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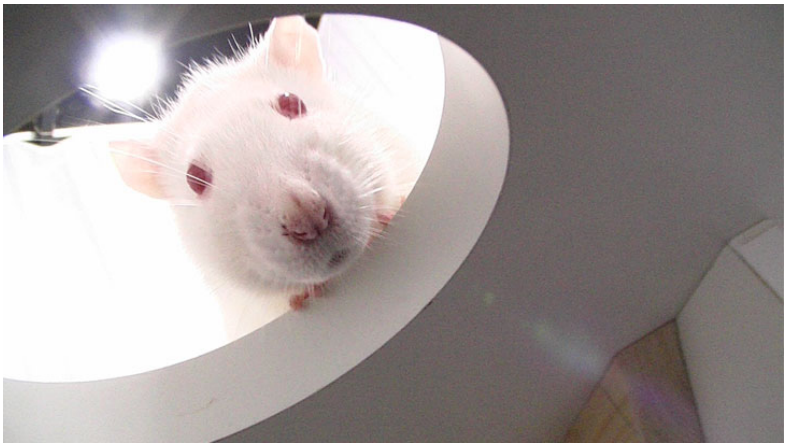
Physical Exercise and Diet in Animal Models: Emotional, Physiological and Cognitive Effects



A sedentary lifestyle could be considered one of the great epidemics of the century. In the past 100 years, technological advances and socioeconomic development have shaped society, eliminating much of the physical work and altering eating habits. The consequences of these changes are evident in increased cardiovascular disease, obesity, diabetes, stress and anxiety. This thesis aims to analyze the physical activity recommendations made by global health organizations in a basic research model. Are recommendations for a healthy lifestyle adequate?

The study with laboratory animals allows scientists to control a large number of extraneous variables. The recommendations for humans made by the American College of Sports Medicine (ACSM), the first global benchmark, are based primarily on epidemiological or prevalence studies. However, until now, basic research is not entirely consistent on the effects of specific exercise protocols. In this thesis, we trained male and female rats to moderate aerobic exercise protocol; very similar to the 30 min of brisk walking or running slowly, recommend for humans, for 9 months. We first demonstrated that: i) these guidelines can be modeled in rodents, ii) there are differential effects on males and females, and iii) it may be necessary to increase the intensity in order to improve some physiological parameters.

Firstly, the analogous procedure to study the recommendations of the ACSM in rats is the treadmill. In one of the papers presented in this thesis, we demonstrate for the first time that long-term moderate exercise on the treadmill acts as a protective factor in front of stressful events. Exercised rats for 9 months had a moderate hormone reaction in stressful conflicts. Nevertheless, at a behavioral level, both trained rats on the treadmill and those that had been manipulated in the same way (i.e. being placed on the treadmill, but at zero speed) showed less anxious behavior than the group of rats that never went out of their cage. In other words, in our laboratory model stimulation, which involves taking rats out of the cage, reduces behavioral anxiety in a similar manner that moderate exercise does.

Another important finding of this thesis is that there are gender differences related to the effects of exercise. In general, it has been found that female rats are more active than male rats in open arenas. In our studies, we have seen that the effects of moderate exercise are beneficial in males and, probably, higher intensities are needed to achieve similar benefits on stress hormones in females. In the same way, we also found similar results regarding weight loss, and even cardiovascular benefits (with the index of Heart Rate Variability, HRV); possibly, higher intensity is needed. In any way, this new hypothesis must be checked in both humans and rodents.

Finally, we wanted to study the other side of the coin of lifestyle: obesity and unhealthy diets. Following the above approach, we used a cafeteria diet as an unhealthy diet, which, in previous studies, has shown very similar results in negative effects in animals as in humans. The advantages of using this model are: we give the same products for human consumption to animals, we are able to control the harmful effects of the nutritional composition of foods and it allows us to control its palatability and the pleasure of eating it. In adolescent rats, the main risk group, we found harmful physiological effects (associated with the metabolic syndrome pathology) from the cafeteria diet, but also we saw decreased anxiety and increased socialization of animals (males and females). Therefore, the recommendations and policies to improve diet should take into account these beneficial effects on the psychological level.

In conclusion, this thesis demonstrates the importance of interdisciplinary work. In addition, we must take into account gender differences and the importance of studying exercise and diet from different perspectives. We have seen that exercise, but also handling and environmental stimulation reduce anxiety in animals. And regarding diet, unhealthy but tasty foods may also positively influence the emotional state.

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References

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