This is a pre-copyedited, author-produced PDF of an article accepted for publication in *British Journal of Nursing* following peer review. The version of record [BJN (September 2013) 22 (13): 738 - 740, published 27 September 2013] is available online at doi: 10.12968/bjon.2013.22.13.738

Nutritional Needs of the Neonate

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This commentary provides an overview of the nutritional requirements of both the term and preterm and / or low birth weight (LBW) neonate. The topic is discussed within the context of recognising the importance of early feeding to optimise physical growth and intellectual outcomes preventing adverse future outcomes. The provision of optimum nutrition forms an essential part of the care of both well and hospitalized neonates. For any neonate, early feeding ideally straight from birth to deliver essential nutrients for growth and development is paramount.

Neonatal-specific nutrition: The nutritional needs of neonates differ substantially from other age groups, presenting unique challenges in how we optimise their nutrition. Firstly, there are unique biological features of this age group that need consideration. For example; the digestive tract is structurally complete at term but functionally immature due to reduced levels of certain digestive enzymes in the first months of life. Until feeding is established, the healthy newborn is able to cope in the early hours of life with the sudden cessation of energy via the placenta by relying on alterative substrates such as ketones for brain metabolism (Petty, 2011). However, feeding should start as soon as possible to ensure that glucose and all other essential nutrients are obtained from milk as the sole exogenous source.

Secondly, growth is at its most rapid during early life with brain development and maturation being equally rapid (Lawson, 2007). Neonates have a much higher basal metabolic rate than older ages.

IMAGE SOURCE http://commons.wikimedia.org/wiki/File:Incubator-tahrir.jpg

Therefore, provision of sustained optimum nutrition through appropriate feeding must keep up with this need. Thirdly, the sick or preterm, / LBW neonate is more susceptible to catabolic stress because of their reduced energy reserves and markedly increased energy needs. Immature organ systems and metabolic pathways further complicate the delivery of adequate nutrition in the preterm neonate (Mayhew and Gonzalez, 2003). The immediate aim here is to provide nutrients and energy to match the growth rate expected in the last trimester of pregnancy since they lose out on the normal storage of nutritional reserves during this time. Additionally, in the long term, there is increased evidence that early nutrition can have a significant impact on later outcomes (Dusick et al, 2003; Cooke et al, 2004; Poindexter et al, 2006) by the effect of early programming (Fewtrell, 2004). Early nutritional support therefore is essential to reduce catabolism, promote growth, improve survival and limit developmental problems later in life.

Nutritional needs; Neonates at any gestation require a continuing supply of a variety of nutrients in a balanced form to facilitate optimum growth and metabolic activity. Generally, preterm neonates, due to their limited reserves and physiological immaturity, have higher requirements for fluids, glucose, fat and protein along with other key elements such as iron, phosphate and sodium, than those born term (King and Jones, 2005).

Fluid: A newborn baby in the first few days of life has increasing fluid requirements relating to the normal adaptation following birth and contraction of extra-cellular fluid. Due to this and their relatively immature kidneys compared to older children and adults(Petty, 2011), they require 50-60 mls/kg of fluid on day one; this increases incrementally over each day or so until, in the healthy term neonate, 150 mls / kg is sufficient to meet energy requirements (Hawkes and Paterson, 2010). During this time, they will lose up to 10% birth weight reflecting again the fluid changes that occur following birth. In the sick or preterm neonate however, increasing fluid should be done with caution along with careful assessment of urine output and weight. Fluid restriction will mean it takes longer for them to reach their full requirement.. Neonates at young gestations require up to 150-200 mls/kg to meet an increased energy requirement.

Energy: The neonate requires provision of a constant energy source, mainly in the form of glucose, for basic metabolism and growth. Certain factors can increase energy expenditure such as respiratory illness, thermal stress, infection; thereby necessitating a higher requirement of glucose. This additional requirement must be

met to prevent any adverse consequences of hypoglycaemia and poor weight gain.

Carbohydrate; Carbohydrate, most of which is provided through milk as lactose, is an important energy source for a neonate. Approximately 40% total energy should be provided as carbohydrate (Fewtrell and Chomtho, 2012).

Fat; A minimum of 30% energy should also be obtained from fat, another vital energy source, up to as much as 50%. This decreases as the neonate gets older through infancy and beyond. Fat also provides fat soluble vitamins (A, D, E and K) and long-chain-polyunsaturated-fatty-acids (LCPUFAs) needed for brain, visual and cognitive development (Hawkes and Paterson, 2010).

Protein; Protein in the form of amino acids is needed for the synthesis of body protein for growth and as essential building blocks for body's hormones, enzymes and many vital blood products.

Other; Neonates also require constant supplies of minerals (sodium, potassium, phosphorus, and calcium), iron, folic acid, trace elements (zinc, copper, selenium) and vitamins.

Provision of needs; The optimal source of nutrition in both term and preterm neonates is by breast milk (Arnold, 2009)which delivers all said nutrients in a natural and complete form that is more easily absorbed and digestible ('bioavailable') than milk from other sources. It also provides other beneficial properties such as immunoglobulins, enzymes, nucleotides and prebiotics.

When breast milk is not available or a mother chooses not to breast-feed, formula milks can be prepared. The components and levels of many nutrients in formula milks have been modified in order to be as closely related to breast milk composition as possible (for example, LCPUFAs, prebiotics, trace elements and folic acid).

IMAGE SOURCE: http://commons.wikimedia.org/wiki/File:Breastfeeding.jpg

Milk from either source should be nutritionally complete to meet the needs of neonate. However, there are times when extra supplementation is necessary to meet any additional requirements mentioned previously. Examples here are; Preterm formulas containing higher protein and energy composition , breast milk fortification preparations to add calories and protein and specialized formulas for neonates with specific clinical needs such as post surgery (modified formula) and faltering growth (energy rich).

Supplementation through special preparations, additions to breast milk or via additional multivitamins, folic acid and iron should be ascertained according to the individual needs, condition, age and gestation of the neonate. Finally, of course, in the event that a neonate cannot be fed enterally, all essential nutrients are then provided by intravenous means through total parenteral nutrition, the neonatal period comprising a significant proportion of children receiving this form of nutrition within the clinical setting (Mayhew and Gonzalez, 2003).

IMAGE SOURCE http://commons.wikimedia.org/wiki/File:Babies.jpg?uselang=en-gb

Monitoring nutritional needs; There are many factors to consider in the nutritional management of neonates in relation to age, gestation, weight and clinical condition. For any neonate regardless of these different factors, it is important to ascertain as part of their care, whether dietary provision meets their needs adequately. Monitoring of growth is therefore important with key measurements taken at regular intervals of weight, height and head circumference, all standard

growth parameters. Regular and accurate measurements should be plotted to observe the individual centile for each neonate but more importantly to check for changes in the trends for growth over time. Poor growth may be indicated if there is a disparity between centiles for weight and height. Generally, weight should be plus or minus one centile from length but one also must consider ethnic grouping and familial factors (Bates and Ducker, 2005).

Conclusion; Despite advances in nutritional management in recent years, poor growth within the preterm / LBW population remains a continuing issue within neonatal practice (Cooke et al, 2004). Preterm / Low birth weight (LBW) infants almost universally exhibit postnatal poor growth, which has been linked to adverse neurodevelopmental outcomes (Hans et al, 2009). Therefore, the importance of early nutrition should be emphasised to any health professional working with neonates and families either within primary care or hospital. Tailoring optimum dietary intake to the specific needs of the neonate will hopefully prevent any adverse outcomes and optimise development. Nutritional principles should also be an essential component of any current and ongoing education within neonatal and paediatric healthcare practice, ensuring that nutrition remains an integral part of the holistic care delivered to any neonate and their family.

References

Arnold. LDW (2009) *Human Milk in the NICU* Jones and Bartlett publishers, Sudbury USA / Ontario / London

Bates A and Ducker T (2005) Inadequate growth and nutritional requirement of preterm and term babies. *Infant.* 1 (4): 119-122

Cooke RJ, Ainsworth SB, Fenton AC. (2004) Postnatal growth retardation: a universal problem in preterm infants. *Arch Dis Child Fetal Neonatal Ed*. 89(5):F428– F430

Dusick AM, Poindexter BB, Ehrenkranz RA, Lemons JA. (2003) Growth failure in the preterm infant: can we catch up? *Semin Perinatol*. 27 (4):302– 310

Fewtrell M (2004) The long-term benefits of having been breast-fed *Current Pediatrics* 14 (2): 97-103

Fewtrell M and Chomtho S (2012) New perspectives in Neonatal Nutrition; Chapter 16.1 in Rennie JM (ed) *Rennie and Roberton's Textbook of Neonatology* (5th edition). Churchill Livingstone, London

Hans DM, Pylipow, M, Long JD, Thureen PJ, Georgieff MK, (2009) Nutritional Practices in the Neonatal Intensive Care Unit: Analysis of a 2006 Neonatal Nutrition Survey *Pediatrics* Vol. 123 No. 1 January 1, 2009
pp. 51 -57

Hawkes L and Paterson M (2010) Nutrition of the Term and preterm infant – Chapter 12 in; Meeks M, Hallsworth M and Yeo H (eds) *Nursing the Neonate (second edition*) Wiley Blackwell: Chichester / Iowa

King C and Jones EA (2005) *Feeding and Nutrition in the Preterm Infant*. Churchill Livingstone, London / Philadelphia

Lawson M (2007) Contemporary aspects of infant feeding. *Paediatric Nursing*. 19 92): 39-45

Mayhew SL and Gonzalez ER (2003) Neonatal nutrition: a focus on parenteral nutrition and early enteral nutrition. *Nutrition in Clinical Practice*. 18 (5): 406

Petty. J (2011) Neonatal Biology- an overview Part 2. *Journal of Neonatal Nursing.* 17: 89-91

Poindexter BB, Langer JC, Dusick AM, Ehrenkranz RA. (2006) Early provision of parenteral amino acids in extremely low birth weight infants: relation to growth and neurodevelopmental outcome. *J Pediatr*.148 (3):300– 305