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DHA Status Shown to be Positively Associated with School Age Children's Cognitive Performance

Docosahexaenoic acid (DHA) is a major structural lipid deposited in neuronal membranes of the central nervous system, including the brain and eye, and present in high concentrations in the membrane-rich nervous tissue of the brain grey matter.[1,2] It plays a critical role in normal retinal and brain development in infants and toddlers.[3] Various research has demonstrated that DHA has a positive impact on visual acuity[4] and improves cognitive outcomes[5] during early stages of development.

There is mounting clinical evidence that the DHA status of infants is positively associated with neurocognitive development. Studies in infants have shown the role of early dietary DHA intake and DHA status in optimal development of the brain and eye of the infant,[6] and have also shown the benefit of DHA supplementation in neurodevelopmental performance.[7,8] **However, there is limited evidence to support similar findings in children. But one recent study with a cohort of 5- to 6-year-old children was conducted to provide understanding and preliminary evidence for the relationship of DHA intake and DHA status with cognitive performance through a novel functional magnetic resonance imaging (fMRI) technique.**

Recent cohort study shows positive associations between DHA and cognitive performance in school age children

A research team led by Dr. Bruce Bjornson from the Child & Family Research Institute in Canada conducted a cohort study on school age children using a novel brain mapping approach called "functional magnetic resonance imaging" to understand the link between DHA status, brain activity, and cognitive performance.

A recent study by Bjornson and colleagues (Williams et al 2016) investigated the relationship of DHA intake and DHA status with cognitive performance in children 6 years of age. Additionally, with the use of a novel brain mapping approach called "functional magnetic resonance imaging," researchers further investigated the relationship of DHA status and brain activity.

Sixty-two children in Vancouver, Canada were assessed in a cross-sectional observational study. The study measurements included:

Study Measurements	Method of Measurement
DHA intake	Food Frequency Questionnaire completed by parent
DHA status	Red blood cell (RBC)-DHA (n-3)/DPA (n-6) was used as an indicator
Cognitive performance	Various mental assessments: • Kaufman Assessment Battery for Children (KABC-II): (1) Sequential Processing Scale (short-term memory); (2) Learning Ability Scale (long-term storage and retrieval); (3) Simultaneous Processing Scale (visual processing); (4) Delayed Recall Subtest (long-term memory) • Mental Performance Index (MPI) was obtained via the combination of results from (1), (2), and (3) scales
Brain functioning	Functional magnetic resonance imaging (fMRI)

Functional magnetic resonance imaging (fMRI) is an MRI-based technique for measuring brain activity. It works by detecting the changes in blood oxygenation and flow that occur in response to neural activity—when a brain area is more active, it consumes more oxygen and, to meet this increased demand, blood flow increases to the active area.[9] As blood flow increases to the active area, iron in the blood distorts the magnetic field enough to be picked up by the fMRI scanner.[10]

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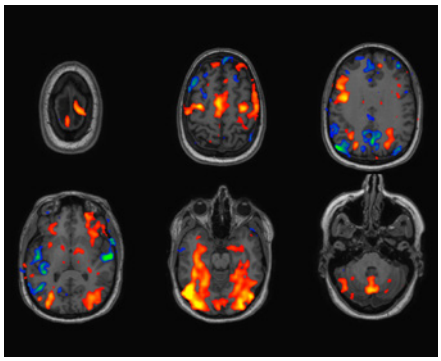
Figure 1 (left): fMRI equipment **Figure 2 (right):** Example of generic fMRI scan showing activities of different brain regions (red and yellow colors indicate activated regions; blue and green colors indicate deactivated regions)



NOTE: This example fMRI scan is from a different task that was not analyzed for this study.

Study results:

- DHA intake is positively correlated with DHA status in children ~6 years old.
- DHA intake is positively correlated with improved cognitive outcomes:
  - Short-term memory
  - General intelligence – as measured by Mental Performance Index (MPI) scores
- fMRI results suggest that DHA status is associated with two different brain networks:
  - One brain network associated with attention
  - One brain network associated with working memory load
- DHA-dependent activation of these two brain networks may mediate the positive associations between DHA and cognitive performances.

Overall, these preliminary results indicate that DHA intake and DHA status may influence cognitive outcomes in school age children. Although the observational nature of the study could not establish causality, existing literature data support these findings.

KEY TAKEAWAYS

- In a cohort study of school age children, the results report that DHA intake is positively correlated with DHA status and improved cognitive outcomes.
- A novel brain mapping approach called "functional magnetic resonance imaging" was used to measure the association between DHA status and brain functioning and to provide insight on how DHA may impact cognitive outcomes.
- Additional research is needed to better understand how DHA-dependent differential brain activation patterns are linked with cognitive performance in school age children.

Citation: Williams LJ, Mulder K, Fitzpatrick KPV, et al. DHA Status Associated with Cognitive Performance and Differential Patterns of Brain Activation in School Age Children. *FASEB J.* 2016;30:lb245.

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