New computational model enables personalized simulation of exercise's metabolic effects

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Modeling system-level effects of exercise could help clarify how it prevents disease. Credit: Mārtiš Zemlickis

A new mathematical model incorporates personalized details to simulate

the metabolic effects of exercise. Presented in PLOS Computational Biology by Maria Concetta Palumbo of the National Research Council of Italy, Rome, and colleagues, the model can be adapted to different individual characteristics, such as age and weight, as well as different types and intensities of exercise.

Physical activity can help prevent or treat metabolic diseases, and better understanding of the molecular effects of exercise could aid clinical efforts to address disease. System-level effects of exercise are difficult to monitor in people, so scientists have developed mathematical models to simulate them. However, previously developed models do not account for key details, such as exercise type and personal characteristics.

To address this challenge, Palumbo and colleagues extended an existing model to make it more personalized. The existing model used known properties of different organs and tissues to simulate the effects of exercise on metabolic dynamics of glucose, hormones, and related substances in those tissues. However, the model only addressed one type of exercise (cycling) at a fixed intensity level for one type of person (a 70-kilogram male with no cycling training).

Without changing the biological basis of the older model, the researchers mathematically extended it to incorporate a better, more personalized definition of physical exercise. The resulting new model accounts for a subject's gender, age, body weight, fitness level, exercise duration, and exercise intensity as measured in the context of personal fitness level.

The researchers validated their model by showing that it accurately simulated results from previous, real-world studies in which blood samples were used to monitor metabolic effects in people with different individual characteristics who performed different forms of exercise.

"Modeling the influence of physical exercise on the control of glucose

homeostasis is of primary importance in the understanding of how physical activity prevents disease and improves health outcomes, and consequently in the development of eHealth monitoring devices for personalized medicine," Palumbo says.

Next, the research team plans to extend their model further to incorporate key parameters related to an individual's lifestyle, such as nutrition.

More information: Palumbo MC, Morettini M, Tieri P, Diele F, Sacchetti M, Castiglione F (2018) Personalizing physical exercise in a computational model of fuel homeostasis. *PLoS Comput Biol* 14(4): e1006073. doi.org/10.1371/journal.pcbi.1006073