Transcriptional adaptation found to play a role in inherited epigenetic changes

December 29 2022, by Bob Yirka
The germline plays a key role in IGTA in zebrafish. (A) Schematic representation of experimental setup and genetic crosses used to obtain wild-type offspring; red cell indicates a germline-specific mutation. (B) Relative mRNA levels of aldhl1a2 and aldhl1a3 in 24 hpf wild-type embryos from aldhl1a2+/+ incrosses (inx) and aldhl1a2rec/+ intercrosses (intx). Control expression levels were set at 1. n = 3 biologically independent samples. Data are means ± SD, and a two-tailed Student's t test was used to calculate P values. Credit: Science Advances (2022). DOI: 10.1126/sciadv.abj2029

A team of researchers at the Max Planck Institute for Heart and Lung Research, working with a colleague from Temple University, has found that transcriptional adaptation appears to play a role in inherited epigenetic changes.

In their study, published in the journal Science Advances, the group conducted mutant messenger (mRNA) degradation experiments with nematodes and zebrafish.

Prior research has shown that people can inherit traits from their parents that are not due to genetic sequences—instead, the traits are passed down epigenetically. Such instances are mainly due to environmental factors, such as stress during pregnancy or malnutrition. In this new effort, the researchers found that there may be other ways it can happen, such as via a process they call transcriptional adaptation, in which epigenetic changes might be directed due to mutations in a parental genome.

Suspecting that non-genetic traits can be passed from parent to offspring due to a mutation in a parent that increases the expression of other kinds of genes, the researchers conducted experiments with nematodes and
zebra fish.

They began by breeding nematodes with a single copy of a mutated act-5 gene—each also had a functional copy. Prior research had shown that act-5 pushes protein expression from the act-3 gene. The researchers altered the gene to make the protein fluorescent red to make it easy to see in tests. The researchers chose to study act-3 because it is normally only expressed in the pharynx. But when there was a mutated act-5 gene, the protein was expressed in the intestine.

Testing showed the intestines of offspring also lighting up with red protein, despite having no mutated act-5 genes, an example of transcriptional adaptation. The researchers also found that the red intestinal trait lasted for up to six generations. The researchers then repeated roughly the same experiment with zebrafish to find out if inherited transcriptional adaptation can also happen with vertebrates and found roughly the same results.

The researchers suggest that transcriptome traits can come from both mutations inherited from their parents and also from those that are not inherited.


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