

Perinatal Supplementation of Egg Yolk Enhances Cognition and Alters Brain Network Function in Offspring

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Objectives: Egg yolks are a nutrient dense food often recommended to pregnant women, as they contain bioactive compounds that enhance brain development in offspring. We examined the effects of perinatal intake of egg yolks on cognition and brain functional network activity in offspring using a translational sow/piglet dyad model.

Methods: Sows were fed a control diet ($n = 6$) or a diet containing egg yolks ($n = 5,350$ mg egg yolk powder/kg BW/day, equivalent to ~ 3 eggs/day for humans) from late gestation throughout lactation. At weaning, piglet offspring ($n = 4$ /sow, total $n = 44$) performed object recognition testing (ORT) to assess hippocampal-dependent learning and memory outcomes. A subset of the piglets ($n = 2$ /sow, total $n = 22$) underwent magnetic resonance imaging (MRI) to acquire diffusion tensor imaging (DTI) and resting-state functional MRI. Correlation analysis of outcomes from ORT and MRI was performed.

Results: Piglets from egg yolk fed sows spent more time with novel objects than familiar objects ($p = 0.039$), suggesting that maternal

intake of egg yolk may improve hippocampal-dependent cognitive outcomes. DTI analysis showed that perinatal intake of egg yolks tended to increase fiber length in the hippocampus ($p = 0.073$) compared to control. Moreover, intake of egg yolk resulted in a 14.3% increase in functional connectivity in the cerebellar network ($p = 0.025$) and a 15.6% trending increase in the executive network ($p = 0.089$) compared to control. Interestingly, the visual network was positively correlated with proportional frequency ($p = 0.043$) and time ($p = 0.078$) spent with novel objects and negatively correlated with proportional frequency ($p = 0.007$) and time ($p = 0.016$) spent with familiar objects, suggesting that the activation of visual network may influence hippocampal-dependent cognitive outcomes at weaning.

Conclusions: Perinatal intake of egg yolk enhanced hippocampal-dependent learning and memory, increased fiber length in the hippocampus and altered brain functional connectivity in offspring at weaning. The findings from this study support that egg yolk altered activation of specific brain networks are that associated with cognitive outcomes in weaning piglets.

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