CHIMPANZEE ENERGETICS, ECOLOGY, AND EVOLUTION

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Chimpanzees have the largest relative brain size, greatest reproductive output, and longest lifespan of any non-human ape; they also have the highest level of physical activity in the wild, as measured by daily walking and climbing distances. In this study, we examined variation in total energy expenditure (TEE, kcal/day), body composition, oxidative stress, and physical activity to test whether chimpanzees have evolved metabolic strategies to fuel these evolved changes in ecology, encephalization, and life history. We used the doubly labeled water method to measure TEE and body fat percentage in adult chimpanzees (*Pan troglodytes*, *n*=27), bonobos (*Pan paniscus*, *n*=8), Western lowland gorillas (*Gorilla gorilla*, *n*=10), and orangutans (*Pongo* spp., *n*=11) housed in zoos and sanctuaries. Walking and climbing activity was recorded via direct observation. Oxidative stress was assayed via urinary 8-hydroxy-2' -deoxyguanosine (8-OHdG). Chimpanzee metabolic and activity measures were similar to bonobos' ($p>0.05$ all comparisons). In comparisons among genera, TEE in *Pan* was greater than that of *Pongo* ($p<0.01$) and trended higher than that of *Gorilla* ($p=0.22$) in multiple regression controlling for body size and activity. By contrast, urinary 8-OHdG and percent body fat were lower in *Pan* than in *Gorilla* or *Pongo* ($p<0.05$) in analyses controlling for age. These results indicate that chimpanzees have evolved an accelerated metabolism while simultaneously decreasing the safety margin against food shortage that body fat provides. We discuss this metabolic acceleration, which appears to predate the chimpanzee-bonobo divergence, and its importance for reconstructing the ecological pressures shaping chimpanzee life history, anatomy, and ranging.