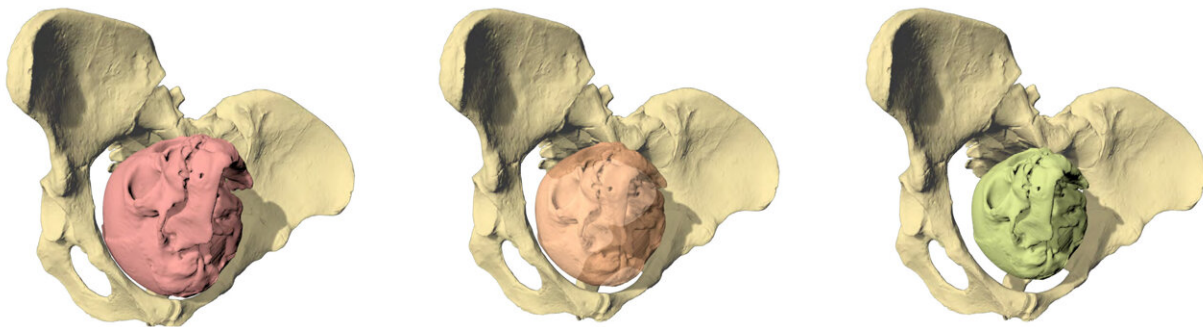


# Complex human childbirth and cognitive abilities a result of walking upright

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Birth simulation of Lucy (*Australopithecus afarensis*) with three different fetal head sizes. Only a brain size of maximum 30 percent of the adult size (right) fits through the birth canal. Credit: Martin Häusler, UZH

Childbirth in humans is much more complex and painful than in great apes. It was long believed that this was a result of humans' larger brains and the narrow dimensions of the mother's pelvis. Researchers at the University of Zurich have now used 3D simulations to show that childbirth was also a highly complex process in early hominins that gave birth to relatively small-brained newborns—with important implications for their cognitive development.

During [human birth](#), the fetus typically navigates a tight, convoluted [birth](#) canal by flexing and rotating its head at various stages. This complex process comes with a high risk of birth complications, from

prolonged labor to stillbirth or maternal death. These complications were long believed to be the result of a conflict between humans adapting to walking upright and our larger brains.

## **Dilemma between walking upright and larger brains**

Bipedalism developed around 7 million years ago and dramatically reshaped the hominin pelvis into a real [birth canal](#). Larger brains, however, didn't start to develop until two million years ago, when the earliest species of the genus *Homo* emerged. The evolutionary solution to the dilemma brought about by these two conflicting evolutionary forces was to give birth to neurologically immature and helpless newborns with relatively small brains—a condition known as secondary altriciality.

A research group led by Martin Häusler from the Institute of Evolutionary Medicine at the University of Zurich (UZH) and a team headed up by Pierre Frémondrière from Aix-Marseille University have now found that australopithecines, who lived about four to 2 million years ago, had a complex birth pattern compared to great apes. "Because australopithecines such as Lucy had relatively small brain sizes but already displayed morphological adaptations to bipedalism, they are ideal to investigate the effects of these two conflicting evolutionary forces," Häusler says.

## **Typical ratio of fetal and adult head size**

The researchers used three-dimensional computer simulations to develop their findings. Since no fossils of newborn australopithecines are known to exist, they simulated the birth process using different fetal head sizes to take into account the possible range of estimates. Every species has a typical ratio between the brain sizes of its newborns and adults. Based on

the ratio of non-human primates and the average brain size of an adult Australopithecus, the researchers calculated a mean neonatal [brain](#) size of 180 g. This would correspond to a size of 110 g in humans.

For their 3D simulations, the researchers also took into account the increased pelvic joint mobility during pregnancy and determined a realistic soft tissue thickness. They found that only the 110 g fetal head sizes passed through the pelvic inlet and midplane without difficulty, unlike the 180 g and 145 g sizes. "This means that Australopithecus newborns were neurologically immature and dependent on help, similar to human babies today," Häusler explains.

## **Prolonged learning key for cognitive and cultural abilities**

The findings indicate that australopithecines are likely to have practiced a form of cooperative breeding, even before the genus *Homo* appeared. Compared to great apes, the brains developed for longer outside the uterus, enabling infants to learn from other members of the group. "This prolonged period of learning is generally considered crucial for the cognitive and cultural development of humans," Häusler says. This conclusion is also supported by the earliest documented stone tools, which date back to 3.3 million years ago—long before the genus *Homo* appeared.

The study appears in *Communications Biology*.

**More information:** Pierre Frémondrière et al, Dynamic finite-element simulations reveal early origin of complex human birth pattern, *Communications Biology* (2022). [DOI: 10.1038/s42003-022-03321-z](https://doi.org/10.1038/s42003-022-03321-z)

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