Brain plasticity and neurogenesis in relation to (early life) stress, nutrition and major depression

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Hippocampal neurogenesis in animals is well regulated by exercise or antidepressants, a.o. (2), and has been implicated in cognition, mood and antidepressant efficacy.

Interestingly, exposure to stress, particularly during the vulnerable early-life period, increases the chance to develop psychopathologies like depression, and accelerates cognitive decline in adults (2,4,5). I will present data on brain plasticity in relation to (early) stress in animal models and in human depression.

In mice, exposure to stress in the first week of life reduced adult neurogenesis and lastingly affected cognition and the immune system (2,3,4). Notably, supplementation of the diet of the dam with specific micronutrients or lipids could rescue early life stress induced effects on neurogenesis and cognition in her pups later in life (4,5). Hence, early stress as well as early nutrition 'program' adult brain structure, function and disease vulnerability (1,3).

To further address neurogenesis in human brain, we studied postmortem tissues of established, well-characterized, major depressed patients, and have further optimized automated procedures to detect the 1.28 ppm NMR spectroscopic signal, that identifies neural precursor cells (NPCs) in human brain in vivo (6). We studied changes in neurogenesis markers in relation to age, depression and antidepressant treatment. We conclude that, consistent with other measures in literature (7,8), neurogenesis is present also in the human hippocampus in vivo, and reductions occur with age and in depression.

1) PJ Lucassen (..) A. Korosi. Perinatal programming of hippocampal structure and function; emerging roles of stress, neurogenesis, epigenetics and early nutrition. Trends Neurosci 2013.
2) Lucassen PJ (..). Regulation of Adult Neurogenesis (..). Cold Spring Harb Perspect Biol. 2015.
3) Hoeijmakers L, Lucassen PJ, Korosi A. The interplay of early-life stress, nutrition, and immune activation programs adult hippocampal structure and function. Front Mol Neurosci. 2015 Jan 9;7:103.
4) Naninck EF (..), Lucassen PJ, Korosi A. Early micronutrient supplementation protects against early stress-induced cognitive impairments. FASEB J. 2017.
5) KY Yam, (..), PJ Lucassen, A Korosi. Increasing availability of omega-3 fatty acid in the early life diet prevents the early-life stress induced cognitive impairments without affecting metabolic alterations. FASEB Journal, in press, 2019.
6) Manganas et al., Magnetic resonance spectroscopy identifies neural progenitor cells in the live human brain. Science. 2007.
7) Lucassen PJ (..). Decreased numbers of progenitor cells but no response to antidepressant drugs in the hippocampus of elderly depressed patients. Neuropharmacology. 2010.
8) Kempermann G, Gage FH (..), Lucassen PJ, Frisén J. Human Adult Neurogenesis: Evidence and Remaining Questions. Cell Stem Cell. 2018.