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Epigenetics, Media Coverage, and Parent Responsibilities in the Post-Genomic Era

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Abstract

Environmental epigenetics is the study of how exposures and experiences can turn genes “on” or “off” without changing DNA sequence. By examining the influence that environmental conditions including diet, stress, trauma, toxins, and care can have on gene expression, this science suggests molecular connections between the environment, genetics, and how acquired characteristics may be inherited across generations. The rapid expansion of research in this area has attracted growing media attention. This coverage has implications for how parents and prospective parents understand health and their perceived responsibilities for children’s wellbeing. This review provides insight into epigenetic research, its coverage in the media, and the social and ethical implications of this science for patients and clinicians. As epigenetic findings continue to elucidate the complex relationships between nature and nurture, it becomes critical to examine how representations of this science may influence patient experiences of risk and responsibility. This review describes some of the social and ethical implications of epigenetic research today.

Keywords

Epigenetics; Environment; Policy; Parenting; Media; Ethics

The Rise of Epigenetics

Over the past decade, environmental epigenetics has become an area of growing interest for scientists, physicians, policymakers, and the public. Epigenetics is the study of how exposures and experiences can turn genes “on” or “off” without changing DNA sequence. By examining the influence that environmental conditions including diet, stress, trauma, toxins, and care have on gene expression, this science suggests molecular connections between the social environments in which we live and our genetics [1]. Research in this area also traces the effect that epigenetic modifications can have on health, behavior, and disease.

Compliance with Ethics Guidelines

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

Conflict of Interest

Martine Lappé declares that she has no conflict of interest.

The rapid expansion of epigenetics in recent years has brought renewed attention to the lasting influences that social life can have on the body and, perhaps most surprisingly, the potential that acquired characteristics may be passed on from one generation to the next [2].

Through positing a connection between social life and how genes are expressed, epigenetics offers what many have called a “paradigm shift” in thinking about the relationships between nature and nurture. 3 Rather than starting life merely with the genes passed on from your mother and father, it now appears that the impact of their experiences and that of your grandparents and great-grandparents may be passed down as well [4]. This revelation has led some to argue that epigenetics has the potential to produce more holistic understandings of health and to invigorate investments in the social and environmental conditions that shape human wellbeing. However, others observe that rather than influencing more just or preventive social policies, epigenetics may lead to individually-oriented approaches that privilege biomedical or technological interventions and forms of “*epigenetic determinism*” [5, 6, 7, 8]. Some scholars even caution that epigenetics could lead to new forms of eugenic thinking if we are not careful to guard against them [9].

All of these perspectives point to the importance of understanding epigenetic research and its potential applications across clinical and social spheres. While the specific translation of epigenetic findings remains to be seen, in this review I briefly describe the state of the science, introduce several themes that have appeared in media coverage of epigenetic research, and consider the implications that these representations may have for clinicians, patients, and the public. My emphasis is on how epigenetic information may influence understandings of health and experiences of responsibility related to pregnancy and parenting in particular.

Overview

Current research on epigenetics can be organized into three broad areas. These include first, efforts to characterize the epigenome by generating an “encyclopedia” or “roadmap” of the epigenetic mechanisms involved in silencing and activating genes already known to influence disease susceptibility. These efforts include the International Human Epigenome Consortium, the Encyclopedia of DNA Elements Consortium, and the US NIH Epigenetics Roadmap [10, 11]. Second are animal studies that explore the epigenetic effects that various environmental factors may have within and across generations. While there are numerous studies in this area, readers are likely to be familiar with the widely cited research on rat mothers (dams) and their offspring (pups) [12]. These studies suggest that exposures *in utero* and experiences during early life can have lasting effects on offspring health, affecting stress management in later life, risk of obesity, and the traits they pass on to future generations [13]. Other research in animal models points to the mechanisms that may underlie patterns of epigenetic inheritance and suggests interventions that could reverse such effects [14]. Third, research in human populations has examined how unequal or extreme living conditions including poverty, racism, war, and famine can cause epigenetic modifications that influence individual and intergenerational health, behavior, and risk of disease [15, 16]. These studies include prospective epidemiologic investigations, research with twin pairs, and

efforts to identify the lasting biological effects of the Holocaust, Dutch Hunger Winter, and the September 11th Terrorist Attacks [17, 18].

Together, these three areas of epigenetic research have informed contemporary understandings of how social and environmental factors influence human wellbeing, providing what some have called the “missing molecular evidence” to support social and environmental justice approaches to health [2]. By emphasizing the effect of socioeconomic and political events such as trauma, famine, and care on individuals and their genetic lineage, these studies offer a way of tracing how experiences get “under the skin” and their influences across multiple generations [19]. To date, epigenetic modifications have been linked to numerous outcomes including obesity and diabetes [20], cancer [21], heart disease [22], depression [23], anxiety [24, 25], and autism [26], among others. These findings reveal the growing influence of epigenetic research for both public and professional understandings of health and disease, and the important role that various sectors of society can play in shaping our interpretations of this science.

Media Coverage & Parent Responsibilities

Media coverage and popular depictions of epigenetics provide a growing resource with the potential to shape patient and clinician understandings of this science. Over the past decade, coverage of epigenetics in major newspapers and online resources has increased considerably. I focus here on how this coverage may influence parents and prospective parents through its emphasis on how both exposures in early life and forms of epigenetic inheritance influence offspring. These themes raise important social and ethical considerations that warrant attention both within and beyond the clinic.

Although changes to the epigenome occur throughout the lifespan, many epigenetic studies point to the prenatal and early postnatal periods as formative developmental windows when the environment can produce durable – but potentially reversible – changes in the epigenome [27, 28, 29, 30, 31, 32]. Animal studies reveal that older sperm cells [33, 34, 35], maternal stress [36], and parental care during early life [37] may all have epigenetic effects on offspring that can be heritable. [15] These claims join epidemiologic studies showing that traumatic social conditions including famine [38], war [39], and poverty [40, 41] may lead to epigenetic modifications in the germ line. 42 These findings have brought new attention to the lasting effects that exposures and experiences may have on offspring during critical periods of development, including *in utero* and children’s first years of life. Media coverage of these findings often reinforces the biological importance of parents’ experiences and actions, raising important questions about how the communication of epigenetic research is shaping social and individual responsibilities for health.

Stories in major newspapers and scientific magazines highlight the potential of epigenetic findings to influence experiences of pregnancy and parenting in particular. In the *New York Times*, *Nature*, *Science*, *Discover*, and *Time Magazine*, for example, headlines have shifted from descriptions of epigenetics’ broad implications to more specific statements about parents’ role in shaping children’s health. Earlier headlines including, “Genes are Mirrors of Life Experiences” [43] and “Why Your DNA Isn’t Your Destiny” [44], have been followed

in more recent years by reports that “Grandma’s Experiences Leave a Mark on Your Genes” [45], “Mom’s environment during pregnancy can affect her grandchildren” [46], and “How a woman’s choices during pregnancy could shape a child’s health” [47]. Other headlines highlight the importance of fathers, stating that “Fathers may pass down more than just genes” [48], “Don’t Stress Dad – it’s bad for your kids’ health” [49], and “Dad’s Experiences Affected You, Even Before You Were Born” [50].

Websites with prenatal advice also rely on epigenetic findings to shape the messages they share with expectant parents. The website *Begin Before Birth* notes that “what happens in the womb can last a lifetime.” It provides a section on epigenetics which highlights findings that “the early emotional environment can lead to long lasting epigenetic changes in the brain” and that epigenetic changes that occur as a result of child abuse, stress, and partner violence can be passed down to future generations from either mothers or fathers [51].

In the headlines and website noted above, the emphasis on parents’ experiences runs the risk of emphasizing individual behaviors and exposures over the social and political conditions that often influence such experiences. As a result of this emphasis, reporting on parental experiences and the lasting influences of the *in utero* and early life environments has the potential to influence parents’ and prospective parents’ senses of responsibility for children’s health [52, 53]. For example, a highly publicized commentary in *Nature* entitled “Don’t Blame the Mothers,” recently alerted readers to the consequences that coverage of epigenetics may have for women in particular. The authors argue that “careless discussion of epigenetic research on how early life affects health across generations could harm women” by implying that mothers alone are responsible for their children’s wellbeing. The authors point out that reporting on epigenetics often fails to note the preliminary nature of the research findings and depicts women’s choices and behaviors as the primary source of children’s risk, rather than situating these factors in their larger social contexts [54].

The social and historical context in which these headlines and articles circulate also matters. While the family has historically played a central role in supporting child wellbeing, social science scholars observe that it is often women as mothers who bear disproportionate responsibility for their children’s behavior and wellbeing, with expectations about the proper care and development of children influencing understandings of what constitutes a “good” mother [55, 56, 57]. Empirical research has shown that these societal pressures are even more significant during pregnancy, when women’s behaviors are often regarded medically and legally in relationship to the health of their future children [58, 59]. This social context is important to bear in mind when considering the effect of headlines that have accompanied reports on epigenetic findings in recent years [60].

In addition to stories highlighting the role of mothers and grandmothers, news stories and articles reporting on the epigenetic contributions of fathers have also increased [61, 62]. These stories reflect findings from genomic and epigenetic studies that show that paternal age, men’s experiences of trauma, and their environmental exposures can all influence the epigenomes of their offspring [63, 64]. Some have celebrated these studies and their coverage in major newspapers and magazines as counterbalancing mothers’ responsibilities for children’s wellbeing by promoting the biological role of fathers [65]. However, such an

assessment may lose sight of the larger promise of epigenetic research, which is its potential to connect the social and structural conditions in which we live to the biological legacies they have not only for our families, but for society as well. Such a promise has the potential to shift the emphasis away from individuals and toward a structural understanding of health and development, one that considers the social and political conditions in which we live – not just individual decisions – as critical factors in shaping health outcomes.

A story in *Nature* titled “Epigenetics: the Sins of the Father” provides a final point for consideration. While the headline is provocative, and the reference to ‘sins’ carries a moralized connotation, the article itself describes epigenetic findings that remain heavily debated among scientists [66]. This example and others suggest the importance of recognizing epigenetic research as a diverse and rapidly developing field with the potential to change before the eyes of the reading public.

Conclusion

In the sections above I have highlighted ongoing debates about the potential of epigenetic research to influence understandings of health, and discussed its possible translations across clinical and social domains [67]. I described the state of the science and its rising profile in the media, focusing on how a growing number of news stories have come to emphasize the role of parents in their coverage of epigenetic findings. At the core of ongoing debates about epigenetics are its potential social and ethical implications, including how its coverage in the media may influence experiences of risk and responsibilities related to health, disease, and difference [68, 69, 70]

It is important for clinicians to be aware of how epigenetic findings are reported in popular media, particularly because reports often emphasize parents’ responsibilities for offspring health, rather than emphasizing the role of structural factors and social contexts. Clinicians should be prepared to interpret reports of epigenetic findings to reduce parental anxiety and self-blame, while helping parents and prospective parents understand the environmental factors that may emerge as influential for children’s health. By keeping abreast of how epigenetic research is reported, clinicians, through their interactions with parents and prospective parents, can help shape their patients’ and the public’s understanding and expectations of epigenetics.

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