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Effect of 30%，50% and 70% VO2 max treadmill exercises on gut microbiome in hypertensive mice

Jin Li,Wenting Shi,Pengyi Zhang
Sport Science Research Center， Shandong Sport University， Jinan， China

Objective Gut microbiome has a significant impact on human health through the interaction with host and environment, which is closely related to a series of chronic diseases. The diversity of gut microbiome and its metabolic disorder are the risk factor of hypertension. The changes of gut microbiome structure and abundance are closely related to the pathogenesis of hypertension, in which *Bifidobacterium* and *lactic acid bacteria* can bind with the hypotensive substances to show the hypotensive therapy. However, the diet and exercise have great impact on the structure and function of gut microbiome, and of which aerobic exercise could increase the ratio of gut beneficial bacteria to harmful bacteria effectively. The effect of treadmill exercise on gut microbiome of hypertensive mice was studied in this paper, which provided a theoretical basis for the prevention and treatment of hypertension by gut microbiome.
Methods SPF Kunming mice were fed with 8% high salt diet for 6 weeks to make the hypertension model. Compared with the blood pressure of mice before the formal experiment, The standard was that the blood pressure of the experimental mice was increased by SBP >15% or DBP > 5%, which was indicated the model of hypertension was established successfully. The motion slope and velocity of the maximum oxygen uptake of 30%, 50%, and 70% were measured respectively. The mice were divided into 4 groups randomly according to their body weight, 10 mice/group. The 30% VO2 max, 50% VO2 max, and 70% VO2 max were exercised for 6 weeks as well as the control group. The mice were divided into cages and fed in accordance with the national standard rodent diet. The blood pressure of mice was measured weekly by tail pressure method (Tail-cuff).The abundance of *Bifidobacterium, Bacteroides, Lactobacillus* and *Enterobacter* in the gut microbiome of mice feces were tested by 16S sequencing every two weeks. The ratio of *Firmicute / Bacteroides* (F/B ratio) was also measured by sequencing as a parameter to reflect the disorder of gut microbiome. The ratio of *Firmicutes* / *Bacteroides* is almost equal 1, and the present study found that the F/B increased significantly in the hypertensive group. Real-time PCR was used to detect the changes of plasma inflammatory factors IL-1β, IL-6 and TNF-α. The previous study had shown that the intestinal disorders can lead to an increase in pathogenic bacteria, further leading to the inflammation. Finally, the experimental data were analyzed by independent sample t-test.
Results (1) After six weeks of exercise intervention, the blood pressure (132.87mm Hg±5.23mm Hg) of the exercise group was significantly lower than the control group (99.57mm Hg±7.47mm Hg), especially in the 50%VO2 max mice. (2) Compared with the rest group, the abundance of gut microbiome in the exercise group was increased, among which the number of *Bifidobacteria, Lactobacillus,* and *Bacteroides* were increased significantly, of which 50% of VO2 max group increased most significantly, and the number of *Enterobacter* was less than the control group ($p<0.05$). (3) Compared with the control group, the ratio of F/B in the exercise groups were lower than the control group, but the 50% VO2 max group was decreased most obviously ($p < 0.05$). (4) Compared with the control group, the plasma levels of IL-1β, IL-6 and TNF-α in exercise groups were significantly lower than the control group ($p < 0.05$).
Conclusions (1) The aerobic exercise could change the abundance and structure of gut microbiome in hypertensive mice, increase the beneficial bacteria *Bifidobacteria* and *lactobacillus* in the intestinal tract of mice, and reduce the ratio of F*irmicutes*/*Bacteroides,* improving the gut

microbiome disorder. (2) The aerobic exercise could alleviate the inflammatory reaction of the body by regulating the structure of gut microbiome of hypertensive mice, improving the blood pressure of mice; (3) 50%VO2 max was the most significant exercise intensity to improve the abundance and structure of gut microbiome in hypertensive mice.