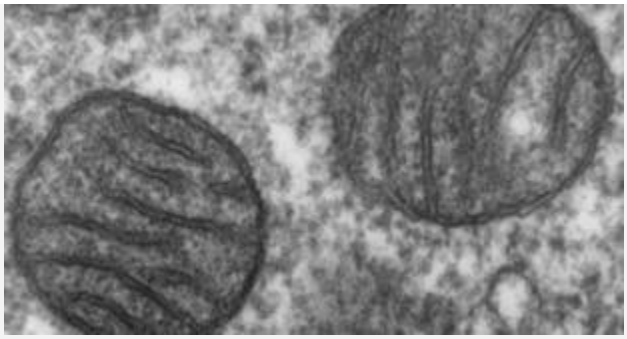
Qualia

'Curse' may explain why daughters live longer than sons

August 14, 2012 | Author:Summer Allen, Graduate and Postdoc, Brown University



Transmission electron microscope image of a thin section cut through an area of mammalian lung tissue. The high magnification image shows a mitochondria. (Photo: Louisa Howard)

A person's genome is a unique combination of genes inherited from both his or her mother and father (with some random mutations thrown in). But each person also inherits another type of DNA — mitochondrial DNA (mtDNA). Mitochondria, the bacteria-like organelles that provide power for our cells, contain their own genomes. An individual's mtDNA is almost identical to that of his or her mother's mtDNA because those mitochondria are direct descendants of the mitochondria in the fertilized egg cell (the sperm's mitochondria are usually chewed up by the egg). In fact, we can take advantage of this fact to track how groups of people are genetically related and to trace our ownancestry. But the fact that mtDNA is only inherited from our mothers produces an interesting evolutionary phenomenon: Some mutations in mtDNA are harmful only to male offspring and not to female offspring. A recent paper by M. Florencia Camus, David Clancy, and Damian Dowling published in *Current Biology* examines how this "Mother's Curse" may lead to shorter lifespans in male flies.

mtDNA, like all DNA, accumulates mutations over time. Some mutations are harmful, some are helpful, and many are neutral. The basis of the Mother's Curse is that some mutations may be helpful or neutral to females but harmful to males. If a mutation in mtDNA is harmful to females it will be harmful to the mother and may lead to an early death. This type of mutation is less likely to be passed on to offspring of either sex (since there will be fewer offspring). On the other hand, because mtDNA is only inherited from the mother, there is no selection pressure to prevent mutations that are specifically harmful to males to be passed on to sons. Thus mutations that harm males can continue to accumulate in mtDNA over generations. In their study, Camus, Clancy, and Dowling wanted to test if those deleterious mutations could explain why male flies die at younger ages than female flies.

The researchers compared mtDNA from 13 different lines of *Drosophila melanogaster* from across the world and recorded how long male and female flies from each line lived in ideal conditions (in jars with plenty of food and no predators). They found that male flies from some lines had long lives while those from other lines died young, but just about all female flies (independent of mtDNA lines) had long lives. This finding suggests that mutations in mtDNA led to the male flies' early demise, and it supports the Mother's Curse hypothesis. By analyzing the mtDNA from the different lines, the researchers found multiple deleterious mutations located across the mitochondrial genomes rather than in single locations — showing how mitochondrial genomes overall are hotspots for mutations that negatively impact male flies (presumably due to the lack of selective pressure on these mutations).

These results are intriguing because they show that mitochondrial genomes can act as a “sex-specific sieve” (as the researchers word it) for mutations, and that this “sieve” can lead to increased differences in longevity between the sexes over time. We don’t yet know whether this type of evolution is at work in humans and other mammals whose females outlive their males, although this seems quite plausible given that mtDNA in these species is also passed from mother to offspring.