

Maternal diet during lactation shapes functional abilities of milk bacteria

16 December 2020, by Homa Shalchi



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Research has shown that human milk is the optimal nutrition source for neonates and infants. It confers protection against both immediately life-threatening infant diseases such as necrotizing enterocolitis, as well as later onset diseases in adults, like obesity, diabetes and inflammatory bowel disease. Scientific evidence suggests that what a mother eats while she is breastfeeding can modulate the beneficial composition of the mother's milk, but the underlying mechanisms involved have not been elucidated.

In a new study published in *Nature Scientific Reports*, researchers from Baylor College of Medicine, Texas Children's Hospital and other institutions describe a natural mechanism that can modify the benefits of maternal milk. They report the first evidence that the mother's diet while breastfeeding can shape the profile of [human milk oligosaccharides \(HMO\)](#), a type of complex carbohydrate in the mother's milk. Changing the HMOs, which are food and fodder for healthy [microbes](#), in turn modifies the functional abilities of the milk microbiome. It has been proposed that the establishment of a healthy microbiome in the newborn and infant influences lifelong metabolic

health.

"In previous work in both humans and primates, we found that what a [pregnant woman](#) eats during pregnancy has the capacity to affect her child's lifelong metabolic health. In the current study we present the first evidence showing that the diet of a breastfeeding mother can directly affect the milk's HMO composition," said senior and corresponding author Dr. Kjersti Aagaard, Henry and Emma Meyer Chair in Obstetrics and Gynecology and professor of molecular and human genetics at Baylor.

"This was particularly exciting, since HMOs are basically inert substances to a mother or her baby. However, they exert their health benefits by acting as food or fodder to microbes—both bacteria and some viruses. This appears to be a very interesting example where what we eat affects our microbes via an intermediate (the HMOs), which we make but don't directly benefit from. It gives us a fascinating glimpse into what we and others believe is a natural co-evolution process," Aagaard said.

Working with Dr. Morey Haymond, professor of pediatrics-nutrition at Baylor, the team of researchers supplied breastfeeding mothers with all their meals in a controlled setting at the USDA Children's Nutrition Research Center. The mothers consumed a particular diet for 30 to 70 hours. After a two-week washout period, the same woman ate a different diet also provided by the researchers.

The researchers carefully collected milk samples from each subject at these different time points including the diet "switches." In this way, each woman could serve as her own control, something referred to as a "cross-over" trial design. This helped the researchers to control for the possibility of how individual women may vary one to the next in the amount of HMOs made, as well as the possibility of confusing microbes in the milk with environmental contaminants. The team analyzed

the HMO and microbiome composition of the milk and gleaned clues as to the effect of the mothers' diet.

"We found that distinct maternal carbohydrate and energy sources in the diets we provided preferentially altered the milk concentrations of HMOs, and this was accompanied by changes in the metabolic capacity of the milk microbiome," said first author Dr. Maxim Seferovic, instructor of obstetrics and gynecology at Baylor working in the Agaard lab. "It is not that the maternal diet itself is directly affecting the microbes, but that the diet affects the microbes' food, the HMOs, which in turn shape the functional capacity of the community of microbes in the milk that will be consumed by the baby. Interestingly, the changes in HMO occurred quickly, in a matter of 2 to 3 days, after the mothers changed their [diet](#)."

The researchers propose that the findings can have implications not only for the baby but also for the mother.

"We propose that our findings can have potential effects on baby's health and development, including the potential for promoting healthy gut integrity at the mucosal surface. HMOs feed certain microbial communities, and it has been suggested that the establishment of those microbial communities is probably important for neonatal development of brain function," said co-author Dr. Melinda Engevik, postdoctoral fellow in pathology and immunology at Baylor. "We speculate that having certain HMOs promotes the growth of certain microbes in the milk, which then pass to the baby and may promote healthy development."

"One other exciting aspect of our study is the suggestion that HMOs seem to preferentially affect the growth potential of microbes that may also impart health risk or benefit for the mother. For instance, by shaping the community of microbes in the [milk](#) in ways that may favor the growth of certain beneficial microbes via the simultaneous exclusion of those that cause mastitis during breastfeeding," Agaard said.

If not treated with antibiotics, mastitis, or the painful inflammation of breast tissue that typically involves

an infection, prevents breastfeeding and can become a serious condition.

HMOs also can potentially prompt a healthy microbiome in other ways. For example, by feeding the good microbes, acting as a decoy that attracts and sequesters potentially dangerous microbes and by breaking down HMOs and producing nutrients that may benefit other microbes.

More information: Maxim D. Seferovic et al, Maternal diet alters human milk oligosaccharide composition with implications for the milk metagenome, *Scientific Reports* (2020). [DOI: 10.1038/s41598-020-79022-6](https://doi.org/10.1038/s41598-020-79022-6)

Provided by Baylor College of Medicine

APA citation: Maternal diet during lactation shapes functional abilities of milk bacteria (2020, December 16) retrieved 20 April 2021 from <https://medicalxpress.com/news/2020-12-maternal-diet-lactation-functional-abilities.html>

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