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Siblings of centenarians live longer: a computer simulation

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Sir

Thomas Perls and colleagues (May 23, p 1560)[1] show that human longevity is an inherited trait by comparison of the survival rates for the brothers and sisters of centenarians with those of siblings of people who died at age 73. At old age the survival probability for sisters and brothers of centenarians was found to be four times higher than usual. We report this effect in the widespread Penna[2] model for computer simulations of ageing.

This model is based on the mutation accumulation hypothesis.[3] We die because of the action of inherited harmful mutations. Although new mutations can become active with equal probability at any age, those that get fixed in the population are mainly active at old age, whereas those that act at a younger age are likely to be eliminated by selection pressure. The genome is represented by a string of many computer bits that correspond to as many age intervals; a bit set to one instead of zero signals a genetic disease (mutation) active from that age on. Children may differ from their parents by one randomly selected bit, which is flipped at birth. Three active mutations kill the individual. Monte Carlo simulations (with random numbers) show reasonable agreement with the steep (exponential) increase of mortality with increasing age,[3], [4] as given by the Gompertz law or the catastrophic senescence of Pacific Salmon.[4]

In the computer simulation (asexual version) we measure age not in years but by the intervals corresponding to our computer bits; for human beings such age intervals might correspond to 6 or 7 years. Parents who died in the 16th age interval had 25% of their children surviving at least to age 16, whereas parental death at age 15 meant such survival for only 9% of the children, and with parental death at age 14 only 5% of the children reached age 16.

This inherited longevity leads to the correlations of longevity between children of the same parent. The probability of surviving to at least age interval 15 was 44% for siblings of individuals who died at age 16, but only 7% for siblings of individuals who died at age 14. Our figure shows how the average age at death for all siblings of one family is strongly correlated with the age of death of the oldest of them.

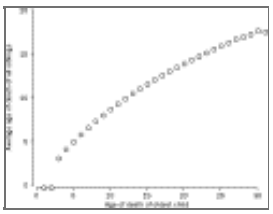

Figure Full-size image (5K) Download to PowerPoint

Correlations in the age of death: average child versus oldest child within one family

published elsewhere.

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References

1 Perls TT, Bubrick E, Wager CG, Vijg J, Kruglyak L. Siblings of centenarians live longer. *Lancet* 1998; **351**: 1560. Full Text | PDF(46KB) | CrossRef | PubMed

2 Penna TJPP. Bit-string model for biological aging. *J Stat Phys* 1995; **78**: 1629. PubMed

3 Wachter KW, Finch CE. Between Zeus and the Salmon: the biodemography of longevity. Washington DC: National Academy Press, 1997.

4 Moss de Oliveira S. A small review of the Penna model for biological ageing. *Physica A* 1998; **257**: 465. PubMed

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