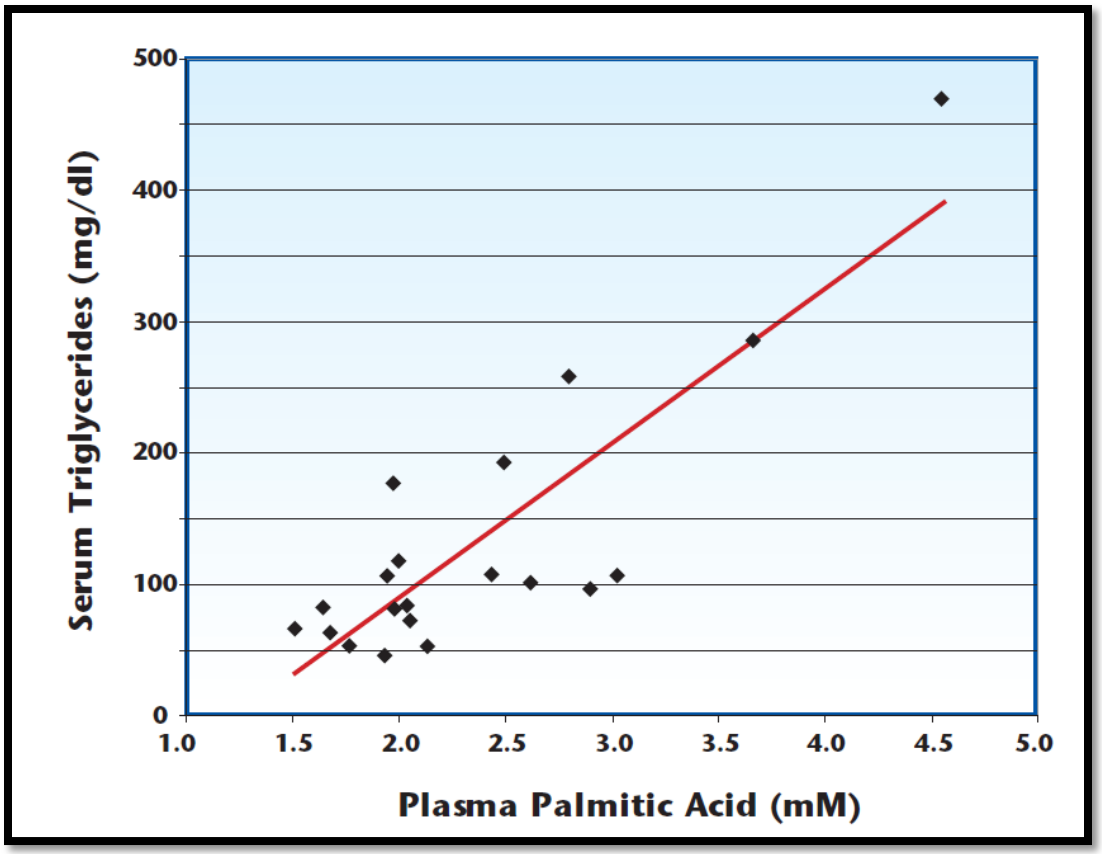
Fatty Acid Laboratory Reports Supplemental Slides

Serum triglycerides vs. plasma palmitic acid

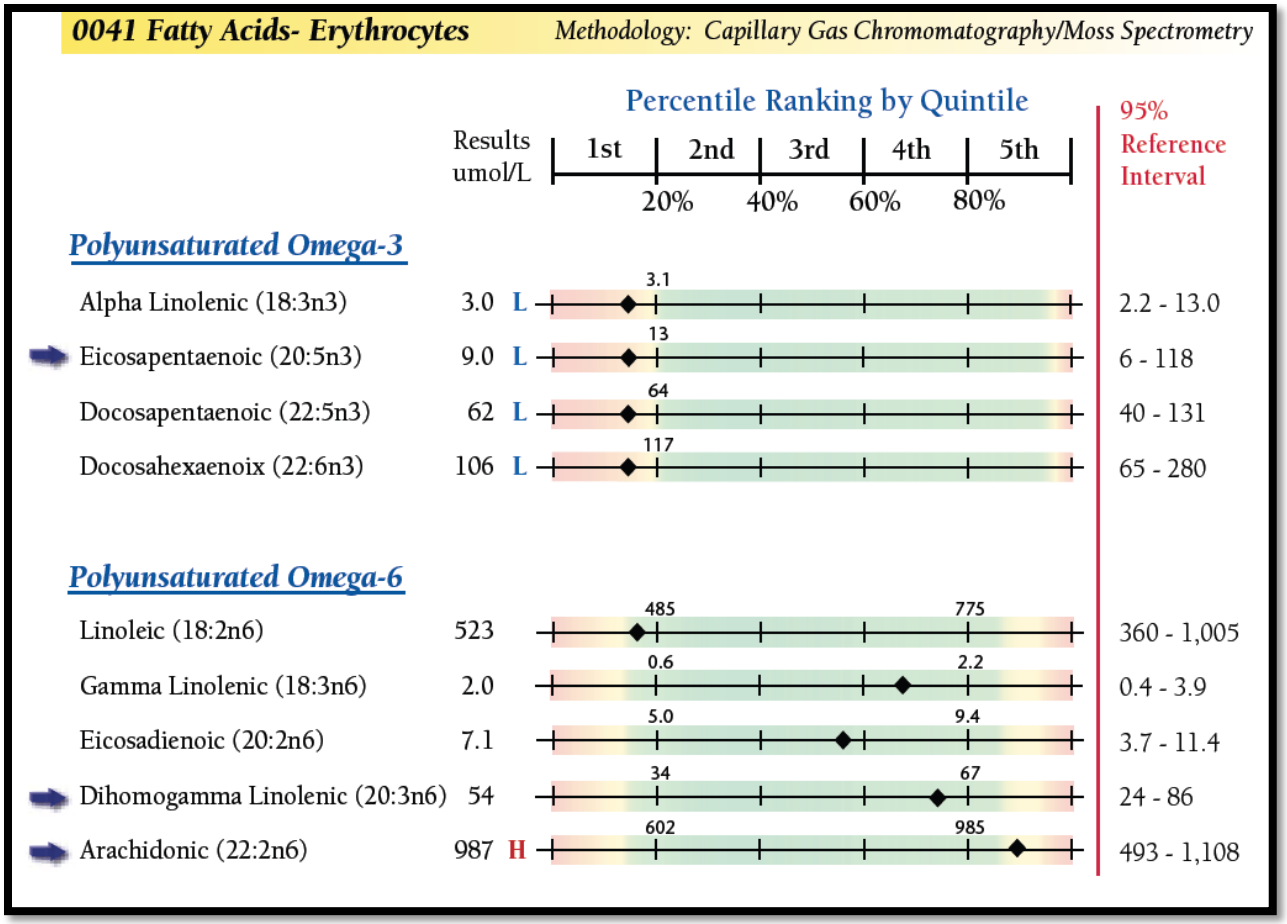
Lab Report Examples of

1. Pro-inflammatory pattern
2. General EFA deficiency pattern
3. Omega 3 dominant patterns
4. Blood spot specimen fatty acid profile
5. Zinc insufficiency pattern
6. Metabolic syndrome pattern
7. VLFA coA dehydrogenase deficiency pattern
8. Another VLCFA Genetic Polymorphism Case
9. MCFA Genetic Polymorphism
10. 63y M – diabetic, hypertension, glaucoma, inflammation, kidney function issues
11. 39y M, High-stress executive



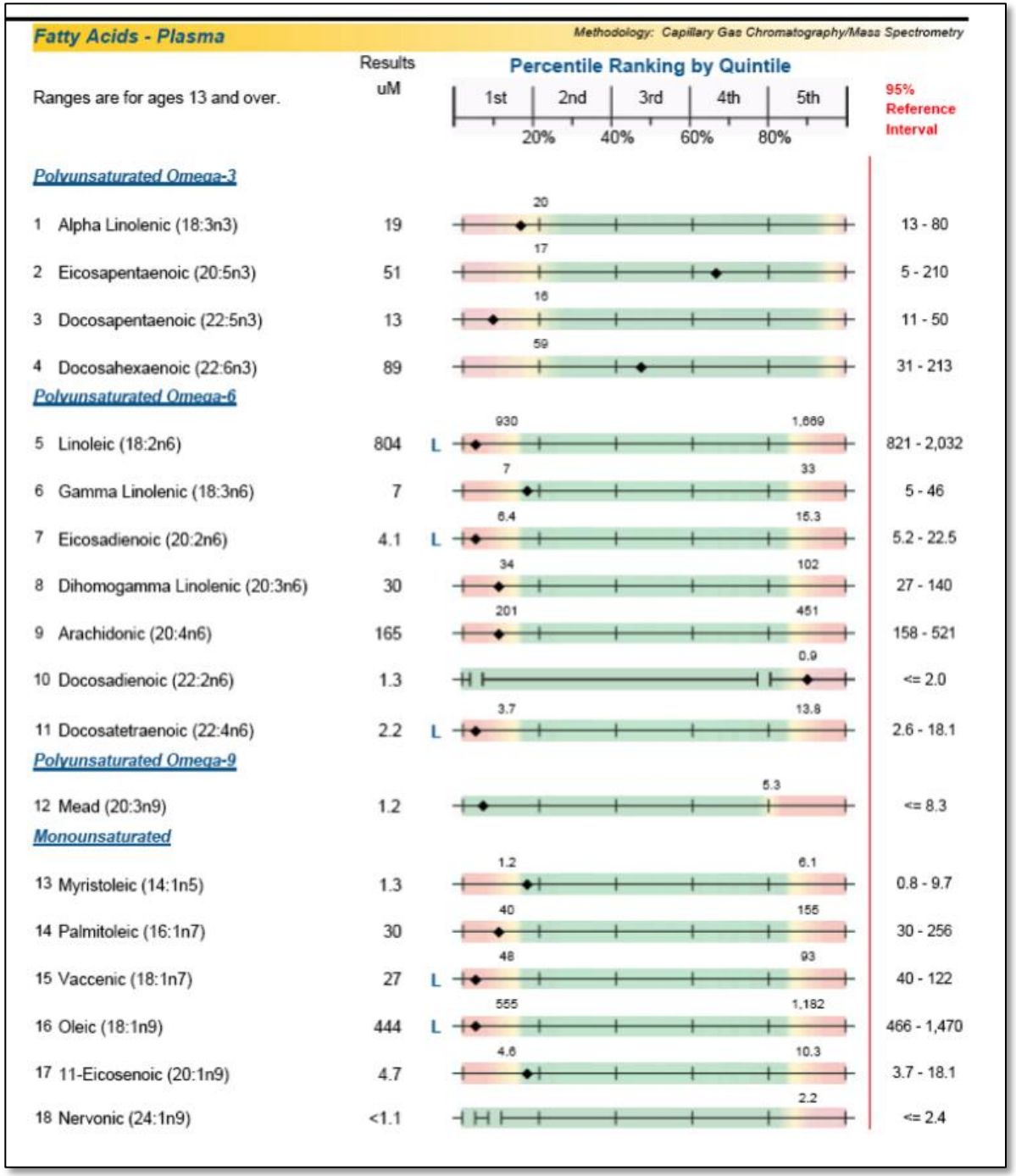
Hypertriglyceridemia is related to endogenous fatty acid synthesis and clearance. As the principal product of the fatty acid biosynthetic pathway, palmitate represents endogenous synthesis, and the level of palmitate in plasma reflects serum triglyceride levels. The trend line shows a strong linear relationship.

A Pro-Inflammatory Pattern



- Note: Generally low n-3 fatty acids; Elevated AA; Arrows point to eicosanoid precursors
- This pattern does not mean that the patient is necessarily in a state of inflammation. It means that, when the inflammatory signaling cascade is stimulated, tissue responses will be exaggerated and slow to return to baseline due to lack of class 3 eicosanoid products.

The General EFA Deficiency State p.1



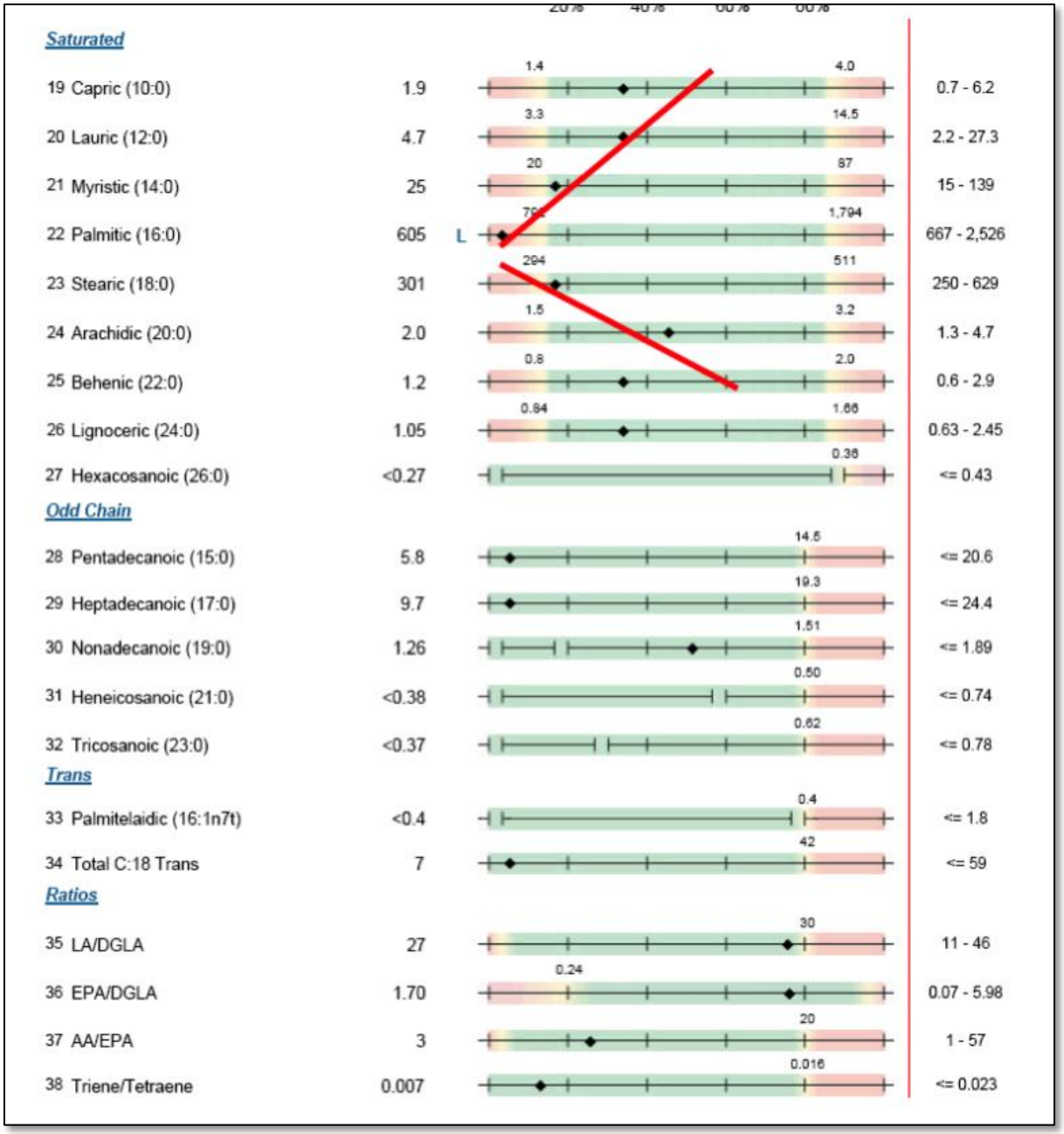
Fatty Acids - Plasma

Methodology: Capillary Gas Chromatography/Mass Spectrometry

Ranges are for ages 13 and over.

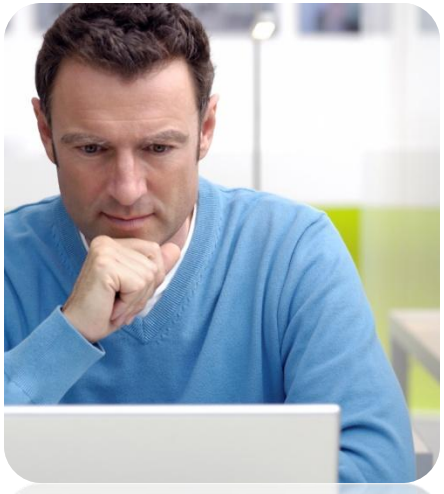
		Results uM	Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
Polyunsaturated Omega-3				
1	Alpha Linolenic (18:3n3)	19	20	13 - 80
2	Eicosapentaenoic (20:5n3)	51	17	5 - 210
3	Docosapentaenoic (22:5n3)	13	16	11 - 50
4	Docosahexaenoic (22:6n3)	89	59	31 - 213
Polyunsaturated Omega-6				
5	Linoleic (18:2n6)	804 L	930 1,669	821 - 2,032
6	Gamma Linolenic (18:3n6)	7	7 33	5 - 46
7	Eicosadienoic (20:2n6)	4.1 L	6.4 15.3	5.2 - 22.5
8	Dihomogamma Linolenic (20:3n6)	30	34 102	27 - 140
9	Arachidonic (20:4n6)	165	201 451	158 - 521
10	Docosadienoic (22:2n6)	1.3	0.9	<= 2.0
11	Docosatetraenoic (22:4n6)	2.2 L	3.7 13.8	2.6 - 18.1
Polyunsaturated Omega-9				
12	Mead (20:3n9)	1.2	5.3	<= 8.3
Monounsaturated				
13	Myristoleic (14:1n5)	1.3	1.2 6.1	0.8 - 9.7
14	Palmitoleic (16:1n7)	30	40 156	30 - 256
15	Vaccenic (18:1n7)	27 L	48 93	40 - 122
16	Oleic (18:1n9)	444 L	555 1,182	466 - 1,470
17	11-Eicosenoic (20:1n9)	4.7	4.6 10.3	3.7 - 18.1
18	Nervonic (24:1n9)	<1.1	2.2	<= 2.4

The General EFA Deficiency State p. 2



Saturated				
19	Capric (10:0)	1.9		0.7 - 6.2
20	Lauric (12:0)	4.7		2.2 - 27.3
21	Myristic (14:0)	25		15 - 139
22	Palmitic (16:0)	605	L	667 - 2,526
23	Stearic (18:0)	301		250 - 629
24	Arachidic (20:0)	2.0		1.3 - 4.7
25	Behenic (22:0)	1.2		0.6 - 2.9
26	Lignoceric (24:0)	1.05		0.63 - 2.45
27	Hexacosanoic (26:0)	<0.27		<= 0.43
Odd Chain				
28	Pentadecanoic (15:0)	5.8		<= 20.6
29	Heptadecanoic (17:0)	9.7		<= 24.4
30	Nonadecanoic (19:0)	1.26		<= 1.89
31	Heneicosanoic (21:0)	<0.38		<= 0.74
32	Tricosanoic (23:0)	<0.37		<= 0.78
Trans				
33	Palmitelaidic (16:1n7t)	<0.4		<= 1.8
34	Total C:18 Trans	7		<= 59
Ratios				
35	LA/DGLA	27		11 - 46
36	EPA/DGLA	1.70		0.07 - 5.98
37	AA/EPA	3		1 - 57
38	Triene/Tetraene	0.007		<= 0.023

Patient is Supplementing with High-Dose Omega-3 and Omega-6, Contributing to Increased Lipid Peroxides



0041 Fatty Acids - Erythrocytes

Methodology: Capillary Gas Chromatography/Mass Spectrometry

Ranges are for ages 13 and over.

Percentile Ranking by Quintile: 1st (20%) | 2nd (40%) | 3rd (60%) | 4th (80%) | 5th

		Results uM		95% Reference Interval
Polyunsaturated Omega-3				
1	Alpha Linolenic (18:3n3)	102	H	13 - 107
2	Eicosapentaenoic (20:5n3)	230	H	9 - 238
3	Docosapentaenoic (22:5n3)	75	H	17 - 78
4	Docosahexaenoic (22:6n3)	300	H	53 - 324
Polyunsaturated Omega-6				
5	Linoleic (18:2n6)	3200	H	1,334 - 3,697
6	Gamma Linolenic (18:3n6)	30		4.3 - 51.7

	Results		Reference Limits mg/L
1 Coenzyme Q10	1.5		0.8 - 1.5
2 Vitamin E	12.9		12.0 - 50.0
3 Vitamin A	0.84		0.65 - 1.60
4 ß-Carotene	1.06		0.25 - 2.40
5 Lipid Peroxides	2.0	H	<= 1.4

Patient is Supplementing with High-Dose EPA, Contributing to Omega-3 Dominance and a Deficiency of Omega-6

Metametrix Clinical Laboratory
4855 Peachtree Industrial Blvd.
Norcross, GA 30092
770.446.5483 Fax:770.441.2237

Ordered By:
Metametrix Research

Accession Number: **A0606270001**
Patient: Sample Report
Report Date: 6/27/06
Reprinted: 6/28/2006
Comment:

Polyunsaturated Omega-3

1	Alpha Linolenic (18:3n3)	20		15 - 50
2	Eicosapentaenoic (20:5n3)	186	H	20 - 80
4	Docosahexaenoic (22:6n3)	118		70 - 150

Polyunsaturated Omega-6

5	Linoleic (18:2n6)	1,054	L	200 - 2,500
6	Gamma Linolenic (18:3n6)	9	L	10 - 26
7	Eicosadienoic (20:2n6)	4	L	6 - 16
8	Dihomogamma Linolenic (20:3n6)	26	L	45 - 115
9	Arachidonic (20:4n6)	569		300 - 700
10	Docosadienoic (22:2n6)	1.1		<= 7.0
11	Docosatetraenoic (22:4n6)	4.7	L	8.0 - 17.0

5	Lipid Peroxides	2.0	H	<= 1.4

At Follow-Up,
She is Doing Well.
She Decreased single EPA Supplementation and Started Vitamin E

1 Coenzyme Q10	0.72	0.50 – 1.50	0.40 - 2.3
2 Vitamin E	13.3	8.6 – 24.6	7.1 - 31.0
3 Vitamin A	1.13	0.53 – 1.30	0.41 - 1.5
4 ß-Carotene	0.93	0.22 – 1.55	0.22 - 2.7
5 Lipid Peroxides	1.2	1.5	<= 2.0

Polyunsaturated Omega-3

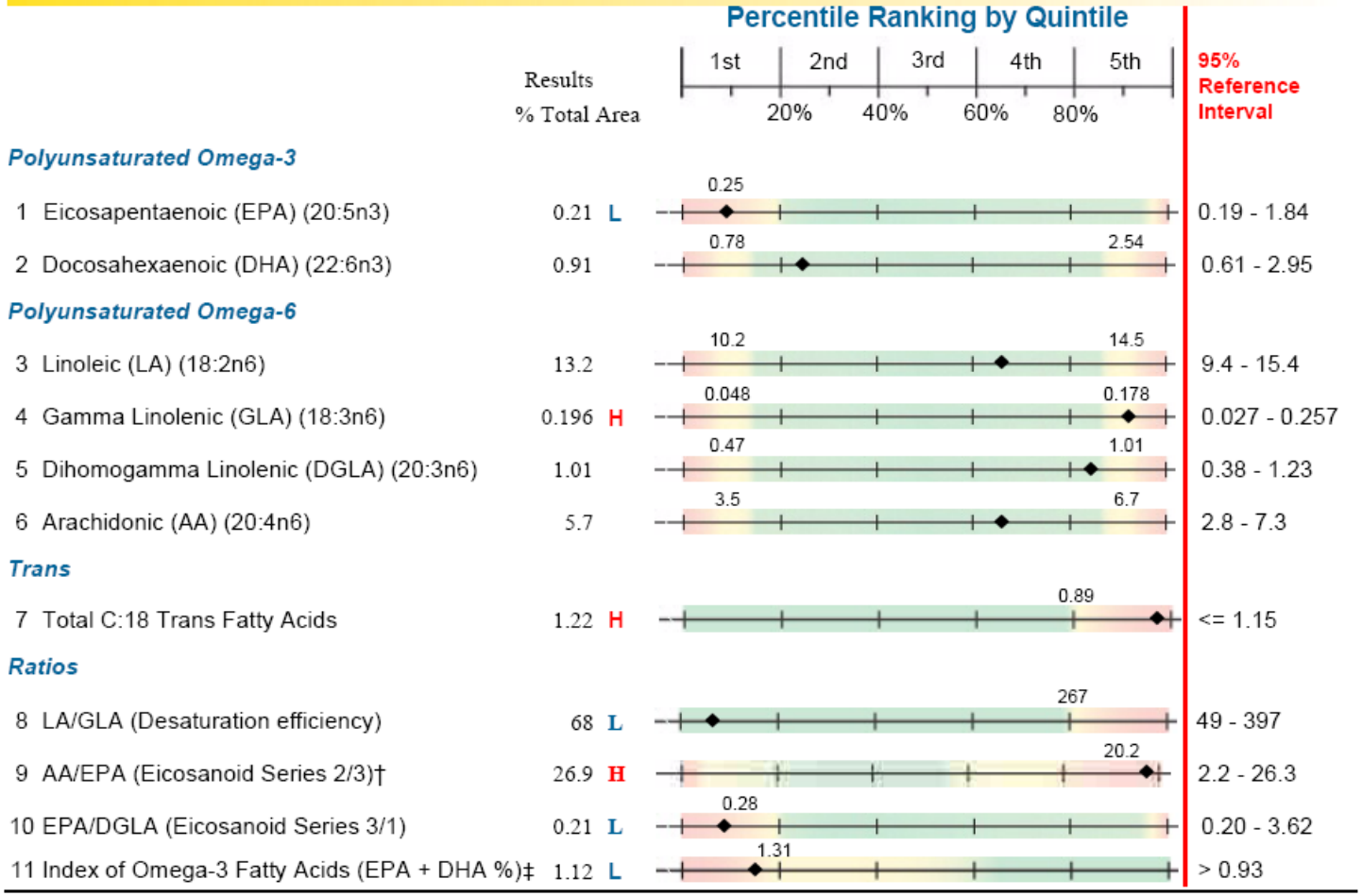
1 Alpha Linolenic (18:3n3)	33	24	13 - 107
2 Eicosapentaenoic (20:5n3)	75	24	9 - 238
3 Docosapentaenoic (22:5n3)	36	25	17 - 78
4 Docosahexaenoic (22:6n3)	176	96	53 - 324

Polyunsaturated Omega-6

5 Linoleic (18:2n6)	2,222	1,566 – 2,959	1,334 - 3,697
6 Gamma Linolenic (18:3n6)	6.6	6.3 – 33.5	4.3 - 51.7
7 Eicosadienoic (20:2n6)	7.9 L	8.3 – 19.9	6.6 - 26.0
8 Dihomogamma Linolenic (20:3n6)	64	47 – 154	37 - 203
9 Arachidonic (20:4n6)	590	366 – 813	284 - 1,046
10 Docosadienoic (22:2n6)	1.3	1.2 – 3.8	0.8 - 4.9
11 Docosatetraenoic (22:4n6)	5.8	5.2 – 19.3	3.6 - 25.7

0241 Bloodspot Fatty Acid Profile

Methodology: Capillary Gas Chromatography/Mass Spectrometry



	Results % Total Area		95% Reference Interval
Polyunsaturated Omega-3			
1 Eicosapentaenoic (EPA) (20:5n3)	0.21	L	0.19 - 1.84
2 Docosahexaenoic (DHA) (22:6n3)	0.91		0.61 - 2.95
Polyunsaturated Omega-6			
3 Linoleic (LA) (18:2n6)	13.2		9.4 - 15.4
4 Gamma Linolenic (GLA) (18:3n6)	0.196	H	0.027 - 0.257
5 Dihomogamma Linolenic (DGLA) (20:3n6)	1.01		0.38 - 1.23
6 Arachidonic (AA) (20:4n6)	5.7		2.8 - 7.3
Trans			
7 Total C:18 Trans Fatty Acids	1.22	H	<= 1.15
Ratios			
8 LA/GLA (Desaturation efficiency)	68	L	49 - 397
9 AA/EPA (Eicosanoid Series 2/3)†	26.9	H	2.2 - 26.3
10 EPA/DGLA (Eicosanoid Series 3/1)	0.21	L	0.20 - 3.62
11 Index of Omega-3 Fatty Acids (EPA + DHA %)‡	1.12	L	> 0.93

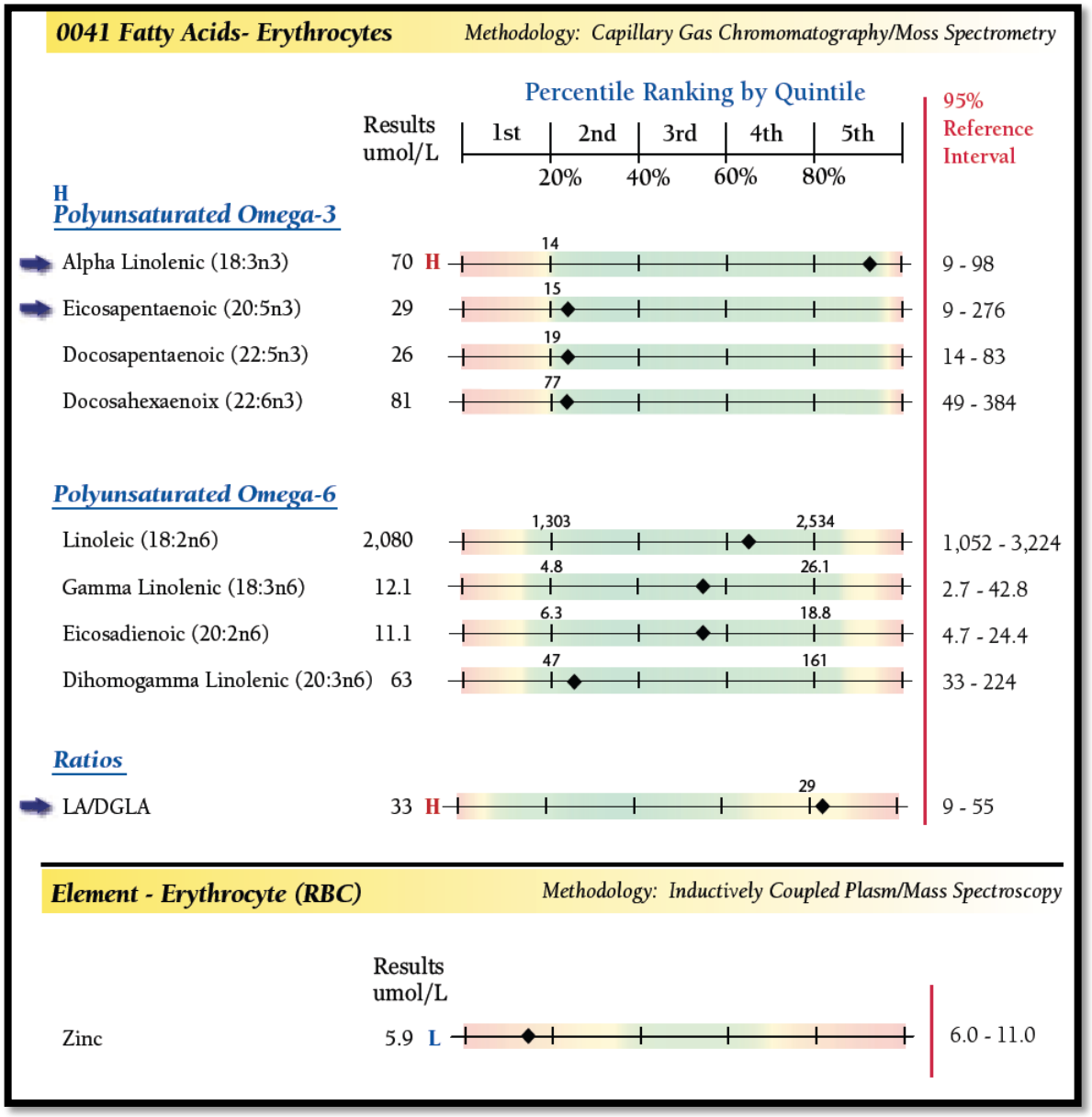
†Inflammatory Risk	High	Moderate	Mild	Low	Omega-3 Dominance
AA/EPA Ratio	> 20.2	8.9-12.3	5.8-8.9	3.0-5.8	<2.2

The inflammatory risk corresponds to data published by Dr. Barry Sears based on serum specimens. The numerical values from blood spot specimens are somewhat shifted. (Sears, Barry. The Omega Rx Zone. New York: Harper Collins Publishers Inc., 2002.)

‡Relative Disease Risk Index*	High	Intermediate	Low
Index of Omega-3 Fatty Acids	< 1.3	1.3-2.7	> 2.7

*Harris WS, von Schacky C. The Omega - 3 Index: A new risk factor for sudden cardiac death? Prev Med 2004; 39:212-20.

Zinc Insufficiency Sign



0041 Fatty Acids- Erythrocytes — *Methodology: Capillary Gas Chromomatography/Moss Spectrometry*

	Results umol/L	Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
H ***Polyunsaturated Omega-3***			
Alpha Linolenic (18:3n3)	70 H	14	9 - 98
Eicosapentaenoic (20:5n3)	29	15	9 - 276
Docosapentaenoic (22:5n3)	26	19	14 - 83
Docosahexaenoix (22:6n3)	81	77	49 - 384
Polyunsaturated Omega-6			
Linoleic (18:2n6)	2,080	1,303 – 2,534	1,052 - 3,224
Gamma Linolenic (18:3n6)	12.1	4.8 – 26.1	2.7 - 42.8
Eicosadienoic (20:2n6)	11.1	6.3 – 18.8	4.7 - 24.4
Dihomogamma Linolenic (20:3n6)	63	47 – 161	33 - 224
Ratios			
LA/DGLA	33 H	29	9 - 55

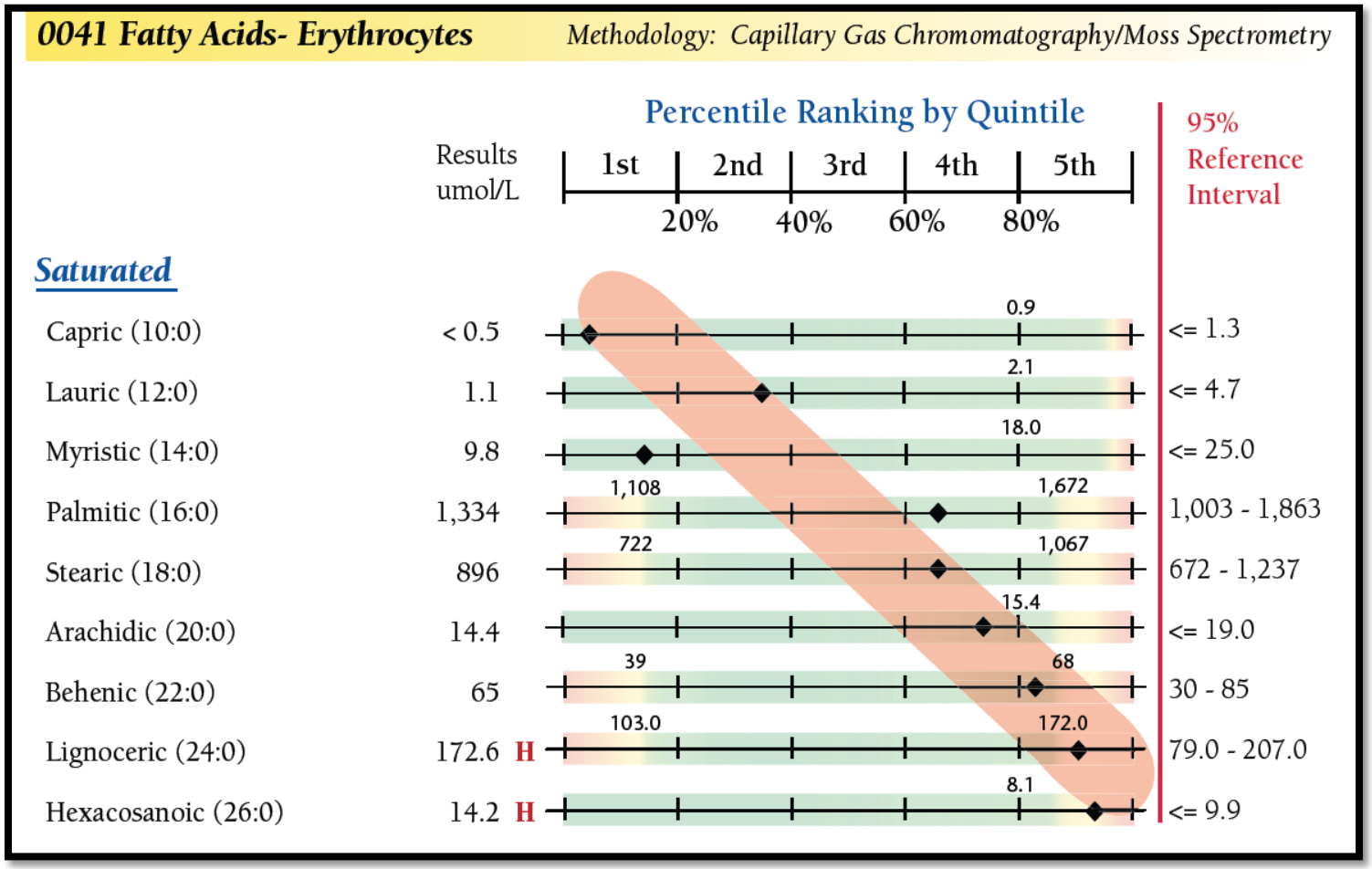
Element - Erythrocyte (RBC) — *Methodology: Inductively Coupled Plasm/Mass Spectroscopy*

	Results umol/L		
Zinc	5.9 L		6.0 - 11.0

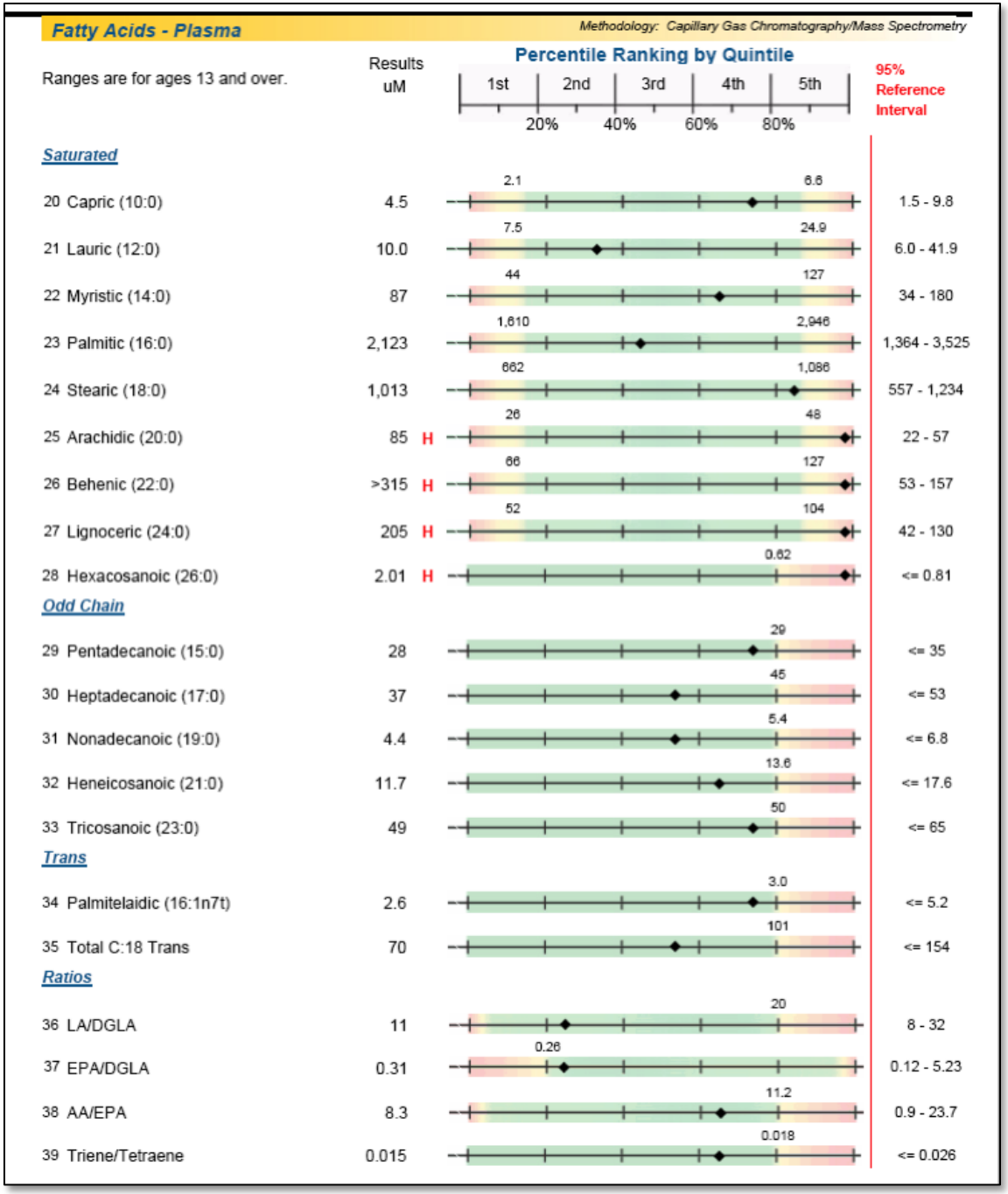
Metabolic Syndrome

- Dominance of 16-20 carbon chain lengths, with falling relative levels on either side
- Stimulation of lipogenesis by high insulin levels can produce such patterns.

Very Long Chain Fatty Acyl Coa Dehydrogenase Deficiency



Another VLCFA Genetic Polymorphism Case



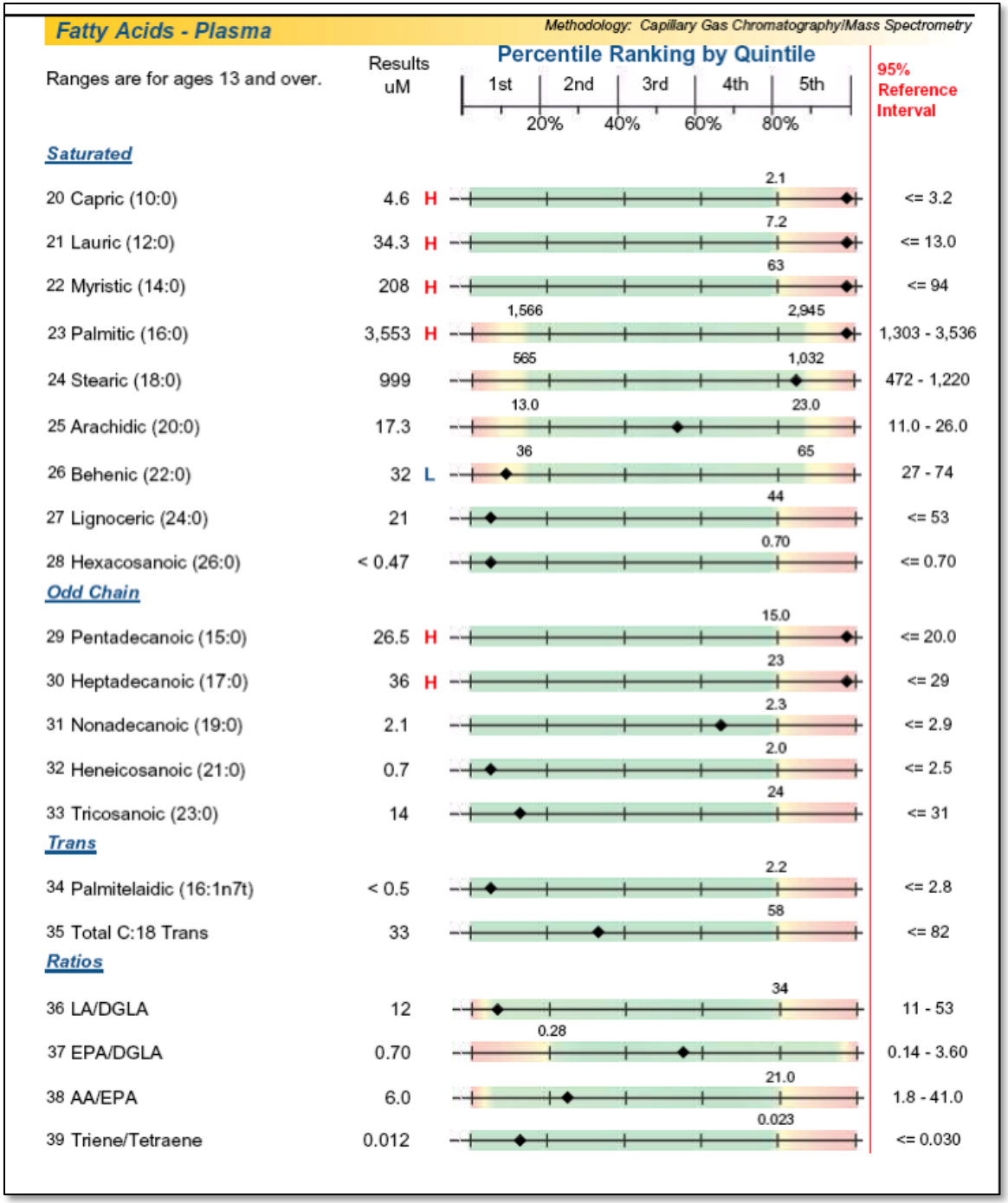
Fatty Acids - Plasma

Methodology: Capillary Gas Chromatography/Mass Spectrometry

Ranges are for ages 13 and over.

		Results uM		Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
Saturated					
20	Capric (10:0)	4.5		2.1 – 6.6	1.5 - 9.8
21	Lauric (12:0)	10.0		7.5 – 24.9	6.0 - 41.9
22	Myristic (14:0)	87		44 – 127	34 - 180
23	Palmitic (16:0)	2,123		1,610 – 2,946	1,364 - 3,525
24	Stearic (18:0)	1,013		662 – 1,086	557 - 1,234
25	Arachidic (20:0)	85	H	26 – 48	22 - 57
26	Behenic (22:0)	>315	H	66 – 127	53 - 157
27	Lignoceric (24:0)	205	H	52 – 104	42 - 130
28	Hexacosanoic (26:0)	2.01	H	0.62	<= 0.81
Odd Chain					
29	Pentadecanoic (15:0)	28		29	<= 35
30	Heptadecanoic (17:0)	37		45	<= 53
31	Nonadecanoic (19:0)	4.4		5.4	<= 6.8
32	Heneicosanoic (21:0)	11.7		13.6	<= 17.6
33	Tricosanoic (23:0)	49		50	<= 65
Trans					
34	Palmitelaidic (16:1n7t)	2.6		3.0	<= 5.2
35	Total C:18 Trans	70		101	<= 154
Ratios					
36	LA/DGLA	11		20	8 - 32
37	EPA/DGLA	0.31		0.26	0.12 - 5.23
38	AA/EPA	8.3		11.2	0.9 - 23.7
39	Triene/Tetraene	0.015		0.018	<= 0.026

MCFA Genetic Polymorphism



Fatty Acids - Plasma

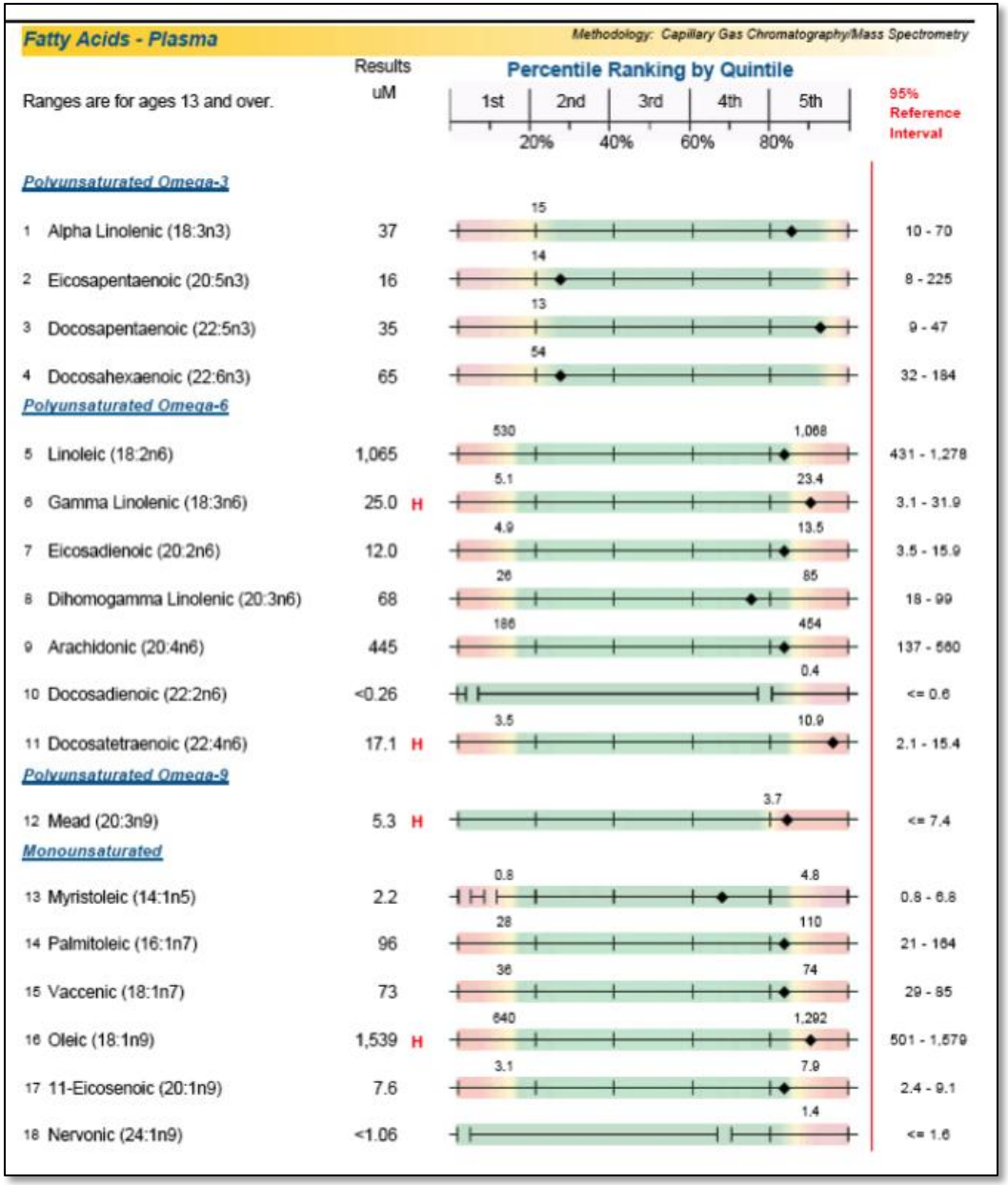
Methodology: Capillary Gas Chromatography/Mass Spectrometry

Ranges are for ages 13 and over.

	Results uM		Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
Saturated				
20 Capric (10:0)	4.6	H	2.1	<= 3.2
21 Lauric (12:0)	34.3	H	7.2	<= 13.0
22 Myristic (14:0)	208	H	63	<= 94
23 Palmitic (16:0)	3,553	H	1,566 – 2,945	1,303 - 3,536
24 Stearic (18:0)	999		565 – 1,032	472 - 1,220
25 Arachidic (20:0)	17.3		13.0 – 23.0	11.0 - 26.0
26 Behenic (22:0)	32	L	36 – 65	27 - 74
27 Lignoceric (24:0)	21		44	<= 53
28 Hexacosanoic (26:0)	< 0.47		0.70	<= 0.70
Odd Chain				
29 Pentadecanoic (15:0)	26.5	H	15.0	<= 20.0
30 Heptadecanoic (17:0)	36	H	23	<= 29
31 Nonadecanoic (19:0)	2.1		2.3	<= 2.9
32 Heneicosanoic (21:0)	0.7		2.0	<= 2.5
33 Tricosanoic (23:0)	14		24	<= 31
Trans				
34 Palmitelaidic (16:1n7t)	< 0.5		2.2	<= 2.8
35 Total C:18 Trans	33		58	<= 82
Ratios				
36 LA/DGLA	12		34	11 - 53
37 EPA/DGLA	0.70		0.28	0.14 - 3.60
38 AA/EPA	6.0		21.0	1.8 - 41.0
39 Triene/Tetraene	0.012		0.023	<= 0.030

63y M – diabetic, hypertension, glaucoma, inflammation, kidney function issues
H BUN
H cholesterol

p. 1



Fatty Acids - Plasma

Methodology: Capillary Gas Chromatography/Mass Spectrometry

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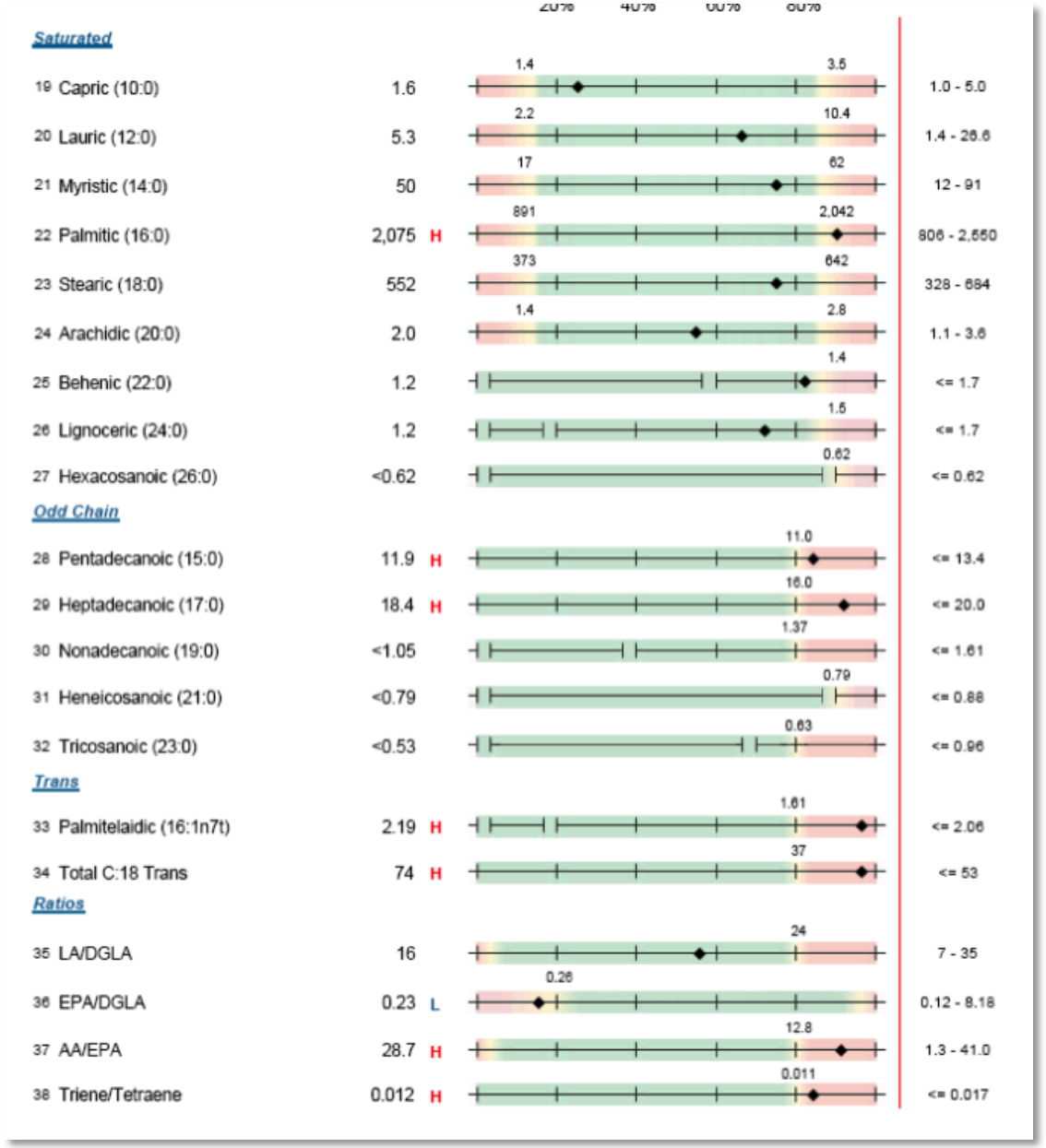
		Results uM		Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
Polyunsaturated Omega-3					
1	Alpha Linolenic (18:3n3)	37		15	10 - 70
2	Eicosapentaenoic (20:5n3)	16		14	8 - 225
3	Docosapentaenoic (22:5n3)	35		13	9 - 47
4	Docosahexaenoic (22:6n3)	65		54	32 - 184
Polyunsaturated Omega-6					
5	Linoleic (18:2n6)	1,065		530 1,068	431 - 1,278
6	Gamma Linolenic (18:3n6)	25.0	H	5.1 23.4	3.1 - 31.9
7	Eicosadienoic (20:2n6)	12.0		4.9 13.5	3.5 - 15.9
8	Dihomogamma Linolenic (20:3n6)	68		26 85	18 - 99
9	Arachidonic (20:4n6)	445		186 454	137 - 560
10	Docosadienoic (22:2n6)	<0.26		0.4	<= 0.6
11	Docosatetraenoic (22:4n6)	17.1	H	3.5 10.9	2.1 - 15.4
Polyunsaturated Omega-9					
12	Mead (20:3n9)	5.3	H	3.7	<= 7.4
Monounsaturated					
13	Myristoleic (14:1n5)	2.2		0.8 4.8	0.8 - 6.8
14	Palmitoleic (16:1n7)	96		28 110	21 - 164
15	Vaccenic (18:1n7)	73		36 74	29 - 85
16	Oleic (18:1n9)	1,539	H	640 1,292	501 - 1,579
17	11-Eicosenoic (20:1n9)	7.6		3.1 7.9	2.4 - 9.1
18	Nervonic (24:1n9)	<1.06		1.4	<= 1.6

63y M – diabetic, hypertension, glaucoma, inflammation, kidney function issues
H BUN
H cholesterol

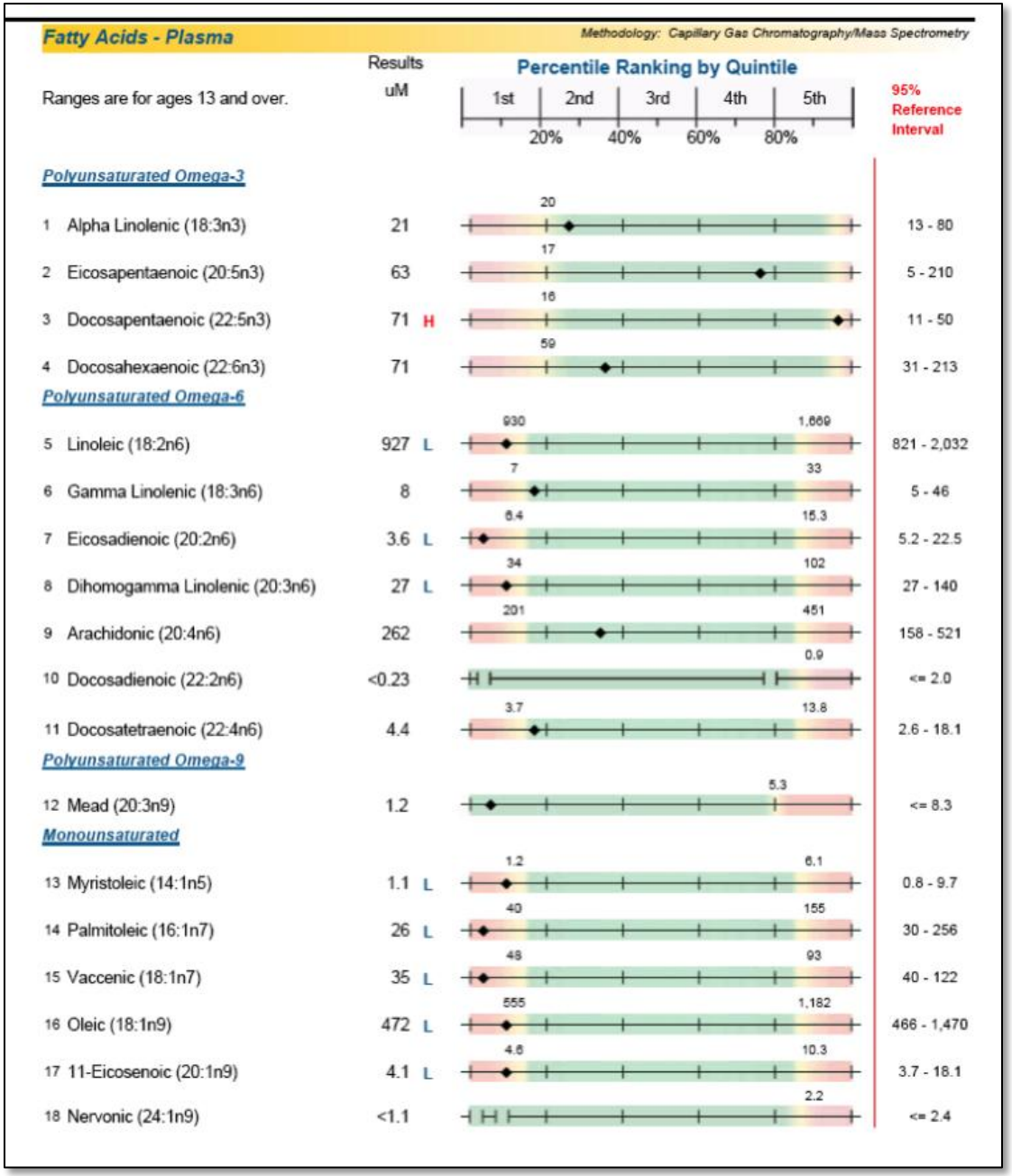
p. 2



Saturated				
19	Capric (10:0)	1.6		1.0 - 5.0
20	Lauric (12:0)	5.3		1.4 - 26.6
21	Myristic (14:0)	50		12 - 91
22	Palmitic (16:0)	2,075	H	806 - 2,550
23	Stearic (18:0)	552		328 - 684
24	Arachidic (20:0)	2.0		1.1 - 3.6
25	Behenic (22:0)	1.2		<= 1.7
26	Lignoceric (24:0)	1.2		<= 1.7
27	Hexacosanoic (26:0)	<0.62		<= 0.62
Odd Chain				
28	Pentadecanoic (15:0)	11.9	H	<= 13.4
29	Heptadecanoic (17:0)	18.4	H	<= 20.0
30	Nonadecanoic (19:0)	<1.05		<= 1.61
31	Heneicosanoic (21:0)	<0.79		<= 0.88
32	Tricosanoic (23:0)	<0.53		<= 0.96
Trans				
33	Palmitelaidic (16:1n7t)	2.19	H	<= 2.06
34	Total C:18 Trans	74	H	<= 53
Ratios				
35	LA/DGLA	16		7 - 35
36	EPA/DGLA	0.23	L	0.12 - 8.18
37	AA/EPA	28.7	H	1.3 - 41.0
38	Triene/Tetraene	0.012	H	<= 0.017

39y M, High-stress executive

p. 1



Fatty Acids - Plasma

Methodology: Capillary Gas Chromatography/Mass Spectrometry

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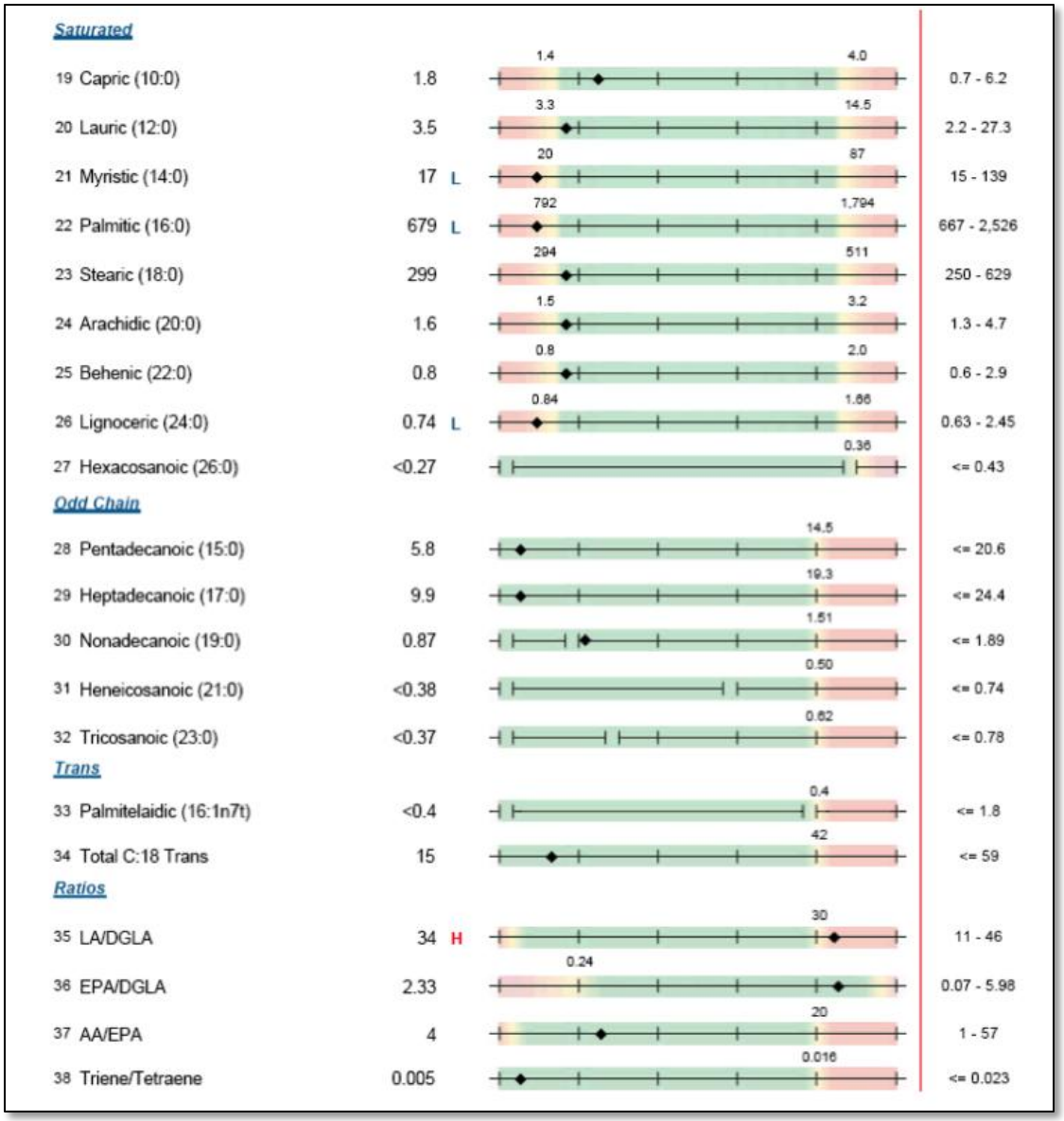
		Results uM		Percentile Ranking by Quintile (1st 2nd 3rd 4th 5th; 20% 40% 60% 80%)	95% Reference Interval
Polyunsaturated Omega-3					
1	Alpha Linolenic (18:3n3)	21		20	13 - 80
2	Eicosapentaenoic (20:5n3)	63		17	5 - 210
3	Docosapentaenoic (22:5n3)	71	H	16	11 - 50
4	Docosahexaenoic (22:6n3)	71		59	31 - 213
Polyunsaturated Omega-6					
5	Linoleic (18:2n6)	927	L	930 1,669	821 - 2,032
6	Gamma Linolenic (18:3n6)	8		7 33	5 - 46
7	Eicosadienoic (20:2n6)	3.6	L	6.4 15.3	5.2 - 22.5
8	Dihomogamma Linolenic (20:3n6)	27	L	34 102	27 - 140
9	Arachidonic (20:4n6)	262		201 451	158 - 521
10	Docosadienoic (22:2n6)	<0.23		0.9	<= 2.0
11	Docosatetraenoic (22:4n6)	4.4		3.7 13.8	2.6 - 18.1
Polyunsaturated Omega-9					
12	Mead (20:3n9)	1.2		5.3	<= 8.3
Monounsaturated					
13	Myristoleic (14:1n5)	1.1	L	1.2 6.1	0.8 - 9.7
14	Palmitoleic (16:1n7)	26	L	40 155	30 - 256
15	Vaccenic (18:1n7)	35	L	48 93	40 - 122
16	Oleic (18:1n9)	472	L	555 1,182	466 - 1,470
17	11-Eicosenoic (20:1n9)	4.1	L	4.6 10.3	3.7 - 18.1
18	Nervonic (24:1n9)	<1.1		2.2	<= 2.4

39y M, High-stress executive

p. 2



Saturated				
19	Capric (10:0)	1.8		0.7 - 6.2
20	Lauric (12:0)	3.5		2.2 - 27.3
21	Myristic (14:0)	17	L	15 - 139
22	Palmitic (16:0)	679	L	667 - 2,526
23	Stearic (18:0)	299		250 - 629
24	Arachidic (20:0)	1.6		1.3 - 4.7
25	Behenic (22:0)	0.8		0.6 - 2.9
26	Lignoceric (24:0)	0.74	L	0.63 - 2.45
27	Hexacosanoic (26:0)	<0.27		<= 0.43
Odd Chain				
28	Pentadecanoic (15:0)	5.8		<= 20.6
29	Heptadecanoic (17:0)	9.9		<= 24.4
30	Nonadecanoic (19:0)	0.87		<= 1.89
31	Heneicosanoic (21:0)	<0.38		<= 0.74
32	Tricosanoic (23:0)	<0.37		<= 0.78
Trans				
33	Palmitelaidic (16:1n7t)	<0.4		<= 1.8
34	Total C:18 Trans	15		<= 59
Ratios				
35	LA/DGLA	34	H	11 - 46
36	EPA/DGLA	2.33		0.07 - 5.98
37	AA/EPA	4		1 - 57
38	Triene/Tetraene	0.005		<= 0.023