Volume 20 Issue 43
Originally issued as A10



Global Journal of human-social science: A
Arts & Humanities - Psychology
Volume 20 Issue10 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-460x & Print ISSN: 0975-587X

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GJHSS-A Classification: *FOR Code: 420306p*



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Epigenetic Poverty, Coloniality and Intervention Bioethics in Latin America

Cesar Koppe Grisolia [α] & Volnei Garrafa [σ]

Abstract- Numerous studies have documented a relationship between changes in gene expression and biosocial factors. For example, *Nr3c1, Ppara,* and *IGF2* expression alter as a result of poverty-induced biosocial pressures. Such epigenetic changes have already been identified in children born into poor households and children born to malnourished mothers. This study presents an ethical discussion of poverty in Latin America caused by social exclusion and economic exploitation of natural resources by developed countries. Intervention bioethics (IB), a critical purpose for new epistemological territorialism, was developed in Latin America and is based mainly on coloniality studies. This persistent situation exemplifies the relationship of oppression and dependence of peripheral countries on central countries. The inherent social inequality results in perpetual poverty, which in turn leaves epigenetic marks in the genome. We discuss how lower socioeconomic status can cause changes in the DNA-methylation pattern. Intervention bioethics advocates that the State must be more effective in making decisions in favor of excluded populations, thus establishing minimum income policies. In Latin America, the majority of the population is poor. Therefore, the State, possessing both the knowledge and tools to interfere in this social condition and break the cycle, must be questioned ethically.

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I. Introduction

Several studies have reported a correlation between age and DNA methylation, with elderly individuals having significantly more DNA methylation than young people (Hannum et al., 2013). Individuals who have a degree of DNA methylation higher than that expected to correspond to their chronological age are said to be in an accelerated aging process. Individuals in this condition have an elevated risk of chronic degenerative diseases. Accelerated aging, relating to increased DNA methylation patterns, is associated with environmental factors such as diet, stress, pollution, education, and socioeconomic status (Fiorito et al., 2017).

Thus, related situations with lower socioeconomic conditions associated with malnutrition, low educational level and lack of basic sanitation (pollution), among others, contribute to increased morbidity and mortality, especially in populations living in developing countries, also known as peripheral countries. Poverty and maternal abandonment introduce epigenetic marks to the genomes of children and adolescents, leading them to socially disadvantaged conditions of learning difficulties, school abandonment, juvenile delinquency, and teenage pregnancy, which reflect negatively in adulthood (Holzer et al., 2007; Combs-Orme, 2013). Poverty in adulthood causes learning difficulties, increased susceptibility to sickness, and earlier death, together with a substantially decreased social contribution (Holzer et al., 2007).

In the past, it was believed that the aforementioned deficiencies in poor people were the result of genetic inheritance, signifying a kind of genetic determinism whereby rich people would have rich offspring, due to inherited intelligence and competence. Conversely, poor people would have equally poor descendants due to inherited deficiencies. In this article, we propose a discussion of how biological mechanisms and social inequalities became embedded in Latin American countries, even though there are no genetic studies carried out directly with samples from Latin populations. However, empirical studies linking socioeconomic (poverty) status and epigenetic marks are already very well-established.

II. The Relationship between Genes and Poverty

An association study involving 1,193 individuals in the United Kingdom established a relationship between socioeconomic level and DNA methylation levels. The authors used socioeconomic classification based on employment/unemployment, retired/working professional, family income, educational level, family life, smoker/non-smoker/ex-smoker, body mass index, pre-existing disease(s) and income. The most evident results of accelerated DNA methylation were found in children born to poor households with poor socioeconomic status and low education (Hughes et al., 2018). People living in the poorest neighborhoods in England die on average seven years earlier than those living in the richest areas. In this shorter life, they spend 17 years longer with disabilities. Furthermore, economic and health inequality is associated with inequality in environmental degradation (Sell, 2003). There is no such study in Latin American countries to date.

A significant episode in recent human history was the Nazi siege of Holland during World War II, with

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food deprivation causing extreme hunger (Dutch Hunger Winter). Pregnant women deprived of food gave birth to babies with persistent epigenetic marks. Different levels of methylation were observed in the insulin-like growth factor II (IGF2) gene. This maternal imprinting transmitted to babies persisted until adulthood and was verified up to 6 decades after this deprivation episode, thus demonstrating a transgenerational effect. The occurrence of genetic hypomethylation leads to a bi-allelic expression of the IGF2 gene. This means that an epigenetic mechanism was activated to protect against starvation.

The same hypomethylation pattern was reported in the *Nr3c1* and *Ppara* genes in rat pups that suffered food deprivation during pregnancy. The expression of the above mentioned genes was also modified in descendants of Dutch Hunger Winter families. These genes are associated with both the emotional stress response and the physiological stress response induced by exposure to extreme cold (Heijmansa et al., 2008). Thus, children born into poor households and those born to malnourished mothers start their lives with a disadvantage in terms of genetic imprinting, which can contribute to the maintenance of their social position or render their social mobility very difficult. Such epigenetic markers compromise psychosocial development and may result in learning disabilities witnessed in poor school performance, and school dropout levels. The resulting low education causes unemployment, underemployment and difficulty in accessing more qualified jobs. In other words, there is a form of genetic condemnation at birth as a consequence of underdevelopment, 'conformity of the colonized', referred to herein as epigenetic poverty. Figure 1 illustrates three methylation patterns in a gene promoter, which can be caused by environmental factors. It is well-known that different environmental factors act in the establishment of these DNA methylation patterns, including those of a behavioral nature originating from psychosocial pressures, including hunger and malnutrition.

III. The Influence of Biosocial Factors on Gene Expression and their Relationship with Poverty

Several examples in the literature show that social pressures alter gene expression, with such genetic changes persisting through generations as a type of genomic imprinting. Consequently, individuals who inherit these epigenetic changes are more vulnerable to chronic-degenerative diseases and developing psychosocial disorders during adulthood.

A study conducted by Swartz et al. (2017) reported that children from impoverished families who inherited certain DNA methylation patterns were more prone to mental illness. DNA methylation in the serotonin transporter gene (*SLC6A4)* promoter increases the risk of depressive symptoms.

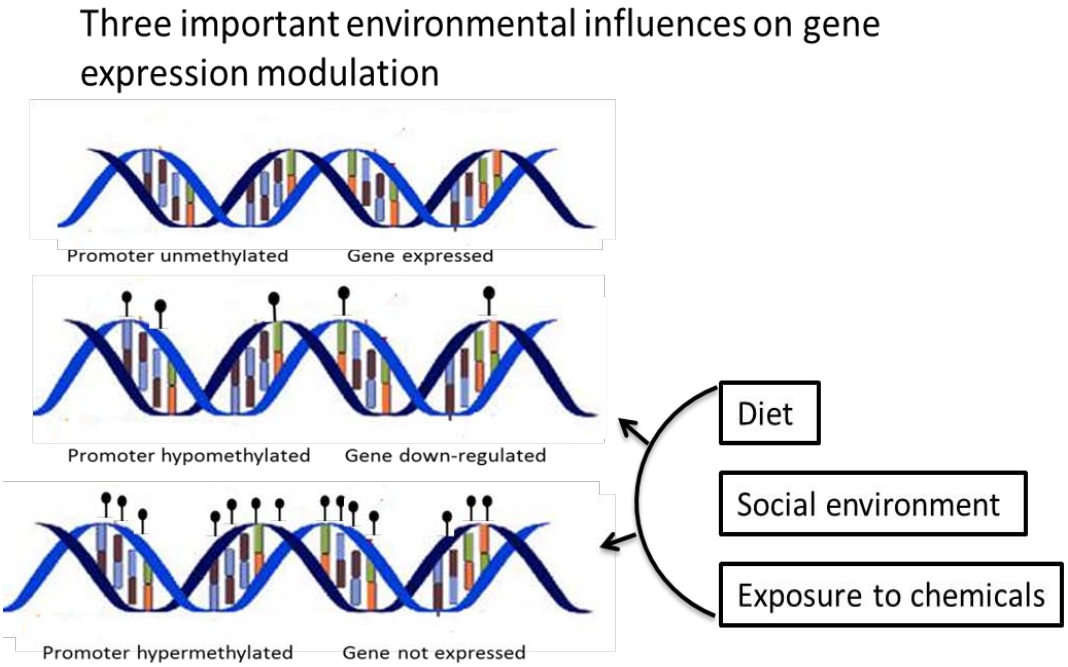


Figure 1: Different patterns of gene expression modulation according to DNA methylation levels in the gene promoter region influenced by different environmental factors. CH_3

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What is the ethical responsibility of the State in the governance of an entire generation of individuals with epigenetic marks resulting from extreme poverty which can be passed down for generations? Especially considering that this socio-genetic discussion relates more to social sciences and bioethics. According to Quijano (2002), it would constitute a new racial connotation, configured in the relationship of domination and hierarchy, based on social population classification. This is a persistent situation in the so-called peripheral countries, which Quijano named 'coloniality.'

Persistent situations of misery, poverty, and hunger produce generations of genetically vulnerable individuals, which governed by the capital and market law, remain a permanent condition of inequality for any type of social mobility in comparison with individuals born to wealthier homes.

Thus, the historical difference between colonizers and the colonized is much more profound and visceral than a mere socio-political and economic condition. The condition of the colonized is biologically imprinted in their DNA and is aggravated by the fact that it not only transmits to their descendants but also persists. For a Latin-American child born into a low social class, it appears that his condition of poverty was already genetically blueprinted in his ancestors. According to Quijano (2002), the coloniality in Latin America is the most profound and effective form of social, material, and subjective domination. This is why it is the basis of political domination within the current pattern of power. Furthermore, in Latin-American countries, the State acts as structural authority maintaining this form of collective domination, which in the current context is ethically unacceptable.

In this modern globalized world with an economy configured by the almost absolute control of international capital, Latin American countries are mere peripheral suppliers of commodities and relatively cheap raw materials to the traditional first-world colonizing countries. For Quijano (2002), this situation articulates the shape of social structure that leads to permanent exploitation of the workforce, servitude, and small commercial production.

The main question in this process is how can this vicious cycle be broken? This perverse State policy consistently leaves peripheral countries, including those in Latin America, without a budget and effectively hostages of international capital. As such, economic development is restricted, as is the ability to acquire the necessary resources to establish more effective permanent programs to combat poverty, not to mention investments in long-term educational projects. The development of a comprehensive educational program from the base up to the university level to allow social mobility could prove the way to break this shameful cycle.

The establishment of public policies defining minimum income programs to eradicate hunger and malnutrition must first enter the ethical conscience of the State before being made mandatory by law. It should not be overlooked that the planet currently surpasses the food production needed to feed more than seven billion inhabitants by about 30%. Hunger is not caused by food shortages, rather by difficulties in accessing food. This situation remains unchanged from the middle of the last century to the present day (Carvalho, Shimizu, and Garrafa, 2019).

Josué de Castro, a Brazilian doctor who was the first president of the United Nations Food and Agriculture Organization (FAO), already anticipated this direct relationship between colonialism/poverty and its harmful consequences on the lives of poor people around the world over 70 years ago. He also emphasized that hunger is not a natural phenomenon, but rather a consequence of perverse economic models. Furthermore, this is a product of man-made problem and with political will could eliminate or maintained by the man himself (Castro, 1946; Castro, 1951). In other words, for 'biopolitical reasons,' an expression coined by Foucault (2008).

In this scenario, epigenetic poverty is closely associated with intellectual and moral poverty, together with poor health and the inability to react, culminating in conformism. This passive and subservient condition is, therefore marked in the genes through biosocial factors that cross generations, viscerally contributing to maintaining the status quo.

IV. Poverty, Coloniality, and Bioethics

Knowledge acquired in the modern world, as well as the way to use it and exercise it as a form of power by more developed nations over more fragile nations, resulted in the validation of individual and collective, private, and public behaviors, creating new global geopolitics. Studies of coloniality emerged precisely as a response to the political, social, and even scientific practices adopted with the advent of this phenomenon named "modernity," with special emphasis on the violence that emerges from the contradiction between "modern people" and "colonized people."

Aníbal Quijano, the founder of the coloniality concept, affirms that modernity as we know it only exists because a form of exercising power has been established that inferiorities others. Thus, different identities are established through the creation of otherness that can and, to a large extent, involves the subordination, violation, and oppression of the inferior party (Quijano, 1992). In this line of reflection, coloniality would be this form of exercising power based on an idea of development in which more powerful countries impose economic, political and moral standards on

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other people(s) not only to establish a mechanism for the expansion of developed nation-states but also for the creation of another "more developed" identity.

Articulation of these levels created a certain hierarchy between what is local and what is global, in so far as what is local in particular needs to be developed to reach global hegemony. In this sense, modernity can be considered as the construction of a new image of the world (orderly, rational, predictable, and in constant progress). Coloniality studies refer to this image of the modern world as a "Eurocentric way of interpretation." Eurocentric in terms of it having the axis of understanding the modern process in its projections for Europe and also for the USA (Quijano, 2000). This image projects the idea that everything which is not modern is not civilized, that is to say, crosses the mark of barbarism, marginalization, and subordination. In this context, the place is smaller, marginalized, barbaric and subordinate. The place is therefore moved from the center seen as being somewhat retrograde, in need of education, improvements, or development to achieve a global ideal. Such an image assumes (and institutes) a hierarchical escalation between who is developed and who is not, to a point where this hierarchy is thought of in terms of who is modern and who is not.

Coloniality establishes hierarchies in which the least developed must not only be under the tutelage of the most developed, but the development in itself is somehow linked to this tutelage. The different ways of life in developed and peripheral countries not only imply a difference in the level of development, but also the scaling of values between lives. This was a variant of colonial difference that contributed to what Nascimento and Garrafa (2010) termed the 'Coloniality of life.' This concept is the process of creating an ontology of life that allows us to suppose that some lives are, from a political point of view, more important than others. A hierarchy is therefore established, together with a justification for domination, exploitation, and submission under the pretext that this represents an adequate path for the development of less developed ways of life.

Colonialism is over, but the same rationale of exploitation and violence continues to be applied, however, by more sophisticated methods than the former metropolis presentation in the colonized country. Currently, Latin America is colonized without a single metropolis. Here lies one of the most perverse coloniality effects: there is no concrete nation-state to blame for the excesses and injustices that have claimed lives in the name of progress of the globalized world (Nascimento and Garrafa, 2010). It is also important to emphasize that the interpretation of coloniality is not based purely on a biological concept of life but also on medical, religious, economic, and political beliefs that, when articulated with other beliefs, strategically stratify lives to achieve domination. Factors above mentioned support the rationale of the present study of epigenetic poverty to consider bioethics and social sciences as theoretical references for understanding the complexity of this entire context.

V. Neoliberal Policy in Latin American Countries and the Absence of State Social Responsibility Regarding Poverty

The trend towards a neoliberal policy implementation in Latin American countries alleviates the State's healthcare and education program responsibilities. This neoliberal logic promotes the free market and consequently weakens public healthcare systems. Healthcare privatization effectively increases both inequality and vulnerability. Furthermore, such programs usually exclude a range of bioethical concerns regarding the vulnerability of lower social classes. From the neoliberal perspective, it is recognized that only State regulation of private corporations can solve problems and protect public health.

The COVID-19 pandemic has shown the importance of a strong State presence to protect jobs and save lives in Brazil, especially for poor people who cannot afford private healthcare services. Corporations lack the moral commitment to social inequalities as this does not increase profits.

In looking at epigenetics, it becomes easier to understand why poverty is ignored in Latin American countries, especially in Brazil. Once the rich become richer, so too will their children, grandchildren, as will their great-grandchildren and generations to come. Moreover, it is important to understand that it is incorrect to say that poor people are genetically inferior and therefore destined to live in poverty. The growing social inequality in Brazil demonstrates that the promise of neoliberal policies is also false. It is an economy based on a mythical belief that wealth is the result of hard labor. Most of the wealth is inherited, and the remainder of the population does not benefit from increasing wealth. In reality, it is associated with increased inequality, vulnerability, marginalization, and exclusion.

VI. Intervention Bioethics (IB), Social Inequality and Epigenetic Poverty

Intervention Bioethics, originally termed "Hard Bioethics" as it is a theoretical-practical construction committed to "the most fragile band in society," is a proposal for epistemological re-territorialization of bioethics from Latin America (Garrafa and Porto, 2003). It is a conceptual strand of thought inspired by the theoretical references of coloniality. IB systematizes academic criticisms of so-called "bioethical principlism," a theoretical current of Anglo-Saxon origin predominantly concerning bioethics based on four presumably universal principles: respect for autonomy,

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beneficence, non-maleficence, and justice. IB criticisms of principlism focus especially on its maximalist application of autonomy to the detriment of justice, in preference of the individual over the collective.

According to IB principles regarding protection and prevention, there must be a rupture in the system by the State to induce the transformation process. This starts with the establishment of programs to protect all forms of vulnerability caused by poverty and the guarantee of rights regarding social justice. The governmental intervention also includes systems to prevent new forms of colonialism, such as barriers against technological development in Latin America by industrialized countries. Also there must be continuous development of state policies establishing social programs conscious of the transgenerational consequences of poverty. The State has an ethical obligation to act decisively to break this condition. In Latin American countries, the social pyramid has a wide base of poverty with no prospect of change, so how can we demand a policy with social ethics? This question is compounded by the fact that the State controllers at the apex of this pyramid are the representatives of rich and powerful white people, descendants of European colonizers from the beginning of settlement in the Americas. This condition is more pronounced in Latin American countries.

One of the lines of thought developed in intervention bioethics refers to "persistent situations" (Garrafa and Porto, 2003) in which these conditions have persisted in Latin American societies for more than five centuries. Such factors include gender discrimination, social exclusion, racism, inequality in the allocation and distribution of sanitary resources, together with the child and elderly abandonment. This proposal aims to break this paradigm by dissolving this configuration and is based on more equality between the segments of society.

Considering epigenetic poverty as the prominent reference of the present study, together with intervention bioethics and studies on coloniality as theoretical references for critical analysis, it is easier to understand why poverty is ignored in Latin American countries. Once the rich become richer, biomedical and biosocial circumstances dictate that the same is likely to happen to their children, grandchildren, great-grandchildren, and generations to come. Also it is important to understand that the premise of poor people being genetically inferior, and therefore destined to live in poverty is false.

In this sense, this study on Epigenetic Poverty combined with Intervention Bioethics and related studies assume the task of denouncing, demystifying and proposing interventions in this colonized image of life affirmed by imperialism in different areas (political, economic, moral, biomedical, etc.) which ends up not only structuring social inequality but, above all, contributing to its maintenance (Feitosa and Nascimento, 2015).

One important global bioethics principle (Potter, 1995) is the responsibility the incumbent generation has for future generations. It raises ethical concerns about what kind of genes we have transmitted to our offspring. Moreover, it constitutes a compromise in reducing social inequality by providing hygiene, sanitation, clean water and sewage disposal for all as it is these environmental elements that may alter a child's gene expression.

VII. Final Remarks

The establishment of public minimum income policies to eliminate hunger is an ethical and humanitarian issue but alone is insufficient to eradicate poverty. What narrows the base of the Latin American social pyramid are State social policies investing considerably more in health and education. The improvement of State healthcare services and nutritional programs should be the first step to afford children of low social class the opportunity to improve their academic performance. And then, to achieve professional goals and ultimately increase their social mobility, leaving misery and poverty behind.

Based on the epigenetics of poverty and intervention bioethics, elimination of these negative biosocial factors by fighting against hunger, decreasing poverty, eliminating social exclusion and improving schooling, can alter genetic markers relating to poverty. The creation of mechanisms to rupture the elements that established coloniality, social injustice, and barriers to social mobility constitutes a significant contribution for generations to come. Furthermore, it is important to ensure that future generations do not inherit genes with the epigenetic marks of a colonized past, ultimately breaking the epigenetic cycle.

Science has demonstrated that poverty is not a stigma of genetic inferiority, but rather a social condition causing epigenetic marks which can be passed from generation to generation. This puts more onus on the State because the negative epigenetic marks of poverty are reversible and, as such, can be removed. Moreover, 'removal' tools are now well-documented. Intervention bioethics advocates that it is imperative that the decisive hands of the State favor the community or the majority. In Latin America, the majority is poor. Therefore, a State possessing both the knowledge and tools to successfully interfere in this social condition, together with biopolitical reasons, effectively break this cycle must be questioned ethically.

Acknowledgments

The authors wish to thank the Brazilian Research Council for Scientific and Technological Development (CNPq) for research grant n.

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304209/2019-8 and declare that there is no conflict of interest.

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