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Short communication

Breast milk from women living near Lake Malawi is high in docosahexaenoic acid and arachidonic acid[☆]

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ABSTRACT

Adequate long-chain polyunsaturated fatty acid (LCPUFA) intake is critical during the fetal and infant periods. We quantified fatty acid content of breast milk ($n=718$) and plasma from six month old infants ($n=412$) in southern Malawi, and in *usipa* ($n=3$), a small dried fish from Lake Malawi. Compared to global norms, Malawian breast milk fatty acid content (% of total fatty acids) was well above average levels of arachidonic acid [ARA] (0.69% vs. 0.47%) and docosahexaenoic acid [DHA] (0.73% vs. 0.32%). Average Malawian infant plasma ARA (7.5%) and DHA (3.8%) levels were comparable to those reported in infants consuming breast milk with similar fatty acid content. The amounts (mg) of DHA, EPA and ARA provided by a 3 oz (85 g) portion of dried *usipa* (1439, 659 and 360, respectively) are considerably higher than those for dried salmon. *Usipa* may be an important source of LCPUFA for populations in this region.

1. Summary

Adequate long-chain polyunsaturated fatty acid (LCPUFA) intake is critical during the fetal and infant periods. We quantified fatty acid content of breast milk ($n=718$) and plasma from six month old infants ($n=412$) in southern Malawi, and in *usipa* ($n=3$), a small dried fish from Lake Malawi. Compared to global norms, Malawian breast milk fatty acid content (% of total fatty acids) was well above average levels of arachidonic acid [ARA] (0.69% vs. 0.47%) and docosahexaenoic acid [DHA] (0.73% vs. 0.32%). Average Malawian infant plasma ARA (7.5%) and DHA (3.8%) levels were comparable to those reported in infants consuming breast milk with similar fatty acid content. The amounts (mg) of DHA, EPA and ARA provided by a 3 oz (85 g) portion of dried *usipa* (1439, 659 and 360, respectively) are considerably higher than those for dried salmon. *Usipa* may be an important source of LCPUFA for populations in this region.

2. Introduction

Adequate long-chain polyunsaturated fatty acid (LCPUFA) intake is critical during the fetal and infant periods. Arachidonic acid (ARA) and docosahexaenoic acid (DHA) have important roles in supporting optimal structural and functional development of the brain and eyes and of the immune, metabolic and autonomic nervous systems [1]. Animal studies have demonstrated that DHA depletion during brain development results in abnormalities in visual and auditory processing and cognitive performance [2–4]. In addition, ARA and DHA impact gene expression and cell division and differentiation, and thus LCPUFA status early in life may fundamentally influence the long-term function of body systems and consequently affect

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health and well-being into adulthood [5]. Both DHA and ARA accumulate in the fetus during the last trimester via placental transfer and by a small amount of in vivo conversion of the plant precursors of these LCPUFAs, alpha-linolenic acid [ALA] and linoleic acid [LA], respectively [6–8]. DHA and ARA are also provided by the postnatal diet in breast milk [2,9].

The fatty acid composition of breast milk can vary significantly between women and across populations, as it is strongly influenced by maternal diet [2]. In particular, breast milk DHA can vary by 10-fold across populations [10]. Women from populations that regularly consume marine fish have much higher breast milk DHA than women from populations where such fish are seldom consumed [2,11,12]. In addition, a growing trend towards the use of high LA/low ALA oils (e.g. sunflower, safflower, corn, cottonseed and peanut oils) may lead to low intake of ALA, limiting maternal endogenous production of DHA [4,11,13]. The ARA content of breast milk is generally less variable, with approximately a 3- to 4-fold observed variation among populations. The reasons for the reduced variability in ARA content are unclear but could be due to less variability in ARA consumption (food sources such as meat and eggs) or in the in vivo conversion of LA to ARA, or highly regulated biochemical pathways designed to maintain specific amounts of ARA in breast milk [2,10,11]. Simultaneous supplementation with ARA, DHA and EPA leads to increases in milk concentrations of all three LCPUFAs, while supplementation with only ARA decreases milk DHA concentration, and supplementation with only DHA decreases milk ARA concentration [14,15].

Infants in low-income countries may be in particular need of the pre-formed sources of DHA and ARA found in breast milk. Iron and zinc deficiency, which are common in low-income settings, may negatively affect the desaturase and elongase activity required for the conversion of LA to ARA and ALA to DHA [11]. In addition, preterm birth is common in low-income countries [16,17]. Because preterm infants do not receive the full transfer of LCPUFAs from the mother during the final trimester, they need higher postnatal DHA and ARA intake compared to term infants [1,2,9].

The objectives of this paper are to describe breast milk fatty acid content and infant fatty acid status in the Mangochi district of southern Malawi, to examine how breast milk and infant plasma fatty acid concentrations correlate with each other, and to present data on the fatty acid content of one commonly eaten species of fish from Lake Malawi, *usipa (Engraulicypris Engraulicyprisardella)* that may be an especially rich source of DHA and ARA for women and children in the region.

3. Patients and methods

3.1. Study setting and population

The mothers and infants included in this analysis were participants in a randomized, controlled, single-blind, parallel group clinical trial (ClinicalTrials.gov identifier: NCT00524446) of micronutrient fortified lipid-based nutrient supplements conducted in two health facility catchment areas (Lungwena and Malindi) in Mangochi district, southern Malawi [18]. Both sites are primarily rural but the Malindi site is closer to Mangochi town than the Lungwena site (17 vs 32 km distance). The Lungwena site has a government health center, whereas the Malindi site is centered around a mission

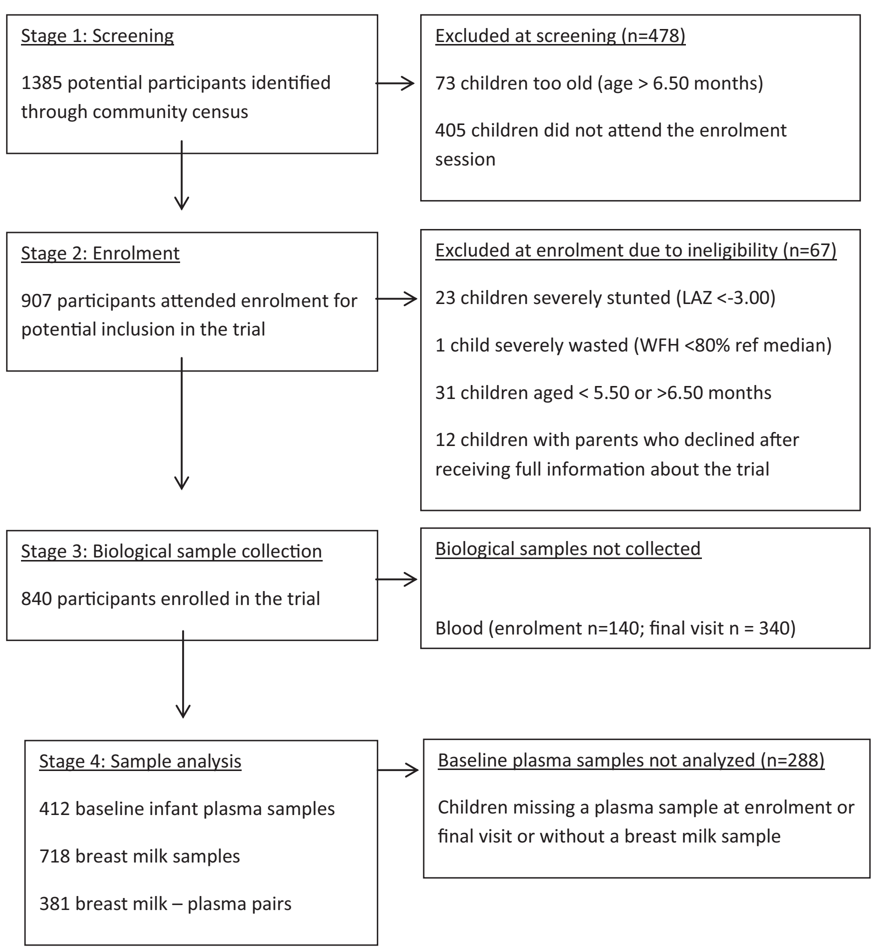

Fig. 1. Study profile.