INSIDE JEB

Female immune-boosted chicks get longer telomere clocks

An adult female zebra finch (*Phanaeus vindex*) with two of her fledged chicks. Photo credit: Victoria Winter.

As the effects of time take their toll, things begin to wear out. Joints get stiff and elderly animals tend to be less sharp than they once were. The effects of time are felt even down in the tiny capping structures, known as telomeres, at the tips of chromosomes. François Criscuolo from the Centre National de la Recherché Scientifique, France, and Tony Williams from Simon Fraser University, Canada, explain that telomeres shorten as cells age, like a clock ticking down. However, they were curious to find out how events back at the start of life mould the telomeres that will eventually influence an animal's resilience and longevity. Knowing that chicks developing from the eggs of mothers that had experienced a fake infection when they laid their eggs inherit more antibodies and tend to be larger at ∼4 weeks of age, Williams and his colleague, Roxana Torres from the Universidad Nacional Autonoma de Mexico decided to find out what effect this additional immunity provided by mothers has on the length of their youngster's telomeres when they hatch and later in life.

Williams and Torres injected female zebra finches with fragments of bacteria prior to mating – to trick the birds' immune systems into trying to fight off the feigned infection – and then collected the eggs laid by the females, injecting some eggs with testosterone, to find out whether the hormone also affected the length of the chromosome-capping structures. Incubating the eggs until they hatched, the duo monitored the chicks' growth until they were almost 3 months old. In addition, as bird red blood cells are packed with DNA, the researchers collected blood samples from the youngsters at the age of 4 weeks and again at 3 months, to track the condition of their telomeres. They also collected blood samples from the mothers – before the simulated infection, when they laid their first egg and when their chicks were 4 weeks old – to find out whether motherhood had taken a toll on the condition of their own telomeres and whether the offspring inherited their mothers' telomeres. Then, Williams passed the blood samples on to Criscuolo and Sandrine Zahn at the University of Strasbourg, France, to analyse the length of the chicks' and mothers' telomeres.

Not surprisingly, when Criscuolo and Williams investigated the impact of motherhood, the females with the largest clutches of eggs suffered the most telomere loss. However, the mothers that had been fighting off a fake infection when they laid their eggs suffered less telomere degradation; 'perhaps telomere loss was reduced due to earlier activation of the immune system, prior to laying, in these immune-challenged females', says Williams. And the mothers with the longest telomeres passed on the benefit to their daughters. However, the length of the sons' telomeres bore little resemblance to those of their mothers.

When it came to the state of the youngsters' telomeres as they developed and grew, female chicks that had received a testosterone boost in addition to the boost from their mothers' immune systems had longer telomeres, while a testosterone injection alone improved the sons' telomeres. Also, the youngsters that had the longest telomeres shortly after hatching were still ahead in the telomere stakes when they matured into adults, 'suggesting that individual differences in telomere length are established early in life, partly thanks to the combined effects of in-egg maternal molecules', say Williams and Criscuolo.

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