LETTER

Adult pelvic shape change is an evolutionary side effect

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In their interesting article, Huseynov et al. (1) propose the "developmental obstetric dilemma (DOD) hypothesis," which posits that human pelvic morphology reflects the changing obstetric needs during a female's lifetime. In particular, the authors state that the female pelvis reaches its "obstetrically most adequate morphology" during peak fertility, around the age of 25–30 y, and reverts to an obstetrically less-adequate morphology thereafter, when fertility declines.

Because the reported adult variation in pelvis shape was large, moving-average trajectories highly depend on the smoothing parameters, which were not published by Huseynov et al. (1). Using data from Fischer and Mitteroecker (2), which are available from the DRYAD data repository, we were able to reproduce some, but not all of the results of Huseynov et al. (1). Pelvis shape, as measured by 126 3D landmarks, underwent significant change in adulthood in both sexes. We found that the pattern of shape change in the female pelvis from 20 to 45 y differed significantly from that after 40–45 y, whereas males showed more constant shape change. The shape of the female pelvic inlet became rounder (more gynecoid) until about 40–45 y, and more oval thereafter. Additionally, the subpubic angle decreased in females after 40–45 y. In adult males, the pelvis became narrower throughout adulthood, but the magnitude of change per year (measured as Procrustes distance) was only about half of that in females.

Because a wide pelvis with a round inlet and a large subpubic angle is considered more adequate for childbirth than a narrow oval one, our results support Huseynov et al.'s (1) conclusion that the female pelvis reaches an obstetrically most-adequate shape until about 40 y, and changes again thereafter. However, we disagree with the authors' evolutionary interpretation: such a pattern is very unlikely to evolve as an adaptation to changing obstetric needs. First, after the reproductive period, the female's fitness is not directly affected by pelvic shape changes, only indirectly via its influence on the reproductive success of her relatives. It is not plausible that the small pelvic changes observed after 40 y have a considerable effect on the relatives' fitness. Second, during human evolution few females survived past their reproductive period, which again renders the late pelvic shape changes fitness-irrelevant.

We agree with Huseynov et al. (1) that pelvic bone remodeling persists into adulthood and is likely mediated by sex-specific steroid hormone expression. It remains to be studied if the hormonal effects on the female pelvis from 20 to 40 y are specific to modern nutritional conditions, or if they could have contributed to reproductive success throughout human evolution. But for the reasons mentioned, the later decrease in obstetrically relevant pelvic dimensions in females cannot be an adaption to changing obstetric needs; it is a side effect of the hormonal changes—a "spandrel" sensu (3)—not the direct result of natural selection.

1 Huseynov A, et al. (2016) Developmental evidence for obstetric adaptation of the human female pelvis. *Proc Natl Acad Sci USA* 113(19):5227–5232.
2 Fischer B, Mitteroecker P (2015) Covariation between human pelvis shape, stature, and head size alleviates the obstetric dilemma. *Proc Natl Acad Sci USA* 112(18):5655–5660.
3 Gould SJ, Lewontin RC (1979) The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme. *Proc R Soc Lond B Biol Sci* 205(1161):581–598.

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The authors declare no conflict of interest.

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