Omega-6 and omega-3 fatty acid nutrition amongst Malaysians are far from desirable

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Abstract: This paper reviews available reports on the omega-6 (linoleic acid, LA) and omega-3 fatty acid [alpha-linolenic acid (ALA) + eicosapentaenoic acid (EPA) + docosahexaenoic acid) intakes amongst Malaysians against Malaysian Recommended Nutrient Intakes (RNI), focussing particularly on pregnant and lactating women because of the availability of data for these latter vulnerable groups. Overall, the omega-6 and omega-3 fatty acid nutrition amongst Malaysians are poor and far from desirable. The nutritional situation regarding these long-chain polyunsaturated fatty acids (LCPUFA) amongst Malaysian pregnant and lactating women is alarming and warrants urgent attention in nutrition promotion activities/counselling. Daily consumption of LA by these women and other Malaysians studied ranged from 3.69 - 5.61 % kcal with 38-60% of individuals not meeting their RNIs. Daily intakes of omega-3 fatty acids faired worse, averaging 0.21- 0.33 % kcal with as high as 92% of subjects in one study not meeting their RNIs. The omega-6 to omega-3 fatty acid ratios obtained in the studies reviewed are about 20:1, which is way above the World Health Organisation-recommended ratio of 5-10:1. Dietary sources of these omega- fatty acids in the subjects studied are chicken, fish and milk. Since local foods are not particularly rich in LCPUFA such as EPA and DHA, the options to improve EPA/DHA nutrition amongst Malaysians are the greater consumption of omega-3 enriched foods and in the case of pregnant and lactating women, LCPUFA supplementation may warrant serious consideration.

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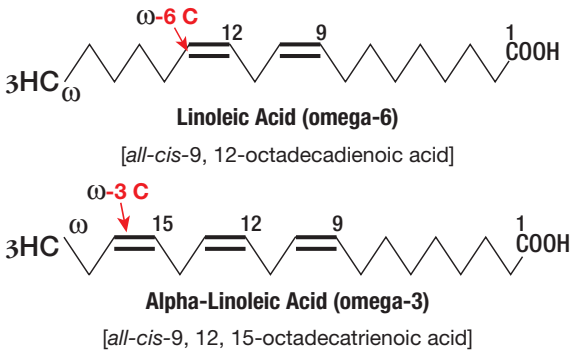
Introduction

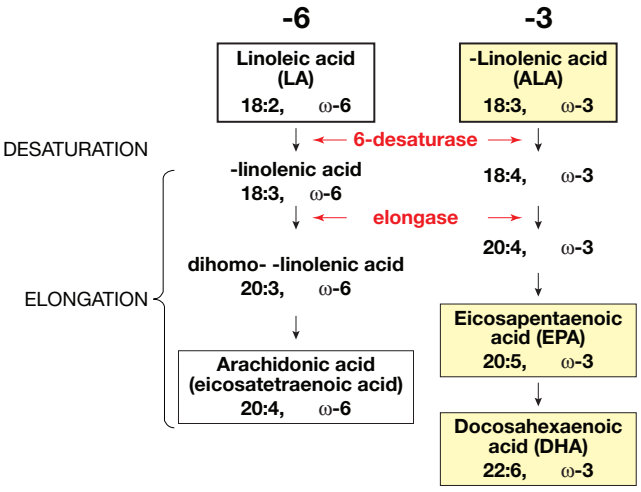
Humans cannot synthesise a carbon-carbon double bond at carbon 3 and/or carbon 6, counting from the methyl end (also known as the "omega" end) of the fatty acid molecule. Therefore these fatty acids are regarded as "essential" and must be supplied by the diet. There are two such essential fatty acids; the main one being linoleic acid (LA) and the second one often consumed in much smaller quantities is *alpha-linolenic acid* (ALA) [Figure I].

Figure 1: The two essential fatty acids in human nutrition



LA is metabolised to the 20-carbon arachidonic acid (omega-6), while ALA is metabolised to the omega-3 long-chain polyunsaturated fatty acids (LCPUFA)-eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) [Figure II].

Figure II: Simplified metabolic pathways of the two essential fatty acids



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There are a few important points to note about the above metabolic pathway of the two essential fatty acids. Firstly, the metabolites of the initial two essential fatty acids remain in the same "omega family". Secondly, the first two metabolic steps of LA and ALA involve the same enzymes (6-desaturase and elongase). What this means is that LA, often consumed in much higher amounts than ALA, would inhibit the conversion of ALA to EPA and DHA. This inhibition is strong, causing the conversion of ALA to EPA and DHA to have an efficiency below 5%.[1,2] Therefore it is wise for consumers, particular pregnant or lactating women, to obtain their EPA/DHA needs direct from animal sources.

Essential fatty acid (EFA) nutrition, namely that of omega-6 LA and especially the LCPUFA derivatives of ALA- EPA and DHA, are of paramount importance during pregnancy and lactation.[3,4] During these physiological periods, adequate omega-6 and omega-3 fatty acids are vital for membrane formation, visual acuity and brain development in foetal, neonatal, and infant growth. These omega-6 and omega-3 fatty acids also play very important functions in our body, namely: a) required for cell membrane synthesis, b) LA functions as the most effective plasma cholesterol-lowering dietary factor, c) omega-3 fatty acids lower plasma triglycerides and have an anti-inflammatory action, d) arachidonic acid and EPA produce local hormones called "eicosanoids" which regulate constriction of blood vessels and inflammation.

The purpose of the present article is to review the habitual intakes of omega-6 LA and the sum of omega-3 fatty acids, namely (ALA + EPA + DHA) of Malaysians and to recommend appropriate dietary corrections, if necessary.

How much omega-6 LA and omega-3 are Malaysians consuming at the present?

We are now in a better position to answer this question because of the recently available nutrient calculator- DietPLUS[5] which has a few added-value features including nutrient values for omega-3 fatty acids of foods.

The basic daily EFA requirement is 3% kcal (about 6.7 g) of omega-6 LA and 0.3% kcal omega-3 fatty acid based on a 2,000-kcal diet.[6] For women, however, an additional 1.5% kcal/day is to be consumed during pregnancy (total=4.5% kcal/day) while 2- 4% kcal/day is to be added during lactation (total=5-7% kcal/day).[4,6] During pregnancy and lactation, there is an additional specific recommendation that women must ensure a DHA intake of 300 mg per day.[7]

Analysis of typical Malaysian diets based on a 7-day rotation menu had shown that the LA content to be only about 3.0% kcal while that of the omega-3 fatty acid to be 0.3% kcal, yielding an omega-6 to omega-3 fatty acid ratio of 10.[8] Although this ratio just about meets with World Health Organisation's (WHO) recommendation of 5-10 parts of LA to 1 part of omega-3 fatty acids, the absolute amounts of these omega-6 (LA) and omega-3 PUFAs are low and far from optimal.

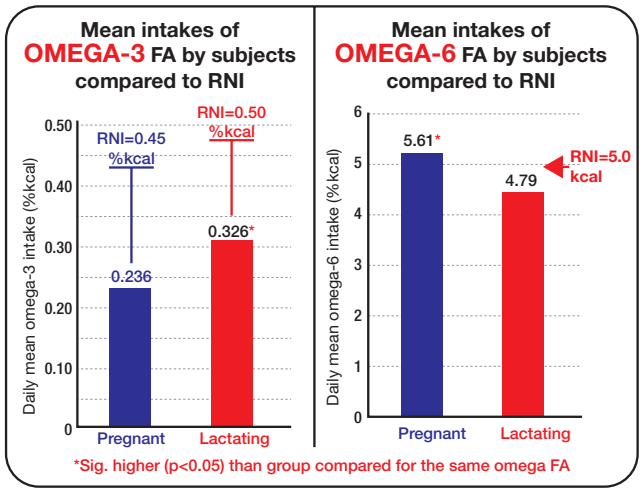
In another study[9], four final-year Pharmacy students analysed the food diaries of 70 staff and 35 students (n=105, aged 22-60 years) who recorded 3 separate day's total food intake - two on weekdays and one weekend. The food intake records analysed with DietPLUS[5] showed that overall, males consumed 4.95±2.12 % kcal omega-6 LA (11.5±4.90 g/day) and 0.20±0.23 % kcal omega-3 FA (0.45±0.52 g/day). The females consumed daily 4.90±1.96 % kcal omega-6 LA (9.25±3.71 g/day) and 0.22±0.23 % kcal omega-3 FA (0.41±0.44 g/day) [Table I]. While omega-6 FA consumption amongst the subjects seemed satisfactory, the omega-3 FA intakes in both male and female subjects were very low. This situation yielded an omega-6/omega-3 FA ratio of >20: 1, which is very unsatisfactory compared with the WHO's recommendation of 5-10:1.[4]

Table 1: Omega-6 (LA) and Omega-3 fatty acid intakes of IMU's campus population.

Macronutrient	Combined (n=103)	Males (n=35)	Females (n=68)
Fat (g)	69.2 ± 17.36 (34.0% kcal)	77.5 ± 23.2 (33.3% kcal)	64.9 ± 21.8 (34.4% kcal)
Omega-6 (g)	10.03 ± 3.17 (4.92% kcal)	11.5 ± 4.90 (4.94% kcal)	9.25 ± 3.71 (4.90% kcal)
Omega-3 (g)	0.42 ± 3.29 (0.21% kcal)	0.45 ± 0.52 (0.20% kcal)	0.41 ± 0.44 (0.22% kcal)
Malaysian RNI:			
Omega-6, % kcal	3.0-7.0		
Omega-3, % kcal	0.3-1.2		
WHO:			
Omega-6, % kcal	5.0-8.0		
Omega-3, % kcal	1.0-2.0		

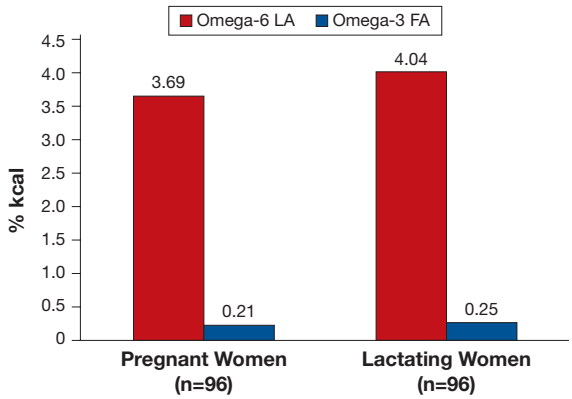
Subsequently, an IMU research team[10] investigated omega-6 LA and omega-3 fatty acid intakes of the most vulnerable groups namely 64 pregnant and 64 lactating attending out-patient clinic sessions at the Health Centre, Jalan Rasah, Seremban. They reported an overall mean ±SD of 5.20 ±3.36 % kcal for omega-6 LA intake and 0.28 ±0.14 % kcal for the combined 64 pregnant + 64 lactating women (Figure III). A large proportion of the women subjects, namely 60%, did not meet their RNI for the omega-6 LA, and 92% did not meet their RNI for omega-3 fatty acids (ALA + EPA + DHA). The estimated dietary omega-6/omega-3 fatty acid ratio is 18:1.

Figure III: Omega-6 (LA) and omega-3 fatty acid intakes amongst 64 pregnant and 64 lactating women[10]



Unsatisfactory omega-6 and omega-3 fatty acid nutrition were also reported for Malaysian mothers attending ante-natal and post-natal sessions at the Health Clinic, Presinct 9, Putrajaya.[11] Dietary assessment of the pregnant (n=96) and lactating women (n=96) interviewed revealed that their mean intakes for LA was 4.04 % kcal for omega-3 fatty acids. About 38% of pregnant mothers and 60% of lactating women did not meet their RNIs for omega-6 and omega-3 fatty acid nutrition (Figure IV).

Figure IV: Omega-6 and Omega-3 fatty acid intakes amongst women subjects from the Health Clinic, Putrajaya[11]



Omega-6 and omega-3 consumption in developed nations are slightly higher compared to in Malaysia

According to a Report of the Pan American Health Organization[12], where data are available on fatty acid intakes in women and young children of the Americas, omega-3 fatty acid intakes are far below what is considered as adequate.

In a developed nation such as the United States, a National Health and Nutrition Examination Survey (NHANES) 2001-2002 showed that adults 19 years and older consumed an average of 6.7 % kcal (14.8 g) based on a 2,000-kcal diet.[13] Another report on the NHANES III data estimates the total omega-3 fatty acid to be 0.60 % kcal comprising 1.33 % kcal ALA, 0.04 % kcal EPA and 0.07 % kcal DHA.[14] From these reports, the omega-6/omega-3 fatty acid ratio for the general United States population is about 11:1.

In the EPIC (European Prospective Investigation into Cancer and Nutrition)-Norfolk cohort study[15] on 14,422 men and women aged 39-78 years, dietary assessment with a 7-day food diary showed that total linoleic acid (omega-6) intake in men was 12.35 ± 5.04 g/day and in women, 9.42 ± 3.90 g/day. Based on a 2,000 kcal-diet, this works out to be 5.56% kcal for the men and 4.24% kcal for the women. For total daily omega-3 fatty acid intake, the same study found 1.50 ± 0.59g (0.67% kcal) for men and 1.22 ± 0.49 (0.55% kcal) for women. Omega-6 to omega-3 fatty acid intake ratio in the above population is approximately 8:1.

In Australia, median intakes of omega-6 and omega-3 PUFAs were reported to be 9.9 g/day and 1.2 g/day. Based on a 2,000-kcal diet this would be equivalent to 4.5 % kcal omega-6 and 0.54 % kcal omega-3, giving a omega-6/omega-3 fatty acid ratio of about 8:1.[16]

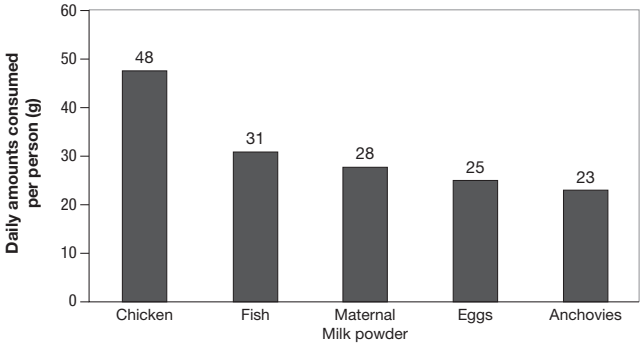
In the above examples in western nations, omega-6/omega-3 fatty acid ratios are in the region 8-11:1. There appears to be too much emphasis on omega-6 fatty acid intake with little attention on omega-3 fatty acid nutrition. A lower omega-6/omega-3 fatty acid ratio, emphasising improved omega-3 fatty acid nutrition, is desirable in reducing the risk of many chronic diseases of high prevalence in both advanced nations and developing countries.[17]

Sources of dietary omega-6 LA and omega-3 PUFAs

In the study of Ho *et al.*[10] on the pregnant and lactating women attending ante-natal and post-natal care at the Health Clinic in Seremban, the omega-6 and omega-3 fatty acids are from the same common dietary sources in the order: oil > meat> fish/nuts. The omega-6 LA is found in abundant amounts (50-60%) in PUFA-vegetable oils such as soya bean oil, corn oil, and sunflower seed oil. Since cooking oils are also the major source of omega-3 PUFAs in the study cited, it is not surprising that the daily intake of omega-3 fatty acids in the subjects studied was not satisfactory. Consumption of imported deep-sea fish rich in EPA/DHA such as salmon or Spanish mackerel, and supplementation with omega-3 fish capsules were rare amongst the subjects.

Dietary assessment by use of a semi-quantitative food frequency questionnaire on the pregnant/lactating women from the Health Clinic Putrajaya showed that chicken and fish were important sources of omega-3 fatty acids. However, the mean daily amount of fish consumed at 31g/person (see Figure V), appears to be very low compared to the national average of 70g/person/day (freshwater and seawater fish combined).[18]

Figure V: Dietary sources of omega-6 and omega-3 fatty acids amongst pregnant subjects from the Health Clinic, Putrajaya[11]



In the Australian study of Ollis *et al.*[16] polyunsaturated margarine, nuts/seeds, bread, snacks/desserts and takeaway foods were cited as important sources of omega-6 PUFAs. On the other hand, fish, canola oil and margarine, takeaway foods, snacks/desserts and bread were sources of ALA and the omega-3 LCPUFAs.

In the past two decades, a variety of omega-3 fortified foods have "hit" the supermarket shelves and retail outlets. These foods include the omega-3 fortified milk drinks, dairy products and the omega-3 eggs. Malaysian housewives should include these food items in the household food basket. In a report by Ng *et al.*[19], potential sources of omega-3 fatty acids in the local diet towards achieving recommended nutrient intakes have been highlighted.

Several plant oils, such as flaxseed oil and chia oil, which are rich in ALA are unavailable in the local retail shops. These oils are highly unstable due to their high polyunsaturation and their acceptance by the average Malaysian is not known.

Conclusion

Available Malaysian data indicates that the consumption of omega-6 LA by adult men and women is about 4.9 % kcal – 5.2 % kcal. These intake levels appear satisfactory for the general Malaysian population but are only borderline for pregnant or lactating women when compared with corresponding Malaysian Recommended Nutrient Intakes of 3-7% for the general population and 5.0-7.0 % kcal for pregnant and lactating women.

The dietary levels of omega-3 fatty acids (ALA + EPA + DHA) are very low among the Malaysian subjects cited in this article. Intake of these omega-3 fatty acids were reported to be in the region of 0.22 - 0.28 % kcal, which is below the Malaysian recommended range of 0.30- 1.2% kcal for these omega-3 PUFAs. This very poor omega-3 PUFA nutrition amongst the Malaysians studied are reflected in the very high omega-6/omega-3 fatty acid ratios recorded of about 20:1, which are far from desirable.

In view of the fact that local foods are not good sources of EPA or DHA, the greater consumption of omega-3 enriched foods such as milk and dairy products, or even omega-3 supplementation during pregnancy and lactation may warrant serious consideration.

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