PROFESSOR SPOTLIGHT | SOCIAL SCIENCES

Mysteries of Human Milk: A Spotlight on Dr. E.A. Quinn

Written by Kefan Cui '29
Washington University in St. Louis

Nearly every baby in the world receives breastmilk at some point in their early development. Yet, as Dr. E.A. Quinn points out, "We don't know that much about it. There's only probably about 20,000 articles ever published on breast milk, and there's over a million published on HIV. It really just speaks to the huge gap…and an incredible need for research."

Quinn, an Associate Professor of Biological Anthropology at WashU, is determined to close that knowledge gap. There are the applied questions," she remarks, "how do we help premature babies grow with milk? How do we increase access to milk for all babies? How do we improve nutrition for all babies?" Then, there are the bigger evolutionary questions: "How does milk allow us to adapt?... I want to know how our babies and their unusual biology of big brains and high body fat evolved. And how does that co-evolve with our milk? Like, what are the signals…and hormones and the nutrients and the microbes in our milk that are supporting [our significantly larger brains and higher body fat at birth]?"

> ***"I want to know how our babies and their unusual biology of big brains and high body fat evolved. And how does that co-evolve with our milk?***

These are just some of the evolutionary and applied questions that drive Quinn's research. In fact, her quest for answers has taken her across the world, from high-altitude communities in Nepal to cohorts of mothers in the Philippines, and even to the National Zoo in D.C.

Recently, however, Quinn has shifted her focus closer to home. "I have a three-year-old and a six-year-old. So that makes traveling halfway around the world and being about 30 hours away from home kind of difficult right now." Currently, she collaborates with the NICU at St. Louis Children's Hospital, leading breast milk assay development—a project she's been involved in since 2008.

Quinn's fascination with human milk traces back to her senior honors thesis research on the Kulubnarti cemetery in the Batn el-Hagar region, an area of Southern Sudan. There, she analyzed "the third rib on 300 children's mummies from the cemetery to do dietary reconstruction and understand infant weaning age." Spending much of her senior year of college "cutting ribs out of mummies" and digesting them into collagen for stable isotope analysis, Quinn reflected that she "walked out of that experience knowing I loved it. I loved research." Yet, Quinn sought to move beyond bones. "I didn't want to work with mummies anymore…But I wanted to keep working with kids, and I wanted to work with living adults."

Taking a gap year after graduation, Quinn did just that. She transitioned to work with a graduate student mentor as a research assistant, exploring "how kids grew…extracting growth hormones from their feces." However, Quinn began to think "that maybe [her mentor] only had half the story if she was only looking at what was going on with the babies, and not looking at what was going on with the milk" in relation to infant development.

"So, I decided that that was the direction I wanted to go in," Quinn said with conviction, detailing the decision that would define her career in human milk research. By the end of her gap year, she carried that conviction into graduate school at Northwestern, where she began studying variation in breastfeeding behaviors and human milk composition.

For her dissertation, Quinn took a longitudinal approach to these questions on Cebu Island in the Philippines. There she spent six months living and working with the community, as well as studying three generations of mothers from the Cebu Longitudinal Health and Nutritional Survey. She "collected breast milk samples and analyzed them for their nutritional and fatty acid composition." Quinn's work yielded a remarkable pattern and novel results: mothers of low-birth-weight babies produced breast milk with a completely different nutritional and fatty acid composition than mothers of full-term infants. "We're actually detecting a maternal effect of birth size on milk composition," she explained. "In fact, we're the first group to describe it in humans."

Upon returning to the U.S., Quinn spent three months at the National Zoo in Washington, D.C., where she turned her attention to evolutionary questions in milk: another area she's deeply passionate about. Quinn's work consisted of analyzing primate milk samples, occasionally working with the primates themselves. In fact, she returned the summer after graduating to continue analyzing additional samples.

Beginning in 2020, Quinn has continued this comparative research at WashU, holding a grant from The Smithsonian Institution to study "brain development and milk composition" across 144 samples from 14 different species of primates. "We've had a lot of Orangutan milk and a lot of Gorilla milk," she notes, "we haven't had any chimp milk…but we got chimps coming, so we're excited." Through their work, Quinn and her colleagues highlight some fascinating evolutionary patterns. Humans, for example,

"have a whole lot more sugar in their milk," as well as "slightly higher milk fat than other primates." Quinn hypothesizes that this extra milk fat is actually protective. "We're putting more fat in our milk so that we can protect long-chain fatty acids for inclusion in brain and eye tissue and nervous tissue. And so we produce more of the unsaturated fatty acids that are cheap to burn so that they can be metabolized, and those longer specialized fatty acids can be incorporated into our neural tissue and our nervous system." In fact, this hypothesis aligns with the relatively rapid postnatal brain development seen in human infants compared to other primates.

"

We're putting more fat in our milk so that we can protect long-chain fatty acids for inclusion in brain and eye tissue and nervous tissue.

Since 2013, Quinn has conducted fieldwork in the Nubri Valley, a remote high-altitude region within Nepal's Manaslu mountain range. There, Quinn studies "infant growth, infant health, and breast milk composition" among ethnic Tibetan communities that live between 8000 and 13000 feet above sea level. Her findings are striking. "We have found very high concentrations of milk fat among ethnic Tibetans compared to other human populations," she explains. Quinn hypothesizes that this difference in milk fat "is related to the hypoxia inducible factor one gene HIF-1," which is thought to regulate oxygen, hypoxia, and fat regulation in the mammary gland in Tibetan populations.

Carrying out this research, however, is no easy feat. "There are no roads, only footpaths where we work," Quinn says. "There were footpaths up and down the sides of mountains. There were landslides. We had an earthquake—we've had a couple of earthquakes while we were there. Parts of the trail can collapse. We've had some very scary bridge crossings, that kind of stuff." To make science possible in such conditions, her team brings the lab with them…literally. Their entire operation is portable, carried from village to village with human power. "We have two highly trained porters whose entire job is to move the lab…they are fantastic…some of the cornerstones of our project," Quinn shares. Porters Shaum and Gautum also shoulder tanks of liquid nitrogen as the team travels from community to community, ensuring milk samples are frozen within hours of collection on site. "Sometimes we also fly it up in a helicopter," she admits, laughing, "which is completely and utterly terrifying because liquid nitrogen boils at altitude. So as you go up, it starts boiling faster and faster, and it effectively becomes a bomb."

Innovative discoveries, just like ones she made in Nepal, are what captivate Quinn. "You know, it's just, it's so exciting what we're actually learning," she raves. "We're learning all this cool new stuff in all these new ways." Nevertheless, between these breakthroughs, Quinn is still keenly aware of the barriers facing her field. She points out that human milk research is still severely underfunded relative to its importance and subsumed under "pediatric growth" at the NIH: "The usual budget for human milk research from the NIH is like $6 million a year. That's nothing. If you think about the budget of the NIH being in the billions, it's a rounding error." Furthermore, Quinn described times where she "submitted grant proposals to study aspects of human milk," but "got comments back from reviewers that nobody cares about this, or that this isn't an important question." Yet, when she "read those reviews to moms…they're shocked, because these are things that really matter and really impact their health."

These obstacles make Quinn more determined to highlight the tangible public health implications of her research. To her, the best choice for infants is "the birthing parent's milk," with donor milk a close second. However, ready access to donor milk for same sex or adoptive couples is a huge concern. "We can donate milk and it's sent to Ohio or Indiana, but we don't have a donor milk bank in St. Louis," Quinn says, noting the lack of better alternatives to the third-best option, baby formula.

In fact, her research is vital for infants who only have access to formula, since the more we know about what's in human milk through research like Quinn's, "the better we can understand how to design formulas that maximally support infant growth…and make evidence-based decisions for all infants."

Though Quinn advocates breastfeeding or donor milk as the best options for infant nutrition, she recognizes the complex social and economic barriers many parents face in taking unpaid maternity leave to nurse an infant. The Family and Medical Leave Act (FMLA) guarantees job protection during leave, but not pay. Consequently, without a federal mandate for paid maternity leave, the majority of employers simply don't offer it. Quinn echoes this point, stating that, even now, many parents (including WashU staff fourteen years ago) don't get paid time off for the birth or adoption of a child. "They have to take accumulated leave, or unpaid FMLA." As a result, many parents who don't have the financial privilege to forgo income for long periods make the choice to return to work immediately, making breastfeeding at home impossible.

For Quinn, this stark reality underscores the broader point that scientific efforts promoting breastfeeding or designing better alternatives must go hand in hand with broader social support for families. She also sees this as an opportunity to push back against the narrative that you have to breastfeed as an expression of love. "No, the people that go to work two days after having a baby to keep a roof over their heads—that's an incredible amount of love…but they also shouldn't be in that position, right? We can't advocate for breastfeeding without advocating for more support and more paid family leave."

"

We can't advocate for breastfeeding without advocating for more support and more paid family leave.

Even if large-scale policies are slow to shift, Quinn's role as a breast milk researcher is equally powerful. Her research generates the knowledge needed to guide the design of better formula for infants. This means that families who rely on formula aren't left behind. Instead, they'll benefit from science that directly informs their infant's nutrition. Through her work, Quinn is able to bridge the gap between her lab's results and the real-world impact on infants and parents. ■