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Association of complex lipids containing gangliosides with cognitive development of 6-month-old infants

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ABSTRACT

Background: Human breastmilk contains gangliosides which may play an important role in infant neurodevelopment.
Aim: A pilot study was conducted to assess the impact of infant formula supplemented with gangliosides from complex milk lipid on cognitive functions of normal healthy infants.
Study design: The study was a double-blind, randomized, controlled, parallel group clinical trial in which infants received the treatment or control product from 2 to 8 weeks of age until 24 weeks of age. The control group (n = 30) received standard infant formula and the treatment group (n = 29) received the same formula supplemented with complex milk lipid to increase the ganglioside content to approximately 11 to 12 μg/ml. A reference group (n = 32) consisted of normal healthy exclusively breast-fed infants.
Outcome measures: Cognitive development using the Griffith Scales and serum gangliosides was measured before (2–8 weeks of age) and after intervention (24 weeks of age).
Results: Ganglioside supplementation using complex milk lipids significantly increased ganglioside serum levels (control group vs treatment group, $P = 0.002$) and resulted in increased scores for Hand and Eye coordination IQ ($P < 0.006$), Performance IQ ($P < 0.001$) and General IQ ($P = 0.041$). Cognitive development scores and serum ganglioside levels for the treatment group did not differ from the reference group.
Conclusions: Supplementation of infant formula with complex milk lipid to enhance ganglioside content appears to have beneficial effects on cognitive development in healthy infants aged 0–6 months, which may be related to increased serum ganglioside levels.

1. Introduction

Gangliosides are complex glycosphingolipids which make up approximately 10% of the total mass of brain lipids and contain negatively charged sialic acids [1]. Gangliosides play a role in the formation of synapses between neural cells and also their functioning during the process of neural transmission by facilitating transmitter molecule binding to synaptic membranes [2]. They also contribute to neural growth, modulate neural functions and are involved in neuritogenesis, information storage and the process of memory formation. Gangliosides are also presumed to act as substrates for neural layer formation which generates higher cognitive functions in the brain [3]. Brain growth and maturation is associated with an increase in ganglioside levels, with accretion being highest in the pre-natal and early post-natal periods [1].

Guidelines for infant feeding in Indonesia follow UNICEF/WHO recommendations which endorse exclusive breastfeeding until the age of 6 months and where this is not possible, the use of standard infant formula. Exclusive breastfeeding until the age of 6 months is thought to result in a child's optimum cognitive development [4–7]. It has been presumed that this is due to optimal mother–child interactions, and perhaps higher docosahexanoic acid (DHA) levels in breastmilk. However, other nutrients present in breastmilk may also contribute to cognitive development, in particular milk fat membrane lipid components such as gangliosides. Human breastmilk contains gangliosides at significantly higher levels than cow's milk based infant formula products [1]. Further, it has been shown that the brains of infants who were breastfed contained higher levels of gangliosides than the brains of babies who were fed standard infant formula [8]. Given the role of gangliosides in brain development and function, this raises the possibility that ganglioside intake may contribute to an infant's cognitive development and memory. To date, studies investigating the correlation between the level of dietary ganglioside intake and cognitive functions have only been undertaken in animal models [9,10]. Only one study in humans has investigated the benefits of ganglioside-supplemented feeding but this was with

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