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NUTS CONSUMPTION AND FOETAL PROGRAMMING: NEW PERSPECTIVE ON HUMAN GROWTH

A moderate intake of nuts, as part of the maternal diet, may be essential for correct early-stage development and to maintaining a healthy life, reducing the risk of common chronic diseases in adulthood.

Dr. Jesús García-Gavilán and Prof. Jordi Salas-Salvadó
Human Nutrition Unit of the Department of Biochemistry and Biotechnology, Hospital Universitari de Sant Joan de Reus, Faculty of Medicine and Health Sciences, IISPV (Institut d'Investigació Sanitària Pere Virgili), Universitat Rovira i Virgili, Reus (Spain). CIBERobn (Centro de Investigación Biomédica en Red Fisiopatología de la Obesidad y Nutrición), Institute of Health Carlos III, Madrid (Spain).

Nuts contain great amount of polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA) in addition to a large variety of vitamins, minerals, phytosterols and fibre, which are essential for a healthy balanced diet, such as the Mediterranean diet. Maternal nutrition and diet, both before and after birth, is critical for the infant as it is closely related to foetal and new-born growth[1].

Lipids, for instance, are vital for neurological and visual development. In this regard, PUFA alpha-linolenic acid (ALA, n-3) and linoleic acid (LA, n-6) are precursors of docosahexaenoic acid (DHA) and arachidonic acid (ARA), a type of long-chain polyunsaturated fatty acid (LCPUFA)[2], which has been demonstrated to be essential for the proper development of neuronal membranes, visual cell growth, as well as for the correct synaptic plasticity and cognition of the new-born[1]. These nutrients can be obtained first via the placenta, and the mother's milk thereafter. Therefore, it is critical that the mother guarantee the dietary intake of such nutrients by consuming foods rich in LA and ALA, such as certain vegetable oils, nuts, seeds, legumes and oily fish.

Although it is not completely clear which biological processes are involved, several studies have shown that differences in the quality and amount of fatty acid intake by the mother can modify foetal programming, for example, in changing maturation and memory for the subsequent generation[3].

In this sense, a recent animal study in rats on the offspring's memory and reflex development has focused on assessing the effect of cashew nut consumption during pregnancy and lactation in the context of a normolipidic or hyperlipidic diet [cashew nuts have significant levels of monounsaturated (oleic and gadoleic) and polyunsaturated FA (α-linoleic and α-linolenic)]. Total MUFA consumption was different between diet groups, being higher in the hyperlipidic diet group. Researchers showed that cashew consumption in the context of a normolipidic diet accelerated the maturation of the nervous system and prevented memory loss in the offspring, in comparison with the hyperlipidic diet group[4]. The authors suggested that MUFA levels may interfere in reflex development, indicating that the dietary MUFA/PUFA ratio could be important for development and maturation in the offspring.

Previously, Fan and co-workers demonstrated that, upon a deficiency of n-3 PUFA in the maternal diet during pregnancy or lactation, significant changes in brain structure and function occur, which are lasting and irreversible after weaning[5]. Therefore, these studies suggest that the quality and the amount of fat consumption may have important consequences for the mother and baby.

Another study conducted in animals has evaluated the effect of a high-fat diet on *Notch/Hes* pathway activation in the hippocampus of the offspring, a brain area related to neuronal proliferation and differentiation. The authors observed higher Hes5 expression in the hippocampus in addition to increased *Notch1* and *Hes5 mRNA* in the offspring whose mothers ate a high-fat diet compared to normal-fat diet control group[6]. This study reinforces that maternal diet can produce epigenetic modifications in the children even after birth, thus affecting their normal development.

These effects can also influence other developmental processes in relation to the hypothalamus and produce adverse consequences in the subsequent generation. Prior and collaborators[7] compared the effect of a maternal hyperlipidic diet with a maternal normolipidic diet on blood pressure, renal sympathetic nerve activity, responses to stress and sensitivity to central administration of leptin and ghrelin (two hormones) in rabbit offspring. After 4 months, they observed increased blood pressure, renal sympathetic nerve activity and changes in the sympathetic response to leptin and acute stress, suggesting maternal nutrition can negatively influence cardiovascular risk factors in the offspring. In this regard, there are some epidemiological studies supporting these hypotheses, such as those pointing towards the association between gestational weight gain or gestational diabetes mellitus with cardio-metabolic risk in the following generation, potentially driven by changes in the neurotrophic actions of leptin or the melanocortin pathway[8].

Overall, beyond dietary type or quantity, unsaturated fatty acids play an important role in the health of the new-born.

Maternal nutrition and fatty acid consumption during critical development time-windows for the offspring, such as pregnancy or lactation, can be critical factors influencing modifications in foetal programming and the risk of developing chronic metabolic diseases during the life of the new-born.

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Foetal programming has recently become an area of research of high interest in nutrition sciences. Overall, beyond dietary type or quantity, unsaturated fatty acids play an important role in new-born health. Results from these studies support the finding that maternal diet may determine, to a great extent, the proportion of saturated fatty acids and unsaturated fatty acids in their new-born, thereby influencing their neuronal functional status and limiting their total brain development.

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