Effect of perinatal undernutrition in Merinos d'Arles ewes on physiology and reproductive function

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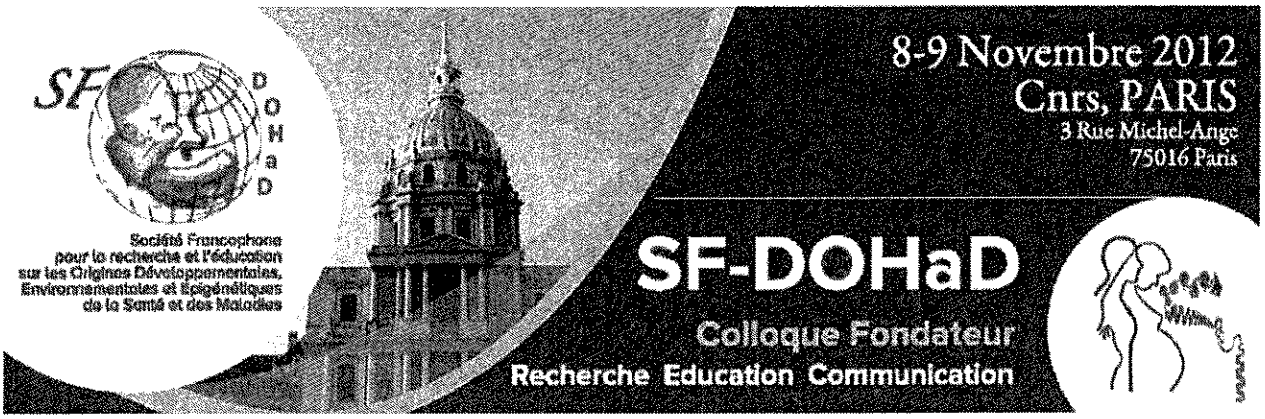

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unknown. To determine the long-term metabolic effects of high protein neonatal feeding, pups born with a low birth weight from dams fed a low-protein diet during gestation were separated from their mothers, and equipped with gastrostomy tubes on the 5th day of postnatal life (D5). Between D7 and D21, they received as their sole feeding a milk substitute of either 'adequate' (AP; $n = 14$; 8.7 g/dl), or 'high' (HP; $n = 14$; 13.0 g/dl) protein content administered through the gastrostomy tube in the 'pup in the cup' system, and were then weaned to standard chow until they were killed at adulthood. At D18, HP feeding was associated with higher rates of protein turnover ($P = 0.007$) and synthesis ($P = 0.051$), as assessed using L-[$U^{13}C$]valine infusion. Rats that had received HP milk in early life gained more weight from puberty through adulthood, had a slightly higher food intake, higher serum insulin (179 + 58 *v.* 55 + 7 pmol/l; means + S.E.), a higher HOMA-IR index, increased pancreatic β-cell number, plasma triglycerides (95 + 8 *v.* 73 + 9 mg/dl), serum leptin (9.7 + 1.0 *v.* 5.5 + 1.2 ng/ml), increased mesenteric fat mass and larger adipocytes. In a model of intrauterine growth restriction, high-protein neonatal feeding may 'program' metabolic syndrome in adulthood. Whether such programming effect is relevant for human infants born with IUGR clearly deserves further investigation.

Key words: amino acid metabolism, early development and adult disease, insulin resistance, metabolic syndrome, pup in the cup

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POSTER N°48

Early exposure to a high-fat diet has more drastic consequences on metabolism compared with exposure during adulthood in rats

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The peripuberal period in rats, which is characterized by several alterations, such as increased levels of steroid hormones, is critical for the final maturation of most neuroendocrine circuits, including those that regulate energy expenditure.[1–4] We aimed to determine whether the introduction of a high-fat (HF) diet during the peripubertal phase induces significant changes in body weight control, glucose homeostasis and the parasympathetic tonus than when HF diet is administrated to adult rats. An HF diet was offered at weaning or during adulthood to male Wistar rats. A group of animals received the HF diet for 60 days, from weaning to 81 days old (HF81) or from 60 to 120 days old (HF120), whereas two other groups received a normal-fat diet (NF81; NF120). Adiposity, glucose homeostasis, insulin sensibility and vagal activity were analyzed. HF diet increased the accumulation of adipose tissue in all animals but to a much larger degree in animals fed an HF diet since weaning ($P < 0.001$). The HF rats showed glucose intolerance with high levels of insulin secretion during the glucose tolerance test ($P < 0.01$). Rats that were fed the HF diet presented severe insulin resistance, indicated by a low Kitt ($P < 0.01$). Interestingly, the HF81 rats exhibited greater insulin resistance compared with the HF120 rats ($P < 0.05$). The recordings of vagus nerve activity showed that the HF rats had higher parasympathetic activity than the NF rats irrespective of age ($P < 0.01$). Our results show that an HF diet offered to rats just after the weaning or in adulthood both cause impairment of glycemic homeostasis and imbalance in parasympathetic activity. Importantly, the consumption of HF diet immediately after weaning has more drastic consequences compared with the consumption of the same diet during adulthood.

Key words: glycemic homeostasis, insulin sensibility, nutrition, parasympathetic activity, puberty

Statement of interest: Authors report no conflict of interest.

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POSTER N°51

Effect of perinatal undernutrition in Merinos D'Arles ewes on physiology and reproductive function

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Maternal nutrition can affect postnatal growth and development of offspring. The aim of this study was to evaluate the long-term effects of maternal periconceptional undernutrition

(PCUN) in ewes on postnatal development of male lambs. A total of 52 Merinos d'Arles ewes were fed to requirements (control group, C), whereas 64 restricted (R) ewes received 50% of their dietary needs from −15 days to +30 days post conception. Thereafter, both groups were fed according to needs. Male offspring were weighed at birth and then weekly. They were weaned at 22 kg body weight (BW). Male lambs were raised until about 35 kg BW at commercial slaughter. Plasma leptin and cortisol concentrations were determined monthly. Organ weights were recorded at slaughter, and histological analysis was performed on testicles and adrenals. A total of 22 C and 34 R male lambs were obtained at lambing. Gestation was significantly longer in the nutrient-restricted group ($P < 0.01$).[1] Birth weight and growth rate in all lambs was not significantly different between groups.[1] Plasma leptin concentrations were significantly lower in R male lambs at birth ($P < 0.001$), increased gradually in both groups until 3 months and tended to be higher at 4 months in R group. There was a significant interaction between groups, age and litter size for basal cortisol concentrations: in singletons, cortisol was significantly lower in R at 3 months ($P < 0.05$) and tended to be higher at 4 months, whereas in twins, cortisol was significantly lower at birth ($P < 0.05$) but not thereafter. The ratios of carcass weight/BW and perirenal fat/BW were increased in R lambs. Adrenal on BW ratio tended to be higher in R lambs but adrenal corticomedullary ratio was not different between groups. There was no significant difference for adrenal and testicular tissue analyses. These results obtained in a hardy breed confirm the effects of PCUN on metabolic function but not on male reproductive development.

Key words: cortisol, fetal programming, leptin, male lamb, maternal nutrition

Statement of interest: Authors report no conflict of interest.

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POSTER N°66

Sleep longitudinal study among French children and the impact on adiposity and overweight risks in the EDEN cohort

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Sleep represents one-third of our lifetime and is a vital function allowing physical, psychological and intellectual recuperation. Sleep mechanisms are better understood but their implications in health are still not completely elucidated. In humans, bad sleep has an impact on wake vigilance, body's temperature, energetic stock reconstitution, hormone production, metabolic functions, mood and stress activation regulation, toxin elimination, immune defense system stimulation, learning and memorization mechanisms and physical and intellectual performances. Adult and childhood obesity is associated with diabetes, insulin resistance, sleep obstructive apnea, cardiovascular diseases, hypertension and several cancers. In adults, sleep deprivation (<6 h/night) is associated with overweight, obesity and type 2 diabetes. Similar results have been obtained by cross-sectional studies among children on body mass index (BMI) *z*-score (BMI adjusted on sex and age). Few longitudinal studies have been conducted on healthy children to determine the impact of sleep on overweight and obesity; none in France. EDEN is a mother–child cohort study. Mothers' inclusions during their first trimester of pregnancy were carried out between 2003 and 2006. Mothers and children were followed up by questionnaires and clinical examinations over 5 years. Data, including socio-demographic, economic, nutritional, psychological, physical, intellectual and health variables, are currently available for 1310 mother–child pairs. None of these variables were simultaneously analyzed in the previous longitudinal studies. The project aims at studying children's sleep pattern in the EDEN cohort, taking into account these specific potential modulating factors available (from first trimester of pregnancy to 5 years of age of the children). We will identify factors associated with sleep pattern at each age (2, 3 and 5 years old) through cross-sectional analyses. We will also focus on sleep trajectory and modulating factors over time with longitudinal analyses. Impact of sleep and sleep variations on children's adiposity and overweight in childhood will be studied. Preliminary results will be discussed.

Key words: epidemiology/public health, newborn/children, obesity

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PLACENTA: A PROGRAMMING TISSUE

2 – P. Chavatte-Palmer and R. Levy

The central role of the placenta is emphasized both in humans and in animal models (rats, pigs and rabbits). Differential physiological, transcriptomic and epigenetic responses to adverse maternal conditions were observed in cases of spontaneous intrauterine growth restriction (IUGR), maternal high-fat diet, maternal diabetes and global food restriction. Early embryo adaptations were related to placental observations in the case of high-fat diets in rabbits, the role of placental transporters, circulating angiogenic factors and macrophages were highlighted in several studies and a specific epigenetic signature has been observed in the placenta of IUGR rats. These observations shed light on mechanisms and may provide early markers of subsequent adverse effects in adult offspring.