

**Fat in the critical 1000 days:  
Ensuring  
Adequacy of Essential Dietary Fats for  
Mothers and Young Children in  
Low and Middle Income Countries**

Report of the meeting of April 7, 2011

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## Executive Summary

This report summarizes a meeting held in Washington DC in April, 2011 entitled “Fat in the Critical 1000 days: Ensuring adequacy of essential dietary fats for mothers and young children in low and middle income countries.” Speakers from Bolivia, Ghana, Malawi, Mexico, South Africa, India, Europe and the US spoke about the importance of fatty acids (FA) for optimal growth, enhanced immunity and neurobehavioral development.

Optimal omega-3 FA intake is associated with reductions in prematurity, improvements in gestational age, birth weight, birth length and in some groups, enhanced post-natal growth and development. Omega-3 fatty acid supplementation of lactating mothers of preterm infants improves infant neurodevelopmental performance as does supplementation of infant formula with DHA for sub-groups of preterm infants. The impact of DHA on neurodevelopment of full term infants is less clear, but few studies have been conducted in developing countries.

Some illnesses (especially those related to inflammatory processes), appear to be reduced with enhanced omega-3 status. Observational studies also have shown benefits for reductions in maternal postpartum depression.

Although few studies have assessed fatty acid intake and status in developing countries, the available data suggest that many women and children are at risk of insufficient intake of fat. Both omega-3 and omega-6 fatty acids are important and adequate intakes of both these classes of fatty acids need to be ensured. Even when total fat intakes are adequate, intake of essential fatty acids (alpha-linolenic acid (ALA) and linoleic acid (LA)) may be inadequate in some populations. This may be particularly an issue for omega-3 fatty acid intakes, given the fact that in many developing and emerging countries, vegetable oils are good sources of omega-6 FA. However, in situations where total fat intake is low, such as observed in studies in Bangladesh, interventions should aim to increase the intake of both omega-6 and omega-3 fatty acids if both EFAs are below the recommended intakes. Food availability and intake data in many developing countries suggest that diets are often limited in omega-3 fatty acids. While most commonly consumed oils are good sources of omega-6 fatty acids (corn, safflower, cottonseed), only a few contain significant amounts of omega-3 fatty acids (canola, soy, mustard seed oil). Increasing intake is possible through foods rich in omega-3 fatty acids: animal products (especially fish, breastmilk, eggs), soy, rapeseed or canola oil, some nuts/seeds (chia seeds, walnuts, soy beans) and pastes and spreads made with soy oil or full fat soy flour.

Supplementation with FAs alone is likely to not be a solution to the problem of poor FA status, since certain micronutrients are important for the conversion of ALA to DHA.

Programmatic interventions (including fortification of products for consumption by pregnant women or infants and young children) which resulted in improved omega-3 intake, have been successful. Lipid-based nutrient supplements (LNS) had high

acceptance by infants and young children as well as their caregivers and positive growth outcomes were observed in children consuming LNS.

LNS given to pregnant women in Burkina Faso was associated with increases in birth length and placental weight in malnourished women (< 18.5 body mass index). Supplemental DHA to lactating women increased breast milk DHA concentration and intake by infants. Fortified full-fat soy flour developed by the China Centers for Disease Control and Prevention had positive impacts on anemia, growth and IQ.

The **agricultural sector** has an important role to play to increase the availability of foods containing omega-3 fatty acids:

- Increasing fish production, especially small fish raised in local ponds, and improve water quality in ponds
- Increasing small animal production (chickens, eggs)
- Improving omega-3 content of animal and fish feeds and expanding access to farmers
- Enhancing FA content of food aid, such as through use of soy oil rather than corn oil in commodities supplied or through production of complementary foods (corn soy blend) or LNS with soy oil or full fat soy
- Building or expanding nutrient reference data bases of foods consumed in developing countries to include omega-3 and omega-6 fatty acid content

**Health programs** can encourage improved FA intake through promotion of improved infant and young child feeding:

- Encouraging mothers to exclusively breastfeed in the first six months and continue for 24 months and beyond
- Identifying needs, gaps and local solutions to addressing omega-3 intake in complementary foods through tools such as ProPAN
- Enhancing distribution or sale of fortified complementary food supplements containing good sources of omega-3s (such as LNS or fortified full fat soy powder)
- Including information on fat intake, and essential fat status in systematic data collection efforts such as DHS
- Encouraging a regulatory environment that allows access to affordable high quality sources of FAs

- Providing target beneficiaries with access to accurate information on foods that contain FAs and access to these foods

**The private sector** can develop new products, improve shelf life and expand distribution of products containing omega-3 fatty acids. Moreover their marketing expertise can be leveraged in developing behaviour change communications with emotional appeal that addresses not only the needs but also the wants of the consumer beneficiaries. They can:

- Develop appropriate cost effective vegetable oil combinations to increase omega-3 content and improve shelf life
- Fortify foods with mustard seed, fenugreek, and full fat soy
- Explore seaweed, algae and other marine products for sources of EPA and DHA and make it available at lower cost
- Label products with types of oil used
- Provide information on ALA, DHA and EPA content of foods on labels
- Deliver insights into the wants of consumers
- Translate consumers wants into emotional appeals in behaviour change communication

## List of acronyms

AA	arachidonic acid (a preformed Omega-6 FA), 20:4 n-6
ALA	alpha-linolenic acid (an Omega-3 FA), 18:3 n-3
DHA	docosahexaenoic acid (a preformed Omega-3 FA), 22:6, n-3
EFA	essential fatty acids (ALA and LA)
EPA	eicosapentaenoic acid (a preformed Omega-3 FA), 20:5, n-3
FA	fatty acid
GAIN	Global Alliance for Improved Nutrition
IUNS	International Union of Nutritional Sciences
LA	linoleic acid (an Omega-6 fatty acid), 18:2, n-6
LCPUFA	long chain polyunsaturated fatty acid
MUFA	monounsaturated fatty acid
PAHO	Pan American Health Organization
PUFA	polyunsaturated fatty acid
SUFA	saturated fatty acid
UL	upper levels
WFP	World Food Program

## Introduction

A meeting on **Fat in the critical 1000 days: Ensuring adequacy of essential dietary fats for mothers and young children in low and middle income countries** was held on April 7, 2011 in Washington, DC. The meeting was organized by the International Union of Nutritional Sciences (IUNS), the Global Alliance for Improved Nutrition (GAIN), UNILEVER and the Home Fortification Technical Advisory Group. The agenda with the speakers and moderators are shown in the Appendix 1 and copies of the presentations are available on-line at <http://www.gainhealth.org/events/fat-critical-1000-days>.

Approximately 150 participants representing UN organizations, national governments, and the public, private, academic and NGO sectors met to review the evidence on essential fats in terms of function, assessment, and programs as they relate to the critical 1000 days of life from pregnancy through 24 months of age. An aim was to link evidence to programs so that scientific knowledge can be applied to program improvement. The stated long-term objectives of the meeting were to:

- 1) Increase understanding of key opinion formers working in middle and low income countries regarding the role of essential fats in maternal and child health
- 2) Increase collection of data on essential fats intake and status in nationally representative surveys
- 3) Increase breastfeeding and consumption of foods and products containing essential fats by pregnant and lactating women and young children

## Opening presentations to the meeting

The meeting was opened by the Chair, Dr. Sandra Huffman (University of California, Davis), who thanked the organizers and host for making the meeting possible. She expressed gratitude to the participants for their interest in this important topic.

Dr. Ebrahim Elmadfa addressed the audience on part of the International Union of Nutritional Sciences (IUNS) about the function of essential fats and the milestones that have lead to an understanding of their importance. Essential fats include the essential fatty acids (EFA) linoleic (LA) and alpha-linolenic (ALA) acids that cannot be produced by the body and other fatty acids (FA) that can be converted in the body from these EFAs (such as docosahexaenoic acid (DHA). Such fatty acids are critical for children's health, growth, development and immune function. Dietary recommendations for healthy children have been provisionally released by FAO/WHO<sup>1</sup>.

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<sup>1</sup> Fat and fatty acid requirements and recommendations for infants of 0-2 years and children of 2-18 years. Uauy R, Dangour AD. Ann Nutr Metab. 2009;55(1-3):76-96. Epub 2009 Sep 15.

Dr. Gina Tambini (Pan American Health Organization) emphasized the importance of breast milk as the major source of EFAs for infants and young children, and thus maternal EFA intake during pregnancy and lactation is important. After 6 months of age, dietary sources of EFAs for children become increasingly essential as well. Because DHA is an important omega-3 fatty acid that plays a critical role in desirable development outcomes, exclusive breastfeeding for the first 6 months of life and continued breastfeeding thereafter is essential in order to ensure adequate intake of DHA by infants and young children. PAHO recognized the importance of EFAs in a technical consultation on the recommended nutrient composition of complementary foods, which resulted in a 2003 *Journal of Nutrition* supplement<sup>2</sup>. This was the first attempt to propose acceptable macro- and micronutrient ranges for cereal-based fortified complementary foods.

Dr. Nune Mangasaryan (UNICEF) emphasized the roles everyone needs to play in this meeting to raise the issue of EFAs to the international community. While there have been improvements in maternal and young child nutrition through increased rates of exclusive breastfeeding, usage of micronutrient supplements by vulnerable groups and fortification to reduce iodine deficiencies, the issue of EFAs has been neglected and now we see evidence of its importance.

Dr. Regina Moench-Pfanner (GAIN) emphasized that an expanded understanding of the role of essential fats in maternal and child nutrition and health is timely, and why this meeting was organized. The meeting illustrates how partnerships such as what this meeting represents are important to advance efforts to move from science to programs.

## The Science

Dr. Kathryn Dewey (University of California, Davis) summarized the background papers of a conference sponsored by the Mathile Institute for the Advancement of Human Nutrition held in September 2010 on FAs in low-income countries (*Fatty acid status in early life in low income countries, determinants and consequences. Maternal & Child Nutrition, Volume 7 Supplement 2, April 2011*)<sup>3</sup>. She emphasized that despite much knowledge on complementary feeding, there is a relative vacuum in what is understood about fats. In particular, little is known about FAs in developing countries; most knowledge on FAs in infants comes from studies conducted in industrialized countries to address nutrients in infant formula.

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<sup>2</sup> Lutter CK, Dewey KG. Proposed nutrient composition for fortified complementary foods. *J Nut* 2003;133:3011S-3020S.

<sup>3</sup> <http://onlinelibrary.wiley.com/doi/10.1111/mcn.2011.7.issue-s2/issuetoc>

## Functional consequences of fatty acids

Dr. Dewey explained the importance of FA for neurobehavioral development. The brain is made primarily of fat (50-60% of the adult dry brain is fat), and DHA and AA are among the most important fatty acids in the brain, in particular for incorporation into synaptic membranes. The critical period for accretion of these fats into the infant's brain is during the last trimester of gestation up to 2 years of age.

Animal studies have shown that high LA/low ALA (high omega-6/low omega-3) seed oils fed as the exclusive source of fat to pregnant and lactating primates, mice, rats, and other species leads to biochemical, neural, visual, and behavioral abnormalities in the offspring.

Omega-3 fatty acid supplementation of lactating mothers of preterm infants improves infant neurodevelopmental performance as does supplementation of infant formula with DHA for sub-groups of preterm infants. The impact of DHA on neurodevelopment of full term infants is less clear, but few studies have been conducted in developing countries.

The effect of postnatal omega-3 supplementation on growth of infants in low-income countries, particularly those who experienced intra-uterine growth restriction, has also not been well studied. One randomized controlled trial in rural Gambia<sup>4</sup> included 183 infants randomized to receive fish oil or placebo (olive oil) from 3 to 9 months of age. Significant increase in MUAC and skinfold thickness in fish oil group were observed with a non-significant increase in length gain (+0.79 Z-scores (95% CI -0.27 to 0.90 Z), p=0.084). Another study in Ghana<sup>5</sup> found that LNS increased blood ALA levels by 33-40%. Path analysis suggested that increased energy intake from LNS explained part of the impact on weight gain, but not length gain. The shift in plasma ALA explained part of the impact on length gain. However, the growth effect could also be due to milk content and/or other nutrients essential for growth in lean body mass.

Fatty acids have been shown to have benefits on the duration of gestation and growth in utero. In meta-analyses, omega-3 fatty acid supplementation during pregnancy was related to an increase in gestational age (+2.5 days), which was related to increased birth weight (~50 g) and length (~0.5 cm)<sup>6</sup>. Additionally, supplementation with omega-3 fatty acids reduced risk of preterm birth (<34 weeks gestation) by 31% in all pregnancies and by 61% in high-risk pregnancies.

The evidence is fairly robust for efficacy of omega-3 supplementation reducing inflammatory illnesses, including childhood asthma, Crohn's disease and rheumatoid arthritis. Since gut damage (chronic environmental enteropathy) is characterized by

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<sup>4</sup> Prentice & van der Merwe 2011 (<http://onlinelibrary.wiley.com/doi/10.1111/mcn.2011.7.issue-s2/issuetoc>)

<sup>5</sup> Adu Adu-Afarwuah S, Lartey A, Brown KH, Zlotkin S, Briend A and Dewey KG (2007). Randomized comparison of 3 types of micronutrient supplements for home fortification of complementary foods in Ghana: effects on growth and motor development. *Am J Clin Nutr* 86, 412-420.

<sup>6</sup> Makrides, Collins and Gibson, 2011 (<http://onlinelibrary.wiley.com/doi/10.1111/mcn.2011.7.issue-s2/issuetoc>)

inflammation, it is possible that improved omega-3 intake could reduce this common condition among children in developing countries and thereby improve growth. However, there have been almost no fatty acid trials in low-income countries in which immune function has been measured.

FAs are thought to play a role in the development of diabetes and obesity. They may influence programming of appetite and energy metabolism early in life. There is also emerging evidence that omega-6 FAs can promote maturation of fat cells and fat deposition, whereas omega-3 FAs can block this process. By providing the correct balance early in life, the risk of obesity later on may be reduced.

Omega-3 fatty acids play a role in processes that can affect mental health, e.g., dopaminergic and serotonergic transmission. Observational studies suggest that low intakes of omega-3 fatty acids such as DHA are associated with postpartum depression, which affects 20-30% of women in developing countries and is a leading cause of disability worldwide<sup>7</sup>. However, two large randomized controlled trials in Australia and Mexico did not find any impact of prenatal DHA supplementation on postpartum depression. Effects may depend on whether there are other nutrient deficiencies, total FA intake and genetic factors.

## **Food sources and dietary intakes of fatty acids**

Overall, the omega-3 FA content of the diet is lower today than in the past, particularly compared to the diets of hunter-gatherers (Paleolithic era), when animals were grass-fed, insects were consumed, there were no processed vegetable oils and very little consumption of grains.

Where data are available on FA intakes in women and young children in developing countries, ALA was found to be inadequate and DHA was far below what is considered adequate. The reason is that intakes of good food sources of omega-3 FAs are very limited. Additionally, as breast milk intake decreases, FA intake decreases accordingly in infants and young children.

Both omega-3 and omega-6 fatty acids are important and adequate intakes of both these classes of fatty acids need to be ensured. Even when total fat intakes are adequate, intake of essential fatty acids (ALA AND LA) may be inadequate in some populations. This may be particularly an issue for omega-3 fatty acid intakes, given the fact that in many developing and emerging countries, vegetable oils are good sources of omega-6 FA. However, in situations where total fat intake is low, such as observed in studies in Bangladesh, interventions should aim to increase the intake of both omega-6 and omega-3 fatty acids if both EFAs are below the recommended intakes.

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<sup>7</sup> Ramakrishnan, 2011 (<http://onlinelibrary.wiley.com/doi/10.1111/mcn.2011.7.issue-s2/issuetoc>)

Food availability and intake data in many developing countries suggest that diets are often limited in omega-3 fatty acids. While most commonly consumed oils are good sources of omega-6 fatty acids (corn, safflower, cottonseed), only a few contain significant amounts of omega 3 fatty acids (canola, rapeseed, soy, mustard seed oil). . Increasing intake is possible by increasing access to foods rich in omega-3 fatty acids: animal products (especially fish, breastmilk, eggs), soy oil, some nuts/seeds (chia seeds, walnuts, soy beans) and pastes and spreads made with soy oil or full fat soy flour.

Generally, low-income countries have the lowest intake of omega-3 FAs but many industrialized countries have inadequate intakes as well, when the type of oil commonly used is not high in omega-3 FA and/or fish intake is low<sup>8</sup>.

When considering dietary shortfalls, it is important to consider the mother-child dyad as the target for any intervention. The mother's FA intake affects her baby's status during pregnancy and lactation. During lactation, the mother's FA stores become depleted as her baby increases its stores at the expense of the mother. There is a wide range in breast milk DHA content and one cannot assume that breast milk provides enough DHA if the mother's intake is inadequate in ALA or DHA. In Japan and the Philippines, mothers generally have high DHA in breast milk due to high fish intake.

Interventions to address inadequate intakes of EFAs should emphasize adequate total fat intake among pregnant and lactating women and especially adequate EFA consumption. Consuming fish, even some freshwater fish, can improve omega-3 FA intakes. For example, in Malawi, some small, locally available dried fish have amounts of DHA that are close to that of salmon (an excellent source of DHA).

However, simply adding fat to the diet is not a solution as the type of fat is important and micronutrient density (amount per 100 kcal) will be decreased unless adequate micronutrient levels are assured (such as through fortification) .

## **Assessing fatty acid intake and status**

Dr. Marius Smuts (North West University, South Africa) reported on how FA intake and status can be measured. In developing countries where diets are monotonous, small studies can be done and assumptions can be made about the larger population.

Data on FAs in developing countries are very limited, largely because nutrient databases on foods consumed in these countries do not have FA much information.. There is a need to build or expand nutrient reference data bases of foods consumed in developing countries to include omega-3 and omega-6 fatty acid content. National surveys such as Demographic and Health Surveys can include questions of fat intake

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<sup>8</sup> Michaelsen et al. 2011 (<http://onlinelibrary.wiley.com/doi/10.1111/mcn.2011.7.issue-s2/issuetoc>)

and types of fats consumed, as well as consumption of fish, eggs and other animal products. A single 24-hour recall can be used for group assessment but cannot be used for individual assessment.

Biological specimens such as whole blood, red blood cells (RBC), plasma, breast milk, whole dried blood spots and white blood cells can be used to assess EFA status.

RBCs indicate FA status over the long term and have the best correlation with brain development. Plasma is good for assessing fatty acid intake from the diet.

Dried blood spot testing is a relatively new approach to measure FAs. The method is not sensitive but is easy and low cost for surveys. If the method can be standardized, it would eliminate blood draws from babies and allow for national and regional comparisons. Sample handling of dried blood cells is critical, especially for long chain fatty acids.. No established cut-offs exist and there are few existing results for comparison. However, dried blood spots can provide the same results as whole blood if stabilized using Butylated hydroxytoluene.

Dr. Beth Yakes (University of California, Davis) reported on consumption of FA among breastfed vs. non-breastfed children ages 2-4 years and their mothers in Bangladesh. Her study found that 60% of the women in the study consumed inadequate amounts of LA and 90% consumed inadequate amounts of ALA. The reasons for the low intakes are due to low total fat intake and very low intake of eggs, fish, and other animal source foods.

The breast milk ALA content was at the lowest end of the observed range for women from different countries. Surprisingly, breast milk DHA content was not as low as expected, despite low dietary ALA intake amongst the mothers. Children also had inadequate fat intake and few EFAs, and most fat was obtained from breastmilk.

The issue was raised on what is known about blood DHA concentrations in vegetarian societies and whether conversion of ALA to DHA is affected by low intake of omega-3 FAs. It was mentioned that a mechanism exists in the body that up regulates conversion to maintain certain levels. Normally, with increased ALA intake, there is better conversion to DHA, yet this is not observed in pregnant women. At the other extreme, if DHA is provided in excess, it is possible to suppress conversion from ALA to DHA.

During the discussion, Dr. Greg Rinehart (Mathile Institute) discussed a study of dogs and effects of parity on EFA status. In the first parity litter, the mothers had better EFA status and puppies had better DHA status, which also led to better training abilities in service dogs, compared to status in subsequent litters.

## **From Science to Programs**

### **How can essential fat intake be improved with relevant products?**

Dr. Susan Brems (Deputy Administrator for Global Health, USAID) emphasized the US government's focus on nutrition in the critical 1000 days from pregnancy to 24 months of age and on food security. There is a willingness to support nutrition and a commitment to test, tailor and scale up approaches that have public health impact.

An important component to improve maternal and child nutrition includes use of high quality fortified products containing EFAs. Dr. Ken Maleta (Univ. of Malawi) reported on the impacts of a lipid based nutrient spread (LNS) with EFAs on women and children. The product included peanuts, canola oil, milk powder, and sugar. Providing LNS avoids the risks of adding fat alone, which decreases the density of other important macro and micronutrients. In contrast to complementary foods, such as corn-soy blend, LNS is less likely to be shared within a household. Although containing similar raw ingredients as ready to use therapeutic food (RUTF), LNS is different because its use is in very small amounts as a home fortificant. LNS is unlikely to interfere with breast milk consumption, it can mix easily with complementary porridge, it can increase fatty acid content of the diet, and can be locally produced if there is adequate quality control.

Acceptability trials in children in Burkina Faso, Ghana and Malawi show the product is well liked, and children aged 8-12 months consumed more than 75% of the doses provided. Mothers also liked the product. A study in Malawi where LNS was fed to young children examined impacts on growth compared to a local fortified porridge (Likuni Phala). Weight gain was better in the children who received LNS and growth outcomes were strongest in children who were most stunted. The International LNS Project (iLiNS) is examining effects of LNS in multiple countries, looking at factors such as whether or not the LNS contains milk, the quantity of product consumed, and the varying amounts of zinc, taking into consideration socioeconomic factors, demand, delivery systems and cost-effectiveness in pregnant and lactating women as well as young children.

Dr. Salvador Villalpando reported on the impact of supplementary DHA in pregnant women in Mexico. Intakes of DHA and EPA were below recommended intakes in this population and supplementation with DHA increased plasma DHA concentration. ALA concentration was also greater for those in the intervention group than for those in the control group, probably because DHA inhibited enzymatic transformation from ALA to DHA so that more ALA accumulated. The findings from this study showed that it is possible to improve breast milk DHA concentration by a dietary dose, equivalent to approximately 2 fish meals per week.

Reporting on home fortification acceptability trials in Niger, Dr. Katie Tripp (CDC) discussed usage and perceptions of LNS and multiple micronutrient powders (MNP)

captured through focused group discussions The LNS was very well accepted and although the intent was to mix the product with a local porridge, 58% of the mothers gave the LNS alone instead of mixing it with food. Mothers reported increased appetite and skin condition improvements after their children consumed the product, which were seen as positive. The mothers were sensitive to expiration dates and valued the integrity of the packaging, which required a razor blade to open.

In the discussion, concern was raised about children consuming a product alone that was intended to be mixed with their porridge. This was seen as a deviation from the product's intended use as a home fortificant. However, sometimes food for mixing is not available and consuming the product alone ensures that the child receives all the intended nutrients in a dose (vs. wastage if the food into which it is mixed is not consumed entirely). The issue of sharing the product within the household was also discussed and it was felt that people are not likely to share it, especially if individual small packages were used. In some cases, LNS is seen more as a medicine than as a food and so sharing is thought to be minimal.

However, data on sharing should be collected, as it is clear that some family members will be curious and mothers with multiple children will be making choices that impact the well-being of all their children. In creating messaging around use of the product, the importance of including broader complementary feeding messages around good feeding in general was stressed. Caregivers of infants and young children need to be educated on optimal infant and young child feeding using local foods and home fortificants as needed.

### **What can the agricultural sector do to increase the availability of essential fats?**

Dr. Catherine Wotecki, (Undersecretary, USDA) introduced the session emphasizing the importance of agriculture in working closely together with public health programs to ensure adequate sources of essential fats are available to the public. She illustrated the wide ranging impact that the Title II legislation under which USAID food aid is administered and distributed can have throughout the world. Dr. Irwin Rosenberg illustrated this in mentioning that 4.2 billion rations of oil are distributed through this mechanism. He illustrated how corn oil provides too few omega-3 fatty acids, while use of soy oil can help meet the needs of young children and pregnant women for omega-3s. Corn soy blend (CSB) rations and the oils used to formulate these are under review, taking into consideration FA requirements.

The importance of fish as a source of EFAs in developing countries and interventions for increasing their availability were presented by Dr. Shakuntal Haraksingh Thilsted, (The WorldFish Center). Fish is an animal-source food rich in nutrients and EFAs. Much of the fish consumed by rural poor are small indigenous fish that are eaten frequently but in small quantities. Fish that are cooked in vegetable oil provide a vehicle

for FAs, although there have been shifts in the oil used (transition from high omega-3 mustard seed oil to palm oil, low in omega-3s). Because seasonality plays a role in availability of fish, drying and storing fish can help increase access to fish year-round.

There are differences in fat content between fish species, e.g. marine vs. freshwater fish, and carnivorous vs. other types of fish. When fish are farmed, the feeds used have a large impact on the nutrients available in the fish. Fishmeal (made from small fish), which has typically been used in fish farms, is increasingly being replaced by vegetable-based feeds. This could negatively impact the omega-3 fatty acid content of the farmed fish unless the feed is designed to have high omega-3 content. Fish farming has focused largely on raising large fish for sale outside the communities where they are farmed, and managing the balance between farming large fish for sale and small fish to be kept and consumed by the local, rural population needs to be a priority. Small surveys done in Bangladesh examining intra-household distribution of small vs. large fish found that dishes made from small fish were more equitably shared among household members than dishes made from large fish.

The cost implications of fish consumption and whether fish consumption is a public health strategy that can be scaled-up were discussed. Even when less expensive vegetable feeds are used in fish farming, these are subject to price volatility (e.g., corn, which more than doubled in cost in recent years and is not expected to decrease anytime in the future). The need to look at integrated farming systems that lead to intakes in EFAs throughout the year and not just seasonally was emphasized.

In promoting fish consumption, some raise the issue as to whether this is sustainable given the problems of overfishing and dwindling marine fish stocks. Additionally, there are health advisories for the intake of some fish due to contamination with toxic metals (e.g., mercury). Extensive work by the US Food and Drug Administration and Environmental Protection Agency on fish intake during pregnancy suggests 2-3 servings per week of some types of fatty fish is safe, if choosing fish that are not at high risk of contamination. Exploring sustainable fish farming and non-mainstream sources of EFAs such as algae and insects should be encouraged. If fish cultivation is encouraged in developing countries, efforts should ensure that the intended population groups have access to these fish.

Fish production in small ponds was discussed as well as post-harvesting steps that could maintain a stable supply of high quality dried fish. An integrated aquatic agriculture system focusing on raising large fish for sale as well as small fish for local consumption is being scaled-up. Vegetables are grown along the dikes, and soil from the fish ponds used as fertilizer.

## How can essential fat intake be improved through enhancing feeding practices?

Dr. Ana Maria Aguilar (Ministry of Health, Bolivia) introduced the session on the importance of improving feeding practices. The role of breast milk in providing EFAs to infants and young children was presented by Dr. Chessa Lutter. The maternal diet is important, and fat and EFA content in breast milk vary, depending on diet. Intake of marine foods is a critical determinant of DHA content in breast milk. Breast milk is high in fat and as children transition from getting the bulk of their energy and nutrient needs from breast milk instead to complementary foods, the percentage of energy from fat in their diets decrease. LCPUFA transfer from mother to fetus/newborn is mainly dependent on maternal status; however, genetic influences also play a role. Maternal LCPUFA status is a function of adipose storage, intake and circulating levels of FA, especially DHA. All EFAs derive from diet; therefore, levels of LA and DHA in blood lipid pools and tissues reflect dietary intake. Biological variability exists in the fat content of human milk by 3-5% of total energy (breastmilk fat averages about 45-55%E as fat) among women and in individual women during the course of a feed. The total amount of EFAs delivered via breastmilk is a function of both fat content and volume of milk consumed. Longer durations of exclusive breastfeeding and breastfeeding will result in more fat and EFA transfer.

Chile has been successful in achieving increased intake of essential fats through fortified milk products. In 2008, Government of Chile introduced Purita Mama into the national nutrition program for pregnant and breastfeeding women. Women are given fortified milk powder containing 97 kcal/portion of 25 g/d, containing 60 mg DHA and 19 mg of EPA per portion. The amount that mothers are given is based on their nutritional status and physiologic status (eg. pregnancy, exclusively breastfeeding). It is estimated that the number of beneficiaries is 112,758 per month, of which 95,600 are pregnant and 17,158 are breastfeeding<sup>9</sup>.

In assessing diets and identifying intervention opportunities, Dr. Mandana Arabi (UNICEF) discussed ProPAN which has four main modules, addressing assessment, recipes, action plans, and monitoring & evaluation. Assessment includes a tool for interviewing key informants and capturing information on market prices using World Bank household surveys. Gaps are identified and solutions to meet these gaps are proposed. One of the current limitations are the food composition tables used as references, and these are presently being updated and expanded. The software is also being updated so that it includes linear programming (a mathematical modeling tool being developed by WHO called Optifoods) to look at the costs of food baskets. The modules will be piloted and training on the updated ProPAN tool will be done in Latin America and the Caribbean, Africa and Asia.

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<sup>9</sup>[http://puritamama.redsalud.gov.cl/url/page/purita\\_mama/g\\_visualizacion/g\\_noticias/detalle\\_noticias\\_1\\_503074\\_1.html](http://puritamama.redsalud.gov.cl/url/page/purita_mama/g_visualizacion/g_noticias/detalle_noticias_1_503074_1.html)

Participants discussed the possibility of including information on fat content of native seeds and plants and incorporating them in ProPAN and whether the Positive Deviance approach is being considered in the revisions to ProPAN. Since ProPAN is designed to target the guiding principles of complementary feeding and address multiple issues through one comprehensive tool that even non-nutritionists can use, inclusion of fat is feasible. For example, interventions developed using ProPAN had high acceptance among mothers in Jamaica where it was used to create recipes and program behavior change communication (BCC) messages. ProPAN can be used in any population, including vegetarian communities, because it is an assessment to address all aspects of foods.

LNS was thought to be useful to vegetarian communities, as vegetarian diets generally cannot meet the micronutrient need. The “Guiding Principles for the non-breastfed child” covers how to address such gaps. Future enhancements to ProPAN include bioavailability calculations, including consideration of the anti-nutrient phytate, which inhibits mineral absorption.

One of the ongoing challenges in ProPan is missing values for key foods consumed. There is concern that if too many foods are missing, accurate analyses cannot be done. At present, the USDA data base is used but the aim is to include data from other sources. The source of the nutrient information was felt to be important, and ProPAN allows adding data from other food composition tables. However, because of discrepancies between values for the same foods in different tables, it was recommended to use the values included in ProPAN (vs. importing one’s own values).

## **How can market based approaches be harnessed?**

Marc Van Ameringen, (GAIN) in opening the presentations, discussed the challenges in trying to get companies to use markets appropriately and work within the Code of Marketing of Breast-Milk Substitutes. There is a need to engage the private sector and make markets work for the poor. Bringing together public and private sector approaches should be considered and the resulting hybrid models examined.

The private sector has expertise in marketing products high in EFAs and research capacity that can be harnessed for public health. Market-based approaches, in combination with public sector approaches can improve access to high quality products that can impact nutrition. Publically funded programs face the challenge of political commitment to keep them funded and sustainable. With urbanization and globalization, consumers have access to technology and tools, rural regions are becoming less rural and increasingly, consumers are accessing the goods and services they need through the market.

Dr. Marti Van Liere (UNILEVER) stressed that the private sector has good knowledge of balancing convenience, cost and health needs, and it understands what the consumer wants as well as their needs. Efficient supply chains, innovation, being sensitive to

consumer insights, and creating habits are additional strengths of the private sector. The public sector generally uses an information approach whereas the private sector often uses emotional appeal. By harnessing the strengths of both of these approaches, consumers (or beneficiaries, in public health terms) can be informed and empowered to make the right choice and have access to high quality products that can have meaningful impact on EFAs in the critical 1000 days. Public and private sectors should work together to increase a broader range of affordable, appropriate, and appealing products.

In China, a home fortification product consisting of micronutrient fortified full fat soy flour helped build bridges between public and private sectors. Dr. Klaus Kramer reported on this effort and the product, which because it contained full fat soy flour, was a good source of ALA. The Chinese Center for Disease Control and Prevention assessed the benefits of this product and found significant reductions in anemia, significant increases in full IQ, verbal IQ and performance IQ and decreased stunting prevalence in intervention vs. control groups. Results must be interpreted cautiously because there was no randomization or blinding, and comparisons were made using cross-sectional data. Before this public-private partnerships can be scaled-up, additional studies are needed, as well as a closer look at anti-nutrient (phytate) and taste issues. A genetic variation in FA metabolism and its prevalence in developing countries should also be examined.

Dr. Kamala Krisnaswamy illustrated ways the private sector can help increase access to processed foods high in EFAs. In India, there are a variety of oils, including mustard seed, rapeseed, and soy oil used in cooking and food preparation, yet fat intake is very low. In the past, pregnant women in Southern India typically consumed seaweed and children from middle- and high-income families were given cod liver oil capsules. In Kerala State, fish are commonly consumed but intake is still inadequate.

Nationally, 20-42% of Indians are vegetarian (mostly lacto vegetarian) and thus interventions emphasizing increased intake of animal source foods to meet EFA needs might not be feasible. DHA from seaweed could be a solution, and the public and private sectors should work together to see whether a seaweed approach is affordable, practical and can meet EFA needs. At present, micro algal DHA are imported and are very expensive because of nitrogen packing, quality control, and food labeling, and thus cannot reach low-income consumers.

Genetic modification to yield seeds, leaves, and seaweed high in EFAs is another strategy that should be considered, although this might not be possible in the foreseeable future in countries where genetically modified organisms (GMOs) are banned. Industry could explore use of flaxseed, mustard, and fenugreek as fortificants in its products, and support additional research on the mechanisms of conversion of ALA to EPA and DHA. The agriculture sector can help meet nutrition needs by promoting inland fisheries in and high DHA-containing eggs.

In the discussion, the issue of marketing to those who make household purchasing decisions vs. those who are the intended target recipients was raised. Messaging might be directed at caregivers of infants and young children but the purchasing power might be in the hands of another family member. In either case, the aim is to trigger an emotional response that goes beyond a cognitive message to influence behavior.

In discussing vegetable oils, concern was expressed that oil manufacturers are moving towards reducing the level of ALA in products to increase shelf life and that current food databases will need to be updated to reflect these changes. Strategies to keep ALA levels high and use antioxidants such as vitamin E were suggested.

The challenges of balancing cost, stability and taste were discussed. Making foods affordable, appropriate and appealing is a priority by industry but it remains a challenge to deliver these qualities through a viable business model. Industry is willing to provide technical assistance to parties that are interested in pursuing these aims, and an example of this was demonstrated through a multi-national food company working together with World Food Program (WFP) on quality management. WFP staff members spend time with this company to learn skills, and this company grants licenses to certain companies working in developing countries.

It was mentioned that some companies work in the humanitarian space, but this is done largely as part of the company's corporate social responsibility and not as an income-generating business. Fostering social business, in which companies engage in profit-generating business and achieve socially beneficial outcomes was viewed as important in engaging the private sector to invest in vulnerable populations and create habits that are healthy to consumers and profitable for the company. The public and private sectors should acknowledge their common aim, which is to influence behavior to achieve an outcome, through marketing and behavior change communication.

## **Next steps**

In closing the meeting, Dr. Anna Lartey (IUNS and University of Ghana) asked participants to reflect on the science presented as it relates to the path from pregnancy and the first 1000 days. The challenges of measuring EFA intakes and status, the limited nutrient databases available, and regulatory and labeling considerations were mentioned. The need to be mindful of taking a comprehensive and programmatic approach was emphasized, understanding that we are working within a system and that the mother-infant dyad should be considered when considering models for addressing EFA needs in the first 1000 days.

In light of the nutrition transition that includes increased urbanization, changing diets and increasing commodity prices, strategies for addressing EFAs need to consider these factors. There is a need to support systematic data collection efforts such as the Demographic and Health Surveys (DHS) to help guide science through program implementation and to ensure that low-income households are provided with accurate information about the foods they consume. Products need to be labeled to indicate the

type of oil used, and marketing should inform consumers of benefits of oils with omega-3 fatty acids. If products are fortified with omega-3 fatty acids, they should be labeled with the amount and type (ALA vs DHA).

Dominic Schofield (GAIN) urged that national legislation and international food safety and regulatory systems should ensure that consumers are protected from inappropriate marketing and ingredients and are informed of the contents of the food they consume. Although the focus of the meeting was on EFAs, there was a call to be mindful that the target population's understanding revolves around food and that messages should be food-centered so that they can be understood and passed from generation to generation. EFA needs should be considered in the context of what we know collectively about comprehensive good nutrition.

## Appendix 1: Agenda

### Fat in the critical 1000 days: Ensuring adequacy of essential dietary fats for mothers and young children in low and middle income countries

April 7, 2011,  
Pan American Health Organization\*

- 8:30 Coffee
- 9:00 - 9:30 **Welcome and introduction to meeting:** PAHO (Dr. Gina Tambini), International Union of Nutritional Sciences (Dr. Ibrahim Elmadfa), UNICEF (Dr. Nune Mangasaryan), GAIN (Dr. Regina Moench-Pfanner)
- The Science***
- 9:30 - 10:15 Dr. Sandra Huffman, University of California, Davis, Moderator
- Functional importance of essential fats and groups most at risk of inadequate intakes** Dr. Kay Dewey, University of California, Davis
- 10:15 - 11:00 Discussion
- 11:00 - 11:30 Ms. Monica Kothari, Demographic and Health Surveys/PATH, Moderator
- How can surveys be revised to measure essential fat status developing countries?**
- What measures are available to assess EFA status?  
Dr. Marius Smuts, North West University, South Africa
- Methods and results for a survey of fatty acid intake among women and young children in rural Bangladesh  
Dr. Beth Yakes, University of California, Davis
- 11:30 - 11:50 Discussion
- 12:00 - 1:00 Lunch at the American Foreign Service Association, 2101 E St, NW. (corner of 21<sup>st</sup> and E Streets)

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\* PAHO's hosting of this meeting does not endorse the products of any commercial company

## ***The Programs -From Science to Public Health***

- 1:00 - 1:40      **How can essential fat intake be improved with relevant products?**  
Dr. Susan Brems, Deputy Administrator for Global Health, US Agency for International for Development, Moderator
- Impacts of peanut based spread with essential fats on women and children  
Dr. Ken Maleta, University of Malawi
- DHA in pregnancy improves breastmilk DHA Dr. Salvador Villalpando, National Institute of Public Health, Mexico
- Acceptability trials of LNS in Niger  
Dr. Katie Tripp, US Centers for Disease Control and Prevention
- 1:40 - 2:00      Discussion
- 2:00 - 2:40      **What can the agricultural sector do to increase availability of essential fats?**  
Dr. Catherine Wotecki, Undersecretary for Research, Education, and Economics (REE), US Department of Agriculture, Moderator
- How can Title II foods enhance essential fat intake?  
Dr. Irwin Rosenberg, Tufts University
- How can production of food sources of essential fats be increased in developing countries? Dr. Shakuntala Haraksingh Thilsted, World Fish
- 2:40 - 3:00      Discussion
- 3:00 - 3:30      **How can essential fat intake be improved through enhancing feeding practices?**  
Moderator
- Dr. Ana Maria Aguilar, Nutrition Advisor to the Minister of Health, Bolivia,
- What impact will enhancing breastfeeding have on essential fat intake?  
Dr. Chessa Lutter, PAHO
- Use of the ProPAN tool to identify and optimize use of local foods high in essential fatty acids, Dr. Mandana Arabi, UNICEF
- 3:30 – 3:50      Coffee
- 3:50 - 4:10      Discussion
- 4:10 - 4:50      **How can market based approaches be harnessed?**  
Mr. Marc Van Ameringen, Executive Director, GAIN, Moderator
- The private sector's role: examples from the food industry practical issues  
Dr. Marti Van Liere, UNILEVER
- Fortified full fat soy flour in China  
Dr. Klaus Kramer, Sight and Life
- Is there potential for the private sector to produce low cost products containing essential fatty acids?

Prof. Kamala Krishnaswamy, Scientific Advisory Board, Glaxo Smith Kline  
(former Director of the National Institute of Nutrition, Indian Council of Medical  
Research)

4:50 - 5:10 Discussion

5:10 - 5:30 Closing, Dr. Anna Lartey (IUNS), Mr. Dominic Schofield (GAIN)