Mice delivered by C-section gain more weight than those delivered naturally

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Mice born by Caesarian section gained on average 33 percent more weight in the 15 weeks after weaning than mice born vaginally, with

females gaining 70 percent more weight.

This is the finding of a study led by researchers from NYU School of Medicine and published online on Oct. 11 in *Science Advances*.

The study revolves around the microbiome, the set of bacterial species living in the human gut. Such microbes evolved over millions of years to play roles in human immunity, digestion and metabolism. But, they have been disrupted by practices like antibiotic treatment and C-section delivery in recent decades - just as the rate of obesity has more than doubled.

Past epidemiological studies have shown links between Caesarian section and increased risk of obesity in humans, say the study authors. One theory has it that C-section interrupts transmission of maternal microbes at birth, and the "education" they provide to metabolic and immune systems early in development.

"Our study is the first to demonstrate a causal relationship between C-section and increased body weight in mammals," says lead study author and microbiologist Maria Dominguez-Bello, PhD.

According to the World Health Organization, C-section is needed in about 15 percent of births to avoid risking the life of mother or child. However, this delivery mode is overused, representing nearly 50 percent of births in some countries, including Brazil, Dominican Republic and Iran, researchers say.

"The question of whether a baby's founding microbiome affects its future obesity risk becomes more urgent as C-sections are increasingly used by choice in many parts of the world," says Dominguez-Bello, an associate professor in the Department of Medicine at NYU School of Medicine.

In the current study, 34 mice delivered by C-section were compared with 35 control mice born vaginally. The team then followed body weight and used genomic techniques to analyze intestinal bacterial DNA from newborn pups through development and into adulthood. Past studies had matched key DNA sequences to known bacterial species, enabling researchers to determine the make-up of each pup's microbiome, and to watch the effect of C-section.

Along with higher weight, study mice born by C section had significant differences in bacterial species in their guts when compared to mice born vaginally, and regardless of gender. The microbiome structure of mice born vaginally matured normally over the course of the study, but did not in mice delivered by C-section. In these mice, microbiome structure matured too soon initially, but then became relatively immature later in life.

These results confirm the findings of a recent NYU School of Medicine study in human babies that found that birth by C-section decreased the diversity of gut microbes through the first year of life.

The current study also indicated that the normal pioneer microbiota transmitted from mothers to vaginally born pups provided protection against weight gain. Bacterial groups found to dominate in pups delivered vaginally (Bacteroides, Ruminococaceae, and Clostridiales) had been previously linked to leaner body type in mice, according to the authors.

Should early microbe changes be found to be causative for obesity in future human studies, a 2016 pilot study led by Dominguez-Bello offers a potential solution. The study found that swabbing babies born by C-section with their mother's birth fluid partially restored the mix of bacteria that coat a newborn's body when delivered naturally.

"Further research is needed to determine whether the dominance of certain bacterial groups can protect against obesity," says Dominguez-Bello. "Our results support the hypothesis that acquiring maternal vaginal microbes is needed for normal immune and metabolic development."

More information: K.A. Martinez II el al., "Increased weight gain by C-section: Functional significance of the primordial microbiome," *Science Advances* (2017). advances.sciencemag.org/content/3/10/eaao1874 , DOI: 10.1126/sciadv.aao1874

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