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Low energy use fuels a slow existence

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Much of an organism's life is given to the acquisition, assimilation and transformation of energy. Energy is collected, via foraging and feeding, and is in turn allocated to reproduction, somatic growth and the collection of yet more energy. A long-standing hypothesis in the field of physiological ecology has been that the rate at which organisms use energy (their metabolism) dictates the speed at which they live. Thus, those with high metabolic rates relative to their body size would have quick, high rates of energy turnover, usually falling onto the ‘live fast, die young’ side of the slow–fast life history continuum. Conversely, those with low rates of energy usage would have slow life histories: growing slowly, maturing at a later age and producing fewer young.

Consequently, in mammals it would be expected that those with low metabolic rates relative to their body masses would have slow life histories and vice versa. However, attempts to validate this relationship using basal metabolic rate (BMR – measured in animals at rest in favourable thermal conditions, which is the energetic equivalent to the idling speed of a car) have proven to be inconclusive. Take for example the primates; as an Order they have significantly slower rates of living than other mammals of similar body sizes, maturing late, producing only a few young and living for relatively long periods of time. However, after controlling for the effects of phylogenetic relatedness and body mass, primate BMR is no different from that of other mammals. But what if BMR was not the best indication of energy usage? Is there a better way to test whether metabolism is indeed linked to the speed of life?

These were the questions put forward in a study by Herman Pontzer from Hunter College in New York and a large number of colleagues from across the USA, recently published in PNAS. Pulling together countless hours of gruelling fieldwork, the study presented measures for total energy expenditure (measured on a daily basis) from 18 different species of primates spanning a range of body sizes. The results confirmed earlier studies and failed to find a relationship between BMR and a number of life history traits (such as growth rate, litter mass and maximum lifespan). What they did find, however, was a significant relationship between those traits and total energy expenditure. Despite a wide range of activity patterns and lifestyles, and after controlling for body mass and phylogenetic relatedness, the primate total energy expenditure was on average almost 50% lower than that of other mammals. Interestingly, the results did not differ between captive and wild populations of a small subset of these species, indicating that a low rate of energy use is characteristic of these primates regardless of habitat or ready access to food.

The authors suggest that this capacity for surprising energetic frugality contributes to the slow pace of life in primates. The broader implication of this study is not only that energy use might indeed be linked to the pace of life but also that the BMR that we find in the laboratory is not always a true reflection of total energy expenditure that occurs in the wild, leaving open the possibility for more to be learned about the interactions between metabolic rate and life histories as we continue to take the lab to the field.

References

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