Biological age explains variation of responses to stress

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Do the flight or fight mechanisms triggered by responses to stress, diminish with age? And if so, is there a difference between biological and chronological ageing? Questions new research is answering.

Our response to acute stress prioritises behavioural and physiological processes to maximise our survival when we are faced with an immediate threat. This change in priorities comes about through the release of hormones that temporarily suppress behaviour not critical to immediate survival. This includes foraging, courtship and other activities that don't directly lead to avoiding, combating or escaping threats.

Of great interest to those studying evolutionary biology and medicine is what causes the variation between individuals in the strength of the adult stress response. Age is a clear factor: stress responsiveness diminishes with age in a number of species – but unexplained variation remains.

One possible explanation for this variation is that it is future life expectancy rather than chronological age that determines behavioural priorities. A biologically aged body may in fact have a lower life expectancy than a chronologically older body.

Adversity hastens biological ageing

Since individuals of the same chronological age may differ markedly in their pace of biological ageing, the team asked whether biological age – which they measured via telomere length in red blood cells – predicts variation in stress responsiveness in adult animals of the same chronological age.

The researchers have just published their findings in *Royal Society Open Science*. They studied two groups of European starlings. Exposure to adversity is believed to be central to biological ageing, with high levels of adversity in early life being particularly damaging.

To mimic this, the team manipulated the rate of biological ageing in one group by altering the competition chicks experienced in the first fortnight after hatching. The other group matured naturally. The birds

were then bought into captivity at the end of experimental manipulation and kept in uniform conditions until adulthood, around a year later.

Biological or chronological ageing – which impacts more on stress response?

Researchers were interested in measuring the levels of corticosterone, a hormone involved in the regulation of stress responses, 15 and 30 minutes following a stress trigger. They found that birds with greater developmental telomere attrition had lower peak corticosterone levels, which returned to the baseline measurement more rapidly.

As they write, "Our results, therefore, provide strong evidence that a measure of biological age explains individual variation in stress responsiveness: birds that were biologically older were less stress responsive. Our results provide a novel explanation for the phenomenon of developmental programming of the stress response: observed changes in stress physiology as a result of exposure to early-life adversity may reflect changes in ageing."

The ECOTELO (The ecological significance of telomere dynamics: environments, individuals and inheritance) project is addressing the lack of experimental studies that track telomere loss within individuals subjected to varying environmental circumstances. The work presented in their paper is part of a novel and innovative experimental programme testing the effects of environmental stressors on senescence rates and lifespan.

More information: Clare Andrews et al. A marker of biological age explains individual variation in the strength of the adult stress response, *Royal Society Open Science* (2017). DOI: 10.1098/rsos.171208

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