Study finds adversity experienced during childhood or pregnancy affects the gut microbiome across generations

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Because babies acquire their first gut microbes passing through their mother's birth canal, mothers' microbiomes form the basis of their offspring's. Credit: Sarah Chai/Pexels

Hardship experienced by mothers during their own childhood or during pregnancy is reflected in the composition of their 2-year-old children's gut microbiomes, reports an international team of scientists led by UCLA psychologists.

The researchers found small to medium changes in the children's microbiomes. The research is the first to document the transgenerational effects of adversity on the human gut microbiome.

A growing body of evidence links the gut microbiome to brain and immune functioning, and according to the researchers, changes to that community of microorganisms is likely among the ways that hardship affects children's socioemotional development.

The study, which is published in *Proceedings of the National Academy of Sciences*, builds on previous research in rodents, which has shown that that prenatal stress disrupts maternal vaginal and gut microbiomes. Because babies acquire their first gut microbes passing through their mother's birth canal, mothers' microbiomes form the basis of their offspring's.

Previous research in humans has shown that shortly after birth, stress experienced by the infant while in the womb and the mother's own psychological distress influence the infant microbiome. And while it was known that the effects of prenatal stress on rodent microbiomes persist into adulthood, scientists did not yet know how long after birth the disturbances remain in humans, or whether they affected the next generation.

The study investigated the consequences of maltreatment to mothers during their childhoods, anxiety while pregnant and their children's exposure to stressful life events in 450 mother–child pairs in Singapore when the children were 2 years old. The researchers asked mothers to

recall abuse, neglect or other maltreatment they experienced during childhood, and mothers were screened for anxiety during the second trimester of pregnancy.

Researchers also interviewed the children's primary caregivers to learn about stressful events that the children had experienced, and their general behavior and health, during their first two years of life, and researchers collected stool samples from the children. The researchers controlled for family income, which often serves as a proxy for childhood adversity.

Children whose mothers reported more anxiety in pregnancy had microbiomes in which the species of microorganisms had populations of similar sizes, a metric biologists call "evenness," which had not been found before. Typically, the populations of the various species that make up the gut's microflora are "lumpier," with some species being abundant and others less common. In the study sample, however, those differences were less prominent, and populations were of similar sizes.

The gut microbes of children who experienced stressful life events after birth also had less genetic diversity, meaning that the microbes living in each child's gut were more closely related to each other than such microbes usually are.

However, while more experiences of adversity were correlated with less microbial genetic diversity in each child, the amount of adversity did not seem to affect how similar children's gut microbiomes were to each other. There was still variation among the children.

"There are lot of questions around whether more diversity or evenness is better or worse when the gut microbiome is developing during childhood, so we don't know if more is better at 2 years old," said Francesca Querdasi, a UCLA doctoral student and the paper's lead

author.

"But many of the species we found to be related to adversity are known to interact with the immune system in some way, suggesting that maybe the way the gut microbiome interacts with the immune system is different after adversity. There's a lot that we need to explore in the future."

The researchers also found some kinds of behavior and mental health problems associated with an abundance of certain species in the gut microbiome. Although none of those species were the same ones related to adversity in this study, the authors noted that some have been associated with adversity in past studies and may perform similar functions as the species that are related to adversity.

The brain–gut microbiome connection develops rapidly during the first two to three years of life, and it is likely that the changes due to adversity demonstrated in the new study have some influence on children's socioemotional development.

A nascent area of study called nutritional psychiatry, which researches how changes to diet could affect mental health, is developing as scientists learn more about the brain–gut microbiome connection.

"The microbiome gets a lot of attention and is very exciting, but it really is just one piece of the large and complicated puzzle of human health," said Bridget Callaghan, a UCLA assistant professor of psychology and the paper's senior author.

"Our study is part of a growing body of research showing the effects of early exposure and transgenerational experience on the microbiome. When we understand how experiences of hardship can influence the gut microbiome, we can then try to manipulate diet, supplements and

lifestyle to make positive impacts on an individual's gut microbiome and broader developmental trajectory."

More information: Francesca R. Querdasi et al, Multigenerational adversity impacts on human gut microbiome composition and socioemotional functioning in early childhood, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2213768120

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