The biology of aging

UFRGS' Research Group studies how inflammation affects telomeres - structures that can define how we are going to age

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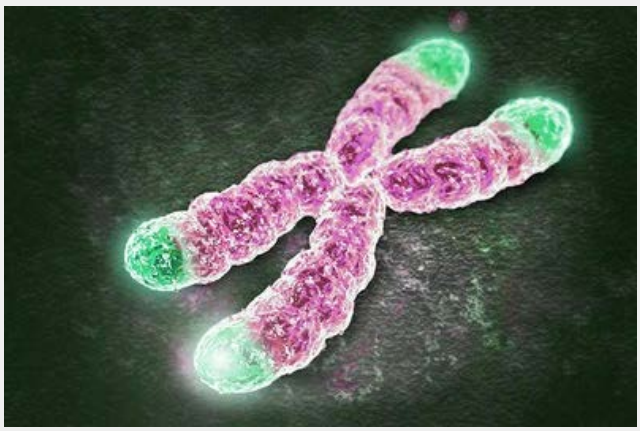

Size of telomeres directly interfere with the functioning of chromosomes - Illustration: Stanford University School of Medicine

Telomeres are the final part of our chromosomes structure. As described the 2009 Nobel Prize winner in Medicine, Elizabeth Blackburn, they are like the shoelace plastic tips of a sneaker: they are there to hold and support the rest of that structure. When they wear, the shoelace rips and slips. It is the same with cells. The professor of the Postgraduate Program in Biochemistry of Universidade Federal do Rio Grande do Sul (UFRGS), Florencia Barbé-Tuana, implemented a research group that is now focused on telomeric biology. As the leader of the group, she explains that researchers try to understand how inflammatory processes can influence the early aging of individuals.

The work converges with studies conducted at the University of Bologna, Italy, where the scientists work with the theory that the chronic inflammations which a person develops throughout the life and that are not restored can influence in his/her survival, because when an inflammation occurs, there is a high level of cell multiplication, and with their replication, the cells have their telomeres progressively shortened at each new reproduction. This is called telomeric friction. When they become too short, the telomeres signal to the cell that it must die. Therefore, Florencia explains that *the shorter a telomere is*, the shorter the cell's lifespan.

The size of the telomere interferes directly with the proper functioning of the chromosomes. People with longer telomeres have a lower risk of having diseases that develop with aging. The question of the scientific community is: what are the things that attack the telomeres and that could shorten our lives? And which things protect the telomeres and could increase their survival and postpone aging? It's believed that the protection of these structures would reduce the chances of diseases such as diabetes and cancer – as telomeres are involved with cell replication, once they wear out, they can begin to replicate cells in the wrong way, giving rise to cancer cells.

Florencia explains that aging can be observed at the molecular, cellular and organism levels – from micro to macro. If a tissue has many cells with shortened telomeres, this tissue begins to have an increased count of cell death and it eventually collapses, compromising its function. In well-known diseases such as Parkinson's and Alzheimer's, a large number of these senescent cells (in the process of dying) are observed in the central nervous system. Professor Barbé-Tuana comments that, with the removal of the senescent cells in animal experiments, the specimens tended to a later aging. Her research group has already observed that even the cells of a healthy young person become senescent cells when incubated with the plasma of individuals with obesity and chronic pro-inflammatory medical conditions.

However, Florencia points out that in the case of obesity, there is nothing indicating that senescence is linked to the individual's condition. In cases such as glaucoma, she says it is different; there is a direct cause and effect relationship between shortened telomeres and the development of the disease. She explains how it happens: chromosomes are replicated by an enzyme called DNA polymerase, which does not replicate the final ends, the telomeres. This is called 'the final problem of replication.' If this were to happen otherwise, the tissues would never suffer from aging. The enzyme that replicates these final portions of the chromosomes, called telomerase, uses an RNA mold to synthesize a DNA strand. It would be very easy for the tissues to keep functional forever if, when the telomeres begin to shorten, the telomerase could appear and replicate them again. But at birth this enzyme stops working in most cells. The only ones that keep telomerase

active are gametes, stem cells and tumor cells – these later due to mutations.

So, what happens is that when a harmful event, such as exposure to ultraviolet rays or stress causes a breakdown at the cellular level, our body can do the necessary repairs naturally. However, if the level of damage to cells exceeds the body's self-repair capacity, then there will be a mutation in the genome. That's what causes about 90 percent of cancer cases, Florencia explains. Therefore, giving less work to the body and avoiding such excessive damage is the way that study groups have found to delay telomeric friction. The golden habits for a healthy life are having a balanced diet, practicing physical exercises, sleeping well, and avoiding stress. The teacher points out that one of the most fascinating discoveries in telomeres biology is that all stressor events, external or internal to the individual's body, can cause changes at the cellular level, changing tissues function and even causing their early death.

Translated by Marcelo Viana Soares, under the supervision and translation revision of Professor Elizamari R. Becker (PhD) – UFRGS/IL.

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