Study on architecture of heart offers new understanding of human evolution

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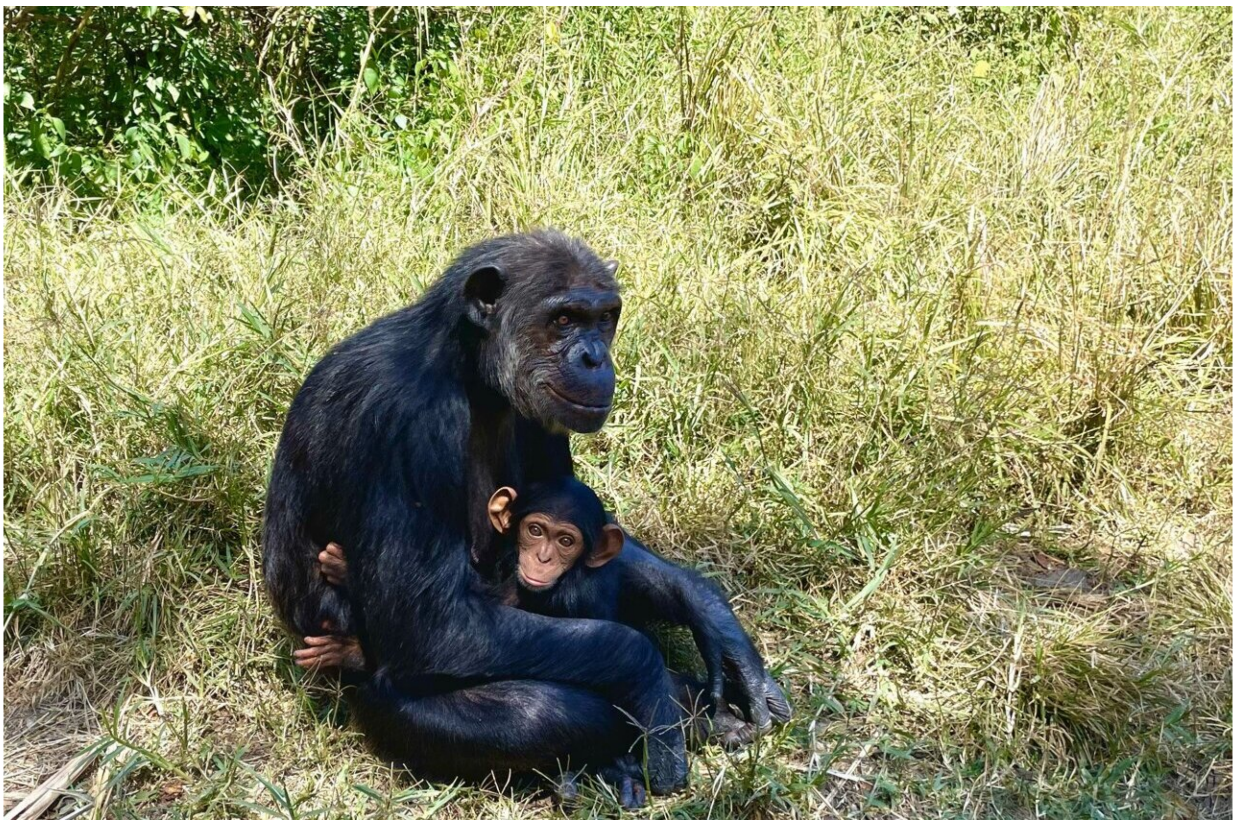

A photo of a chimpanzee mother and its infant. Credit: Dr Robert Shave, UBC Okanagan.

An international research team from Swansea University and UBC Okanagan (UBCO) has uncovered a new insight into human evolution by comparing humans' hearts with those of other great apes.

Despite humans and non-human great apes having a common ancestor, the former has evolved larger brains and the ability to walk or run upright on two feet to travel long distances, likely to hunt.

Now, through a new comparative study of the form and function of the heart, published in *Communications Biology*, researchers believe they have discovered another piece of the evolutionary puzzle.

The team compared the human heart with those of our closest evolutionary relatives, including chimpanzees, orangutans, gorillas, and bonobos cared for at wildlife sanctuaries in Africa and zoos throughout Europe.

During these great apes' routine veterinary procedures, the team used echocardiography—a cardiac ultrasound—to produce images of the left ventricle, the chamber of the heart that pumps blood around the body. Within the non-human great ape's left ventricle, bundles of muscle extend into the chamber, called trabeculations.

Bryony Curry, a Ph.D. student in the School of Health and Exercise Sciences at UBCO, said, "The left ventricle of a healthy human is relatively smooth, with predominantly compact muscle compared to the more trabeculated, mesh-like network in the non-human great apes.

"The difference is most pronounced at the apex, the bottom of the heart, where we found approximately four times the trabeculation in non-human great apes compared to humans."

The team also measured the heart's movement and velocities using speckle-tracking echocardiography, an imaging technique that traces the pattern of the cardiac muscle as it contracts and relaxes.

Curry said, "We found that the degree of trabeculation in the heart was related to the amount of deformation, rotation and twist. In other words, in humans, who have the least trabeculation, we observed comparatively greater cardiac function. This finding supports our hypothesis that the human heart may have evolved away from the structure of other non-human great apes to meet the higher demands of humans' unique ecological niche."

A human's larger brain and greater physical activity compared to other great apes can also be linked to higher metabolic demand, which requires a heart that can pump a greater volume of blood to the body.

Similarly, higher blood flow contributes to humans' ability to cool down, as blood vessels close to the skin dilate—observed as flushing of the skin—and lose heat to the air.

Dr. Aimee Drane, Senior Lecturer from the Faculty of Medicine, Health & Life Sciences at Swansea University, said, "In evolutionary terms, our findings may suggest selective pressure was placed on the human heart to adapt to meet the demands of walking upright and managing thermal stress.

"What remains unclear is how the more trabeculated hearts of non-human great apes may be adaptive to their own ecological niches. Perhaps it's a remaining structure of the ancestral heart, though, in nature, form most often serves a function."

The research team is grateful to the staff and volunteers who care for the animals in the study, including the teams at Tchimpounga Wildlife Sanctuary (Congo), Chimfunshi Wildlife Sanctuary (Zambia), Tacugama Chimpanzee Sanctuary (Sierra Leone), Nyaru Menteng Orangutan Rescue and Rehabilitation Center (Borneo), the Zoological Society of London (UK), Paignton Zoo (UK), Bristol Zoo Gardens (UK), Burgers'

Zoo (Netherlands) and Wilhelma Zoo (Germany).

More information: Bryony A. Curry et al, Left ventricular trabeculation in Hominidae: divergence of the human cardiac phenotype, *Communications Biology* (2024). DOI: 10.1038/s42003-024-06280-9

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