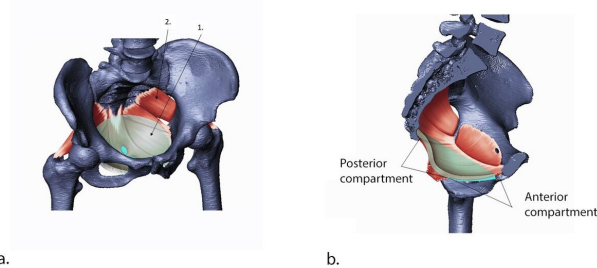


Why the human body has not evolved to make childbirth easier—or has it?

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Researchers used Finite Element analysis, typically deployed to test structures for stress events like earthquakes, to study the pelvic floor in women. Credit: The University of Texas at Austin.

Despite advances in medicine and technology, childbirth isn't likely to get much easier on women from a biological perspective.

Engineers at The University of Texas at Austin and University of Vienna revealed in new research a series of evolutionary trade-offs that have created a near-perfect balance between supporting [childbirth](#) and keeping organs intact on a day-to-day basis. Human reproduction is unique because of the comparatively tight fit between the [birth canal](#) and baby's head, and it is likely to stay that way because of these competing biological imperatives.

The size of the pelvic floor and canal is key to keeping this balance. These opposing duties have constrained the ability of the pelvic floor to evolve over time to make childbirth easier because doing that would sacrifice the ability to protect organs.

"Although this dimension has made childbirth more difficult, we have evolved to a point where the pelvic floor and canal can balance supporting internal organs while also facilitating childbirth and making it as easy as possible," said Krishna

Kumar, an assistant professor in the Cockrell School of Engineering's Department of Civil, Architectural and Environmental Engineering who led the research published this week in the journal *Proceedings of the National Academy of Sciences*.

The pelvic floor in women is a band of muscles that stretches across the bottom of the abdomen from the tailbone to the pubic bone. It supports pelvic organs, including the uterus, bladder and bowel, and it helps stabilize the spine.

A larger pelvic floor and canal would facilitate easier childbirth. But the larger it becomes without additional bones or tissue to support it, the more likely it is to deform under the weight of organs and cause them to fall downward.

These trade-offs, referred to as the pelvic floor hypothesis, were known in the scientific community. But the theory had been difficult to test until this research team used engineering tools to investigate it.

Kumar first started thinking about the problem by comparing the pelvic floor to a trampoline. A bigger trampoline will drop further as weight is applied, whereas a smaller trampoline will hold its structure better.

In addition to studying the size of the pelvic floor, the researchers also looked at thickness. In theory, a thicker pelvic floor could continue to support organs and an expanded size for childbirth. But it did not turn out that way.

"We found that thicker pelvic floors would require quite a bit higher intra-abdominal pressures than humans are capable of generating to stretch during childbirth," said Nicole Grunstra, an affiliated researcher at the University of Vienna's Unit for Theoretical Biology in the Department of Evolutionary Biology. "Being unable to push the baby through a resistant pelvic floor would equally

complicate childbirth, despite the extra space available in the birth canal, and so pelvic floor thickness appears to be another evolutionary 'compromise,' in addition to the size of the birth canal."

The team got to this conclusion by applying principles common in civil engineering. Kumar used a Finite Element analysis, a computerized model often deployed to test the design of structures to see whether they will break or wear down when facing high levels of pressure and stress. In this case, Finite Element analysis allowed the team to model the pelvic [floor](#), change its parameters and see how it responds to the stresses of childbirth and protecting organs, which is otherwise impossible to test using clinical data.

This is the first time Finite Element analysis has been used to explore an evolutionary question. However, it isn't the first time Kumar has applied engineering tools to biology.

While at the University of Cambridge in the U.K., where he met his co-authors who are now at the University of Vienna, Kumar applied a transportation analysis technique to herpes to learn more about how it first spread among humans.

This collaboration shows that engineering approaches and tools are relevant to important problems that, at first glance, may seem well outside the discipline, said Kumar, whose primary research involves numerical models for earthquakes, landslides and other disasters.

"You can abstract all the biology away, and it comes down to what happens if you apply stress, what does it do to bodies and structures with different material properties," Kumar said. "If you squint your eyes, a large landslide can look like a [pelvic floor](#)."

More information: Ekaterina Stansfield et al, Biomechanical trade-offs in the pelvic floor constrain the evolution of the human birth canal, *Proceedings of the National Academy of Sciences* (2021). [DOI: 10.1073/pnas.2022159118](https://doi.org/10.1073/pnas.2022159118)

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