The application of lipid profiling to understand dietary fat metabolism in breast-fed infants.

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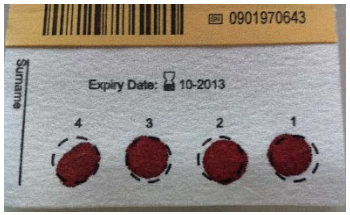
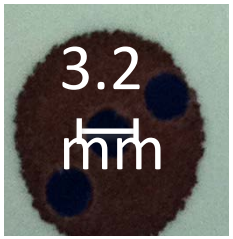
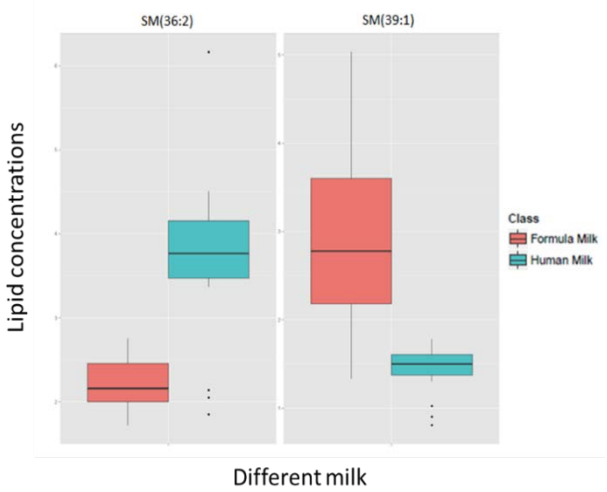
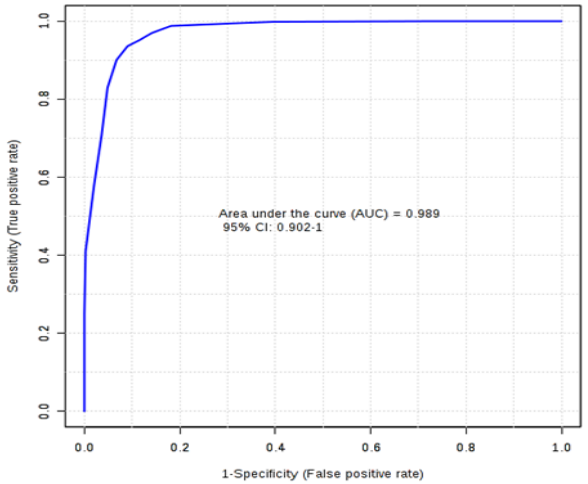
Infant Lipid Metabolism



- Robust lipid profiling using dried blood spots
- Providing information on circulating intact lipids
  - Cholesterol / Cholesterol-esters
  - Phosphatidylcholine lipids
  - Phosphoethanolamine
  - Sphingomyelins
  - Triglycerides





Prentice P, Koulman A, et al., J Pediatr. 2015;166(2):276-81
Koulman A, Prentice P, et al., Metabolomics. 2014;10(5):1018-1025.
Lu L, Koulman A et al., Diabetes Care. 2016 on line

Nutrition determines lipid profile in DBS

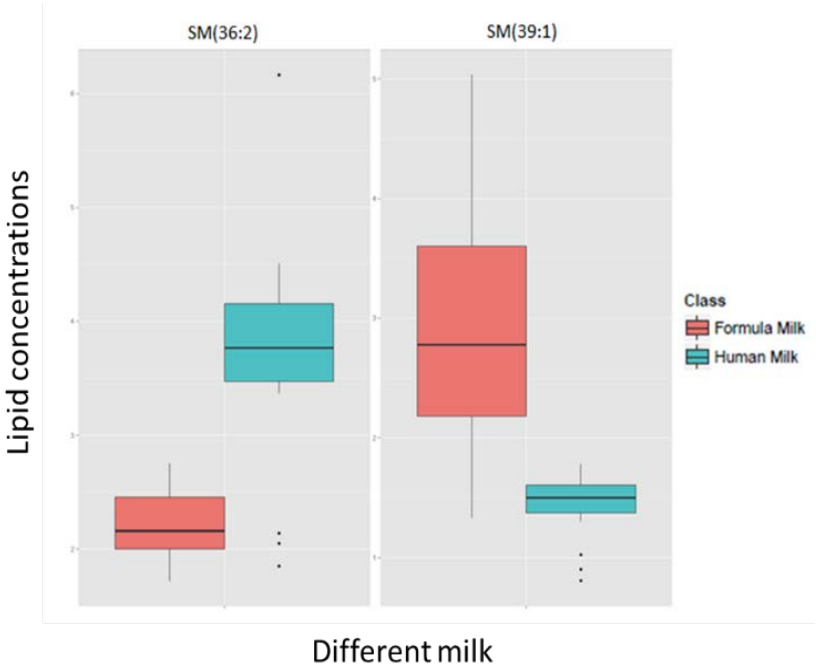


Table IV. Associations between 3-month lipid and infancy weight

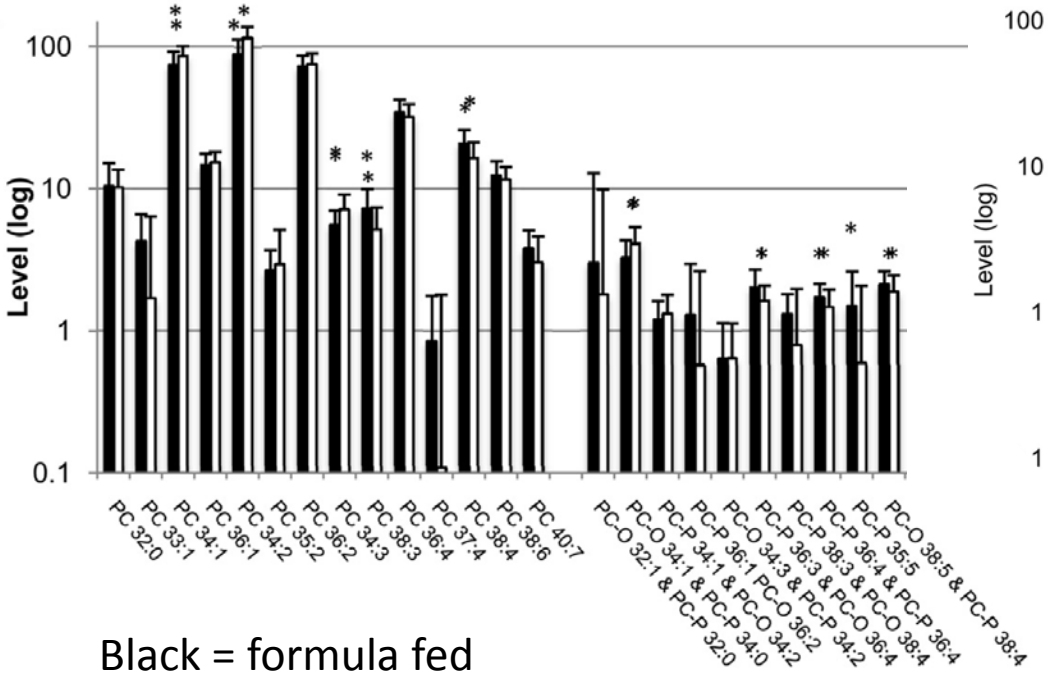
	3-mo weight SDS		12-mo weight SDS		3- to 12-mo weight gain SDS	
Lipid	Spearman	*P* value	Spearman	*P* value	Spearman	*P* value
PC-O 34:1*	0.2	.003	0.2	.009	−0.03	.7
PC 34:1*	0.2	<.0005	0.2	.003	0.01	.9
PC 38:4†	−0.2	<.0005	−0.2	.002	−0.04	.6
SM 34:2†	0.06	.4	−0.07	.3	−0.2	.005
PC-O 36:4†	−0.1	.1	−0.2	.02	−0.2	.004

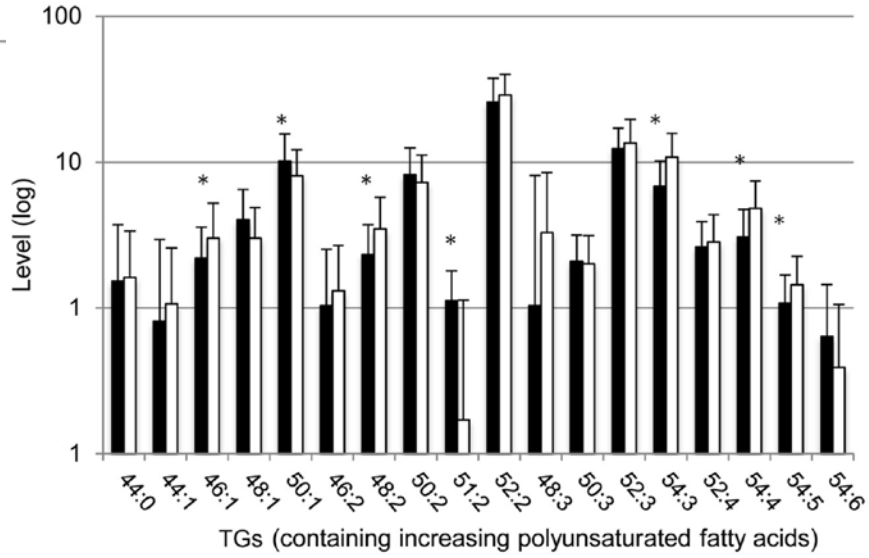
*Lower values in exclusively breast-fed.
†Higher values in exclusively breast-fed.

The ratio between 2 lipids (PC(34:2) and SM(36:2) enough to distinguish breast-fed and formula fed infants.

Prentice et al., J Pediatr 2015;166:276-81

Differences across all lipid classes





Black = formula fed
White = breast fed

Circulating lipids associate with growth

Associations between circulating lipids at 3 months and infancy weight

	3-mo weight SDS		12-mo weight SDS		3- to 12-mo weight gain SDS	
Lipid	Spearman	P value	Spearman	P value	Spearman	P value
PC-O(34:1)*	0.20	0.003	0.20	0.009	-0.03	0.7
PC(34:1)*	0.20	<.0005	0.20	0.003	0.01	0.9
PC(38:4)†	-0.20	<.0005	-0.20	0.002	-0.04	0.6
SM(34:2)†	0.06	0.4	-0.07	0.3	-0.20	0.005
PC-O(36:4)†	-0.10	0.1	-0.20	0.02	-0.20	0.004

*Lower values in exclusively breast-fed.

†Higher values in exclusively breast-fed.

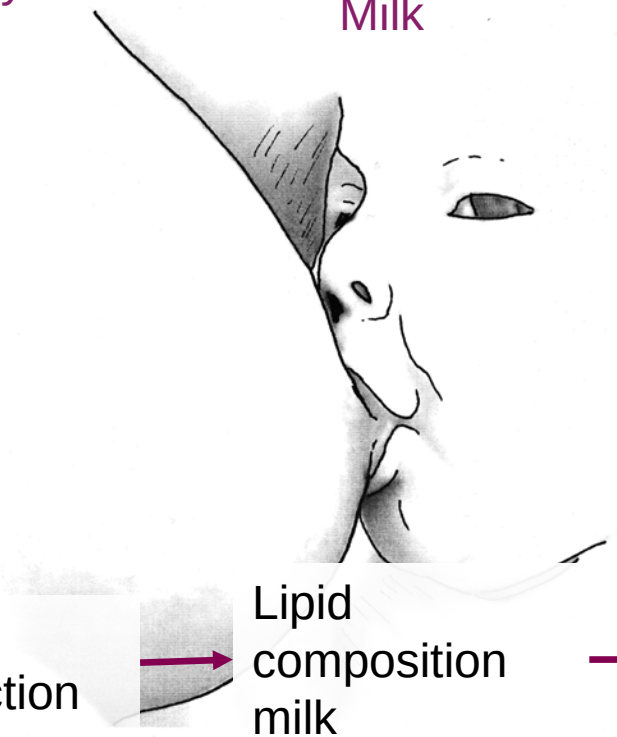
Understanding the role of lipids

Circulation mother

Mammary gland

Milk

circulation infant



Mother circulation → Fat production → Lipid composition milk → Infant circulation

Do dietary lipid influences the circulating lipids?

Proof of principle

Samples collected in the rural Gambia (Drs Georgia Billing & Gail Goldberg).

Infants ca 12 weeks old.

Infant's plasma, mother's plasma collected on the same day, milk collected the next day

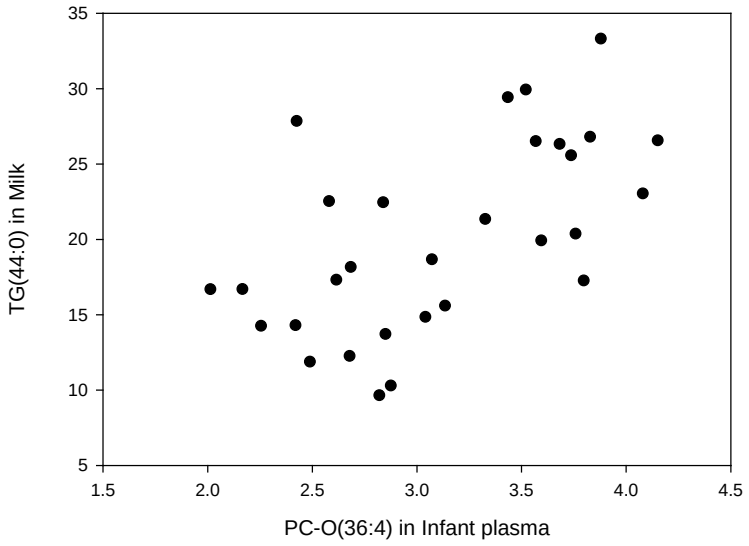
30 infant-mother pairs.

Milk lipids in relation to infant plasma lipids

Spearman correlation between infant plasma lipids and mother milk lipids

		Mother Milk				
		PC(36:4)	TG(44:0)	TG(46:0)	TG(50:2)	TG(57:3)
Infant plasma	PC(34:1)	0.026	0.322	0.214	-0.406	-0.289
	PC(38:4)	-0.165	0.419	0.292	-0.248	-0.414
	PC-O(34:1)	-0.548**	0.224	0.220	-0.129	-0.282
	PC-O(36:4)	-0.228	0.591**	0.550**	-0.469*	-0.529**
	SM(34:2)	-0.362	0.228	0.161	-0.554**	-0.293

*= p<0.01; **=p<0.00268

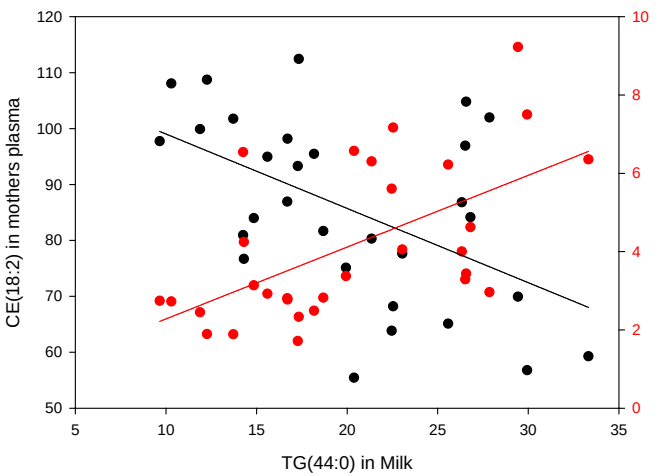


From mothers milk to mother plasma

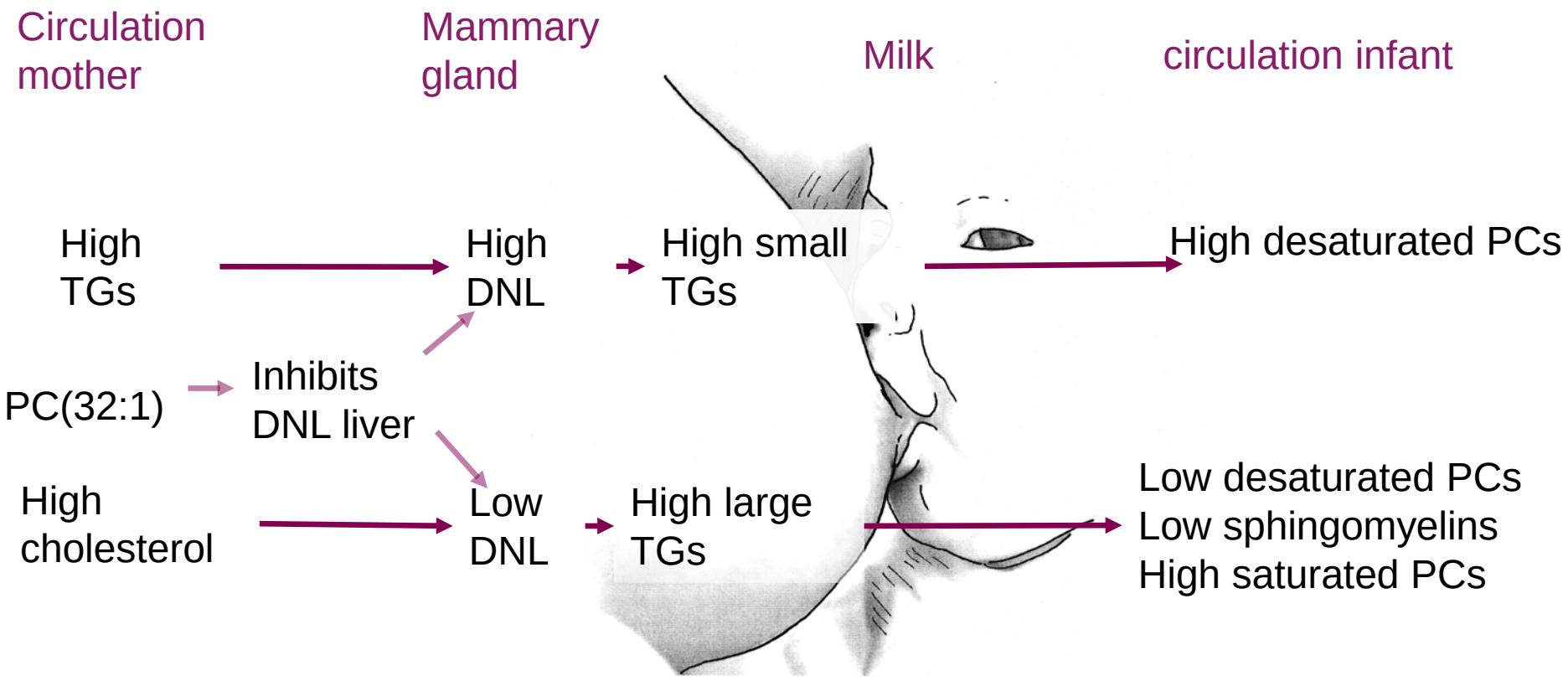
Spearmen correlations between mother milk lipids and mother plasma lipids

Mother plasma	Mother Milk				
	PC(36:4)	TG(44:0)	TG(46:0)	TG(50:2)	TG(57:3)
LysoPC(16:1)	-0.310	0.414	0.540**	0.024	-0.243
CE(16:1)	-0.338	0.456	0.551**	-0.145	-0.236
CE(18:3)	-0.199	0.498*	0.572**	-0.191	-0.207
CE(18:2)	0.376	-0.518*	-0.615**	0.041	0.477*
PE(34:1)	-0.301	0.419	0.579**	-0.049	-0.367
PC(32:1)	-0.359	0.588**	0.686***	-0.074	-0.320
PE(36:1)	-0.281	0.662***	0.741***	-0.162	-0.419
PC(34:4)	-0.268	0.533**	0.613**	-0.167	-0.194
PC(34:3)	-0.300	0.497*	0.583**	-0.126	-0.238
PE(38:3)	-0.308	0.553**	0.628**	-0.115	-0.357
PE(38:1)	-0.300	0.651***	0.651***	-0.128	-0.432
PC(36:1)	-0.209	0.563**	0.534**	-0.173	-0.374
TG(46:2)	-0.288	0.434	0.617**	-0.002	-0.311
TG(46:1)	-0.224	0.456	0.601**	-0.015	-0.300
TG(46:0)	-0.261	0.435	0.587**	0.032	-0.302
TG(48:3)	-0.320	0.390	0.590**	0.017	-0.370
TG(48:2)	-0.367	0.526*	0.701***	-0.058	-0.382
TG(48:1)	-0.325	0.510*	0.678***	-0.026	-0.360
TG(48:0)	-0.323	0.502*	0.639**	-0.018	-0.346
TG(49:3)	-0.214	0.274	0.557**	0.177	-0.303
TG(49:2)	-0.327	0.609**	0.787***	-0.096	-0.462
TG(49:1)	-0.289	0.631**	0.769***	-0.147	-0.470*
TG(50:4)	-0.369	0.307	0.535**	0.023	-0.371
TG(50:3)	-0.389	0.408	0.618**	-0.056	-0.404
TG(50:2)	-0.395	0.561**	0.739***	-0.110	-0.413
TG(50:1)	-0.330	0.542**	0.699***	-0.109	-0.393
TG(51:6)	-0.143	0.542**	0.597**	-0.328	-0.227
TG(51:3)	-0.346	0.562**	0.740***	-0.131	-0.519*
TG(51:2)	-0.292	0.683***	0.815***	-0.203	-0.483*
TG(51:1)	-0.306	0.675***	0.778***	-0.184	-0.465*
TG(52:2)	-0.247	0.445	0.601**	-0.158	-0.360
TG(53:3)	-0.250	0.506*	0.619**	-0.144	-0.441
TG(53:2)	-0.291	0.632**	0.733***	-0.188	-0.486*
TG(53:1)	-0.292	0.438	0.567**	-0.080	-0.381
TG(55:5)	0.029	0.479*	0.557**	-0.119	-0.251

*= p<0.01; **=p<0.00268; ***= p<0.000144



Understanding the role of lipids



Proof of Concept

Limitation

- Selection of circulating lipids based on UK study.
- Milk was collected on the day following blood sampling.
- Did not capture fluctuations milk composition.
- Only lipids were analysed.

Conclusions

- There is strong indirect effect of the plasma lipid profile of the mother on the lipid composition of breastmilk.
- Lipid composition of the milk affects how lipids are metabolised by the infant.

Thank you

Larissa Richardson (CMaLL)

Animesh Acharjee, James West, Lee Matthews, Luke Marney, James Smith, Jules Griffin (LPS)

Sophie Moore (MCN)

Gail Goldberg, Georgia Billing (NBH)

Ken Ong, Nita Forouhi, Nick Wareham (MRC Epidemiology)

Philippa Prentice, David Dunger (Paediatrics UCam)

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