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Fatty Acid Profile

Clinical Information for Professionals

Fatty Acid Profile

Essential Fatty Acids

Essential fatty acids are an integral component of cell membranes and, as such, critical for proper cell function and communication. Given the trillions of cells in the human body, abnormalities and imbalances in essential fatty acids (EFAs) can have wide-ranging effects. Evidence indicates that cardiovascular disease, chronic inflammation, depression, behavioural and mood disorders, and early dementia may all benefit from improvements in essential fatty acid balance. However, finding the right balance of fatty acids for optimal cell function means knowing the fatty acid levels at the start.

Fatty Acid Profile

Measuring the fatty acid content of RBCs via the Fatty Acid Profile shows clinicians how effectively EFAs have been incorporated into cell membranes. A wide array of omega-3 fatty acids, omega-6 fatty acids, mono-unsaturated fatty acids, trans fatty acids and saturated fatty acid levels are measured and reported as a percentage of total fatty acids. We also report the Omega-3 Whole Blood Score¹, which estimates risk for sudden cardiac death; the Omega-3 Index,² which is used as a predictor of cardiovascular disease, and the arachidonic acid (AA) to eicosapentaenoic acid (EPA) ratio as a marker of inflammation.³ Published data supports omega-3 fatty acid levels as a modifiable risk factor for primary and secondary prevention of cardiovascular disease.^{1,2}

Individual fatty acids from the following groups are measured:

Polyunsaturated Fatty Acids (PUFAs)

Omega-3 and omega-6 fatty acids are considered polyunsaturated because they contain more than one double bond in their fatty acid chains. Both are considered *essential* fatty acids because it is physiologically impossible to insert a double bond prior to C-7 in the chain, meaning these fatty acids must come from the diet (see Essential Fatty Acid Metabolism page 4). Omega-3 fatty acids have a double bond at the C-3 position and omega-6's have a double bond at the C-6 position.

Saturated Fatty Acids (SFAs)

Saturated fatty acids contain no double bonds (are therefore 'saturated' with hydrogen) and tend to be solid or semi-solid at room temperature. Myristic and palmitic acids increase low density lipoprotein (LDL) cholesterol whereas stearic acid has no effect on LDL. Replacing SFAs with PUFAs has been shown to decrease both LDL cholesterol and the total cholesterol to high density lipoprotein ratio. Replacing SFAs with monounsaturated fatty acids (MUFAs) has a similar but lesser effect on LDL. Epidemiological studies suggest that high intake of SFAs may increase risk of diabetes.⁴



Trans-Fatty Acids (TFAs)

Trans-fatty acids are unsaturated fatty acids with at least one double bond in the *trans* configuration (instead of the typical *cis* configuration). Consumption of trans fatty acids has been shown to raise blood levels of LDL cholesterol. High intake of TFAs may also worsen insulin resistance in overweight or diabetic individuals. The World Health Organization recommends that trans-fatty acid intake be limited to less than 1% of calories consumed.⁵

Monounsaturated Fatty Acids (MUFAs)

Monounsaturated fatty acids are so named because they have only one double bond in the long carbon chain fatty acid. According to the World Health Organization, up to 20% of total calorie intake can be mono-unsaturated fats.

Reference Ranges

Each individual fatty acid level is reported as a percentage of the total weight of fatty acids in the red blood cells. For example, a result of 18.1 for linolenic acid means 18.1% of all the fatty acids measured in the sample provided were linolenic acid. Fatty Acid Profile test reports give median and 5th to 95th percentile values for each fatty acid (or group) based on a population of over 20,000 people. These values provide a reference point for population comparison, but are not necessarily optimal values for any given fatty acid.



Omega-3
Omega-6
Monounsaturated
Saturated fatty acid
Trans-fatty acids
Omega-3 Index
Omega-3 Score
AA to EPA Ratio

Fatty Acid Profile
measures the
most fatty acids
in red blood cell
membranes.



Fatty Acid Profiles

Omega-3

LOW Alpha-linolenic acid (LNA)

supplement with flax seed, walnuts, unroasted nuts and seeds, dark leafy greens.

LOW Eicosapentaenoic acid (EPA) and/or Docosapentaenoic acid (DHA)

- supplement with high quality, high DHA & EPA fish oils,
- eat cold water fish like salmon, tuna, anchovies, sardines, herring, mackerel, eel, wild trout twice weekly.
- supplement with cofactors to improve conversion of LNA to EPA and DHA.

Omega 3

- alpha-linolenic (LNA)
- eicosapentaenoic (EPA)
- docosapentaenoic (DPA)
- docosahexaenoic (DHA)

Omega-6

LOW dihomo- γ -linolenic (DGLA) and/or Gamma-linolenic acid (GLA)

- supplement with evening primrose oil, borage oil, black currant seed oil

HIGH Arachidonic Acid (AA)

- supplement with high quality, high EPA fish oils.
- use only olive oil or high oleic acid canola or safflower oils for cooking.

HIGH Linoleic Acid (LA)

- use only olive oil, or high oleic acid canola or safflower oil for cooking.
- avoid margarine or shortening.

Omega 6

- linoleic (LA)
- gamma-linolenic (GLA)
- eicosadienoic
- dihomo- γ -linolenic (DGLA)
- arachidonic (AA)
- docosatetraenoic
- docosapentaenoic

Mono-Unsaturated Fatty Acids (MUFAs)

LOW Oleic acid

- increase intake of MUFA (olive oil, avocado, pecans).
- cook with olive oil (Note: use only olive oil or high oleic acid canola or safflower oils for cooking).
- olive oil based salad dressings.

cis-Monounsaturated Fatty Acids

- eicosenoic
- nervonic
- oleic
- palmitoleic

Saturated Fatty Acids (SFAs)

HIGH Myristic and /or Palmitic acid

- replace SFAs with PUFA to reduce LDL cholesterol and the total/HDL cholesterol ratio. Replacing SFAs with MUFAs has a similar, but lesser effect.

HIGH Total Saturated Fatty Acids:

- Replace saturated fatty acids with PUFA or MUFAs. The World Health Organization recommends that less than 10% of total calories should be consumed as SFAs.

Saturated Fatty Acids

- arachidic
- behenic
- lignoceric
- myristic
- palmitic
- stearic

Trans-Fatty Acids (TFAs)

HIGH Trans-Fatty Acids:

- reduce intake of trans-fatty acids. The World Health Organization recommends that less than 1% of total calories should be consumed as trans-fatty acids.
- best accomplished by avoiding commercial snack foods and crackers.

Trans Fatty Acids

- trans-palmitoleic
- trans-oleic
- trans-linoleic

Arachidonic Acid (AA) to Eicosapentaenoic Acid (EPA) Ratio

A ratio of AA to EPA between 1.5 and 4 is associated with improvements in the following diseases:

- rheumatoid arthritis
- asthma
- diabetes

A lowered ratio of AA to EPA may also be beneficial in some cancers.³ A 2010 paper found patients with neurodegenerative, inflammatory, allergic, and skin diseases had much higher levels of AA to EPA than healthy controls.⁶

Test	Result Range	Clinical Considerations
Omega 3 Index Red blood cell EPA + DHA <hr/> RBC total fatty acids	8 to 11 % of total RBC fatty acids as EPA + DHA Low Risk	An Omega-3 Index in this range indicates sufficient EPA and docosahexaenoic acid (DHA) intake and provides best protection against myocardial infarction. ^{2,7} It is also associated with a slower rate of telomere shortening, a marker of aging. ⁷
	4 to 8 % of total RBC fatty acids as EPA + DHA Intermediate Risk	Supplementation with 500mg to 1g of fish oil daily may be beneficial. Some individuals may require higher doses to reach an Omega-3 Index above 8%. ^{2,7}
	less than 4 % of total RBC fatty acids as EPA + DHA Undesirable	Supplementation with 1 to 3 g or more of fish oil daily may be beneficial. ^{2,7} Increasing the Index from 3.4% to 8.3 % over 2 years was associated with slower progression of cardiovascular disease and a trend toward fewer cardiovascular events. ^{2,7} Obese children have much lower Omega-3 Index numbers than non-obese children. ⁸

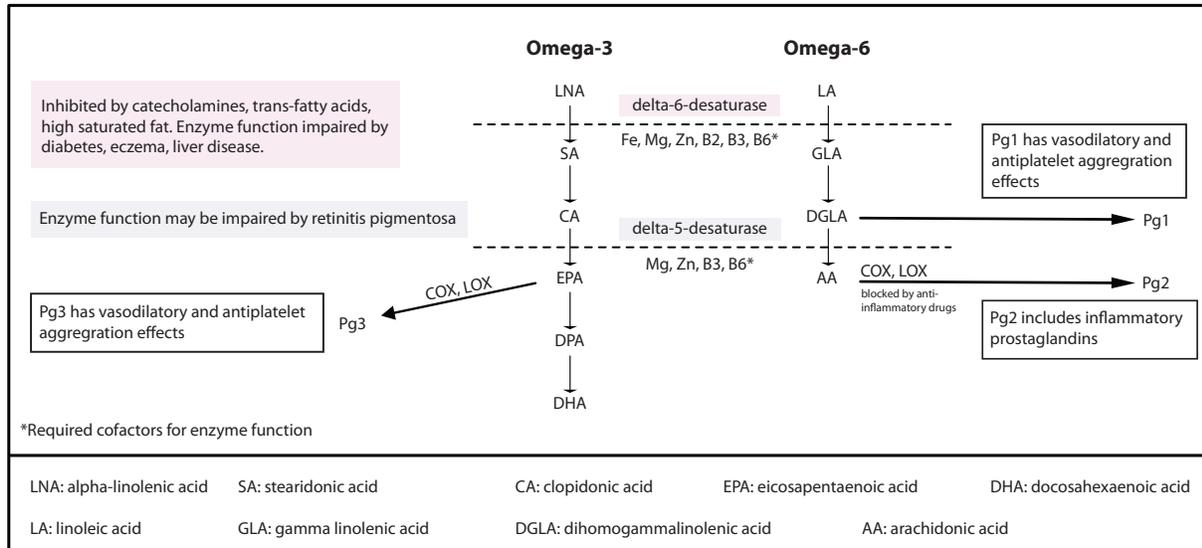
Omega-3 Whole Blood Score EPA + DPA + DHA in whole blood <hr/> total fatty acids in whole blood	6.1 - 10.2 % Low Risk (4th quartile) of total fatty acids as EPA + DPA + DHA	An Omega-3 Whole Blood Score > 6.1% represents a 90% decrease in risk for sudden cardiac death compared to the lowest quartile (2.1 - 4.3%). ¹
	5.2 - 6.1 % Moderate Risk (3rd quartile) of total fatty acids as EPA + DPA + DHA	An Omega-3 Whole Blood Score between 5.2 and 6.1% represents an 80% decrease in risk for sudden cardiac death compared to a score of less than 4.3%. Supplementation with 500mg to 1g of fish oil daily may be beneficial to bring the Omega-3 whole blood score into first quartile. ¹
	4.3 - 5.2 % High Risk (2nd quartile) of total fatty acids as EPA + DPA + DHA	An Omega-3 Whole Blood Score between 4.3 and 5.2% represents an 48% decrease in risk for sudden cardiac death compared to a score of less than 4.3%. Supplementation with 1 to 3 g of fish oil daily may be beneficial to bring the Omega-3 whole blood score into first quartile. ¹
	2.1 - 4.3 % Very High Risk (1st quartile) of total fatty acids as EPA + DPA + DHA	An Omega-3 Whole Blood Score of less than 4.3% represents the highest risk for sudden cardiovascular death. ¹ <ul style="list-style-type: none"> • twice the risk of 2nd quartile • five times greater risk than 3rd quartile • ten times greater risk than 4th quartile

AA to EPA Ratio Arachidonic Acid % by weight <hr/> Eicosapentaenoic Acid % by weight	0 to <1.5 Sub Optimal	An AA to EPA ratio less than 1.5 may be sub-optimal. If fish oils are being supplemented, consideration should be given to lowering the dose.
	1.5 to <5 Optimal	An AA to EPA ratio between 1.5 and 5 is considered optimal and is associated with low risk for inflammation. No intervention is required.
	5 to <10 Sub Optimal	An AA to EPA ratio between 5 and 10 is sub-optimal and is associated with medium risk for inflammation. Supplementation with fish oil may be beneficial.
	> 10 High Risk for Inflammation	Having an AA to EPA ratio greater than 10 is associated with a high risk for inflammation.

Essential Fatty Acid Metabolism

Essential fatty acids in biological tissues play an important role in regulation of blood pressure, lipid levels, inflammation, blood clotting, immune response, and cell communication.

Humans cannot make omega-3 fatty acids or linoleic acids. We must ingest LNA and EPA/DHA similarly, we must ingest LA.



► About the AA to EPA ratio

EPA and AA compete for the same enzymes

- eicosapentaenoic acid requires COX (cyclooxygenase) and LOX (lipoxygenase) enzyme systems to make Pg3, a prostaglandin with vasodilatory and antiplatelet aggregation effects.
- arachidonic acid uses COX and LOX enzyme systems to make inflammatory prostaglandins (Pg2 series).

Conclusion: sufficiency of EPA relative to AA reduces enzyme availability for production of inflammatory prostaglandins.

► Delta 6 desaturase

- some clinicians use the ratio of DGLA to LA as a measure of delta-6-desaturase enzyme efficiency. Higher ratios suggest efficient conversion, while lower ratios may indicate need for supplementation with co-factors, or direct supplementation with GLA or DGLA containing foods.

A good quality fish oil supplement can be used to raise levels of EPA and DHA. Look for products that meet International Fish Oil Standards (IFOS). Amounts from 500mg to 10 grams may be required. Testing can determine whether the optimal percentages of omega-3 fatty acids have been achieved. Note: it takes approximately 4 to 6 months for membrane composition to achieve a steady state after fish oil supplementation/dosage adjustments.

References

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