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Scientists find that genes have help in determining our traits

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A particular type of RNA works in concert with a common protein to protect organisms from harmful genetic variations without the help of genes, reports Haifan Lin, director of the Yale Stem Cell Center, professor of cell biology and genetics and senior author of the paper.

“This mechanism may help explain how ordinary cells such as fibroblasts can be converted to stem cells and why some cancers develop at random,” Lin said.

The theory that factors other than genes are responsible for an organism’s traits, or phenotype, has been around for almost 70 years but has only gained steam in the past decade. For instance, cloned animals are often born with different colors than the animals that are the source of their DNA. But what causes these changes remained unclear.

About a decade ago, scientists found that a noticeable percentage of flies lacking a protein called Hsp-90 ended up with bizarre and random abnormalities such as legs growing where eyes should be. It seemed clear that Hsp-90 protected an organism against harmful genetic variations in its genome. Yet, since Hsp-90's role is to mobilize other molecules to respond to stress, researchers suspected other factors were involved.

One school of thought suspected that Hsp-90 prevents the display of random abnormalities by suppressing the activities of "jumping genes" that can relocate to other areas of the genome and cause mutations. However, the Yale researchers report that their work with flies shows that a type of small RNA called Piwi-interacting RNA, or piRNA, acts in concert with Hsp-90 and another molecule to prevent both the creation of variants and the activation of existing genetic variants. Genes do play a role in protecting against harmful variations but probably work through actions of the molecules piRNA and Hsp-90.

Lin, who studies piRNAs in reproductive cells and stem cells, says that the variations in levels of Hsp-90 and piRNAs among individual cells of the same type might explain why a small number of ordinary cells can be reprogrammed into stem cells and also why harmful mutations are created in some cancers.

"This study shows that we still have a lot to learn about the most basic principles of gene regulation," Lin commented. "Studies of this kind may provide missing puzzles in our understanding of normal development and malignancies."

Vamsi Ganguraju, working in Lin's lab, was first author of the paper. Other Yale authors include Molly M Weiner, Jianquan Wang and Xiao A Huang.

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