

Chronic aggressive behavior in boys: Epigenetic sources?

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Chronic aggressive behaviour exhibited by some boys from disadvantaged families may be due to epigenetic changes during pregnancy and early childhood. This is highlighted by two studies conducted by a team led by Richard E. Tremblay, professor emeritus at the University of Montreal and Moshe Szyf, professor at McGill University, published in the journal *PLOS ONE*. The first author of the two papers, Nadine Provençal, was jointly supervised by professors Szyf and Tremblay.

Epigenetic changes possibly related to the prenatal environment

In the first study, published in July, the team found that among men who had chronic aggressive behaviour during childhood and adolescence, blood levels of four [biomarkers](#) of inflammation were lower than in men who exhibited average levels of aggressive behaviour in their youth, from 6 to 15 years of age. "This means that using four specific biomarkers of inflammation, called cytokines, we were able to distinguish men with chronic [physical aggression](#) histories from those without," says Tremblay, a researcher specializing in [developmental psychology](#). In the second study, it was observed in the same men with aggressive pasts, that the DNA encoding the cytokines showed methylation patterns different from those of the comparison group.

"Methylation is an epigenetic modification—hence reversible—of DNA,

in relation to parental imprinting. It plays a role in regulating [gene expression](#)", says Szyf, who specializes in epigenetics.

The pre- and postnatal environment could cause these differences in biomarkers associated with chronic aggression," Szyf added. Various studies conducted with animals show that hostile environments during pregnancy and [early childhood](#) have an impact on gene methylation and gene programming leading to problems with [brain development](#), particularly in regard to the control of aggressive behaviour.

Previous work by Tremblay's team suggest that men with aggressive pasts have one thing in common: the characteristics of their mothers. "They are usually young mothers at the birth of their first child, with low education, often suffering from mental health problems, and with substance use problems," Tremblay explained. The significant difficulties these mothers experienced during pregnancy and the early childhood of their child may have an impact on the expression of genes related to brain development, the immune system, and many other biological systems critical for the development of their child.

A nearly 30-year follow-up

The blood samples used in the studies published this summer in *PLOS ONE* were collected from 32 participants who took part in either of two longitudinal studies that begun nearly 30 years ago by Tremblay's team. The first study followed young Quebecers from disadvantaged backgrounds, while the second involved a representative sample of children who were in kindergarten in Quebec in 1986-87.

It is important to note that in disadvantaged families, the rate of boys with chronic [aggressive behaviour](#) represents about 4% of the population. This greatly restricts the selection of potential participants. "Once they are adults, they are difficult to find because they have

disorganized lifestyles," Tremblay said.

A prevention perspective

This difficulty has not stopped him from pursuing his research further. "We are studying the impact of the socioeconomic environment on the third generation, now that these children are grown up and have children," Tremblay noted. No study has yet been published on the subject, he anticipates "significant intergenerational ties, since we observed an association between parental criminality of the first generation and the behaviour of their children."

Nevertheless, the researcher, who has conducted his work for decades with a prevention perspective, is optimistic. "If our results show that behavioural problems originate from as far back as pregnancy, it means that we can reduce violence through preventive intervention from as early as pregnancy," says Tremblay. We have already shown that support given to families of aggressive boys in kindergarten prevents school dropout and crime in adulthood.

More information: Childhood chronic physical aggression associates with adult cytokine levels in plasma. *PLoS One*. 2013 Jul 26;8(7):e69481. doi: 10.1371/journal.pone.0069481. Print 2013.

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