Pre- and postnatal factors can change how genes work (epigenetics) causing behaviour problems in children, changes that may become curable, suggest studies.

Major changes in how we support pregnant women, babies and new parents are likely required amid accumulating evidence that key stresses become biologically embedded in fetuses and infants. The study of changes in how genes operate, called “epigenetics,” has revolutionized our understanding of biology. Epigenetic changes can cause mental health problems in children and help explain a wide range of long-term physical health and developmental problems.

Much of this genetic damage, whether in the womb or during early years, may not be permanent. It may be possible to reverse these effects by taking action early in life. For example, reducing
social inequalities might diminish the damage of early life stress and increase the nurturing that can counteract such damage. Short of such a change, findings suggest that well-targeted help for children and mothers who are most vulnerable could prevent or lessen early biological damage that may cause life-long disadvantage and can perhaps even be passed on to later generations. Forms of “support” might include various early years programs, educational help as well as parenting advice.

“In the womb, babies are effectively being prepared biologically for what Mom’s body indicates to be a hostile or non-hostile environment. Early adversity, including social factors and adverse events, have biological consequences that can shape the development of the child and may well carry lifelong burdens for individuals.”

We are trying to study the effect of these kinds of help at the molecular level – what’s going on inside the cells of the body. It really is “in our DNA”. We are looking at how the physical and social environment affects the expression of that DNA. If we can monitor the effects of these interventions, we can ensure optimal impact at a personal and broader policy level.

**Epigenetics is how genes adapt to the environment**

Starting from the embryonic period, genes are switched on, off, dimmed or brightened as part of normal development, through experiences in the womb or in the early years. The brain’s developmental plasticity lets genes adapt to the environment by triggering epigenetic changes. So, for example, a fetus’s genes might be geared to make the individual respond rapidly to any indication of what might seem to be a threat. These changes might make a person hypervigilant about risk or danger. In the womb, fetuses are effectively being prepared biologically for what Mom’s body indicates will be a hostile or non-hostile postnatal environment.
Such biological preparation might have been beneficial in the evolutionary past, preparing them for the dangers that humans once faced, from animals, other humans or otherwise difficult environments. It might even help protect you today as a teenager in the street, if the environment was dangerous and required rapid reactions to, for example, physical threat. But, in reality, our society is safer than this prenatal programming indicates, and what happens in the womb can bite back long-term. For example, it has been calculated that, after age 25, the difference in the average life expectancy between an urban, economically disadvantaged, African American male and a well-off white American woman is as much as 16 years. We cannot trace all this difference to early stress and epigenetics. However, it is now reasonable to assume that such factors may play a significant role in lifelong health and longevity. Epigenetic adaptation may help some people to reach reproductive age, but these changes are a lifelong and potentially life-shortening burden.

The good news is that making changes in the prenatal and postnatal environment can potentially reengineer epigenetic changes. These changes in the environment can lead to more favorable molecular changes that positively influence child development and may benefit long-term health. In short, social policy and practice during pregnancy and early childhood may soon help to reprogram the structure and function of key parts of human behavior.

Placental genes affected by environmental changes

We have already correlated some epigenetic fetal changes with neuro–behavior in newborn infants. A series of studies has shown, for example, that epigenetic changes in placental genes — due to factors such as exposure to mercury, maternal depression and anxiety, and socioeconomic adversity during pregnancy — can predispose an infant to dysfunctional behavior that can lead to later behavioral and mental health disorders. This developmental route for a child can also increase vulnerability to adult health problems including cardiovascular
disease, metabolic disorders and diabetes.

Our review of the evidence around epigenetics also details number of other interesting findings:

- A study of African American youth in poor rural areas found that epigenetic variation was related to factors such as socioeconomic risk, protective parenting and young adult health.
- From middle childhood through to adulthood, epigenetic changes were related to feelings of being rejected by parents and to psychosocial adjustment.
- In the Democratic Republic of Congo there were epigenetic effects found in mothers and their new-born infants related to chronic stress and war.
- Epigenetic alterations were seen in infants whose mothers had symptoms of depression but were more responsive and engaged with their infants than other mothers who were less engaged and responsive.
- In Italy, there were epigenetic alterations associated with stress experienced by pre-term infants in the Neonatal Intensive Care Unit and associated with temperament at 3 months. [Montirosso]
- Epigenetic effects were found in preschool aged children who had suffered early adversity. [Parade]
- Maternal smoking during pregnancy was related to epigenetic effects in babies and these epigenetic effects were then related to lethargic behavior in the newborns.
- Mental health problems were more likely in adults with epigenetic marks who also suffered child abuse.

Much of this research is effectively mapping out molecular pathways and mechanisms by which prenatal and postnatal events can shape children’s long-term outcomes. The FDA has already approved epigenetic treatments for cancer. Developing treatments for human behavior, rooted in epigenetics, would be another big step. But theoretically such treatments are now possible because it has been shown that epigenetics can change child behavior adversely and beneficially.
Epigenetics also has potential for building resilience in children at risk, helping them to adapt and develop coping strategies based on the molecular pathways that drive behavior. For example, Michael Meaney’s research shows that in rat pups, positive mothering causes epigenetic changes that undo negative effects on hormones and behavior. If that result could be translated to human infants, we could develop parenting interventions to induce epigenetic changes that improve children’s behavior. In time, epigenetically based pharmacological treatments could also be developed to treat mental health disorders.

**Epigenetic blood tests for pregnant women**

It is now conceivable – though not yet possible – that an expectant mom could have a blood test during pregnancy indicating, for example, epigenetic changes caused by stress that mean the fetus is exposed to dangerously high levels of the hormone cortisol. Once they are born, babies exposed to high levels of cortisol in the womb are more reactive. They get aroused very quickly and respond faster than you would expect. They tend to be irritable, and they are harder to soothe. We now know that these may be signs of changes to their systems that can lead to later mental health and behavior disorders. Caring for a “difficult” baby can also jeopardize the mother–infant relationship. If the mother–infant attachment doesn’t develop properly, children may suffer mental health problems such as depression and anxiety.

**Questions raised by epigenetics for further research**

In all of this work, we still don’t understand some big issues. We have tended, for example, to focus on what can happen to the gene related to the release of cortisol, which heightens the stress system’s reactivity. We know much less about genes that affect other hormones such as serotonin and oxytocin, which can reduce the impact of too much maternal cortisol. How do these
genes interact? We may discover, for example, that policies and practices that promote the release of these other hormones, associated with strong attachment and nurturing, could be an important option.

The big message, however, is that early adversity, including social factors and adverse events, have biological consequences that can shape children’s development and may carry lifelong burdens for individuals. Policy makers should factor in these serious consequences as they consider policies that affect the health and well-being of our most precious resource – our children.

Policy Implications

At the broadest level, reducing social inequality through human development investments will have the broadest effect. But more immediately, specific policies and prevention strategies focusing on parenting support and stress reduction, along with early childhood programming, are highly promising options.

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Original research and references


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