Children born preterm need expert nutritional care

Premature birth is associated with higher long-term chronic diseases risk

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Nalin Siriwardhana, Ph.D., interviewed Dr. Nicholas Embleton BSc, MD, FRCPCH from Newcastle Neonatal Service, Royal Victoria Infirmary, Newcastle upon Tyne NE1 4LP, UK.

Most preterm kids need comprehensive medical attention and nutrition care to ensure proper development and future wellbeing. Infants born prior to complete 37 weeks of the pregnancy are considered as preterm babies. The weeks and months before and after child birth is critically important to complete the development of important organs such as brain, lungs, liver and immune system. Unfortunately, preterm births are not very uncommon. According to Centers for Disease Control and Prevention (CDC), one in every 9 infants born in United States (US) are preterm kids. Statistics from World Health Organization (WHO) reports 15 million preterm infants annually and it is even more than one in every 10 children.

In a recent scientific article published in World Review of Nutrition & Dietetics journal, Dr. Embleton highlighted the importance of nutrition for preterm kids. According to him "Preterm infants need close attention to nutrient intakes in the first few weeks, especially protein and energy, but also minerals, vitamins and other micronutrients."

Nutrition Remarks interviewed Dr. Nicholas Embleton, a Consultant Neonatal Pediatrician, to clarify the role of nutrition in prematurely born children. Below is a concise summary of the interview:

**Intravenous, feeding tube and bottle feeding for a preterm infant at hospital**

**Question from Nutrition Remarks:** Why high level of nutrition care is important to preterm kids?

**Answer from Dr. Embleton:** Nutrition in the first few days and weeks are critical for later life outcomes. Brain growth is particularly rapid in the last trimester of pregnancy and the first few weeks
after birth so inadequate nutrition during this period may result in worse long-term cognitive outcome. Most very premature babies require intravenous (parenteral) nutrition for the first few days and weeks until milk feeds are established. Mother’s own breast milk is the best for preterm babies and is associated with improved short-term outcomes (less infections and gut diseases) and better long-term outcomes such as bone health and lower rates of cardiovascular disease. However, on its own mother’s own breast milk will not meet macronutrient (especially protein) or micronutrient requirements without fortification or supplementation.

Question: What are the potential major health consequences associated with insufficient nutrition care on preterm kids?

Answer: Inadequate nutrition in the first few days is associated with growth failure, inadequate lean mass deposition, impaired brain growth and a range of other adverse outcomes. Sub-optimal nutritional status may impair ability to withstand stresses such as infections and impair recovery from respiratory illness. Failure to provide sufficient energy in the first few days may mean that body protein (in muscles and organs) is catabolised to meet energy requirements. Any loss of lean tissue will impair function, and this may be compounded by failure to provide sufficient protein for growth and repair. Children and adults who were born preterm have a range of altered metabolic outcomes in later life, including earlier onset of puberty, and an increased incidence of insulin resistance, higher blood pressure and decreased levels of bone mineral density. Inadequate nutrition is also associated with alterations to brain structure, particularly the caudate nucleus (one of the basal ganglia). One study measured the caudate nucleus in adolescents born preterm using MRI and showed that it’s volume was related to early nutrient intakes and was associated with verbal IQ. Whilst several studies have shown associations between nutrition, growth and brain outcomes, the data linking early nutrition per se to adverse later life metabolic outcomes (such as insulin resistance) are not clear.

Question: What are the critical nutrients for preterm kids?

Answer: Preterm infants need close attention to nutrient intakes in the first few weeks, especially protein and energy, but also minerals, vitamins and other micronutrients. Protein requirements per kg for babies at 24 weeks gestation are almost twice that at term, whilst energy requirements may only be 20-30% higher. Preterm infants need higher intakes of calcium and phosphorus, essential fatty acids, iron and some vitamins. This means that just giving more milk is not the answer, preterm infants need fortifiers or supplements with differing nutrient compositions and ratios. Nutritional status is a broader concept than dietary intake so there are many other aspects in addition to considering macro- and micro-nutrient intakes. Breast milk is the best milk for preterm infants and a ‘gram for gram’ comparison of nutrients with formula milk is not appropriate. Breast milk has more than 300 individual components including cells, growth factors and enzymes most of which are not available in formula.

Question: According the available scientific evidence, what is the role of epigenetics in metabolic disease risk of preterm kids?
Answer: Early nutrition and growth might exert long-term effects through a range of mechanisms. Inadequate nutrient intakes may impair structural development of organs, but there is also evidence of ‘programming’, a concept through which nutritional (or other) exposures at sensitive periods during development exert long-term effects. This appears particularly true for the “first 1000 days” - a period spanning the time from conception through to 2 years of age. Programming suggests that cells ‘memorize’ early exposures, and it now seems likely that many of these are due to what are termed ‘epigenetic’ mechanisms. Epigenetics (literally ‘above genetics’) is the study of chemical changes to our DNA that do not alter the nucleotide sequence but result in differing gene expression and protein transcription. The best explored example of this is DNA methylation, where methyl groups are attached to certain CpG nucleotide dense regions of the DNA. Differences in DNA methylation are strongly associated with health and disease and are important not only in nutritional programming, but also cancer and many other diseases. These concepts are part of the ‘Developmental Origins of Health and Disease’ (DOHaD) hypothesis.

Question: What are the scientific evidence available for preterm kids borne to obese moms?

Answer: Programming and epigenetic changes are a feature of all animals and probably evolved as a response to changing nutrient environments. Many millenia ago, periodic shortages of food supply were common, so an ability to adapt and trade off longevity in order to promote short term survival was advantageous. In modern times, food shortages are not common, whilst rates of obesity are rapidly rising. Mothers who are obese are likely to have larger babies with altered metabolism and increased later life risks. There appears to be an optimal range of birthweights – being too big may be as harmful as being too small. In addition, rapid early growth may also be harmful. Proportional growth and body composition are also important concepts. Two babies of the same birthweight may have differing levels of fat and lean mass, and differing later life risks.

Question: According to available scientific evidence, why and how preterm brain is exquisitely vulnerable to undernutrition?

Answer: Unlike many other mammals, humans are born relatively immature. Compared to a newborn chimpanzee who can hold to its mother’s fur, or a lamb, which can stand unsupported shortly after birth, human infants are very reliant on their mothers for several years. The length of human pregnancy is a compromise - if humans were born with a similar level of brain maturity to other primates, the placenta would struggle to meet energy requirements, and the head would be too large to fit through the pelvis - which itself has to be of a certain size and shape for humans to walk on two legs. The human brain grows rapidly in the weeks and months before and after delivery. Impaired nutrient intakes during this period such as might occur in infants born premature will result in altered brain development.

This news release was based on the following original scientific article published by Dr Nicholas Embleton. Additional general background information was acquired from PubMed, CDC, WHO, USDA and NIH sources.

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More about Dr Nicholas Embleton

www.ncl.ac.uk/biomedicine/research/groups/profile/nicholas.embleton
and http://www.researchgate.net/profile/Nicholas_Embleton/

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