

Effect of Perinatal High Fat Diet on Spatial Learning and Memory in SD Rat Offspring

Ling Wang

(Zhengzhou University College of Public Health)

Effect of Perinatal High Fat Diet on Spatial Learning and Memory in SD Rat Offspring

Ling Wang
Zhengzhou University
College of public health

- ◆ According to Barker's hypothesis, the setting in uterus could directly affect the fetal development and the influence could be lasted until adult age.
- ◆ Perinatal high fat diet could result in significant changes in offspring metabolism including birth weight, postnatal growth, volume of body fat deposition, plasma levels of leptin and insulin, etc.

Context

- ◆ Background
- ◆ Material and Methods
- ◆ Results
- ◆ Discussion
- ◆ Conclusion

- ◆ Leptin is known as an important regulator in energy balance by acting on the leptin receptors in hypothalamus.
- ◆ Leptin receptors have been found in cortex, hippocampus, and limbic areas and postulated that they may have impact on cognition especially spatial learning and memory.

Background

- ◆ It has been discovered that obesity and its major risk factor, high fat diet, could increase the risk of developing metabolic syndrome by many previous studies.
- ◆ Up to date, increasing numbers of studies show that dietary factors at early stage of life might have adverse effect on cognition.

- ◆ Leptin is considered as a protective factor on brain development, as it could prevent the hippocampal and cortical neurons from glutamatergic cytotoxicity and oxidative stress, and reduce protein tau tangles to restrain neurofibrillary tangles and senile plaques.
- ◆ Epidemiology studies demonstrate that higher level of serum leptin could slow down cognition deterioration. Data showed that lower serum leptin was found in Alzheimer's patients compared with the non- Alzheimer subjects.

◆ The causal mechanism of obesity on cognition impairment is poorly understood. It is reported that the excessive oxidative stress involved in inflammatory reaction is associated with neuro-degeneration which causes cognitive decline. Since oxidative stress happens in obesity, it is reasonable to link between obesity and brain dysfunction via inflammatory reaction.

◆ However most of the studies were conducted at growing stage or later life of the subjects, it is rear to investigate the effect of maternal high diet on brain function of the offspring.
◆ The aim of this study was to explore the effect of maternal high fat on spatial learning and memory of the offspring and the possible mechanism.

Materials and Methods

◆ SD rats provided by Laboratory Animal Center of Henan Province.
◆ Lard provided by Henan Shineway Food Co, Ltd
◆ Rat leptin Elisa kit provided by Zhengzhou Genesis Biotech company.

◆ Adult female SD rats were randomly divided into control (CD) group and high fat diet (HFD) group, fed with lab chow and high fat diet (containing 20% lard) throughout gestation and lactation periods respectively. After weaning at 4 weeks of age, Morris water maze (MWM) task was conducted to evaluate spatial learning and memory in pups. The body weight, the mass of visceral fat, and brain weight were recorded and plasma leptin level was measured via ELISA.

Results

Table 1 Body weight, visceral fat and brain weight of two groups of rats at 4 weeks of age

Group	Body weight (g)	Visceral fat (g)	Brain (g)
CD	70.60±17.30	0.22±0.07	1.32±0.12
HFD	90.05±6.71*	0.41±0.12*	1.50±0.07*

Data were expressed as mean ± SEM with 10 pups per group

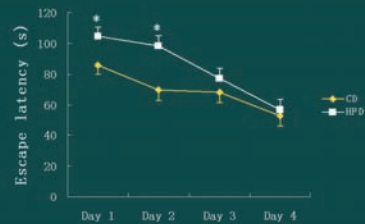


Figure 1. Escape latency of two groups of rats at 4 weeks of age in MWM task

Latency exhibited shorter than last day analyzed by 1-way ANOVA with repeated measures. * $P < 0.05$ vs CD group

Table 1 Performance of rats on MWM of probe test at 4 weeks of age

Group	Time spend in target quadrant (%)	Distance moved in target quadrant (%)	Times of crossing
CD	27.73±9.74	28.59±9.01	2.90±0.96
HFD	23.00±8.09	23.49±7.36	2.10±0.59

Data were expressed as mean ± SEM with 10 pups per group

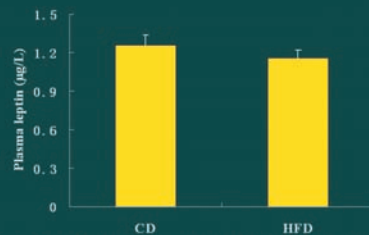


Figure 2. plasma leptin levels in two groups of rats at 4 weeks of age



Discussion

- ◆ Perinatal HFD resulted in spatial learning injury, while not impact the ability of spatial memory, which is different from other studies.

Conclusion

- ◆ Perinatal HFD could impair spatial learning in SD rat offspring, which may relate with obesity and lower plasma leptin in offspring led by perinatal HFD.

- ◆ In accord with Barker's hypothesis, perinatal HFD led to overweight and more adipose tissue.
- ◆ However, the result that perinatal HFD promoted the brain development maybe due to that HFD given during critical period benefits development of brain with high lipid content, or that saturated fatty acid is integrant to myelin sheath, contradicts the performances in MWM.

Thank you!

- ◆ Perinatal HFD lowed the level of plasma leptin, which may induce obesity in maternal HFD offspring.
- ◆ In line with most studies, lower level of plasma leptin displayed cognition decline.