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BREASTMILK: Best Served Straight from the Source

Researchers from CHILD's Manitoba site have discovered a new benefit of breastfeeding.

Reduce infections and illnesses? Yup. Lower the risk for sudden infant death syndrome? Check. Protect against childhood asthma and obesity? Yes, that too.

As most of the world knows by now, breastmilk has been called the "perfect food" for babies. Dr. Meghan Azad, an associate professor and Canada Research Chair in the Developmental Origins of Chronic Disease at the University of Manitoba, has been studying this "perfect food" for years.



Dr. Meghan Azad, Associate Professor
University of Manitoba



Dr. Shirin Moossavi, Postdoctoral Fellow
University of Calgary

"Each mother produces breastmilk uniquely tailored for her baby – I think that's kind of like a superpower," says Dr. Azad. Moms get many benefits from breastfeeding their infants too, including reductions in anxiety, negative mood, and stress. "Breastfeeding is one of those special experiences that can improve mental health and behaviour in not just one, but in two people at the same time," she notes.

Until recently, however, scientists had little reason to think that the way breastmilk reaches the baby is important. Whether it's delivered from the breast or a bottle, it's been assumed that breastmilk provides the same benefits.

However, in a series of research discoveries, Dr. Azad has changed this assumption. As an investigator with the CHILD Cohort Study, she has shown that nursing directly at the breast may be more beneficial than drinking pumped breastmilk from a bottle.

To suckle or to pump ... that is the question

The first discovery came in 2017. Dr. Azad and her colleague Dr. Annika Klopp, a pediatrician at the University of Manitoba, analyzed data from more than 3,200 moms and babies and found that babies fed only at the breast for the first three months of life had a [lower asthma risk](#) than babies fed expressed breastmilk from a bottle.

"We expected to see a difference in asthma risk between breastmilk-fed and formula-fed infants, which we did," says

Dr. Azad. "However, we were surprised to find that for the breastmilk-fed babies, how the babies received breastmilk seemed to matter."

While more research is needed to explain their results, the researchers have a couple of theories. "One possibility is that babies may develop stronger lungs through the physical act of suckling at the breast, which requires more effort than feeding from a bottle," says Dr. Azad. "Another theory is that the steps involved in pumping and storing breastmilk might negatively affect the milk's special cells, proteins and molecules that help to protect against asthma."

Another finding followed a year later. In a separate study, Dr. Azad's team found that babies nursed directly at the breast had a lower risk of obesity within their first year of life compared to babies who received breastmilk from a bottle. That decreased risk may eventually translate into a lowered chance of becoming overweight or obese later in life, according to the researchers.

The findings were published in the journal [Pediatrics](#) and picked up by international media outlets including [People](#), [CNN](#), [Global News](#), [CBS News](#), the [Boston Globe](#), and the [Chicago Tribune](#).

Dr. Azad is quick to note that expressed breastmilk still proved more beneficial than infant formula in both the asthma and obesity studies. "Moms go through a lot of effort to pump



breastmilk for their babies, and I wouldn't want them to get the impression that it's not worth it – there are definitely health benefits to pumped breastmilk over formula feeding."

Still, she was intrigued by the differences they saw and set out to better understand the factors influencing the benefits of breastmilk. "It would be great to be able to share with moms the best way to pump, store and feed breastmilk so as to maximize the benefits for babies who are not directly breastfed."

Learning from CHILD

The breastmilk samples and data Dr. Azad uses in her research come from the CHILD Cohort Study (CHILD) – a longitudinal birth cohort study that has been following nearly 3,500 Canadian children as they grow and develop from mid-pregnancy into childhood, the teen years ... and possibly beyond. Dr. Azad co-leads the CHILD site in Manitoba – one of four provinces involved in the Study.

By collecting biological samples and information at critical timepoints in childhood, CHILD has enabled the identification of early-life factors that influence a child's health and well-being later in life.

When CHILD participants were infants, research staff collected breastmilk samples from the mothers as well as stool samples from the babies' diapers. In Dr. Azad's experience, "it's rare for a study to have the forethought to collect these unique biological samples – that's what makes CHILD so valuable as a research discovery platform." By analyzing the babies' stool, Dr. Azad and other CHILD researchers have been able to pinpoint the different communities of microbes found in each infant's gut.

To build on her previous discoveries, Dr. Azad went back to CHILD's vast repository of biological samples. She began by looking closely at breastmilk itself.

"Pumped breastmilk gives baby many of the same health benefits as nursing – it's just that nursing may have a slight edge," says Dr. Azad.

Not so sterile

Dr. Azad knew from previous research that breastfeeding gives a boost to a baby's developing gut microbiome – the collection of bacteria in a baby's digestive system. She just didn't know how that happened.

Until about 10 years ago, scientists believed that breastmilk was sterile, but ongoing research has altered this thinking: breastmilk actually contains live bacteria, including the "good" kind that support a baby's growing immune system and healthy metabolism.

Dr. Azad wondered if there was a link between a mom's milk bacteria and the bacteria in her baby's gut. "Our initial question was, what does the milk bacteria profile really look like?" she says.

To help her find out, Dr. Azad recruited Dr. Shirin Moossavi, then a PhD student working in a microbiome lab that studied dairy milk. An MD with an abiding interest in the microbiome, and now a 2020 Canadian Institutes for Health Research (CIHR) Postdoctoral Fellow at the University of Calgary, Dr. Moossavi harnessed the capacity of the lab to analyze the microbes in nearly 400 human breastmilk samples from CHILD. "We saw that it was highly variable – milk from different mothers contained different types and combinations of bacteria," says Dr. Moossavi. "So, our next question was, why the differences?"

Using information collected from the mothers, Drs Azad and Moossavi analyzed factors that might influence the milk bacteria. They considered whether the mother delivered vaginally or by C-section; her weight, age, diet, and ethnicity; and breastfeeding practices, such as exclusivity, duration and the method of feeding.

They were intrigued to discover that milk bacteria were different in mothers who pumped their milk compared to those who fed their infant directly from the breast. In fact, of all the variables they analyzed, breastmilk pumping was the one factor consistently associated with differences in milk bacteria. "This may offer us a clue as to why babies who consume pumped breast milk are at greater risk of asthma, allergies and early obesity than those who feed straight from the breast," says Dr. Moossavi.

How to explain the results? Drs Azad and Moossavi suspect that pumping may prevent the transfer of bacteria from the infant's mouth to the mother – in other words, when a baby is nursed, the baby's saliva can creep back into mom's nipple, and "this transfer may be prevented if the baby is fed from a bottle," explains Dr. Moossavi. Pumping might also introduce other bacteria from the pump itself, which could alter the bacterial profile in mom's milk.

The research was published in the journal [Cell Host & Microbe](#) and was one of its most cited papers in 2019. As the paper's first author and architect of the statistical methods used in the study, Dr. Moossavi "found it gratifying to hear back from people who applauded our methodology and rigour."

The paper also drew a lot of interest from mainstream media, including from *CBC's Quirks and Quarks*. As often happens in translating research for the public, however; "some reports exaggerated the implications of the study and cast pumping in a somewhat negative light," says Dr. Azad. "But that's not what people should conclude from our research. Pumped breastmilk gives baby many of the same health benefits as nursing – it's just that nursing may have a slight edge – and we want to understand why, in order to provide helpful advice to moms who pump."

Gut reactions

Their findings prompted several more intriguing questions, including: Is mom's breastmilk bacteria shared with her baby? If so, how does it get there?

There was one way to find out: by comparing the bacteria in mom's breastmilk to the bacteria in her infant's gut. CHILD researchers had already profiled each baby's gut bacteria from stool collected in the diaper, "so it was just a question of looking at the bacteria in the breastmilk and connecting the dots," says Dr. Azad.

To do this, Drs Azad and Moossavi teamed up with CHILD colleagues from The University of British Columbia (UBC). The collaborative study was co-led by Dr. Stuart Turvey, Co-Director of CHILD and a pediatric immunologist and investigator at BC Children's Hospital; and Dr. B. Brett Finlay, Peter Wall Distinguished Professor in the Michael Smith Laboratories Laboratories and professor at UBC. Research trainees Kelsey Fehr at the University of Manitoba, and Drs Rozlyn Boutin and Hind Sbihi at UBC, along with Dr. Moossavi, were co-first authors of the publication, also published by [Cell Host & Microbe](#) in August 2020.

The team's working hypothesis proved correct: a mother's breastmilk and her infant's gut microbiome shared some of

the same bacteria, including bacteria that previous CHILD research by Drs Finlay and Turvey found to [protect against asthmatic wheeze](#).

"It's not just nutrients and immune components that moms transfer to their babies through breastmilk; they also seem to transfer 'good bacteria' that protect babies from illness and infections," comments Dr. Azad. "Our study also showed that the co-occurrence of shared 'good' bacteria was higher when infants nursed directly at the breast."

Dr. Azad believes that this latest research supports their earlier hypothesis that the process of pumping, storing and bottle-feeding breastmilk may reduce the transfer of viable milk bacteria from mom to baby. The results also support the idea that breastmilk may act as an incubator that protects and transports certain bacteria to a baby's intestinal tract. "This also gives us some idea as to which bacteria could make good probiotics, since they appear to withstand the trip to the baby's gut," she adds.

Questions Dr. Azad hopes to answer in future studies include: How might breastfeeding affect a baby's behaviour and brain development? Can a mother's diet while breastfeeding help prevent childhood allergies? How can we improve recommendations on handling and storing human milk for 'real-world' scenarios where many moms need to or choose to pump?

Even more importantly, how can the health benefits of breastmilk be provided to all babies – even those who are not fed breastmilk at all?

A [\\$6.5 million grant](#) awarded to Dr. Azad by the Bill & Melinda Gates Foundation will help advance these investigations. As Director of the newly created International Milk Composition (IMiC) Consortium, Dr. Azad will use the grant to study maternal nutrition and infant health in Canada and four other nations at various stages of development.

In the meantime, "I would like to see policies that support greater choice in feeding practices," says Dr. Azad. For example, "New mothers returning to work may feel that they have no choice but to pump, but we could be looking at ways to enable them to nurse."

Among her many current projects, Dr. Azad is looking at how to best teach children about breastfeeding, "so they grow up understanding that this is simply the normal way to feed babies," she adds. "It's never about coercing behaviour, but about helping people make informed choices and providing access to support – that's something we can all be part of. 🙌🙌"