Perinatal alcohol intake, maternal behaviour and transgenerational inheritance of drug abuse; effects of drinking pattern and environmental enrichment

A. Brancato[1,2], C. Cannizzaro[1]

[1]Dept. of Sciences for Health Promotion and Mother and Child Care, University of Palermo, Italy
[2]BioNeC, University of Palermo, Italy

Alcohol drinking during pregnancy and post-partum is a major concern because of the persistent neurobehavioral deficits in the offspring that include increased vulnerability to substance abuse (McMurray et al., 2008). Moreover, the pattern of alcohol consumption accounts for specific neurobiological alterations that involve brain regions, that significantly overlap with those involved in maternal care behaviour (Stuber et al., 2008; George et al. 2012). Rodent studies on environmental enrichment have clearly demonstrated the capacity for non-drug modification of addiction-related behaviours (Nader et al., 2012).

Thus, this study aimed at: (I) exploring the consequences of continuous vs. intermittent alcohol-drinking pattern on maternal behaviour and offspring vulnerability to alcohol; (II) evaluating the effects of environmental enrichment on the offspring behavioural response to alcohol.

Female rats were given continuous- or intermittent (CA, IA), two-bottle choice with water and 20% alcohol along a 12-week period. Alcohol drinking was suspended during mating and resumed from late gestation throughout lactation, when they were assessed for home-cage undisturbed maternal behaviour. In the adulthood, alcohol-exposed offspring, reared in either standard- or enriched- conditions, were assessed for alcohol consummatory behaviour in a free-choice paradigm (10% alcohol and water) and tested for the deprivation effect. Moreover, they were tested for behavioural reactivity in the open field; anxiety-like behaviour in the elevated plus maze; depressive-like behaviour in the forced swim test; spatial learning and memory and cognitive flexibility in the Morris water maze during the drinking paradigm.

Alcohol drinking was able to disrupt spontaneous maternal behaviour, more in IA-dams ($p<0.001$) than CA ones. In the offspring, perinatal alcohol IA induced higher alcohol intake and a stronger deprivation effect, with respect to CA ($p<0.01$). Overall, perinatal alcohol exposure decreased behavioural reactivity. Indeed, perinatally CA- and IA-exposed groups spent less time in the central area of the open field ($p<0.001$) and on the open arms of the elevated plus maze ($p<0.01$), and showed increased immobility in the forced swim test ($p<0.01$), when compared to controls; notably, perinatal IA-group displayed learning and memory impairment ($p<0.05$) and decreased cognitive flexibility ($p<0.5$) with respect to controls in the water maze. The environmental enrichment exerted a protective role, in perinatally IA-rats and controls towards the deprivation effect ($p<00.1$). Moreover, the enriched rearing condition increased behavioural reactivity ($p<0.01$), decreased anxiety-like behaviour ($p<0.001$) in both CA and IA- groups, and improved spatial learning and memory in IA group ($p<0.01$). No effect was observed on depressive-like behaviour and reversal learning.

In conclusion, this study indicates for the first time that the pattern of alcohol consumption can be responsible for different extents of maternal behaviour disruption and detrimental consequences in the offspring. Rearing conditions that promote high sensory, motor, affective and cognitive stimulations foster resilience to alcohol abuse and improve affective tone and cognitive function; nevertheless they cannot be sufficient to full recovery from harmful effects of perinatal alcohol exposure.

McMurray et al. (2008) *Neurotoxicol Teratol.* 30(6):475-86.
Stuber et al. (2008) *Alcohol Clin Exp Res*. 32(10):1714-20
George et al. (2012) *Proc Natl Acad Sci U S A*.109(44):18156-61
Nader et al. (2012) *Neuropsychopharmacol.* 37, 1579-1587