New mathematical model illustrates link between energy use and aging

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Why does a great dane have a shorter lifespan than a pug? The answer lies in a complex relationship between energy usage and lifespan. That relationship is quickly being unraveled through the use of numerical modeling by a researcher at Missouri University of Science and Technology.

By using the principles of energy conservation and allometric scaling laws, Dr. Chen Hou has developed a theoretical model that can measure aging on the basis of energy expenditure. Hou has found that growth carries a tradeoff with health maintenance, and that previous research in the area is not as straightforward as once thought.

"Past studies of metabolic rates have yielded conflicting results when

comparing different species and introducing diet restrictions," says Hou, an assistant professor of biological sciences at Missouri S&T. "My model shows that energy used during growth is the key to understanding longevity."

Hou's research shows that oxidative metabolism affects cellular damage and longevity in different ways in animals with different life histories and under varying experimental conditions. For example, he compares the birth mass of a greater Swiss mountain dog to that of a silky terrier as an example. A greater Swiss is born at only one percent of its final weight, whereas the terrier already weighs in at eight percent of its final weight at birth. That percentage difference means that the greater Swiss must use more energy to grow to full adulthood, relatively less energy for health maintenance and therefore have a shorter lifespan than the terrier.

"If you were able to suppress or manipulate growth to maintain a smaller stature, the animal would live longer and have more energy for health maintenance – the way the body repairs itself," says Hou. "On the other hand, 'catch-up' growth, referring to individuals with low birth weight reaching or exceeding normal weight later in life, often has negative impacts on adult health outcome and lifespan."

Hou's research is based on a variety of studies, including works on cellular damage; correlations between growth rate, metabolic rate and lifespan; and the effects of diet restriction and genetic modification, and cold temperature and exercise stresses on lifespan.

His most recent work on the subject, "On the complex relationship between energy expenditure and longevity: Reconciling the contradictory empirical results with a simple theoretical model," was published in the journal *Mechanisms of Aging and Development.*

More information: Chen Hou et al. On the complex relationship

between energy expenditure and longevity: Reconciling the contradictory empirical results with a simple theoretical model, *Mechanisms of Ageing and Development* (2015). DOI: 10.1016/j.mad.2015.06.003