

Long-held theory on human gestation refuted: Mother's metabolism, not birth canal size, limits gestation

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Summary:

An anthropologist suggests that the length of human pregnancy is limited primarily by a mother's metabolism, not the size of the birth canal. The research challenges the long-held notion of an evolutionary trade-off between childbirth and a pelvis adapted for walking upright.



Holly Dunsworth.

Credit: Image courtesy of University of Rhode Island

New research by a University of Rhode Island professor suggests that the length of human pregnancy is limited primarily by a mother's metabolism, not the size of the birth canal. The research, published in the *Proceedings of the National Academy of Sciences* the week of August 27, challenges the long-held notion of an evolutionary trade-off between childbirth and a pelvis adapted for walking upright.

Two traits that set humans apart from other primates -- big brains and the ability to walk upright -- could be at odds when it comes to childbirth. Big brains and the big heads that encase them are

hard to push through the human birth canal, but a wider pelvis might compromise bipedal walking. Scientists have long posited that nature's solution to this problem, which is known as the "obstetric dilemma," was to shorten the duration of gestation so that babies are born before their heads get too big. As a result, human babies are relatively helpless and seemingly underdeveloped in terms of motor and cognitive ability compared to other primates.

"All these fascinating phenomena in human evolution -- bipedalism, difficult childbirth, wide female hips, big brains, relatively helpless babies -- have traditionally been tied together with the obstetric dilemma," said Holly Dunsworth, an anthropologist at the University of Rhode Island and lead author of the research. "It's been taught in anthropology courses for decades, but when I looked for hard evidence that it's actually true, I struck out."

The first problem with the theory is that there is no evidence that hips wide enough to deliver a more developed baby would be a detriment to walking, Dunsworth said. Anna Warrener, a post-doctoral researcher at Harvard University and one of the paper's co-authors, has studied how hip breadth affects locomotion with women on treadmills. She found that there is no correlation between wider hips and a diminished locomotor economy.

"That throws doubt on the assumption that the size of the birth canal is limited by bipedalism," Dunsworth said. "Wide hips don't mean you can't walk efficiently."

Then Dunsworth looked for evidence that human pregnancy is shortened compared to other primates and mammals. She found well-established research to the contrary. "Controlling for mother's body size, human gestation is a bit longer than expected compared to other primates, not shorter," she said. "And babies are a bit larger than expected, not smaller. Although babies behave like it, they're not born early."

For mammals in general, including humans, gestation length and offspring size are predicted by mother's body size. Because body size is a good proxy for an animal's metabolic rate and function, Dunsworth started to wonder if metabolism might offer a better explanation for the timing of human birth than the pelvis.

To investigate that possibility, she enlisted the help of Peter Ellison of Harvard University and Herman Pontzer of Hunter College in New York, two experts in human physiology and energetics. Building on Ellison's prior work on human pregnancy and childbirth, the researchers developed a new hypothesis for the timing of human birth called the EGG (energetics, gestation, and growth).

"Under the EGG, babies are born when they're born because mother cannot put any more energy into gestation and fetal growth," Dunsworth explains. "Mom's energy is the primary evolutionary constraint, not the hips."

Using metabolic data on pregnant women, the researchers show that women give birth just as they are about to cross into a metabolic danger zone.

"There is a limit to the number of calories our bodies can burn each day," says Pontzer. "During pregnancy, women approach that energetic ceiling and give birth right before they reach it. That suggests there is an energetic limit to human gestation length and fetal growth."

Those metabolic constraints help explain why human babies are so helpless compared to our primate kin, like chimpanzees. A chimp baby begins crawling at one month, whereas human

babies don't crawl until around seven months. But for a human to give birth to a newborn at the same developmental level as chimp, it would take a 16-month gestation. That would place mothers well past their energetic limits. In fact, even one extra month of gestation would cross into the metabolic danger zone, the researchers found.

"It would be physiologically impossible, regardless of pelvic bone anatomy, to birth a more developed baby," Dunsworth said. "Our helplessness at birth is just a sign of how much more brain growth we have to achieve once we start living outside our mother."

The energetics, gestation and growth hypothesis would downplay an implication of the obstetric dilemma that Dunsworth finds odd.


"We've been doing anthropology with this warped view of the male pelvis as the ideal form, while the female pelvis is seen as less than ideal because of childbirth," she said. "The female births the babies. So if there's an ideal, it's female and it's no more compromised than anything else out there. Selection maintains its adequacy for locomotion and for childbirth.

"If it didn't, we'd have gone extinct," Dunsworth said.

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