Is it genetic code or postal code that influence a child's life chances?

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Most children inherit both their postal code and their genetic code from their parents. But if genetic factors influence where families are able to live and children's health and educational success, improving

neighborhoods may not be enough. Latest research at Columbia University Mailman School of Public Health and University of California at Irvine, provides new insights into the highly debated question of whether the neighborhoods that children live in influence their health and life chances.

This is the first study to bring together genetic and geographic data to test links between children's neighborhood and genetic risk. The findings are published online in *Nature Human Behavior*.

The research team led by Dan Belsky, Ph.D. assistant professor of epidemiology at Columbia Mailman School, and Candice Odgers at the University of California, Irvine Department of Psychological Science, linked the genomic, geographic, health, and educational data of thousands of children living in Britain and Wales. They found that children growing up in worse-off neighborhoods also carried higher genetic risk for poor educational outcomes and earlier childbearing. The authors replicated their findings in the U.S.-based Add Health Study, where they found that gene-neighborhood correlations may accumulate across generations as young people with higher genetic risk for poor educational attainment and younger age at first birth were both born into, and subsequently moved into, worse-off neighborhoods.

"But genetic risk alone was not enough to explain why children from poorer versus more affluent neighborhoods received less education and were more likely to be Not in Education, Employment, or Training (NEET) by late adolescence," said Belsky, who is also with the Columbia Aging Center. "The data on education could explain only a fraction (10-15 percent) of the link between neighborhood risk and poor educational qualifications and NEET status, suggesting that there is ample opportunity for neighborhoods to influence these outcomes."

"Surprisingly, for obesity, one of the most prevalent and costly health

problems facing this generation, we found no link between neighborhood and genetic risk," observed Odgers. "Children who grew up in worse-off neighborhoods were more likely to become obese by age 18, but they did not carry a higher genetic risk for obesity than their peers living in more advantaged neighborhoods."

Similarly, for mental health problems, children in worse-off neighborhoods experienced more symptoms of mental disorder, but there was little evidence that the reason for this link was due to genetic risk. For physical and mental health problems, postal code and genetic code both predicted children's futures.

Analyses were based on data from The Environmental Risk (E-Risk) Longitudinal Twin Study, which has followed 2232 twins born in England and Wales in 1994-1995 into young adulthood, and The National Longitudinal Study of Adolescent to Adult Health, which followed 15,000 American secondary school students into adulthood. For "polygenic scoring" the investigators combined information across the genome based on recent genome-wide association studies (GWAS) of obesity, of schizophrenia, of age-at-first-birth, and of educational attainment. Neighborhood risk assessment and Neighborhood Mobility Analysis tools are described in the paper's Supporting Details.

Using Google Street View and high-resolution geo-spatial data enabled the researchers to capture key features of the neighborhoods where the children lived. Odgers developed the virtual assessments used in the study. "Advances in both genomics and geospatial analyses are rapidly positioning us to make new discoveries. Here, they allowed us to identify outcomes, like obesity and mental health, where neighborhoods are most likely to have unique impacts." But, she added "this is only a first step in tackling the critical question of whether changing neighborhood conditions can improve children's lives across these domains."

"In our study, polygenic risk scores showed a link between genetics and neighborhoods for teen pregnancy and poor educational outcomes. This finding suggests that we should consider neighborhoods when interpreting the results of studies searching for genes related to these outcomes and also that we should consider genes when examining the effects of neighborhoods," said Belsky. But, he cautions that "polygenic risk scores are an evolving and still imperfect tool. They can help us test whether genes and neighborhoods are related. But they cannot tell us how."

Genetic risk accounted for only a fraction of the differences between children living in different types of neighborhoods. According to Belsky and Odgers this provides some reason to hope that "targeting neighborhoods—especially for physical and mental health—will be enough to improve children's life outcomes."

More information: Genetics and the geography of health, behaviour and attainment, *Nature Human Behavior* (2019). DOI: 10.1038/s41562-019-0562-1 , www.nature.com/articles/s41562-019-0562-1

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