



## Exercise improves learning and memory impairments in sleep deprived female rats



Hakimeh Saadati<sup>a</sup>, Saeed Esmaeili-Mahani<sup>b</sup>, Khadije Esmaeilpour<sup>a</sup>, Masoud Nazeri<sup>a</sup>, Shahrzad Mazhari<sup>a</sup>, Vahid Sheibani<sup>a,c,\*</sup>

<sup>a</sup> Institute of Pharmacology, Neuroscience Research Center, Kerman University of Medical Sciences, Kerman, Iran

<sup>b</sup> Department of Biology, Faculty of Science, Shahid Bahonar University, Kerman, Iran

<sup>c</sup> Department of Physiology, School of Medicine, Kerman University of Medical Sciences, Kerman, Iran

### HIGHLIGHTS

- Paradoxical sleep deprivation (PSD) impaired learning in ovariectomized female rats.
- PSD impaired short term memory in intact and ovariectomized female rats.
- Physical exercise alleviated the PSD-induced cognitive impairments in female rats.
- There was no significant change in the plasma corticosterone level of all groups.

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### ABSTRACT

Inadequate sleep is a common problem in modern societies. It has been previously shown that female rats are more vulnerable to the deleterious effects of sleep deprivation on cognitive functions. Physical exercise has been suggested to attenuate the cognitive impairments induced by sleep deprivation in male rats. The objective of the current study was to investigate the effects of physical exercise on cognitive functions of female rats following paradoxical sleep deprivation.

Intact and ovariectomized (OVX) female Wistar rats were used in the present study. The exercise protocol was 4 weeks of treadmill running. The multiple platform method was applied for the induction of 72 h paradoxical sleep deprivation and the cognitive function was evaluated using Morris water maze (MWM). Plasma corticosterone level was evaluated in separate groups of study. ANOVA and repeated measures were used to analyze the data and  $P < 0.05$  was considered statistically significant.

Throughout the investigation, significant learning impairment was observed in sleep-deprived OVX rats compared to the intact and the other OVX groups. Short term memory impairment was observed in both sleep-deprived OVX and intact groups. Physical exercise alleviated the PSD-induced learning and memory impairments in both intact and OVX groups. Corticosterone levels were not statistically significant among the different groups.

The results of our study confirmed the negative effects of PSD on cognitive functions in female rats and regular physical exercise seems to protect rats from these effects. Further studies are suggested to be carried out in order to evaluate the possible underlying mechanisms, and also to evaluate the possible interactions between sex hormones and PSD-induced cognitive impairments.

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\* Corresponding author at: Institute of Pharmacology, Neuroscience Research Center, Kerman University of Medical Sciences, Kerman, Iran. Tel.: +98 341 2264196; fax: +98 341 2264198.

E-mail addresses: [hsadat54@yahoo.com](mailto:hsadat54@yahoo.com) (H. Saadati), [Semahani@yahoo.com](mailto:Semahani@yahoo.com) (S. Esmaeili-Mahani), [Khadijeh.esmaeilpour@yahoo.com](mailto:Khadijeh.esmaeilpour@yahoo.com) (K. Esmaeilpour), [m.nazeri1989@yahoo.com](mailto:m.nazeri1989@yahoo.com) (M. Nazeri), [Shahrzadmz@yahoo.com](mailto:Shahrzadmz@yahoo.com) (S. Mazhari), [Vsheibani2@yahoo.com](mailto:Vsheibani2@yahoo.com), [V-sheibani@kmu.ac.ir](mailto:V-sheibani@kmu.ac.ir) (V. Sheibani).

### 1. Introduction

Animal studies have demonstrated the positive effects of sleep on declarative and procedural memory in various behavioral tasks [1–4]. It has been shown that sleep contributes to the acquisition and consolidation of memory [4–6]. “Sleep” has been considered as a time window through which the acquired information is processed without any disturbance from the sensory system [2]. Sleep disorders are a common