Sugar molecule found in breast milk boosts infant brain development

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Breast milk is not simply sustenance. It also is rich in micronutrients that are critical for healthy brain development in infants.

Now, researchers have identified a component of breast milk that promotes how neurons form connections in infants' brains. Myo-inositol

is a small cyclic sugar molecule in breast milk that also is found in a typical adult diet, including in fruits and grains. The study emphasizes the powerful role that what we eat plays in brain function. It was published in *PNAS* on July 11.

"The effects of micronutrients on the brain are really under-appreciated," says Thomas Biederer, Ph.D., associate professor of neurology and principal investigator. "As a neuroscientist, our findings were stunning to me."

Prior studies have demonstrated that breast milk is beneficial for the cognitive development of infants, but researchers had little understanding of why. Some proposed that breast milk contains certain unidentified components that provide these benefits. "Breast milk is rich in bioactive compounds that we are only starting to understand," says Biederer. "The infant brain is using those compounds to support its developmental processes."

The starting point of this study was a lead provided by the Biederer lab's partners at Mead Johnson Nutrition/Reckitt who did a detailed analysis of milk samples donated by mothers at sites in Cincinnati, Mexico City, and Shanghai over the course of lactation. The researchers wanted to study samples from three geographically diverse locations because they hypothesized that the micronutrients present across all samples—independent of diet, race, and location—may be of biological significance. They were especially interested in components that changed over the course of lactation in the same way.

The team noticed that myo-inositol was present in all breast milk samples in high concentrations early on, and gradually diminished over the course of lactation. Importantly, it also had an identical temporal profile across all three sites. "The molecule is very robustly controlled by the mother," says Biederer.

Intrigued, they examined the effects of myo-inositol on the developing brain using a variety of models, including cultured human neurons and cultured brain tissue. They found that the sugar molecule boosted synapse abundance in the neurons and enhanced neuronal connectivity.

"Our study demonstrates that breast milk is extremely valuable in how mothers can support the formation of connections in an infant's brain," says Biederer. "It truly shows the importance of valuing the complexity of breast milk. It's not just a source of calories, but an extremely rich, complex biofluid, and the mother's body is really attuned to changing the composition of breast milk to match what the infant needs at different stages of development."

These results can guide dietary recommendations for pediatric nutrition. The findings also emphasize the importance of having policies that support breast feeding mothers, says Biederer, because these policies "will help benefit society as a whole."

The current study focuses on the production of connections in the brain, a hallmark of the first months after birth. After these connections are established, the brain then works to refine and optimize these connections. In future studies, Biederer would like to explore how breast milk supports infants during this later stage of development.

"Refinement is a critical process for creating the right patterns in the brain," says Biederer. "Studying this stage will be as important, if not more important, than studying the initial formation of connections."

More information: Andrew F. Paquette et al, The human milk component myo -inositol promotes neuronal connectivity, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2221413120

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