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Eating less enables lemurs to live longer

Chronic caloric restriction strongly increases the lifespan of a small primate, the grey mouse lemur. This is one of the results of a ten-year experiment conducted by researchers at the CNRS and the French National Museum of Natural History (MNHN), in partnership with other French teams.¹ Chronic caloric restriction consists in eating a reduced but balanced diet from the outset of early adulthood. Its beneficial effect on lifespan had been established for many short-lived species (worms, flies, mice), but remained controversial for primates, including humans. Another observation is that the aging process is delayed among animals on a reduced diet. This research is published on April 5, 2018 in the journal *Communications Biology*.

Chronic caloric restriction consists in eating a reduced but balanced diet from early adult life onward. Previous research, into macaques in particular (which have an average lifespan of forty years), had already demonstrated its beneficial effect on the incidence of age-related pathologies. However, its positive effect on the lifespan of primates remained controversial. To study this question, the researchers focused on the grey mouse lemur, a small primate whose lifespan (around twelve years) makes it a very good model for the study of aging. Moreover, this small lemurid has many physiological similarities with humans.

The scientists exposed a group of mouse lemurs to moderate chronic caloric restriction (30% fewer calories than their peers consuming a normal diet) from the outset of early adulthood (Restrikal cohort, see visuals below). They then considered their survival data as well as possible age-related alterations. The first result, after the experiment had been running for ten years, was that in comparison to the animals in the control group, the lifespan of those subject to caloric restriction increased by almost 50%. More specifically, their median survival is 9.6 years (compared to 6.4 years for the mouse lemurs in the control group). And, for the first time among primates, the scientists observed that the maximum lifespan had increased: almost a third of the calorie-restricted animals were still alive when the last animal in the control group died at the aged of 11.3 years.

This beneficial effect was accompanied by the preservation of motor capacities, without any alteration to cognitive performance, and a reduction in the incidence of pathologies usually associated with aging, such as cancer or diabetes. The calorie-restricted mouse lemurs present the morphological characteristics of a younger animal. Furthermore, brain imaging data for these very elderly animals shows a slight loss of grey matter (neuronal cell bodies), an effect that the researchers have not yet explained, as well as significantly slowed atrophy of white matter (the neuronal fibers connecting different areas of the brain).

¹ In addition to the "Mécanismes adaptatifs et evolution" laboratory (CNRS/MNHN, which led the study, the following also participated: several departments at the Ecole nationale vétérinaire d'Alfort; Institut pluridisciplinaire Hubert Curien (CNRS/Strasbourg University); Centre de psychiatrie et neurosciences (Inserm/Paris Descartes University); Laboratoire de psychopathologie et de neuropsychologie (Paris 8 University); Laboratoire de maladies neurodégénératives : mécanismes, thérapies, imagerie (CNRS/CEA/Paris-Sud University).

The results indicate that chronic caloric restriction is currently the most effective way to extend maximum lifespan and delay the aging process in a non-human primate. The next step for the scientists is to associate chronic caloric restriction with another study parameter, such as physical exercise, in an attempt to further extend the upper limits of lifespan.



Example of two 9-year-old mouse lemurs in the Restrikal cohort. © CNRS/MNHN

The animal on the left, which weighs around 100 g, has been fed a "normal" diet throughout its life (CTL). It presents characteristics that are frequently observed among elderly mouse lemurs: cataracts and whitening of the fur.

The animal on the right, which weighs around 70 g, has been fed 30% fewer calories (CR) compared to the control group since early adult life. It has the morphological characteristics of a younger animal.

Bibliography

Caloric restriction increases lifespan but affects brain integrity in grey mouse lemur primates. Pifferi F, Terrien J, Marchal J, Dal-Pan A, et al. *Communications Biology*. April 5, 2018.

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