**Epigenetic Inheritance and the Responsibility for Health in Society.**

Mark Hanson[[1]](#footnote-1) and Ruth Müller[[2]](#footnote-2),[[3]](#footnote-3)

Much has been written about the ‘rediscovery’ of epigenetics towards the close of the last century, several decades after the coining of the term by Conrad Hal Waddington in 1942. The concept has caught the attention not only of leading research groups and institutions (1), but also of the media and popular science writers. It has been argued that a quiet revolution in biomedicine is underway (2) as epigenetic processes of gene-environment interaction are now implicated in the aetiology of a wide range of conditions, including obesity and non-communicable diseases such as diabetes. In many cases, the effects of environmental factors seem to outweigh those of genetic variants. Importantly, the notion of the ‘environment’ in epigenetics includes social context as well as biological exposures, and draws attention to their multiple connections. This raises pressing social and political questions: who should take responsibility for how social and material environments affect health on the molecular level, particularly given the stark socio-economic inequalities in most contemporary societies? We argue that interdisciplinary dialogue is urgently needed to address these questions adequately.

Two time periods come into focus when an epigenetic approach to health is included: first, early (pre- and postnatal) life offers a window of epigenetic plasticity when environmental factors may act to condition the body in ways that shape disease risk in later life. Secondly, as evidence for inter- and possibly transgenerational epigenetic inheritance mounts, the past as experienced by parents, grandparents, and possibly generations even further back, becomes relevant for understanding our disease risks today and tomorrow.

From this perspective, the possible transmission of socio-economic and other social or environmental factors across generations becomes an increasingly pressing topic for discussion. The notion of epigenetic inheritance suggests that some of the cards affecting our health, longevity, and potentially even our social position, may have been dealt even before our gestation commenced. Obesity in women of reproductive age, for example, is not seen as only a possible health problem for them alone (3). Researchers argue that maternal obesity might increase the offspring’s risks of diabetes and cardio-vascular disease, and might even negatively affect cognitive performance (1). We know however that the risk of obesity is unevenly distributed throughout society, with especially individuals of low socio-economic status often suffering from poor access to healthy foods (‘food desserts’) or facilities to engage in physical activity. Here epigenetics links biological to social questions, and biomedical research to fields of expertise within the social sciences. Including social scientists in the emergent dialogue about the significance and meaning of epigenetic research is badly needed if some dangers are to be avoided.

The most obvious danger, of which we can already see evidence, is that the insights arising from epigenetics become viewed in a teleological and deterministic way, both in biomedical science and in society. While epigenetics is based on the assumption of biological plasticity (4), the meaning of epigenetic marks is often discussed in the same deterministic way as genetic variants: the spectre of a “gene for” approach to disease arises again in the shape of an “epigenetic mark for” approach. Metaphors prevalent in epigenetics such as “programming” by environmental factors enhance this simplistic thinking. With regard to differences in health associated with socio-economic status, such a deterministic view of epigenetics raises further problems, reminiscent of the “culture of poverty” narrative that focused on how disadvantaged individuals themselves perpetuate poverty and ill health, rather than addressing the macro-political structures that uphold inequalities in society (5).

This in turn raises questions of how to distribute responsibility for health disparities in an epigenetic paradigm. Currently the search for responsible agents often focuses on mothers, and their obligation to protect the fetus from harm and to modify their behavior in order to provide an environment desirable for epigenetic development (6,7). This is an example of how contemporary societies take an individualized approach to questions of responsibility, adopting a retrospective view and charging often the most vulnerable individuals with the task of improving their own circumstances and those of their children. It also ignores the increasing evidence that fathers can pass epigenetic processes to their offspring (8). While it is important to provide health information and support as a strategy for individual empowerment, solutions for broader societal disparities do not lie at the individual level. We need to find practical strategies that help individuals across society to gain knowledge and take action, without using them as a ‘work around’ for addressing deeper structural inequalities.

As epigenetic science explores the ways in which history and social context are written into the body, it requires a more complex and nuanced approach to the question of the social transmission of, and responsibility for, health and disease. We need to pay better attention to the troubled histories of deterministic claims about biological differences (9), as well as their possible resurgence in the current political climate. Historically, attributing heritable biological difference in relation to social class, ethnicity or race has stigmatized and disadvantaged groups rather than helped improve their conditions (10). At a time when epigenetics might open up new avenues for investigating the complex interactions between the social and the biological, determinist and reductionist perspectives might close them down at the outset. We need to start a conversation that relates epigenetic findings more strongly to questions of social and environmental justice – not only just to individual responsibility. We should draw on the collective knowledge of biomedical and social scientists as well as philosophers, historians and public health professionals in order to develop scientifically robust and socially responsible approaches to health in our still painfully stratified societies.

References

1. Godfrey KM, Reynolds RM, Prescott SL, Nyirenda M, Jaddoe VWV, Eriksson JG, et al. Influence of maternal obesity on the long-term health of offspring. *The Lancet Diabetes & Endocrinology* 2016.

2. Carey N. The Epigenetics Revolution: How Modern Biology is Rewriting Our Understanding of Genetics, Disease and Inheritance. London: Icon Books; 2012.

3. Poston L, Caleyachetty R, Cnattingius S, Corvalán C, Uauy R, Herring S, et al. Preconceptional and maternal obesity: epidemiology and health consequences. *The Lancet Diabetes & Endocrinology* 2016;**4**:1025-36.

4. Hanson MA, Gluckman PD. Early Developmental Conditioning of Later Health and Disease: Physiology or Pathophysiology? *Physiological Reviews* 2014;**94**:1027-76.

5. Guthman J. Weighing In: Obesity, Food Justice, and the Limits of Capitalism (California Studies in Food and Culture): University of California Press; 1st edition (November 5, 2011); 2011. 248 p.

6. Richardson SS, Daniels CR, Gillman MW, Golden J, Kukla R, Kuzawa C, et al. Don't blame the mothers. *Nature* 2014;**512**:131-2.

7. Kenney M, Müller R. Of Rats and Women: Narratives of Motherhood in Environmental Epigenetics. *BioSocieties* 2016.

8. Hughes V. Epigenetics: The sins of the father. *Nature* 2014;**507**:22-4.

9. Hanson C. Eugenics, literature and culture in post-war Britain: Routledge; 2012. 190 p.

10. Reardon J. Race to the Finish. Identity and Governance in the Age of Genomics. Princeton: Princeton University Press; 2005.

1. Institute of Developmental Sciences, University of Southampton, Southampton, UK (MH); NIHR Southampton Biomedical Research Centre, University Hospital Southampton NHS Foundation Trust,

   Southampton, UK (MH); [↑](#footnote-ref-1)
2. Munich Center for Technology in Society (MCTS), Technical University of Munich, Munich, Germany. [↑](#footnote-ref-2)
3. Corresponding author: ruth.mueller@tum.de [↑](#footnote-ref-3)