

## Evolution & Behavior

# Women's birth canals are extremely variable in shape

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### ABSTRACT

*We show that the shape of the birth canal varies among human populations, with important implications for obstetric practice in multi-ethnic societies. These differences reflect genetic variation among populations and ancient global*



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If you open a book on human anatomy or human evolution, you will read that women have a hard time giving birth. This happens because the pelvis, the basin-like bone structure that supports our internal organs and connects to the spine and the legs, has been shaped by two opposing evolutionary forces: the adaptation to bipedal walking, which has led to a shorter and narrower pelvis, and the increase of the brain size, which has required a larger birth canal for a big-headed baby. The result of these opposing forces is a tight compromise—a canal that is narrow enough to enable walking yet large enough to permit for giving birth. The standard anatomy

book will also tell you that women have an odd-shaped birth canal that is initially formed as an oval (in the inlet of the canal) and is longer side-to-side, but then changes to an oval that is longer back-to-front as the baby progresses through the vagina (midplane and outlet of the canal). Because of this twisted and tight canal, our babies need to make a complicated set of rotations, and emerge facing backwards instead of forward like in other primates. This description of the pelvis and of childbirth also defines what is normal and expected in obstetric care. The problem is that this model is based on studies done largely on European women during the

early 1900s, and it is unclear how representative it is of women of non-European ancestry.

In our study, we measured the shape of the birth canal in 348 women from 24 populations and five continents, using skeletal remains preserved in museums and universities. We wanted to evaluate how diverse women's birth canals were and which factors might explain this diversity. What we discovered is that not only women are extremely variable in the shape of their birth canals, but that the most common shape varies depending on the geographic region. While the model currently in use works well for many European women, sub-Saharan African and East Asian women have deeper canals back-to-front. The inlet of the canal, in particular, tends to be rounder and, in many cases, longer back-to-front than side-to-side, completely overturning the current model of what the female pelvis looks like.

We tried to figure out what generated such a geographic diversity in pelvis shape. One of the possibilities was that it arose through random chance during the expansion of our species out of Africa and into other continents. As a group of people moved into a new area, they carried a smaller [genetic diversity](#) (the variety of genetic characteristics among individuals) than the larger population they were coming from. The consequence of this colonisation process is that we can observe a steady decrease in genetic diversity in modern populations the further they are from Africa (because they went through the process more times). We would also expect that populations on different expansion routes (for example, into Europe and into Asia) will have accumulated genetic differences, depending on which characteristics were more common in the first colonisers of the

area. We showed that human populations have less variable canal shapes the more distant they are from Africa, and that differences in the shape of the canal between populations match their genetic differences. This finding suggests that birth canal variation across human populations can be explained by the random accumulation of genetic differences during our species' geographic expansion.

We also tested whether part of the diversity could be explained by climatic adaptation; indeed, on top of the described colonisation pattern, people that live in colder regions tend to have an inlet that is more oval side-to-side. This is possibly useful to preserve body heat in low temperatures, as wider bodies dissipate less heat through the skin.

The take-home message is that the model of the birth canal described in many textbooks is not representative of our species, but just of a portion of European women. This large variation in canal shape challenges the hypothesis that obstetric difficulties in our species are due to a compromise between the narrow pelvis required for bipedal locomotion and the wide canal needed to give birth to large-brained babies. Women with all types of canals seem to walk just fine. On the other hand, the fact that the shape of the canal varies across populations could mean that the rotations of the baby might also be different in non-European women. Indeed, there is some evidence of this in some studies from the early 1900s. Ignoring the extent of normal female variation might lead to unnecessary interventions when childbirth proceeds differently than expected from the European model. Future studies should directly investigate variation in labour and birth in women of different ancestry.