Maternal diet and human milk composition: A short commentary.

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Introduction

The first one thousand days between a woman's pregnancy and her child's second birthday offer a unique window of opportunity to shape short- and long-term health outcomes. In this crucial time frame, nutrition plays a foundational role, children who receives adequate nutrition in the first one thousand days are more likely to born appropriate for gestational age, have a lower risk of developing chronic diseases in later life, have a lower rate of neurodevelopmental and behavioral problems. Neonatal age and breastfeeding are halfway of this unique window of opportunity.

Human milk has been widely acknowledged as the optimal nutritional source for neonates and infants, with enormous potential to positively impact infant health. WHO and UNICEF recommend that children initiate breastfeeding within the first hours of birth and be exclusively breastfed for the first six months of life [1].

Human milk is far from being a mere source of nutrients, but an extremely complex biological system. Many factors, related to infant, maternal, physiological, and behavioural variables, intersect within this system influencing human milk composition, thereby modulating the trajectory of infant development [2].

Among factors influencing human milk composition, maternal diet has been object of increasing interest. Understanding how maternal diet affects human milk composition is the basis to formulate maternal dietary recommendations that could improve short- and long-term infant outcomes.

In this commentary, we will briefly review the current knowledge about the correlation between maternal diet and human milk composition, highlighting the importance of promoting healthy dietary habits in lactating women.

Maternal Diet and Human Milk Macronutrients

From current literature [3,4] macronutrients contents in human milk do not appear significantly sensitive to maternal dietary intake. Fatty Acids (FAs) profile instead, particularly polyunsaturated fatty acids profile, appears to be significantly influenced by maternal dietary habits during breastfeeding.

We know that different types of FAs are associated with different health outcomes: a high intake of Saturated FAs (SFAs) is a cardiovascular risk factor, while high intakes of Monounsaturated FAs (MUFAs) can improve serum lipid ratios. Among Polyunsaturated FAs (PUFAs), the ω-3 ones are associated with improved brain function and cognition, prevention of cardiovascular disease, prevention of retinopathy of prematurity; on the other hand, ω-6 PUFAs are known to exert a proinflammatory effect.

Human milk fatty acids profile shows a great variability among different countries, and part of this variability is plausibly due to different dietary customs.

Several studies have shown Chinese breast milk contains the highest ω6-ω3 ratio and a particular structure of triacylglycerol, different from other countries. A plausible explanation for this characteristic lipid composition is a unique postpartum dietary custom followed in China [5]. According to this cultural practice, called Zuo Yuezi in Chinese, after delivery the mother increases her consumption of "yang" foods, such us poultry, red meat, cheese, which are rich in ω-6 PUFAs.

Several researchers have investigated the association between individual FAs from maternal diet and FA levels in human milk, and the results to date are contradictory. However, dietary habits result from complex combinations of nutrients. Dietary pattern analysis is a way to assess the combined effects of food intake, through the identification of a small number of dietary patterns.

Bravi et al. [3] have recently used the dietary pattern analysis to investigate the overall role of maternal diet on human milk composition. Five major dietary patterns were identified. The "Vitamins, Minerals and Fibres" pattern (associated with high maternal consumption of vegetables, fruits, olive oil) and the "Fatty acids with fins" pattern (high intake of fish) were correlated with higher human milk content of ω-3. On the other hand, the "Proteins and Fatty Acids with Legs" pattern (high maternal consumption of milk products and meat) was inversely correlated with human milk content of MUFA, and weakly positively with SFA and ω-6 [6].

Improving our knowledge about the influence of maternal dietary habits on human milk composition would help us to formulate adequate maternal dietary recommendations.

Maternal Diet and Human Milk Micronutrients

Breast milk provides both minerals and vitamins (water and fat soluble). Regarding minerals, changes in maternal intake have been shown to modify human milk content of iodine and selenium, but not the content of calcium, magnesium, and copper. About the influence on other minerals, evidence is still inconsistent. Human milk vitamin content instead has been clearly correlated with maternal vitamin status: particularly, water-soluble vitamins appear highly sensitive to maternal intake [4]. For this reason, it is mandatory to assess, through a careful dietary history, adequate maternal intakes.

Alert on this topic has been raised from the results of recent studies that have investigated the nutritional adequacy in lactating women [7] nor in Europe, US, or China the eating habits of lactating women

did meet the dietary references intakes currently recommended. In Europe, women who fellow the Mediterranean diet show the highest dietary quality scores.

Data from the US National Health and Nutrition Examination Survey are particularly warning: average intakes (particularly vegetables and fruits intakes) are generally below or in the lower range of recommendations, while exceeding limits for added sugars, saturated fat, and sodium. Although diet quality is higher among pregnant and lactating women compared to peers not in these life stages, nutritional intakes are still far from optimal (NHANES 2013-2016).

Further attention on maternal dietary history is required in case of lactating mothers who follow a vegetarian or vegan diet: human milk in these cases is characterized by low levels of DHA, EPA and vitamin B12. Hence, supplementation with DHA and vitamin B12 is highly recommended [8].

Maternal Diet and Infant Gut Microbiota

There's increasing evidence that microbiota colonization during infancy is associated with long-term health outcomes: a symbiotic relationship between the host and gut microbiota promotes immune tolerance, immune homeostasis, healthy metabolism, while dysbiosis is associated with inflammatory bowel diseases, obesity, allergy, autoimmune diseases [9].

Human milk is the most significant driver of infant gut microbial development.

Even if evidence from human studies is still scanty, it is plausible to hypothesize that maternal diet during lactation may influence the infant gut microbiota [10], we know that human milk exerts its role of shaping infant gut microbiota mainly through the transfer of microbes (milk microbiome) and bioactive molecules (particularly, Human Milk Oligosaccharides-HMOs). Several lines of evidence suggest milk microbiome partially derives from maternal gut microbiome, through an entero-mammary pathway, and studies have confirmed diet during pregnancy and lactation affects the composition of maternal gut microbiome. Furthermore, Seferovic, et al. in a randomised cross-over study has recently demonstrated maternal diet alters HMO composition [11]. Hence, maternal diet during lactation may be an efficient approach to modulate the infant gut microbiota.

Conclusion

Human milk is an extremely complex biological system resulting from the intersection of maternal, infant, behavioural and physiological factors. Variations in each of these variables affect human milk composition, hence modulating the trajectory of infant development.

There is increasing evidence maternal diet has a significant impact on human milk composition. It is therefore crucial to better understand this association and its translation into clinical outcomes, in order to formulate dietary recommendations for lactating women that could positively impact infants' health.

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