

PRESS RELEASE

Toyama, March 2, 2026

Birth Order Difference in Neurodevelopment Appears Within the First Year of Life

Using Ages & Stages Questionnaires[®], Third Edition (ASQ[®]-3), researchers found birth order differences in neurodevelopment within first year of life

Birth order, a non-genetic factor, may influence early neurodevelopment. A nationwide Japanese birth cohort study based on sibling pairs suggests that differences in neurodevelopment emerge during the first year of life. Second-born infants scored slightly lower than firstborns across several domains and had lower levels of parental engagement. The study suggests that differences in caregiver-reported parental engagement may partly account for these small but consistent early developmental gaps, though their long-term clinical significance remains unclear.

Birth order has long been linked to differences in cognition, with firstborn children often outperforming their later-born siblings. Parental engagement and interaction have been suggested as potential influences on this difference. However, only a few studies have compared siblings within the same family, particularly in the first year of life, making it difficult to fully separate birth order from broader family background factors. Such within-family comparisons may help address this gap.

The within-family comparison was made possible by the Japan Environment and Children's Study (JECS). JECS is a nationwide birth cohort study supported by the Ministry of the Environment, Japan, designed to investigate environmental factors affecting children's health and development. Women who became pregnant again during the recruitment period were able to re-enroll, allowing researchers to identify sibling pairs within the same family. In total, approximately 5,000 sibling pairs have been registered in the cohort, of which 2,117 firstborn–second-born pairs were included in the present analysis.

Using data from JECS, the study compared neurodevelopmental outcomes between firstborn and second-born children. It was led by Assistant Professor Akiko Tsuchida from the University of Toyama, Japan, together with co-authors from the University of Toyama, Aomori University of Health and Welfare, and Gunma University. Their study will be published in [Jama Network Open](#) journal on March 6, 2026.

“The research idea was sparked by a news article that noted many players on Japan’s national football team are later-born children, with very few firstborns represented,” said Dr. Tsuchida. *“That observation made me wonder how siblings—who share much of the same genetic background—can nevertheless show systematic differences in outcomes. As I reviewed the literature, I found consistent evidence suggesting that firstborns often have advantages in cognitive and socioeconomic outcomes. Theoretical explanations such as parental investment*

and the confluence model have been proposed, but I wanted to understand how early in life such differences might first emerge.”

The study was based on 2,117 pairs of firstborn and second-born singleton siblings. The Ages & Stages Questionnaire®, Third Edition (ASQ®-3), a popular parent-completed developmental screening tool, was used to evaluate all children at 6 and 12 months. The researchers employed a mother fixed-effects approach, which compares siblings within the same family. This approach accounts for shared, stable family characteristics, such as parenting style and socioeconomic background. The researchers also measured parental engagement using a 5-item composite score, capturing how often caregivers played with, read to, and took their infants outdoors.

At 6 months, second-born infants scored lower than their firstborn siblings across all ASQ®-3 domains, which included communication skills, gross motor skills, fine motor skills, problem-solving skills, and personal-social skills. The gap varied across domains, ranging from a 1.9-point difference in communication to a 13.8-point difference in personal-social development. By 12 months, differences remained for fine motor and personal-social skills, while those in communication and problem-solving were smaller and no longer statistically significant.

These reduced differences observed at 12 months may be partly explained by the ‘confluence model,’ which suggests that a child’s intellectual development is shaped by the average intellectual environment of their home. Later-born infants may benefit from observing and interacting with older siblings as they grow, potentially offsetting reduced parental resources.

An interesting pattern also emerged in the parental engagement, with second-born children having lower engagement scores than firstborns. These parallel reductions in both developmental scores and parental engagement are consistent with the ‘resource dilution model,’ which proposes that as family size grows, the time and attention available per child may decrease. Reduced parental engagement may be related to early developmental differences.

“Our findings suggest that parental engagement may be one piece of the complex processes underlying early neurodevelopmental differences,” Dr. Tsuchida concluded. *“Understanding these dynamics may help inform efforts to support children’s development, regardless of birth order.”*

Image

Birth Order Differences in Neurodevelopment Emerge Within the First Year

Birth order, a non-genetic factor, has long been thought to be associated with differences in early cognitive and motor development



However, studies comparing the neurodevelopment of siblings during the first year is limited



Sibling dyads (firstborn and second-born)
N = 2117



Neurodevelopment evaluation at 6 and 12 months



Parental engagement assessment

Second-born infants showed significantly lower ASQ®-3 scores than firstborns

Significant differences at 6 months

- Communication: -1.9 points (minimum difference)
- Gross motor: -6.4 points
- Fine motor: -5.9 points
- Problem-solving: -6.7 points
- Personal-social development: -13.8 points (maximum difference)



Some differences persisted at 12 months

- Fine motor: -3.9 points
- Personal-social development: -4.8 points



Lower parental engagement for second-born children
Mean difference: -0.77 points (95% CI, -1.26 to -0.29 points)

CI: confidence interval; ASQ®-3: A Ages & Stages Questionnaires®, Third Edition

Small but consistent birth order differences in neurodevelopment are observable within the first year of life

Birth Order Differences in First-Year Neurodevelopment

Tsuchida et al. (2026) | *JAMA Network Open* | DOI: 10.1001/jamanetworkopen.2026.1265



Title: Birth Order Differences in Neurodevelopment Emerge Within the First Year

Caption: A large Japanese cohort study used a within-family design to compare early neurodevelopmental outcomes among pairs of firstborn and second-born singleton children enrolled in the Japan Environment and Children's Study (JECS).

The findings suggest that small but consistent birth order differences in neurodevelopment are observable within the first year of life. Differences in parental engagement were also observed between siblings.

Credit: Dr. Akiko Tsuchida from the University of Toyama, Japan

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Reference

Title of original paper: Birth Order Differences in First-Year Neurodevelopment

Journal: *JAMA Network Open*

DOI: [10.1001/jamanetworkopen.2026.1265](https://doi.org/10.1001/jamanetworkopen.2026.1265)

Additional information for EurekAlert

Latest Article Publication Date: 06 March 2026

Method of Research: Data/statistical analysis

Subject of Research: People

Conflicts of Interest Statement: Dr Matsumura reported receiving research funding from the Japan Society for the Promotion of Science (JSPS KAKENHI) and an honorarium from Sumitomo Pharma for a contributed manuscript within the past 36 months, outside the submitted work. No other disclosures were reported.

About University of Toyama, Japan

University of Toyama is a leading national university located in Toyama Prefecture, Japan, with campuses in Toyama City and Takaoka City. Formed in 2005 through the integration of three former national institutions, the university brings together a broad spectrum of disciplines across its 9 undergraduate schools, 8 graduate schools, and a range of specialized institutes. With more than 9,000 students, including a growing international cohort, the university is dedicated to high-quality education, cutting-edge research, and meaningful social contribution. Guided by the mission to cultivate individuals with creativity, ethical awareness, and a strong sense of purpose, the University of Toyama fosters learning that integrates the humanities, social sciences, natural sciences, and life sciences. The university emphasizes a global standard of education while remaining deeply engaged with the local community. The university also serves as a Regional Center for the Japan Environment and Children's Study (JECS), contributing to large-scale national research on children's health and development.

Website: <https://www.u-toyama.ac.jp/en/>

About Assistant Professor Akiko Tsuchida from the University of Toyama, Japan

Dr. Akiko Tsuchida is an Assistant Professor at the Department of Public Health, Faculty of Medicine, University of Toyama. She is also a researcher at the Toyama Regional Center of the Japan Environment and Children's Study (JECS). An expert in epidemiology and maternal-child health, she researches how environmental, nutritional, and social factors during pregnancy and early life affect child development. She has authored over 80 scientific publications to date, cited more than 1,200 times. Her work contributes towards some of the global Sustainable Development Goals, including Good Health and Wellbeing, Quality Education, and Gender Equality.

Funding information

The Japan Environment and Children's Study (JECS) was funded by the Ministry of the Environment, Japan.

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