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Twin study links exercise to beneficial epigenetic changes

By Sara Zaske, WSU News & Media Relations

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PULLMAN, Wash. – Consistent exercise can change not just waistlines but the very molecules in the human body that influence how genes behave, a new study of twins indicates.

The Washington State University study, published in the journal Scientific Reports, found that the more physically active siblings in identical twin pairs had lower signs of metabolic disease, measured by waist size and body mass index. This also correlated

with differences in their epigenomes, the molecular processes that are around DNA and independent of DNA sequence but influence gene expression. The more active twins had epigenetic marks linked to lowered metabolic syndrome, a condition that can lead to heart disease, stroke and type 2 diabetes.

Since the identical twins have the same genetics, the study suggests that markers of metabolic disease are strongly influenced by how a person interacts with their environment as opposed to just their inherited genetics.

“The findings provide a molecular mechanism for the link between physical activity and metabolic disease,” said Michael Skinner, WSU biologist and the study’s corresponding author. “Physical exercise is known to reduce the susceptibility to obesity, but now it looks like exercise through epigenetics is affecting a lot of cell types, many of them involved in metabolic disease.”

The researchers collected cheek swabs of 70 pairs of identical twins who also participated in an exercise study through the Washington State Twin Registry. A team led by WSU Professor and Registry Director Glen Duncan collected data on the twins at several different points in time from 2012 to 2019. They used fitness trackers to measure physical activity and measured the participants’ waistlines and body mass indexes. The twins also answered survey questions about their lifestyle and neighborhoods.

Many of the twin pairs were found to be discordant, meaning they differed from each other, on measures of physical activity, neighborhood walkability and body mass index.

An analysis by Skinner’s lab of the cells in the discordant twins’ cheek swabs revealed epigenetic differences too. The twin in the discordant pair with a high level of physical activity, defined as

more than 150 minutes a week of exercise, had epigenetic alterations in areas called DNA methylation regions that correlated with reduced body mass index and waist circumference. Those regions are also associated with over fifty genes that have already been identified as specific to vigorous physical activity and metabolic risk factors.

Scientists have previously noted that the majority of identical twins develop different diseases as they get older even though they have the same genes. Epigenetics may help explain the reason why, said Skinner.

“If genetics and DNA sequence were the only driver for biology, then essentially twins should have the same diseases. But they don’t,” said Skinner. “So that means there has to be an environmental impact on the twins that is driving the development of disease.”

This study received support from the John Templeton Foundation and National Institutes of Health. In addition to Skinner and Duncan, co-authors include Jennifer Thorson, Eric Nilsson and Daniel Beck from WSU School of Biological Sciences as well as Ally Avery from the WSU Elson S. Floyd College of Medicine.

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