



EPIGENETICS, SOCIAL DETERMINANTS AND TRANSFORMATION – NATURE AND NURTURE

Dr. Vinita Pandey*

Assistant Professor, Department Of Sociology, Telangana Mahila Viswavidyalayam, Hyderabad *Corresponding Author

ABSTRACT

There is emerging scientific research and evidence which visibly demonstrates that internal body environmental influences can not only impact genes but also how they are expressed. Scientists have discovered that early experiences can determine how genes are turned on and off and even whether some are expressed at all. Epigenetics is the study of how behaviours and environment can cause changes that affect the way the genes work. Unlike genetic changes, epigenetic changes are reversible and do not change the DNA sequence, but they can change how our body reads a DNA sequence. There is strong influence of the epigenetics on social life. The ancient Indian systems of Ayurveda and Yoga indeed have strong bases for the same. It would be appropriate to further explore the same through inter disciplinary research

KEYWORDS : Epigenetics, Social Determinants, Ayurveda

INTRODUCTION

According to National Scientific Council on the Developing Child (2010) experiences leave a chemical “signature” on genes that determines whether and how genes are expressed. Thus, the established views that genes are “set in stone” or that they alone determine development have been negated. Epigenetics and Social Epigenetics

The Centre for Disease Control and Prevention defines Epigenetics as the study of how our behaviors and environment can cause changes that affect the way our genes work. Unlike genetic changes, epigenetic changes are reversible and do not change the DNA sequence, but they can change how the DNA sequence is read by body. Epigenetics literally means Epi – “above” and genetic – “origin” which means that the cells of our body can behave and respond differently based on environmental factors.

Bruce Harold Lipton an American developmental biologist in his book ‘The Biology of Belief’ describes a groundbreaking change in biology and explores a new approach to the connection between mind and matter. According to him “The fundamental difference between the old DNA genetic code and the new epigenetics is that the former notion accepts genetic determinism which implies the belief that genes predetermine and control our physiological and behavioral traits—while epigenetics recognizes that our perceptions of the environment, including our consciousness, actively control our genes.” (Lipton, 2005)

“If genes are our body’s hardware, our epigenome is the software that tells them how to work. It is essentially the instruction book on top of the genome”, according to Dana Dollinoy, Associate professor of environmental health sciences and nutritional

sciences at the School of Public Health. (<https://sph.umich.edu/news/home-releases/understanding-epigenomics-110117.html>)

The epigenome consists of chemical compounds that modify, or mark, the genome in a way that tells it what to do, where to do it, and when to do it. Different cells have different epigenetic marks. These epigenetic marks, which are not part of the DNA itself, can be passed on from cell to cell as cells divide, and from one generation to the next. (National Human Genome Research Institute, USA)

Genes comprise about 29% of the human genome. The human genome contains roughly 20,000 to 25,000 genes. Each cell contains a complete DNA but the genes differ in cells to be able to perform different functions. The cells in the body have diversified functions. Some are designed to produce tissue.

Some are programmed to create enzymes and some clean up waste that has been produced. Irrespective of the function of the cell there is a surface receptor that bonds with an extracellular molecule to trigger the cell into behaving a certain way. Genes can also be activated and/or altered by external stimuli such as infection or stress. This leads to the study of epigenetics. (Brown, 2000)

The different cell types in the human body have a different epigenome. The epigenomes can activate and suppress genes through DNA methylation and histone modifications without changing the genetic sequence of the DNA. According to an interesting observation by the faculty members at the University of Michigan School of Public Health, the epigenome acts as sort of a dimmer switch that can promote a gene to turn on slightly, turn on significantly, or turn off completely.

(<https://sph.umich.edu/news/home-releases/understanding-epigenomics-110117.html>)

Social epigenomics is “a new field of research that studies how the social environment shapes the epigenome and how in turn the epigenome modulates behavior” (Guerrero et al, 2020). A sociological study understands “social epigenetics” as research on “how extreme social adversity can lead to later negative health outcomes” with epigenetic mechanisms defined as “molecular modifications that regulate gene activity without changing the DNA sequence” (Adkins et al, 2018)

Genotype And Phenotype

Genotype and Phenotype are critical components in explaining the genetic and physical characteristics of any biological organism. The hereditary information of the organism is in the form of genes in the DNA and remains the same throughout the life. Phenotype is the expression of genes as the external appearance. The phenotype is not inherited from the parents and is influenced by the environmental conditions. The phenotype influences the individual in terms of appearance, development, and behavior. The activities and lifestyle affect the phenotype and changes the expression of the genotype accordingly. The major factors which impact the phenotype are lifestyle and behavior, diet and digestion, stress, and environmental factors (Sharma, 2018)

Social Determinants

A growing body of evidence demonstrates the importance of the social factors that cause epigenetic changes in the expression of DNA (Abdul et al 2017; Moore, 2017). It has been identified that diet, obesity, physical activity, tobacco smoking, alcohol consumption, environmental pollutants, psychological stress, and working the night shift might modify

epigenetic patterns. (Algeria et al, 2011)

Several factors can change the epigenetic mechanisms, including environmental chemicals, medications, hormones, nutrition, and development and aging. Since epigenomic changes impact gene expression, they can also impact the health. Because they change how genes function, they can trigger conditions like cancer, diabetes, autoimmune diseases, and mental health problems.

Another study focusing on epigenetic programming by maternal behaviour, has raised the possibility that a mother's behaviour can affect the chemistry of DNA in her offspring. Quality of early maternal care has long been acknowledged to have long-term repercussions during the lifetime of an individual. A potential mechanism for this effect was deduced from a study reporting that maternal nurturing in rats alters DNA methylation at the gene encoding the glucocorticoid receptor (Weaver et al, 2004)

Epigenetics – Ayurveda

Ayurveda as a Sanskrit term implies 'knowledge (veda) of longevity (ayus) and is commonly translated as the 'science of life.' A common expression in Ayurveda is yatha pinde tatha brahmande yatha brahmande tatha pinde or 'as is the microcosm, so is the macrocosm; as is the macrocosm so is the microcosm'. Ayurveda focusses on interconnectedness of multiple tangible and intangible elements and its impact on individuals across their lifespan, from preconception to old age. The Atharva Veda and Yajur Veda describe 293 and 81 medicinally useful plants. The practice of Ayurveda is based upon the knowledge gained from these Vedas. As a science of life, Ayurveda maintains that 'health' encompasses the mind, body, and soul. Ancient Ayurvedic texts, such as the Charaka Samhita and Sushruta Samhita, provide a basis for Ayurvedic practice and provide details on 'the physiology and interrelated systems of the body, variations in human constitution, surgical techniques, use of herbs and herbal mixtures, and many other modalities for achieving and maintaining health' (Sharma, 2016).

A key feature in Ayurveda is the defining of body type or constitution. Each person is born with a unique ratio of doshas, which are 'psychophysiological principles that govern various aspects of the human body.' The ratio of the three doshas, known as Vata, Pitta and Kapha will differ for every person. These are central regulatory principles of body, mind, and behaviour which govern the human physiology. While Vata directs motion, flow, and communication, including the flow of the blood, the beating of the heart, the transmission of nerve impulses, etc. Pitta regulates digestion, metabolism, and transformation. Kapha governs the structure of the body. These three doshas make up the psychophysiological constitution.

A person's unique constitution of doshas correlates with an individual's phenotype. Depending on the doshas, each person will respond differently to their environment and have a different predisposition to disease (Ibid). This is why Ayurveda has been attractive for other areas of genomics too, including personalized medicine (Prasher, Gibson and Mukerji 2016).

There is significant emphasis on lifestyle interventions both in Ayurveda and Epigenetics. Ayurveda places importance on one's environment, including a person's behaviour and social environment. An interesting take on epigenetics says "What you see, you become." Development of epigenetic research integrates the social as a 'causative factor for the biology of humans' that has been rarely seen in genetic research. However, in association between Ayurveda and epigenetics, the emphasis is more on lifestyle intervention. Ayurveda encompasses all aspects of a person's life, and places

importance on one's environment, including person's behaviour and social environment. The Ayurvedic Practitioners popularly called as Baidya or Vaidya give directives and advices pertaining to every day and seasonal routines and activities; when to exercise, eat and sleep, and offer recommendations for 'proper behaviour and how to deal with peers' depending their phenotype (Sharma, 2016).

As has been bioIn the biological process of DNA expression, the two strands of DNA separate and the knowledge present in the strand is replicated and comes out as messenger ribonucleic acid (mRNA). The knowledge carried in mRNA is then utilized by transfer RNA (tRNA), which lines up the designated amino acids to form the specified protein. It is proposed that mRNA, tRNA, and protein have features and properties that represent Vata, Pitta, and Kapha at the cellular level. Messenger RNA corresponds with Vata (transmission of information), tRNA corresponds with Pitta (transformation), and protein corresponds with Kapha (structure) (Sharma, 2018).

It is estimated that major part of life is controlled by epigenetics—the changes in gene expression brought about by what one does in one's life. Whatever is done to the phenotype or Ayurvedic psychophysiological constitution (Deha Prakriti) is relayed back to the DNA, which changes its expression accordingly. Thus, the process of epigenetics represents action (Karma—the Sanskrit word for "action") on the level of the cells. Factors that cause epigenetic changes affect DNA expression and this can also be transmitted to the progeny (Skinner, 2014). Thus, in a way, it truly symbolizes every action has equal reaction which is also one of the core principles of Newton's laws of action. Epigenetic dysregulations influence and play a vital part in the onset, progression, and pathogenesis of various human disorders and diseases, including cancer and cardiovascular, neurodegenerative, and autoimmune diseases.

In Ayurveda, optimal digestion is of prime importance in maintaining health. Charaka, one of the most acclaimed Ayurvedic Physicians has mentioned about 13 Agnis (fire) and one among them is the digestive fire in the intestines (jataragni) is the root of all the digestive fires in the body. As it causes the increase or decrease of the elemental and tissue digestive fires it should be treated with great care." (Charaka et al, 2004)

A nutritious diet will not have the maximum impact in promoting health unless the digestive capacity is optimal. Balanced Agni (digestive fire) is critical for proper digestion to occur. If the Agni is not functioning properly, the food will not be properly digested and this can lead to the production of Ama, a toxic byproduct of incomplete digestion that is linked to disorders and diseases. Research has found that the response to food intake and individual nutrients includes epigenetic events. Bile acids, which are necessary for lipid digestion and absorption, are also signaling molecules. (Defabiani, 2010)

The gene expression is strongly influenced even by the stressors. Research studies have proven that the stress-associated epigenetic changes have been correlated with depression. Feelings of anger, stress, frustration, and fear cause the DNA to become shorter and tighter, and switch off many codes. In contrast, feelings of gratitude, love, and appreciation cause the DNA to relax, and the strands unwind and begin to express. (Lancer, 2015). Even the environmental factors can alter gene expression through epigenetic mechanisms

Ayurveda addresses the various factors that cause epigenetic changes, for the maintenance of health and prevention of disease. Ayurveda in its basic premise establishes that

lifestyle routines and activities should be based on time of the day, season etc. For instance, Dinacharya (daily routine) recommends the optimal times for getting up in the morning, eating, exercising, meditating, etc., to stay in tune with the natural rhythms of nature that support optimal health. Ratricharya (night routine) recommends the optimal time to go to bed to ensure a good night's sleep, which is considered one of the main pillars of health in Ayurveda. It is this aspect of Ayurveda that recommends against working the night shift, due to the adverse physiological changes that can result. Ritucharya (seasonal routine) includes recommendations for each season, e.g., eating cooling foods during the summer and minimizing hot, spicy foods.

Other areas of Ayurveda that provide health-promoting recommendations include Ahara-Vihara (diet and guidelines for eating), Sadvritta (social and personal behavior), Manasa Tivra (mental stress) and Manas Vritti (mental fluctuations), and Paryavarana (environment, including home and workplace). Regarding Manas (mind), mental fluctuations are created by the incoming information received through the five senses (sight, hearing, taste, touch, and smell). An overload of this sensory input can cause stress, strain, and imbalance in the mind. Through the mind-body connection, this imbalance can lead to physical disorders. (Sharma and Wallace, 2020)

CONCLUSION

The social determinants influence the internal environment of the body and has the potential to bring in social transformation. Genetics and Epigenetics are the clear reflections of Nature and Nurture. Ancient Indian medicine and wisdom indeed have clear references to strong correlation between nature and nurture. Ayurveda clearly establishes epigenetic influences which in turn is influenced by social determinants. These determinants have immense ability to bring social transformation. Since contemporary epigenetics research is still correlational, greater technological innovations can be of great help to establish strong evidences regarding the role of epigenetics.

REFERENCES

1. Abdul Q.A., Yu B.P, Chung H.Y., Jung H.A., Choi J.S. Epigenetic Modifications of Gene Expression by Lifestyle and Environment. Arch. Pharm. Res. 2017;40:1219–1237. doi: 10.1007/s12272-017-0973-3.
2. Adkins DE, Rasmussen KM, Docherty AR. Social epigenetics of human behavior. Rosemary L. Hopcroft, editor. Oxford: Oxford Handbook of Evolution, Biology, and Society; 2018.
3. Alegria-Torres J.A., Baccarelli A., Bollati V. Epigenetics and Lifestyle. Epigenomics. 2011; 3:267–277. doi: 10.2217/epi.11.22.
4. Brown, T.A. (2002). Genomes (Second Edition). Oxford: Wiley
5. Charaka S, Sashtri Kashinath, Pt, Chaturvedi Gorakhnath., Dr . Ibid verse 15/4. Varanasi: Chaukhamba Bharti Academy; 2004. Chikitsasthana, 15/2; p. 452. [Google Scholar]
6. De Fabiani E, Mitro N., Gilardi F, Galmozzi A., Caruso D., Crestani M. When Food Meets Man: The Contribution of Epigenetics to Health. Nutrients. 2010; 2:551–571. doi: 10.3390/nu2050551
7. Guerrero Tania P, Jörns Fickel, Sarah Benhaïem, Alexandra Weyrich, Epigenomics and gene regulation in mammalian social systems, Current Zoology, Volume 66, Issue 3, June 2020, Pages 307–319, <https://doi.org/10.1093/cz/z0aa005>
8. Lancer D. The Healing Power of Eros. Int. J. Emerg. Ment. Health. 2015;17:213–218
9. Lipton, Bruce. H. "Embracing the Immaterial Universe, Shift: At The Frontiers of Consciousness" No. 9, p. 12, December 2005–February 2006. <http://www.ozarkresearch.org/Site/epigenetics.html>
10. Moore D.S. Behavioral Epigenetics. Wires Syst. Biol. Med. 2017; 9:1333. doi: 10.1002/wsbm.1333.
11. National Scientific Council on the Developing Child (2010). Early Experiences Can Alter Gene Expression and Affect Long-Term Development: Working Paper No. 10. Retrieved from www.developingchild.harvard.edu.
12. Prasher, B, Gibson, G & Mukerji, M 2016, 'Genomic insights into ayurvedic and western approaches to personalized medicine.', Journal of genetics, vol. 95, no. 1, pp. 209–228
13. Sharma, H 2016, 'Ayurveda: Science of life, genetics, and epigenetics', Ayu: Jammu, vol. 37, no. 2, retrieved January 11, 2020
14. Sharma H., Meade J.G. Dynamic DNA. Select Books; New York, NY, USA: 2018.
15. Sharma H. Meditation: Process and Effects. AYU. 2015; 36:233–237. doi: 10.4103/0974-8520.182756.
16. Sharma, Hari and Wallace Robert Keith. 2020 Ayurveda and Epigenetics. Medicina (Kaunas), 2020 Dec; 56(12): 687. Doi: 10.3390/medicina56120687
17. Skinner M.K. Environmental Stress and Epigenetic Transgenerational Inheritance. BMC Med. 2014; 12:153. doi: 10.1186/s12916-014-0153-y

18. Weaver, I. C. et al. Epigenetic programming by maternal behavior. Nature Neurosci. 7, 847–854 (2004).