Prolonged military-style training causes changes to intestinal bacteria, increases inflammation

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A new study finds that long periods of physiological stress can change the composition of microorganisms residing in the intestines (intestinal microbiota), which could increase health risks in endurance athletes and military personnel. The study, published ahead of print in the *American Journal of Physiology—Gastrointestinal and Liver Physiology*, is the first to study the response of the intestinal microbiota during military training. The manuscript was chosen as an APSselect article for May.

Healthy intestines are semi-permeable and act as a defense both to let nutrients into the bloodstream and keep bacteria and other potentially harmful substances out. Physical stress can increase intestinal permeability (IP), which allows more materials out of the intestines and raises the risk of inflammation, illness and symptoms such as diarrhea.

A group of 73 Norwegian Army soldiers participated in a military-style cross country skiing training exercise. Over four days, the group skied approximately 31 miles (51 km) while carrying 99-pound (45 kg) packs. The researchers collected blood and stool samples before and after the training exercise. The soldiers took 24-hour urine tests before the exercise and on the third day of the trek, before which they drank a solution of water mixed with the artificial sweetener sucralose and mannitol, a sugar alcohol. The human body does not break down sucralose during digestion, but gets rid of the sweetener through urination. Levels of excreted sucralose are commonly used as a marker

for IP.

The microbiota and the composition of substances produced during metabolism (metabolites) in the soldiers' blood and stool changed significantly by the end of the aggressive training period. Sucralose excretion rose considerably, indicating an increase in IP. Concentrations of several compounds that are products of bacterial metabolism of amino acids and fat decreased in the stool, and levels of more than half of the different compounds found in the volunteers' blood changed during the military training session. Changes in IP were associated with changes in inflammation, the composition of the intestinal microbiota before training and changes in several metabolites possibly derived from the microbiota. "[Previous] human studies have demonstrated that drastic changes in diet impact intestinal microbiota composition by altering the availability of metabolic substrates for intestinal microbes. Our findings contrast with those reports in demonstrating alterations in microbiota composition that most likely were not solely attributable to diet, and which were more pronounced than is commonly reported in human diet studies," the researchers wrote.

Intestinal microbiota appear to be one influencing factor in the gut's response to physical stress. "Our findings suggest that the intestinal microbiota may be one mediator of IP responses to severe physiologic stress, and that targeting the microbiota before stress exposure may be one strategy for maintaining IP," the researchers wrote.

More information: J. Philip Karl et al. Changes in intestinal microbiota composition and metabolism coincide with increased intestinal permeability in young adults under prolonged physiologic stress, *American Journal of Physiology - Gastrointestinal and Liver Physiology* (2017). DOI: 10.1152/ajpgi.00066.2017

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