60-day bed rest study shows dangers of long-term inactivity for blood sugar levels

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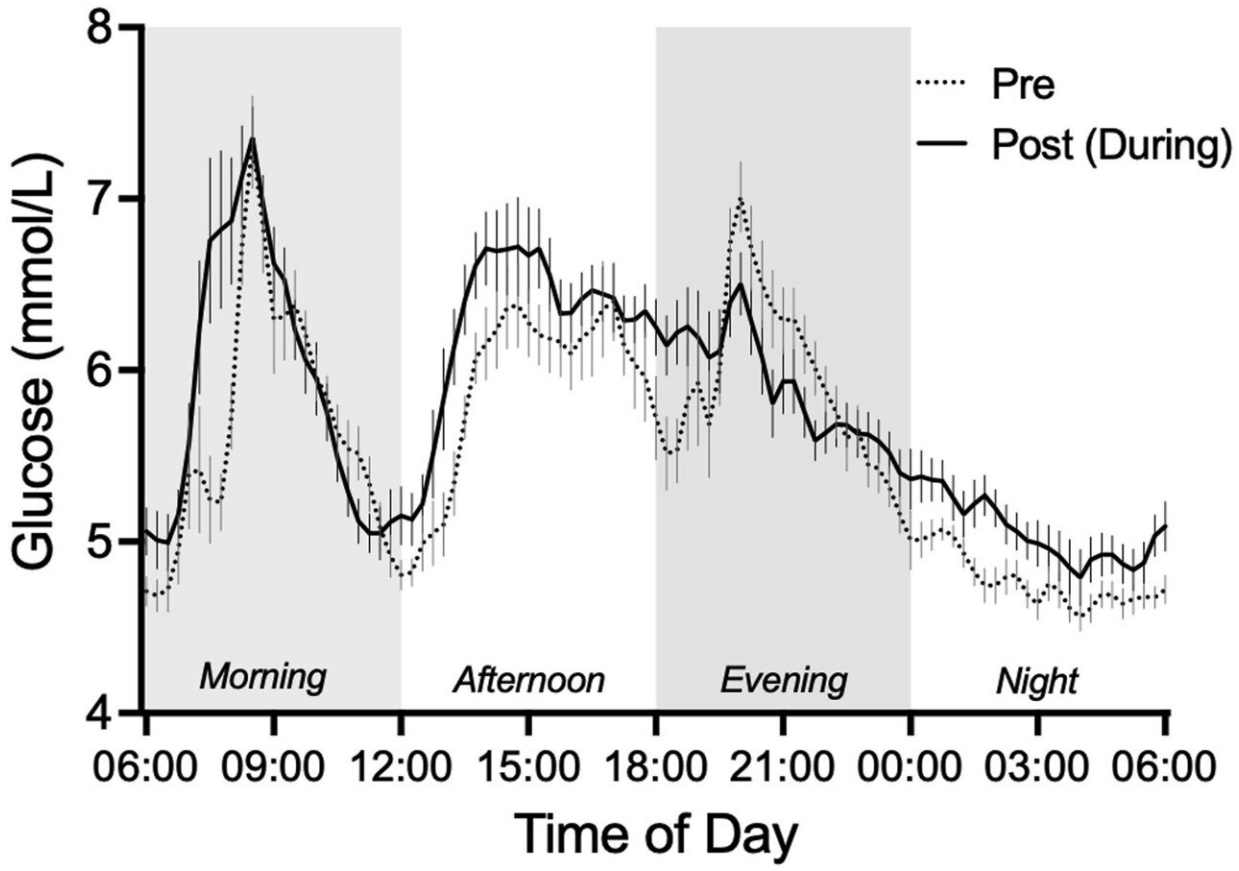

Representative 24 h trace of continuous glucose trace in all 20 participants recorded by CGMS data at 15 min intervals pre- and post-bed rest. Note; all measures denoted at 'Post' refer to at the end of the bed rest protocol, but during its final week. Six-hourly intervals represent segmentation of the 24-h period presented. Credit: *Clinical Nutrition* (2023). DOI: 10.1016/j.clnu.2023.02.006

A unique study which involved 20 men lying in bed for two months straight, highlights the negative impact long-term inactivity places on the body's metabolic health, with implications for future space missions as well as life back on Earth.

Put 20 young men in bed for two months with no physical activity and what do you get? A new study from the University of Bath, published today, shows that long-term inactivity significantly increases blood sugar levels even if you reduce your food intake to avoid gaining weight.

The research, led by a team from the University's Centre for Nutrition, Exercise and Metabolism, was part of a European Space Agency (ESA) bed rest study. For 60 days, 20 young, fit and healthy male participants stayed in bed with their feet above their heads while international researchers assessed numerous health measures. Individuals remained in bed even while they ate, showered, and went to the toilet.

Research from the team from Bath focused on participants' metabolic heath: how well your body controls blood sugar. Previous work from the same team in 2018 demonstrated that exercise, even in short bursts, has a major impact on blood sugar in the short term. With this new study, they wanted to understand more about what happens when there is no physical activity or movement over weeks and months. Participants were fed a much-reduced diet to compensate for their much-reduced physical activity and to stop them gaining weight.

The results, published Feb. 16 in the journal *Clinical Nutrition*, show that even when food intake was reduced to match participants' much lower energy expenditure during bed rest, inactivity negatively and profoundly impacted their blood sugar levels.

Impacts on blood sugar

As a result of taking part in the bed rest study, average blood sugar levels among participants increased by around 6% in the day, and by 10% at night. Their ability to dispose of blood sugar—i.e., to take up blood sugar into muscles—also decreased by nearly a quarter (24%). Participants were struggling to control their blood sugar, which is an important risk factor in developing conditions such as cardiovascular disease or type II diabetes.

The research team explain that the reduction in calorie intake did prevent participants from experiencing even higher blood sugar levels. They speculate that had they eaten the same amount as normal, given the reduction in the ability to dispose of sugar, their blood sugar concentrations would have risen even higher during the bed rest.

The bed rest study was conducted by ESA to help understand the health effects of crewed future space missions for astronauts. However, the researchers say the implications are also relevant for life back here on Earth, where millions of people face periods of long-term inactivity due to poor lifestyles, chronic conditions, ill health, or injury.

Professor of Human Physiology Dylan Thompson at the University of Bath led the research. He explained, "This was a unique study in which 20 young fit and healthy men were subjected to a series of tests over the course of nearly two months during which time they stayed in bed with no physical activity. Such bed rest studies are used to examine deconditioning as a model for microgravity, and this was one of the longest.

"Our results reveal that the withdrawal of physical activity profoundly impacts physiological health over and above the impact of controlling diet. While the changes were not as large as would be expected had participants maintained the same calorie intake as before the study, because of their inactivity, there was a real increase in participants'

blood sugar levels and a reduction in their ability to take up and use sugar. This shows that adjusting diet alone sadly cannot overcome all the negative effects from reducing physical activity—even if you manage to avoid gaining weight."

Dr. Angelique Van Ombergen, discipline lead for life sciences at the ESA, added, "Our spaceflight analogs, of which bedrest is the golden standard, don't only allow us to do research that can directly benefit our astronauts, but they also allow us to apply this knowledge for people on Earth such as the elderly and the immobilized. This newly published study from Prof. Thompson and his team is a good example of that. ESA is currently planning two new bedrest studies where we will test a combination of countermeasures."

The team from Bath are working on countermeasures that could help people who are bedbound on Earth as well as people going into space. Recent work from the CNEM team showed that electrical stimulation of leg muscles can help to recreate some of the effects of exercise on the control of blood sugar, which could be developed in extreme cases where individuals have no mobility whatsoever.

Professor Thompson adds, "This study highlights the importance of physical activity for metabolic health. Without movement, long-term inactivity will increase the likelihood that people will develop chronic conditions, such as type II diabetes. Even in extreme cases where individuals have lost movement completely, we believe there are exciting technological options that could impact muscular contraction for blood sugar control which we are keen to explore and develop."

More information: William V. Trim et al, The impact of physical inactivity on glucose homeostasis when diet is adjusted to maintain energy balance in healthy, young males, *Clinical Nutrition* (2023). DOI: 10.1016/j.clnu.2023.02.006

Provided by University of Bath