age group, accounting for 32% (15 cases). This was followed by children up to 6 months old with 26% (12 cases). A smaller proportion was observed in the 13–18-month age group at 4.35% (2 cases), and the 19–24-month age group at 6.21% (3 cases). The older age groups, including 25-30 months and 31-36 months, each had 2.17% (1 case each). There were 6.21% (3 cases) in the 37–48-month age range, 8.70% (4 cases) in the 49-60 months, and 10.87% (5 cases) in the 61–72-month age range (Table 2).

Among the cases of acyanotic congenital heart disease (CHD), ventricular septal defect (VSD) was the most common, comprising 45.83% (11 cases). Atrial septal defect (ASD) followed, accounting for 29.17% (7 cases), and patent ductus arteriosus (PDA) made up 16.67% (4 cases). Combined forms such as ASD with PDA and ASD with PSD each accounted for 4.17% (1 case each), making a total of 24 cases (Table 3).

For cyanotic congenital heart disease (CHD), Tetralogy of Fallot (TOF) was the most prevalent, found in 40.91% (9 cases). Transposition of the great arteries (TGA) was observed in 27.27% (6 cases), followed by total anomalous pulmonary venous connection (TAPVC) at 18.18% (4 cases), and tricuspid atresia at 13.64% (3 cases), with a total of 22 cases (Table 4).

Regarding the proportion of delay in CHD diagnosis, acyanotic CHD had 9 cases with delays and 15 cases with no delays. In cyanotic CHD, 13 cases experienced delays, while 9 cases

had no delays. Overall, there were 22 cases with delays and 24 cases without delays (Table 5).

Table 1. Gender distribution

Gender	Frequency	Percent (%)
Male	24	52.17
Female	22	47.83
Total	46	100%

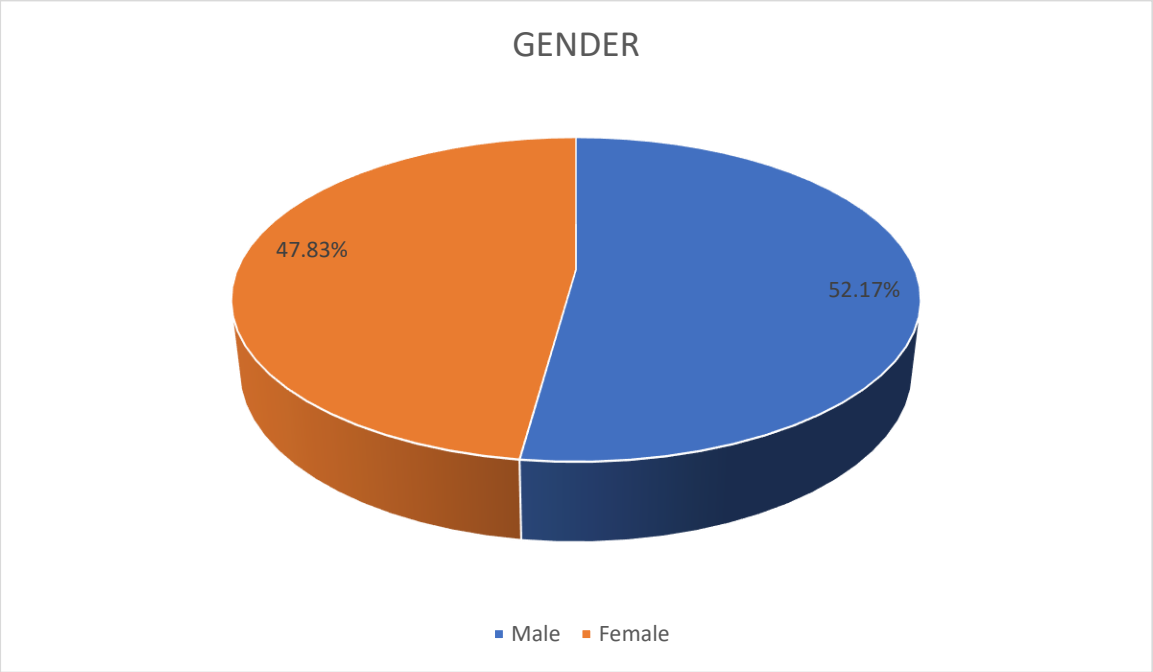


Table 2. Age distribution

Age	Frequency	Percent (%)
Upto 6mo	12	26
7-12 months	15	32
13-18 months	2	4.35
19-24 months	3	6.21
25-30 months	1	2.17
31-36 months	1	2.17
37 – 48 months	3	6.21
49 – 60 months	4	8.70
61 – 72 months	5	10.87

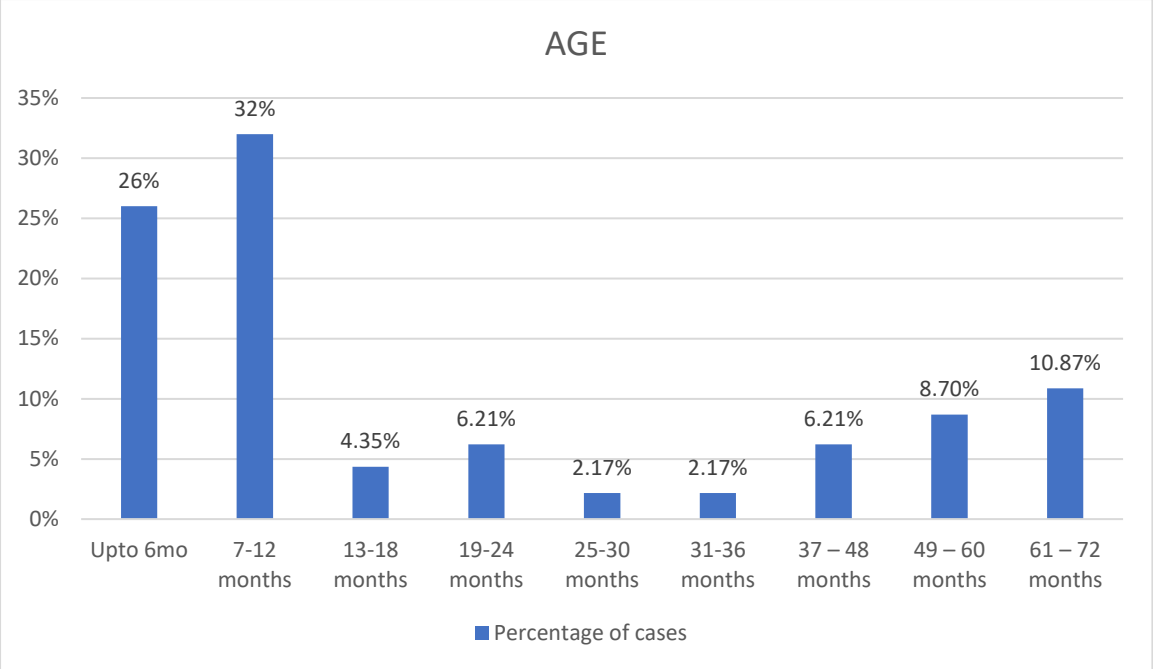


Table 3: Acyanotic congenital heart disease

Acyanotic congenital heart disease	Frequency	Percent (%)
Ventricular septal defect	11	45.83
Atrial septal defect	7	29.17
Patent ductus arteriosus	4	16.67
ASD with PDA	1	4.17
ASD with PSD	1	4.17
Total	24	100.00

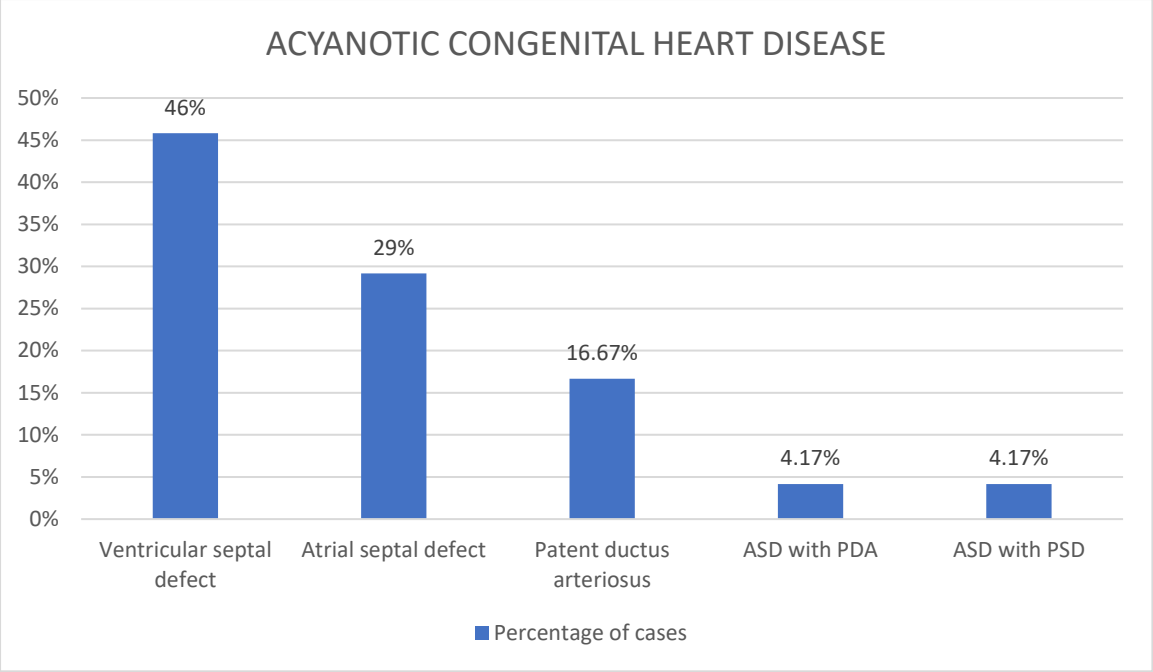


Table 4: Cyanotic congenital heart disease

Cyanotic congenital heart disease	No of cases	Percentage (%)
Tetralogy of fallot	9	40.91
Transposition of great arteries	6	27.27
Total anomalous pulmonary venous connection	4	18.18
Tricuspid atresia	3	13.64
Total	22	100.00

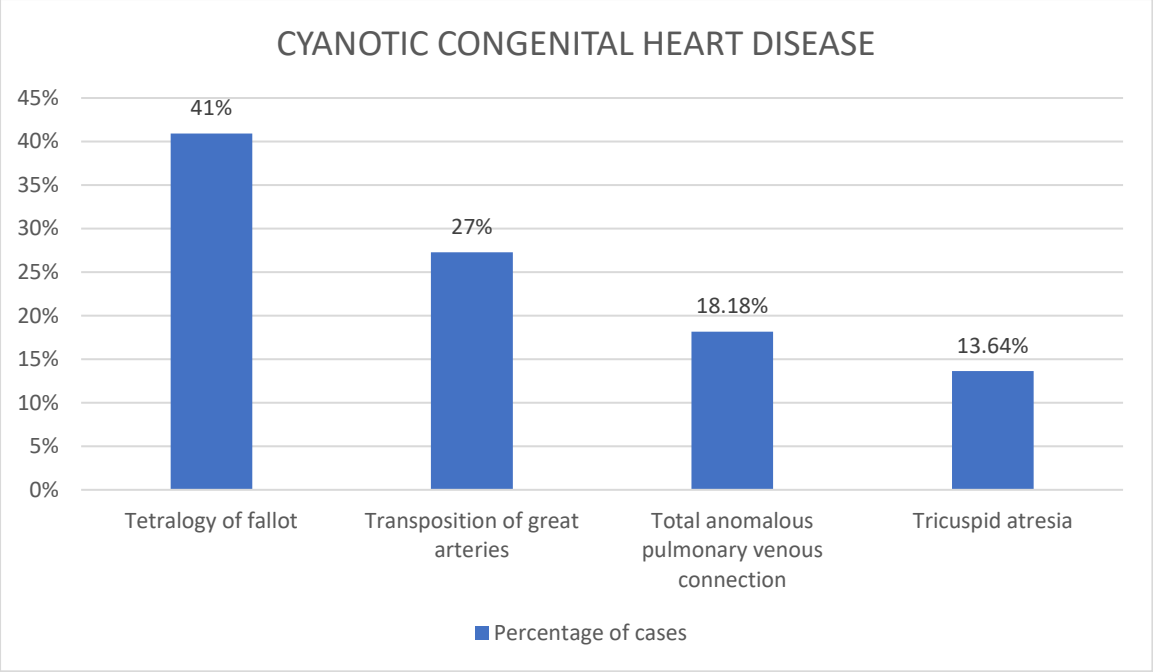
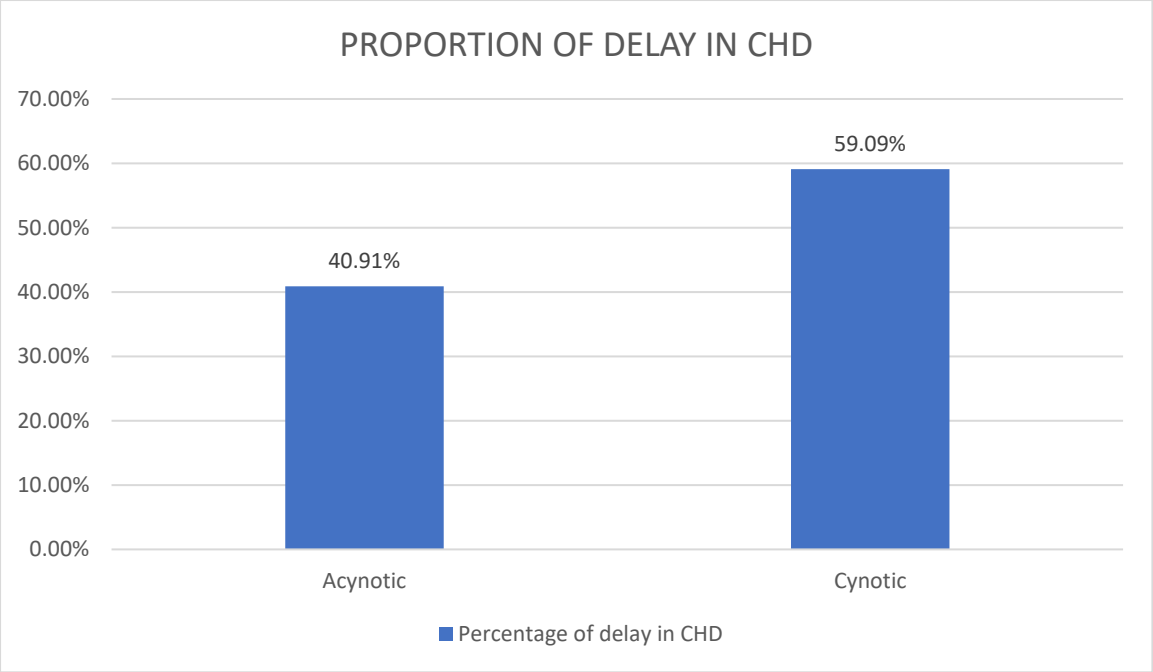

CYANOTIC CONGENITAL HEART DISEASE
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
41%
27%
18.18%
13.64%
Tetralogy of fallot
Transposition of great arteries
Total anomalous pulmonary venous connection
Tricuspid atresia
Percentage of cases

Table 5: Proportion of delay in CHD

Type of CHD	Delay (%)	No delay (%)
Acynotic	9	15
Cynotic	13	9
Total	22	24



DISCUSSION:

One of the major causes of newborn death is congenital heart disease (CHD). Numerous studies have demonstrated that, in comparison to children without CHD, children with CHD experience higher neurodevelopmental delays.[9] Our study's objectives were to ascertain the prevalence of developmental delay in children with congenital heart disease (CHD) and to examine the neurodevelopmental outcome in these children between the ages of 0 and 6 years. A developmental screening method for community screening ought to be straightforward, use less time, be understandable by parents and community health workers, and cover all developmental domains. All these requirements are met by TDSC (0-6 Y).

A research that was commissioned by the Public Health Agency of Canada found that the most popular test for identifying developmental issues in children is the DDST.[10] But because they required additional knowledge, DDST and DDST-II [11] were not thought to be appropriate as screening instruments for community health workers. According to the author, the TDSC (0–6 Y) is an effective, practical, and straightforward Indian tool for identifying 0–6-year-olds in the community who have developmental delays.

Ratanachu-Ek and Pongdara's [12] study on CHD found that the delay was greater in females than in males, with a ratio of 0.7:1, which is similar to our findings. With a ratio of 0.7:1, the delay was more noticeable in females than in males, which was comparable to another study by Mitchell et al.[13] that included 48 instances with CHD and had a M:F ratio of 0.9:1. M: F in our study was 1.09:1. Analogous to Lata et al. [6]. Unlike many other studies, a larger age group was included in our study's study sample. In our study, the male to female ratio was

1.09:1. Plotting on the TDSC chart, children with CHD showed neurological delay in all four developmental domains (gross motor, fine motor, language, and social adaptation).

Lata et al. [6] observed that the motor development was delayed in 75% children with cyanotic heart disease and 35.3% with ACHD. Neurological delay was present in children with CHD as plotted on TDSC chart in all 4 developmental domains, i.e., gross motor, fine motor, language, and social adaptive.
The most frequent type of CHD discovered in this investigation was ventricular septal defect (45.83%). Following ventricular septal defect, atrial septal defect (29.17% and patent ductus arteriosus (16.67%) were the most often occurring cardiac defects in acyanotic CHDs. The current study's findings are consistent with those of a study conducted by Bhat et al., which found that in 30.4% of patients, ventricular septal defect was the most common, followed by atrial septal defect in 17.63% and patent ductus arteriosus in 9.62% of patients.[14] The inclusion of newborns in the current study may be the cause of the greater incidence of VSD. In fact, the incidence of VSDs is overestimated when it comes to hemodynamically relevant VSDs. The decreased incidence of ASD may be caused by the condition's faint murmur and often asymptomatic early life, which lowers the detection rate. As a result, the prevalence of atrial septal defect in children is really understated. It is possible to explain the low incidence rate of PDA by excluding out PDA that is hemodynamically unimportant in newborns. Due to the fact that AVSD is typically linked to triosomy 21, a decreased incidence of AVSD may result from a higher attrition rate among children who have triosomy. In ACHD, 9 (37.50%) children had a delay and 15 (62.50%) children had no delay. In CCHD, 9 (40.91%) children had no delay and 13 (59.09%) children had a delay.

CONCLUSION:

In conclusion, the study highlights key demographic and clinical characteristics of children with congenital heart disease (CHD). The gender distribution shows a slight male predominance. The highest incidence of CHD was found in infants up to 12 months of age, indicating the critical need for early diagnosis and intervention. Among acyanotic CHDs, ventricular septal defect (VSD) was the most prevalent, while Tetralogy of Fallot (TOF) was the most common cyanotic CHD. Additionally, a significant proportion of both acyanotic and cyanotic CHD cases experienced delays in diagnosis, underscoring the importance of timely recognition and management to improve outcomes. The burden of CHD is mostly unacknowledged and undervalued. Children with congenital heart disease (CHD) have a significant rate of neurodevelopmental delay. The TDSC is a straightforward screening instrument that can be used to determine the neurodevelopmental outcome of these children without the need for specialized training. Children with developmental delays are identified as soon as possible through screening using a straightforward test like the TDSC, especially in remote areas with less access to medical care. This helps the children receive early intervention and, over time, has positive neurodevelopmental outcomes.

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