Evolutionary implications for human brain development and fatty acid intake

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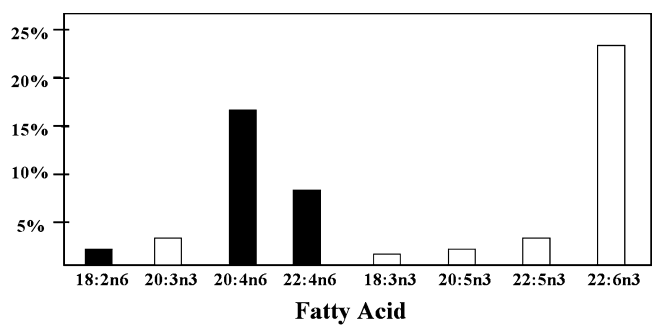
With the emergence of the various species of the genus Homo at least 2–3 million years ago, a rapid increase in brain mass relative to body mass (encephalization) occurred (1). As humans fit the Kleiber equation for predictive value of resting metabolic rate (RMR) relative to body size (2), a reduction in the size and energy demand of another organ was necessary. The human gut is the only organ which shows a reduced size and energy demand relative to that expected for our body size (3). However a reduced gut size is only possible with a shift to a 'high quality' diet.

Tissue	Mass (Kg)		Metabolic	% Body
	Observed	Expected	increment	RMR
Brain	1.30	0.45	+9.5	16.1
Heart	0.30	0.32	-0.6	10.7
Kidney	0.30	0.24	+1.4	7.7
Liver	1.40	1.56	-2.0	18.9
GI tract	1.10	1.88	-9.5	14.8

The selective pressure that allowed for the increase in brain size is attributed to this improvement in dietary quality that involved both higher energy density and abundance of preformed long chain polyunsaturated fatty acids, such as docosahexaenoic acid (DHA) and arachidonic acid (AA), which dominate brain phospholipid (PL) composition as indicated in the Figure below (4).

To establish the likely range of foods leading to this process, the nutrient composition of a wide range of African ruminant tissues (brain, marrow, etc) freshwater fish, and edible wild plants were investigated. The richest source of DHA and AA was ruminant brain tissue (5). African field studies on carcass composition of large herbivores consumed by carnivores indicate that bone marrow (energy dense) and brain tissue were the items most likely left by carnivores. Hence these parts would be the most frequently available to prehistoric hominid scavengers. Freshwater fish most certainly would contribute adequate AA and DHA at sufficient levels for encephalization, however they would fail to meet hominid energy requirements (low energy density 119 kcal/100g). In conclusion it seems likely that evolving hominids consumed scavenged ruminant brain tissue as a rich source of AA and DHA and bone marrow as a principle energy source for the evolution of a large metabolically active brain.



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