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Epigenetic Effects on Health and Behavior

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Epigenetics Affect on Health and Behavior

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NURS 6810 : Advanced Pathophysiology for Advance Practice Nursing

Dr. John Chovan & Dr. Sue Butz

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Epigenetic Effects on Health and Behavior

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Introduction to Epigenetics

Childhood experiences alters the path of one's health and behavior. (Felitti et al., 1998) This poster looks at the mechanisms behind these altering experiences. As shown in Table 1, there are two elements making up individual traits in people. The first being the DNA's nucleotide sequence; genetics. The second is how their genetics is influenced from the transcriptional level to the post-translational level; epigenetics. (Moosavi & Motevalizdeh Ardekani, 2016) In other words, epigenetics is how the gene is expressed or depressed.

The Epigenetic portion of a person is malleable beginning in utero. (Linnér & Almgren, 2019) This poster will look at some influences on one's health and behavior, as well as the influencing factors leading to their modification. The finding of outside influences which modify one's DNA to be expressed or depressed has serious implications for every human interaction. Epigenetic research is more important when one realizes epigenetics, like genes, are transferred through generations. (Moosavi & Motevalizdeh Ardekani, 2016)

The poster will show how epigenetics can be modified for the holistic health of the person. If society does not implement our understanding of epigenetics to transform policy and procedure in every social, medical, political, professional and educational arena, generations will continue to suffer and die from preventable causes.

Pathophysiology

Significance of

- imprintable:** One's time in utero has significant importance for one health and behavior later in life due to epigenetic influences passed from the mother. (Linnér & Almgren, 2019)

- transgenerational:** DNA methylation can be transgenerational specifically through cytosine residues in CpG sequences. (Moosavi & Motevalizdeh Ardekani, 2016)

- reversible:** There is research signifying, despite the negative aspects of epigenetic changes, they can be reversed back to a more healthy expression. (Moosavi & Motevalizdeh Ardekani, 2016)

- costly:** Childhood trauma, which you will see is one component which affects one's health and behavior through epigenetic influences cost the state of California 10.5 billion dollars in the year 2013. (Miller et al., 2020) One can only imagine the actual cost spent on health and behavior due to epigenetic influences if that is only one component.

Underlying Mechanism

- DNA methylation:** can occur on two of the four DNA nucleotides; cytosine and adenine residues, however methylation is most commonly found in cytosine residues. (Aristizabal et al., 2019) DNA methylation most often suppresses the gene expression. (Zhang et al., 2019)

- Histone modification:** are modifications of an enzyme(s) which can be associated with genetic transcription and repression (Zhang et al., 2019) The Histone modifications modulate how close the DNA bonds to the nucleosomes which affects the amount of transcription factors and enzymes that reach the DNA. (Aristizabal et al., 2019)

- Noncoding RNA's:** were once thought to simply be a transcriptional error. They are now known, to have degrading and silencing properties of the proteins which RNA's usually adhere to. (Aristizabal et al., 2019)

These are the three major mechanisms found to affect genetic expression according to Moosavi & Motevalizdeh Ardekani (2016), however there are more ways for one's genetic expression to be changed as well.

Epigenetic Influencers

Positive

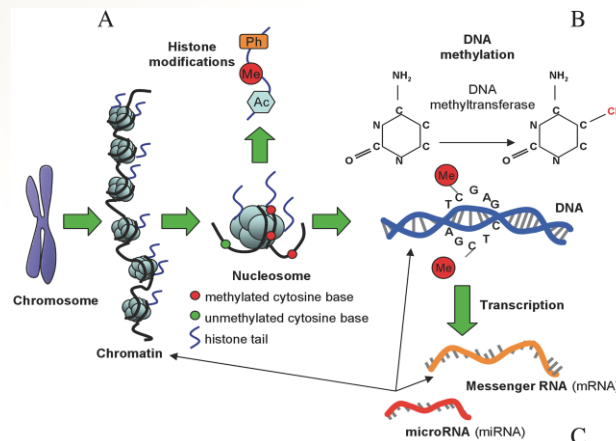
- family support:** The biological aging of epigenetics due to negative influencers can be reversed with support of ones family unit. (Brody et al., 2016)
- trauma informed care:** One of the interventions the medical field needs to adopt is trauma informed care which has proven to have a positive impact on reversing the negative affect of epigenetics in one's health and behavior. (Jacob et al., 2018)
- Pharmaceuticals:** This is one area which is very promising, yet needs more research, in terms of treatment as well as prophylaxis of negative epigenetic influencers. (Fisher et al., 2016)
- Exercise:** Epigenetics can be modified through something as simple as exercise. (Moosavi & Motevalizdeh Ardekani, 2016)

Negative

- childhood trauma:** The experiences lived during one's childhood can impact one's health and behavior negatively by changing their epigenetics for the rest of their life, unless they are able to initiate resiliency. (Kaufman et al., 2018)
- nutrition and diet:** The food that makes up one's diet can affect change on the epigenetic level. (Stover et al., 2018) This means each individual person has the ability to have an impact on the health of not only themselves, but also for generations that come after them based on their diet and nutritional intake.
- racial discrimination:** Discrimination based on one's skin color has been shown to biologically age one's epigenetics prematurely. (Brody et al., 2016)

*This is not an exhaustive list of epigenetic influencers.

Figure 6: Levels of DNA methylation can be used as a marker of disease risk factors. (Abidi, 2020)



Pathophysiology

Processes Affected

- Alcoholism Addiction** (Berkel & Pandey, 2017) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)
- Alzheimers** (Moosavi & Motevalizdeh Ardekani, 2016)
- Asthma** (Linnér & Almgren, 2019)
- Autoimmune Arthritis** (Peeters et al., 2017, p. xx)
- Cancer** (Moosavi & Motevalizdeh Ardekani, 2016) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)

- Cardiovascular Disease** (Kietzmann et al., 2017) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)

- Chronic Lung Disease** (Kan et al., 2017)
- Perinatal Depression** (Garfield et al., 2015)

- Diabetes** (Xu et al., 2019)
- Diabetic Nephropathy** (Xu et al., 2019)

Processes Affected Cont.

- Drug Abuse** (Gentner & Leppert, 2019) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)
- Endometriosis** (Koninckx et al., 2019)
- Obesity** (Kaufman et al., 2018) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)
- Psoriatic Arthritis** (Zhang et al., 2019)
- Schizophrenia** (Moosavi & Motevalizdeh Ardekani, 2016)
- Suicide** (Kouter et al., 2019) This disease process is also directly linked to Adverse Childhood Experiences. (Felitti et al., 1998)

- Systemic Lupus Erythematosus** (Farivar & Shaabanpour Aghamaleki, 2018)

*This is not an exhaustive list of mental and physical disease processes influenced by epigenetics.

References



Nursing Implications

- educate

Medical staff must be educating about the topic of epigenetics and it's role in the health and behaviors of our clientele. They need to educate themselves, the healthcare systems they work for, and the general public. They need to educate themselves enabling them to be intentional about not further perpetuating the negative consequences of epigenetics. They can educate themselves to allow them positions of administration to enact change within the healthcare systems and legislation through knowledge translation, as well as positions of research to further our understanding of epigenetic interventions. They need to educate their healthcare systems in order to motivate administration to change policy and procedures enabling the system to provide mental and physical health to their clientele and employees with the same intentionality. The public needs educated so when they see their medical provider they can bring up the conversation of past experiences and start the conversation of how their experiences may be affecting the current situation, and the best plan of care moving forward.

- implement

Medical staff, after their education, have a responsibility to implement what they have learned in order to work towards the mental and physical health of their clientele. Implementing trauma informed care, with every interaction of every human being should be the expectation moving forward. Medical staff when making an intentional effort through trauma informed care to be supportive can play a part in an individual's as well as communities' resilience.



Table 1: Relative roles of genetics and epigenetics in envisaging transgenerational information (Krupanidhi et al., 2008)

S.N.	Genetics	Epigenetics
1	Emphasizes on heritable changes of characters	Emphasizes on heritable changes in the molecular machinery for gene expression patterns.
2	Deals with traits of individuals in a population.	Deals with gene expression among the population of cells.
3	Reinforces dominance/recessive nature of traits.	Regulates awakening/silencing of gene expression.
4	Revolves around genes	Goes with chromatin.
5	Deals with the functional units of DNA as alleles.	Deals with the regulatory units of chromatin viz., epialleles.
6	Envisages the transgenerational expression of traits across individuals.	Focuses on transgenerational expression of genes in the successive generations of cellular population.
7	Handles with either single or constellation of genes.	Handles with the cellular genome and chromatin remodeling.
8	Elaborates on genetic profiles in a population.	Elaborates on cellular differentiation, gene imprinting and cellular pathobiology.
9	Exclusively depends on meiotic inheritance.	Profusely depends on mitotic inheritance.
10	Describes test crosses and back crosses to validate genes.	Describes epigenetic marks, packaging and modification of chromatin.