

# Stereological Study Of Exercise-Induced Changes Of The Capillaries In The White Matter Of The Depression Model Of Rat

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## Keywords

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## Introduction

Exercise has been shown to be able to improve depressive symptoms when used as an adjunct to medication. Nevertheless, the mechanisms underlying the antidepressant effect of exercise are not well understood. The previous studies showed that running exercise could induce brain angiogenesis and increase the capillary density in the brain. The capillary changes in the white matter have also been discovered in the depression model of rat. However, there have been no studies investigating the effects of running exercise on the capillaries in the white matter of the depression model of rat. The current study was designed to investigate the effects of running exercise on the capillaries in the white matter of the depression model of rat using the new stereological methods.

## Materials and Methods

Male SD rats, weighting 180 ~ 220 g, provided by the Experimental Animal Center of Chongqing Medical University were used. After the sugar consumption test and the open-field test, they were randomly divided into the control group and the model group. In the light of Willner's et al and other references, we made some improvements to build the Chronic Unpredictable Stimulus (CUS) rat model of depression. The model group was given four week chronic unpredictable stimulus, while the control group was left undisturbed in the home cages except for the necessary controls such as regular cage cleaning and weighing. A sugar consumption experiment was weekly performed to estimate depressive state in rats, and the open-field test was only done in the fourth week. After four weeks, the model group rats were divided into the control model group and the running model group. In the running model group, the rats ran on a six-lane motorized treadmill for four consecutive weeks with 20 min each day and five consecutive days each week. The control group rats and the control model group rats

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were housed under identical conditions without running. In the end of the experiment, both the sugar consumption test and the open-field test were performed again.

After the completion of behavioral experiments, five rats from each group were randomly selected and used for the stereological analyses. All brains were taken out. Each hemisphere was cut into serial 1mm parallel slabs coronally. The slabs were photographed under anatomical microscope with a magnification of 10X. The white matter volume was calculated according to the Cavalieri's principle. Five tissue blocks were randomly sampled from each white matter. Four sections with the thickness of 4  $\mu\text{m}$  were cut from each sampled block. From each cut section, 10-15 fields of view were randomly photographed under stereology microscope with a magnification of X 6 000. The length density and total length, volume density and total volume, surface area density and total surface area of the capillaries in the white matter of the three groups were calculated using the stereological methods.

### Results and Discussion

In the fourth week, the percentage of the sugar consumed in sucrose preference test in the model group was significantly lower than the control group ( $P < 0.01$ ). The percentage of the sucrose preference in the running model group was significantly higher than the control model group ( $P < 0.05$ ). The percentage of the sucrose preference between the running model group and the control group was not significantly different ( $P > 0.05$ ). Four week running exercise had a positive effect on the sucrose preference in the depression rats. The difference of white matter volume was significant between the running model group and the control model group ( $P < 0.05$ ). The white matter volume between the running model group and the control group was not significantly different ( $P > 0.05$ ). The difference in the total length of the capillaries in the white matter was significant between the running model group and the control model group ( $P < 0.05$ ). The total length of the capillaries in the white matter between the running model group and the control group was not significantly different ( $P > 0.05$ ). The difference in the total volume of the capillaries in the white matter was significant between the running model group and the control model group ( $P < 0.05$ ), and the total volumes of the capillaries in the white matter of the running model group and the vacuity control group were also significantly different ( $P < 0.05$ ). The difference in the surface area of the capillaries in the white matter was significant between the running model group and the control model group ( $P < 0.05$ ), and the surface area of the capillaries in the white matter of the running model group and the control group was also significantly different ( $P < 0.05$ ).

### Conclusion

The present results further confirmed that running exercise had a therapeutic effect on depression. The present study found that there were significant differences in the total volume of the white matter and the total length, total volume and total surface area of

the capillaries in the white matter between the control model group rats and the running model group rats. Our results suggested that exercise-induced increases of the capillaries in the white matter might be one of the structural bases for the exercise-induced treatment of the depression. All the present results would provide important parameters for further studies of the mechanisms of vascular factors in depression and provide a new research direction for the development of a new clinical antidepressant means.

