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Cell metabolism, genetics and lifestyle

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ABSTRACT
The text addresses the intersection between metabolism, DNA and nutrition in contemporary life, highlighting how these themes are widely discussed and associated by the beauty and health industry. Concern about ageing and cellular maintenance has become central, driving research and practices aimed at understanding and influencing metabolic and genetic processes. The discussion emphasizes the importance of lifestyle in modifying genes and promoting a healthy life.

Keywords: Metabolism, DNA, Nutrition.

INTRODUCTION

The themes "metabolism", "DNA" and "nutrition" entered the homes of the population, became part of the conversation circles and, from then on, there is a concern of current research in relating them, strengthening the advertising and encouragement of genetic tests, the call for companies to sell products in the media, the launch of books related to the subject, the strengthening of discussions among professionals and the approach in textbooks. These factors corroborate to sharpen people's curiosity.

The beauty industry has associated the issues, relating metabolism to longevity, as studies demonstrate the direct relationship between DNA, cellular metabolism and nutrition (MUKHERJEE, 2016; GOTTFRIED, 2020). Topics labeled as controversial are part of everyday life, which brings benefits and care for the functioning of the body. Aging and oxidative stress become part of the vocabulary and it is not even imagined that these terms are related to metabolism (GOTTFRIED, 2020).

Within these discussions, a component of the chromosome, the telomere, comes into play, which, according to Pierce (2016), corresponds to "repetitive segments of non-coding DNA, with action on cell replication". It is known that cell replication is the way a cell maintains its functions. From this perspective, every time a cell suffers division, it may lose proteins, and some are fundamental for the maintenance of physiology (PIERCE, 2016). In this process, proteins act as regulatory sensors or master switches, turning genes on and off, or even combinations of genes, in a coordinated manner. These proteins govern the genome (MUKHERJEE, 2016).

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During our lifetime, the genome participates in the reproduction of our cells. And, in reproduction, protein loss occurs (adult cells), and DNA can also be progressively damaged, presenting dysfunctions; these dysfunctions are related to telomeres; after all, they are the ones that help cell replication (PIERCE, 2016). These discussions would be meaningless if metabolic issues were not being discussed so much in rejuvenation clinics, doctors' offices, or beauty treatments. The beauty industry has managed to associate the themes, highlighting the relationship between the perfect body, healthy skin and cell maintenance. Aging has become a problem for the vast majority of the population, as many methods are used to maintain a younger stereotype.

The tricks used to stay younger are directly related to the understanding that lifestyle causes metabolic changes (ZATZ and FRANÇA, 2021). In this context, it is clear that industrialization has changed the habits of populations. Traditional populations, which maintained their lifestyles, do not have many of the epidemics experienced in large urban centers: chronic non-communicable diseases, for example. Diseases that are related to lifestyle and westernization (MOSS, 2015).

> This lifestyle includes many components that occur simultaneously: little physical activity, high calorie intake, weight gain or obesity, smoking, high alcohol consumption, and high sugar consumption. The composition of the diet usually changes to low fiber intake and high intake of simple sugars, saturated fats, and trans-unsaturated fats (DIAMOND, 2014, p.505).

But what would be the relationship between lifestyle and metabolism? What would be the relationship between cellular dysfunctions, DNA and the action of genes? It is known that dysfunctional cells cause inflammation in the body and inflammation generates diseases. The truth is that about 90% of the signs of aging and diseases are caused by lifestyle and not by genes (GOTTFRIED, 2020). In this way, the individual will be responsible for his choices. And aging involves a set of biological actions that accumulate over time, manifesting themselves little by little (OBLACK et al., 2020).

These manifestations involve the expression of genes. So, scientific research helped the discoveries of ways to control genes. For example, the genes of aging, usually associated with fats and wrinkles, can be altered with diet, exercise, and lifestyle choices (GOTTFRIED, 2020).

Within this context, it can be considered that aging begins in cells. They are always dividing and, with each division, the entire genome is duplicated. However, cells are subject to environmental aggressions. For this reason, failures in cell replication may occur that will not be repaired, inducing dysfunctions (ZATZ and FRANÇA, 2021).

So are our choices and habits actually limited or shaped by the result of the interaction between the 25,000 genes scattered across our 46 chromosomes? (MARCHESI, 2020). This question loses its meaning when we understand that "genes are not our destiny" and when we realize that the quality of our health is shaped by the way we live (EPPEL and BLACKBURN, 2017).

In this way, as a complex algorithm, the situations experienced daily trigger specific biochemical cascades that act on our cells, altering or not our metabolism. Society does not need to wait for research, a magic pill or the invention of a low-calorie potato chip. The necessary changes must come from the human being and include: not smoking, exercising, limiting calorie intake, salt, alcohol, saturated fats, processed foods (DIAMOND, 2014).

OBJECTIVE

Discuss the relationship between lifestyle, cellular metabolism and genetics, using current literature that addresses the theme, serving as a basis for discussing and disseminating concepts.

METHODOLOGY

For the elaboration of this integrative review, the Grounded Theory (GT) was taken into account, which aims to build theories to explain social processes, understanding the meaning of the relationships and interactions between social phenomena, the understanding of reality, life and human action in the real world (STRAUSS and CORBIN, 2002).

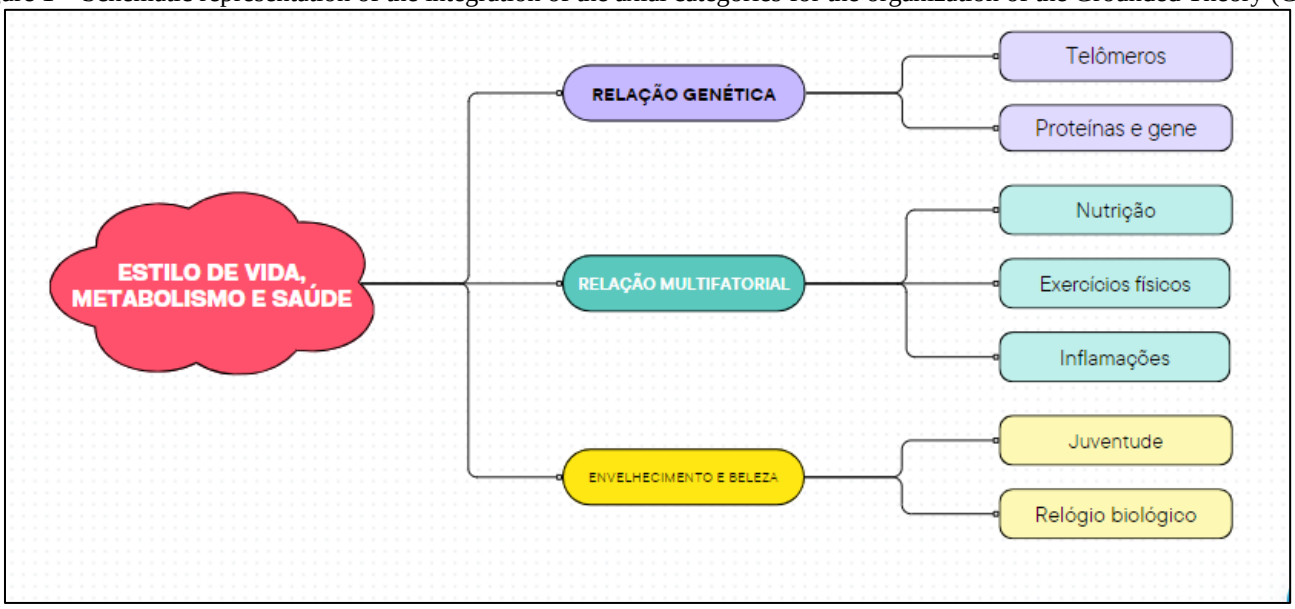
This method makes it possible to define concepts, analyze problems, draw conclusions, and point out gaps (SOUZA. SILVA and CARVALHO, 2010). In this situation, the researcher looks for processes that occur in the social scene, starting from hypotheses, adding new perspectives to the understanding of the researched phenomenon (STRAUSS and CORBIN, 2002).

The integrative review allowed us to understand the significance of the experience with the elaboration of categories that exemplified the context of the research. Thus, the central category was constructed: "Lifestyle, metabolism and aging", delimiting 3 categories for analysis: Genetic relationship, multifactorial relationship, aging and beauty. The process of integration of these categories is illustrated through an explanatory theoretical scheme presented in Figure 1.

RESULTS AND DISCUSSION

The discussion begins by observing the explanatory theoretical scheme, elaborated from the integrative review, which makes up this GT. Figure 1 comprises the central category and the categories of analysis that will support the theme.

Figure 1 – Schematic representation of the integration of the axial categories for the organization of the Grounded Theory (GT).



Source: Prepared by the authors.

The relationship between the themes and their interdependence is noted, as the cell, a morphophysiological unit, will directly suffer genetic and multifactorial relationships, expressing proteins or dysfunctions that accelerate or delay aging. Like thousands and thousands of small switches, some genes are being turned on and others turned off, all at the same time, in response to what you are doing to your body (MOALEN, 2016).

To better understand this relationship, we separated the study into categories. The genetic relationship is related to telomeric action and the expression of proteins and genes. The relationship between DNA, RNA and protein is expressed in the following quote:

> The information contained in DNA is transcribed in the form of RNA and part of it serves as a substrate to form proteins. RNA and protein molecules interact with each other and with the chromosomal DNA itself, controlling the transcription of new molecules that feed the cycle. The information inscribed in the DNA serves to build the molecular apparatus, a set of molecules that would function as a network. The molecular network, in turn, would control the synthesis of new transcripts that will feed it and control the reading of genetic information (BRÍGIDA, 2021, p.180).

This quote makes it clear that DNA will transcribe RNA and RNA will produce proteins that will be used for the normal functioning of the body. Thus, the impact of our actions would directly affect the reading and interpretation of this DNA. The quote below reaffirms this impact:

> Unlike the genome (set of genetic material), which changes slowly over generations, the transcriptome, proteome and metabolism (set at a given time of transcripts, proteins and metabolites, respectively) undergo constant changes, in response to different environmental factors, including diet (...) The integration of the different omics methodologies (transcriptomics, proteomics and metabolomics) has the potential to develop biomarkers for health status; to identify early changes in the development of chronic non-communicable diseases (NCDs); to differentiate

> into individuals who respond and do not respond to dietary interventions, in addition to the discovery of bioactive compounds (OBJECTIVE). 2008, p.759).

The possibility of analyzing the genome is already a reality and is part of everyday life. It should be considered that DNA replication can be turned on and off by other signals and regulators, for example, the age or nutritional status of the cell, thus allowing cells to only produce copies of DNA when they are ready to divide. However, when regulators present anomalies, nothing can prevent a cell from replicating continuously (MUKHERJEE, 2016). This process characterizes a dysfunction known as cancer.

Dysfunctions cause diseases or inflammatory responses. Nutrition becomes a primary factor for normal metabolic development, hence the importance of water, an inorganic component, which makes up 70% of the cellular composition and the consumption of proteins that represent up to 15% of the organic constitution of the cell (AMABIS and MARTHO, 2016). Proteins are known to be end products of a gene. However, not all dysfunctions presented by the body are related to a gene, but to a series of genetic variations that occur in each person's body, and that interact with the lifestyle and environment where they are found (ZATZ and FRANÇA, 2021).

Corroborating these statements, Gottfried (2020) reports that researchers have learned that diseases are not linked to DNA, but that they are malleable, resulting from complex interactions involving DNA, lifestyle, and the environment in which the person lives. Thus, the union of efforts between Medicine and Nutrition arises, launching on the market concepts that involve the interaction between nutrition, genetics and quality of life, called nutrigenetics and nutrigenomics (ROMBOLLI and VIOLA, 2017).

What we're learning now is that our genes are part of a larger flexible network. This runs counter to much of what we have been taught about our genetic identities. Our genes are not fixed and rigid as most of us have been led to believe (MOALEN, 2016). If this were the case, the adjustments would not occur and the environment in which we find ourselves would not make a difference in the expression of our genes.

The environment influences our metabolism so much that sleep deprivation has been shown to make genes moody: 97% of rhythmic genes become arrhythmic. In addition, this deprivation changes the expression of one in three genes, a dangerous alteration for diseases such as cancer (ARCHER et al., 2015).

Sleep is essential to delay aging, because during this time, the release of growth hormone occurs, which is essential for the body's repair. An example of this restoration is melatonin, a hormone that controls more than 500 genes in the body, including those involved with the immune system (GOTTFRIED, 2020).

Regarding exercise, it is observed that it alters the expression of thousands of genes, activating longevity genes. According to Rönn et al. (2008), exercise causes changes in the methylation of 18,000

loci in 7663 genes. The more you exercise, the more your cells adapt to help you control blood sugar, increase muscle mass, resist aging, and look younger (HARGREAVES, 2015).

Studies on telomeres, known as the biological chronometers of cells, show that moderate activity levels appear to better protect telomere length (DU et al., 2015). Silveira and Rosa (2017) observe that changes in lifestyle and the practice of meditation are factors that directly affect genes, in addition to activating the expression of the enzyme telomerase, which acts by readjusting the biological clock.

FINAL CONSIDERATIONS

The PDT of this study makes it clear that cellular aging, metabolic dysfunctions, and inflammation are directly related to lifestyle. To be healthy, it is necessary to express genes that produce proteins that will regulate the normal functioning of the body. However, our choices affect these genes, which can turn genes on or off, causing damage.

It is observed that balanced nutrition, physical activity and adequate sleep directly influence cell reproduction. Aging and beauty are subjects that have become much explored, we begin to understand that the result of our health, beauty and rejuvenation depend on our choices. In this way, we are not doomed to genetic destinies, it is proven that genes suffer the action of the environment during the expression of their characteristics, because what we are is the culmination of our choices. It is essential to continue the studies so that publications can be produced that support this discussion that is just beginning.

REFERENCES

Amabis, J. M., & Martho, G. R. (2016). Biologia 3 (2ª ed.). São Paulo: Moderna.

Archer, S. N., Laing, E. E., Möller-Levet, C. S., Veen, D. R. van der, et al. (2014). Mistimed sleep disrupts circadian regulation of the human transcriptome. Proceedings of the National Academy of Sciences, 111(6), E682-E691. https://pubmed.ncbi.nlm.nih.gov/24449876/. Accessed June 2024.

Brígido, M. de M. (2021). As dificuldades em se definir a materialidade do gene em uma ciência em transformação. Genética na Escola, 16(2), 170-183.

Diamond, J. (2014). O mundo até ontem: o que podemos aprender com as sociedades tradicionais (M. L. de Oliveira, Trad.). 1ª ed. Rio de Janeiro: Record.

Du, M. M., Prescott, J., Kraft, P., Giovannucci, E., et al. (2012). Physical activity, sedentary behavior, and leukocyte telomere length in women. American Journal of Epidemiology, 1(5), 414-422. https://pubmed.ncbi.nlm.nih.gov/22302075/. Accessed June 2024.

Epel, E., & Blackburn, E. (2017). O segredo está nos telômeros: receita revolucionária para manter a juventude e viver mais e melhor (S. Pinheiro, Trad.). São Paulo: Planeta.

Fialho, E., Moreno, F. S., & Ong, T. P. (2008). Nutrição no pós-genoma: fundamentos e aplicações de ferramentas ômicas. Ver Nut, 21(6), 757-766.

Gottfried, S. (2020). Mais jovens pelos seus genes: um programa inovador para reajustar seus genes, reverter o envelhecimento e voltar o relógio em dez anos (C. Barbosa, Trad.). Belo Horizonte: Editora Laszlo.

Hargreaves, M. (2015). Exercise and gene expression. Progress in Molecular Biology and Translational Science, 135, 457-469. https://www.sciencedirect.com/science/article/abs/pii/S1877117315001386?via%3Dihub. Accessed June 2024.

Marchesi, J. A. (2020). Como a genética transformou o mundo. Jaboticabal: Edição Independente.

Moalen, S. (2016). Herança: como os genes transformam nossas vidas e como a vida transforma nossos genes (A. Carvalho, Trad.). 1ª ed. Rio de Janeiro: Rocco.

Mukherjee, S. (2016). O gene: uma história íntima (L. T. Motta, Trad.). São Paulo: Companhia das Letras.

Moss, M. (2015). Sal, gordura e açúcar: como a indústria alimentícia nos fisgou. 1ª ed. Rio de Janeiro: Intrínseca.

Oblack, L., Zaag, J. V. d., Higgins-Chen, A. T., Levine, M. E., & Boks, M. P. (n.d.). Uma revisão sistemática dos fatores biológicos, sociais e ambientais associados à aceleração do relógio epigenético. Retrieved from: [Link not provided]

Pierce, B. A. (2016). Genética: um enfoque conceitual (5ª ed.). Rio de Janeiro: Guanabara Koogan.

Romboli, P. de B., & Viola, R. R. (2017). Nutrigenômica na promoção da saúde humana. In F. M. Sarti & E. A. da Silva Torres (Orgs.), Nutrição e Saúde Pública (pp. [page numbers]). Barueri, São Paulo: Manole.

Rönn, T., Volkov, P., Davegardh, C., Dayeh, T., et al. (2013). A six months exercise intervention influences the genome-wide DNA methylation pattern in human adipose tissue. PLOS Genetics, 9(6), e1003572. https://journals.plos.org/plosgenetics/article?id=10.1371/journal.pgen.1003572. Accessed June 2024.

Sandel, M. J. (2013). Contra a perfeição: ética na era da engenharia genética. Rio de Janeiro: Civilização Brasileira.

Silveira, L. C. M., & Rosa, T. G. (2023). Telômeros, telomerase e envelhecimento. Anais XI Mostra de Iniciação Científica do Centro Universitário CESUCA, 11. Retrieved from: [Link not provided]

Souza, M. T. de, Silva, M. D. da, & Carvalho, R. de. (2010). Revisão integrativa: o que é e como fazer. Einstein, 8(1), 102-106.

Strauss, A., & Corbin, J. (2002). Bases de la investigación cualitativa: técnicas y procedimientos para desarrollar la teoría fundamentada. Medellín: Facultad de Enfermería, Ed. Universidad de Antioquia.

Zatz, M., & França, M. S. J. (2021). O legado dos genes: o que a ciência pode nos ensinar sobre o envelhecimento (1ª ed.). Rio de Janeiro: Objetiva.