Early postnatal environmental enrichment restores neurochemical and functional plasticities of the cerebral cortex and improves learning performance in hidden-prenatally-malnourished young-adult rats

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Moderate reduction of dietary protein (from 25% to 8% casein) in pregnant rats, calorically compensated by carbohydrates, gives rise to ?hidden prenatal malnutrition? (HPM) in the offspring since it does not alter body and brain weights of pups at birth. However, this dietary treatment leads to decreased ?-adrenoceptor signaling and brain derived neurotrophic factor (BDNF) levels in the pup? brain, altogether with defective cortical long-term potentiation (LTP) and lowered visuospatial memory performance. Since early postnatal environmental enrichment (EE) has been shown to exert plastic effects on the developing brain and neuroprotection both on cognition and on structural properties of the neocortex, in the present study we addressed the question of whether early postnatal EE during the lactation period could exert compensatory changes in the expression of

®-adrenergic receptors and BDNF in the neocortex of HPM rats, and if these effects are associated with an improvement or even a restore of both neocortical LTP in vivo and cognitive performance induced by HPM. The results obtained show that EE restored ?-adrenoceptor density, BDNF expression and the ability to support LTP at prefrontal and occipital cortices of HPM rats. Besides, EE improved learning performance in visuospatial and operant conditioning tasks. The latter support the notion that adequate maternal protein nutrition during pregnancy is required for proper brain development and function. Further, the results highlight the role of environmental enrichment during early postnatal life in increasing later brain plasticity and exerting neuroprotection against brain deficits induced by prenatal malnutrition. © 2019

Brain-derived neurotrophic factor

Learning

Long-term potentiation

Neocortex

Prenatal protein malnutrition

?-Adrenoceptor

beta adrenergic receptor

brain derived neurotrophic factor

beta adrenergic receptor

brain derived neurotrophic factor

adult

animal experiment

animal model

animal tissue

Article

brain cortex

brain development

brain function

cognition

controlled study

environmental enrichment

female

fetal malnutrition

gene expression

in vivo study

instrumental conditioning

lactation

learning

long term potentiation

maternal nutrition

memory

neocortex

nerve cell plasticity

neurochemistry

neuroprotection

nonhuman

occipital cortex

perinatal period

prefrontal cortex

pregnancy

priority journal

protein intake

rat

receptor density

spatial memory test

young adult

animal

brain cortex

learning

male

malnutrition

metabolism

nerve cell plasticity

newborn

occipital lobe

pathophysiology

physiology

postnatal care

prenatal exposure

procedures

psychology

Sprague Dawley rat

Animals

Animals, Newborn

Brain-Derived Neurotrophic Factor

Cerebral Cortex

Cognition

Female

Learning

Long-Term Potentiation

Male

Malnutrition

Memory

Neocortex

Neuronal Plasticity

Occipital Lobe

Postnatal Care

Pregnancy

Prenatal Exposure Delayed Effects

Rats

Rats, Sprague-Dawley

Receptors, Adrenergic, beta