UCD Institute of Food & Health

Relationship between fitness level and the metabolomic profile

Ciara Morris

Outline

- Overview of JINGO/MECHE
- Relationship between fitness level and the amino acid profile of healthy adults

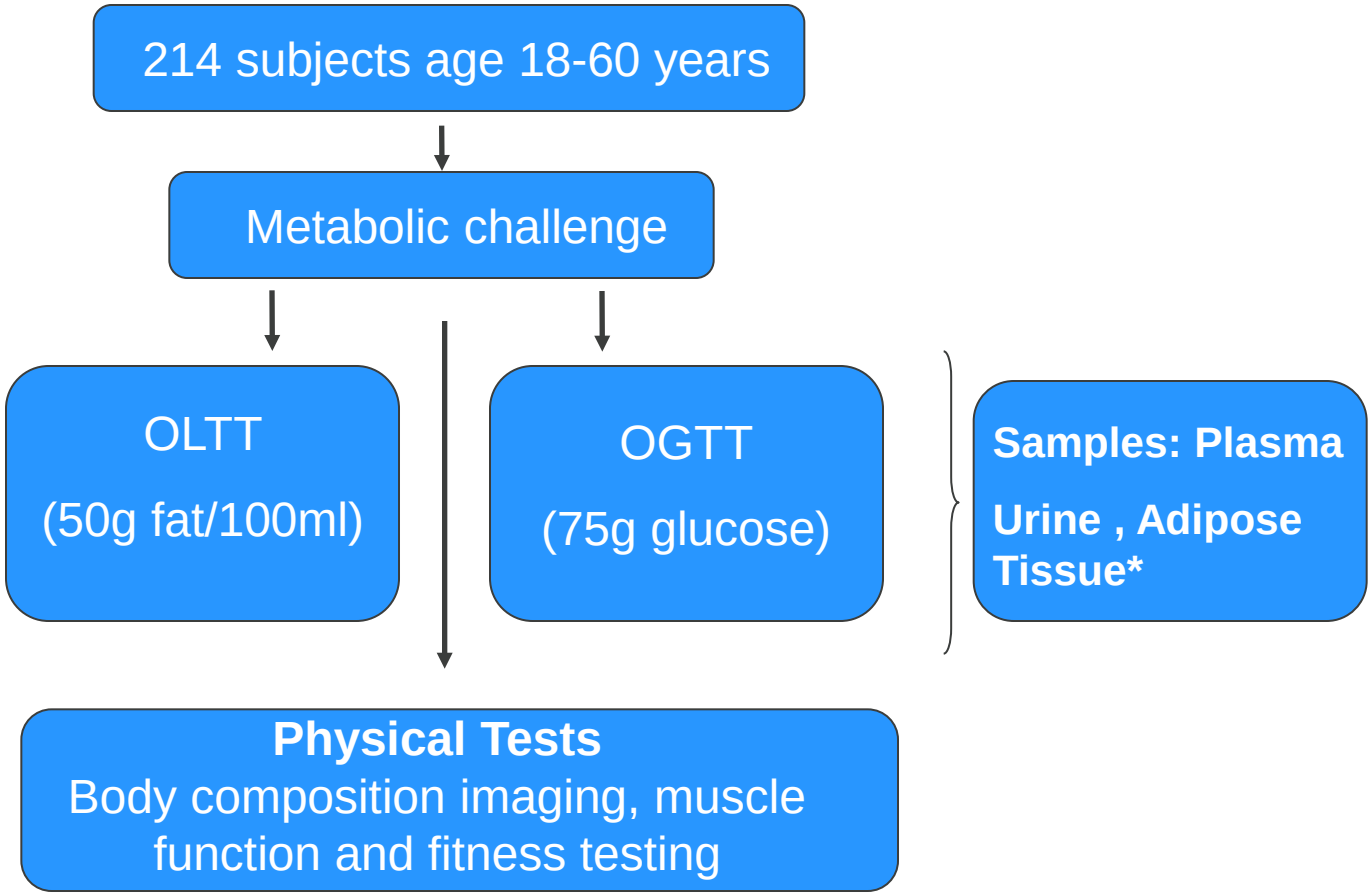
Joint Irish Nutrigenomics Organisation - JINGO

- National Nutrition Phenotype Database.

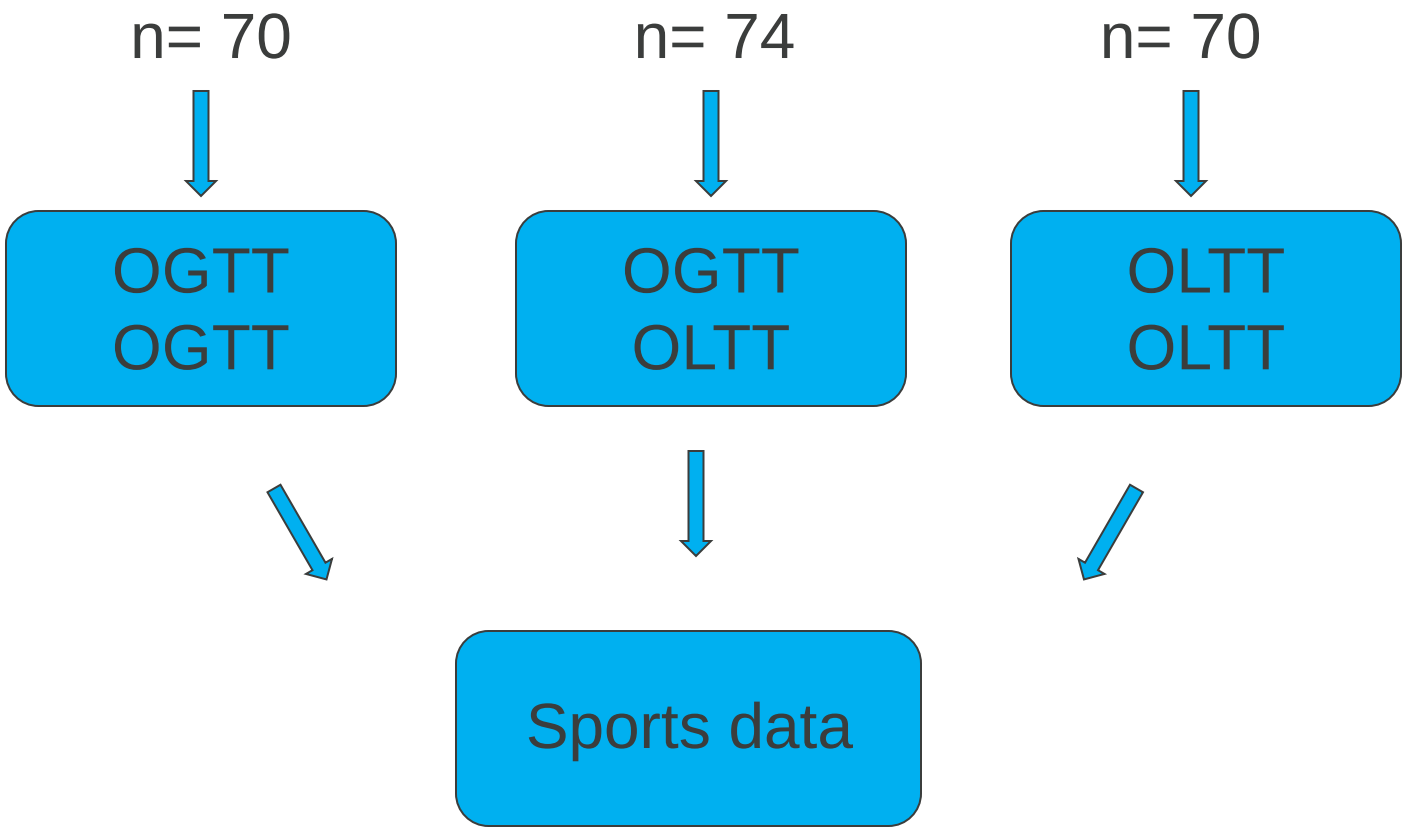
- The database will extend and deepen traditional dietary survey databases by combining dietary, physical activity, body measurement and lifestyle data with nutrigenomics technology data from three projects:
  - National Adult Nutrition Survey (NANS)
    - UCC (1500 adults 18+ yrs)
  - Trinity-Ulster Department of Agriculture Project (TUDA)
    - TCD and UU (6000 adults 60+ yrs)
  - Metabolic challenge study (MECHE)
    - UCD (200 adults 18 - 60 yrs)

National Nutrition Phenotype Database

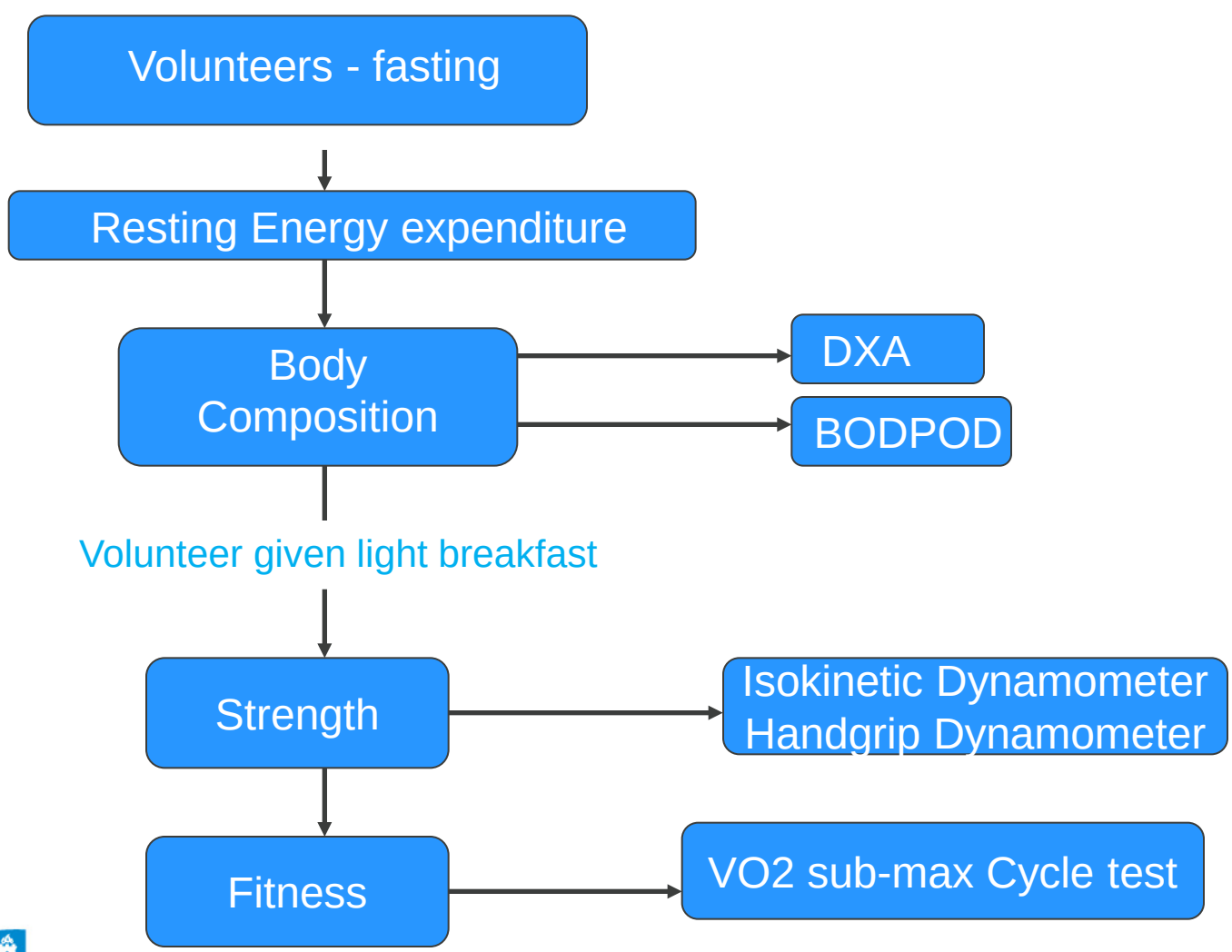
MECHE: Metabolic Challenge Study

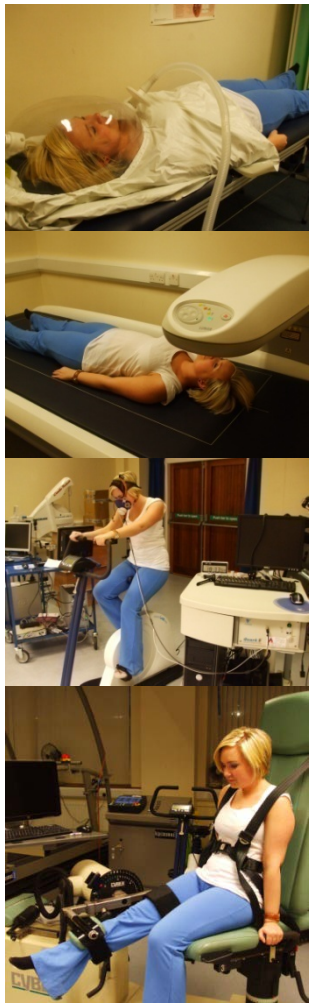


Metabolic Challenge Study



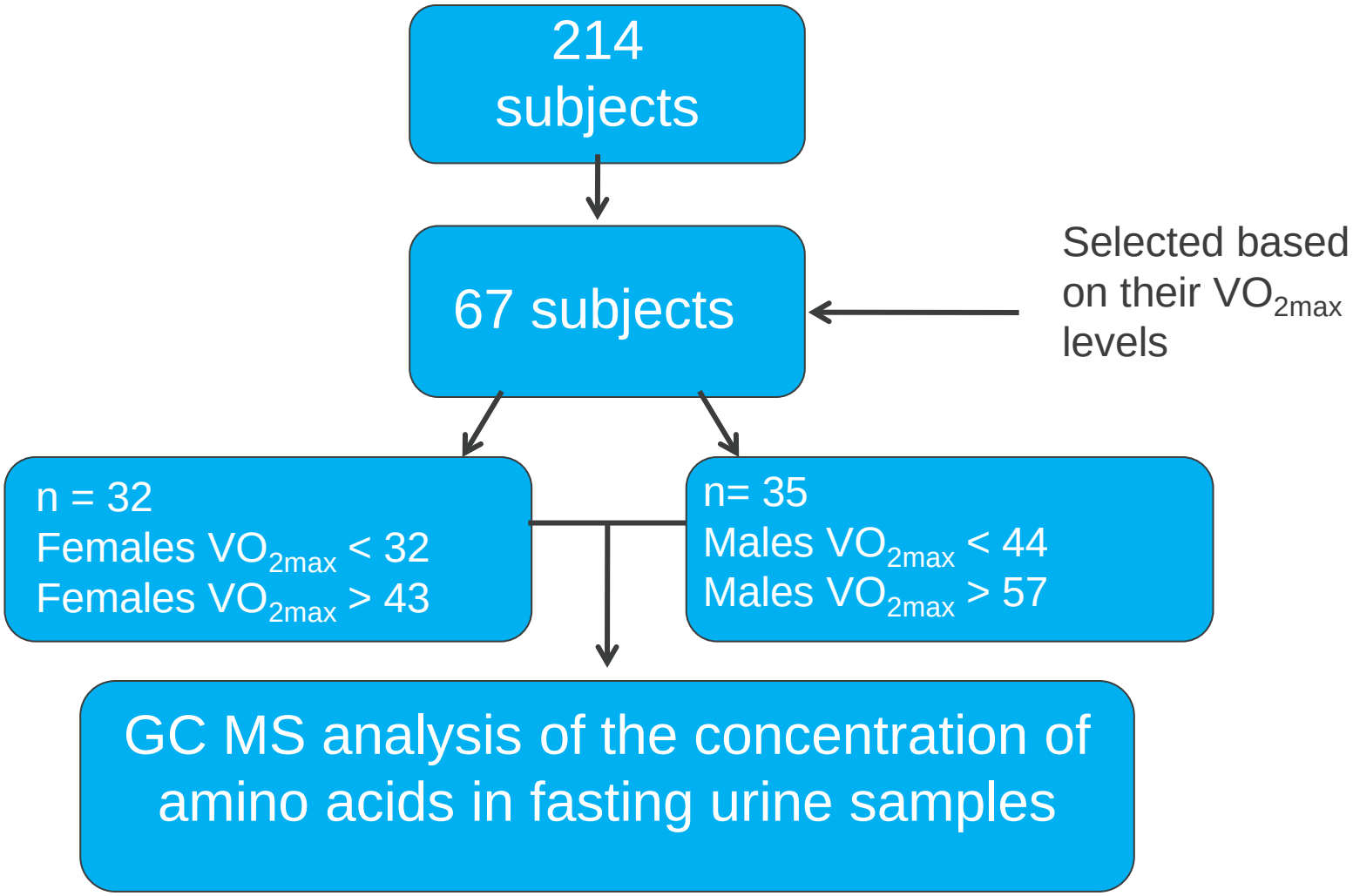
Metabolic Challenge Study





Relationship between fitness level and the metabolomic profile

Study Design



Demographics

	Male		Female	
	Low fitness	High fitness	Low fitness	High fitness
Age (years)	36 ± 12	27 ± 5*	37 ± 11	30 ± 12
BMI ($kg.m^{-2}$)	28.5 ± 7.8	24.6 ± 3.3*	27.2 ± 7.4	22.3 ± 2.4*
% Body Fat	26.1 ± 9.2	13.9 ± 4.2*	37.9 ± 10.4	26.0 ± 4.2*
VO2 Max (ml/min/kg/ffm)	47.1 ± 8.8	71.7 ± 5.2*	43.0 ± 8.0	66.3 ± 5.6*

Dietary Intake

	Males		Females	
	Low fitness	**High fitness**	**Low fitness**	**High fitness**
Energy (kcal)	2319.2±879.7	2469.3±1438.8	1581.5±428.2	1818.7±516.9
Protein*	16.7±6.7	17.9±6.7	18.4±6.2	20.5±6.3
Carbohydrate *	47.6±17.4	51.3±34.2	48.2±16.3	59.9±21.7
Fat – total*	35.9±18.1	37.2±23.1	33.1±9.9	36.3±14.3
Alcohol *	3.5±3.6	4.3±6.9	3.4±2.7	2.1±1.8

***(% of total energy)**

Biochemistry

	Male Low Fitness	Male High fitness	Female Low fitness	Female High fitness
TAG (mmol/l)	1.34±0.77	0.79±0.43*	1.24±0.56	0.8±0.24*
GLU (mmol/l)	4.88±0.52	4.73±0.46	4.85±0.47	4.71±0.31
CHOL (mmol/l)	5.1±1.11	4.01±0.79*	5.07±0.88	4.56±0.92
HDL-C (mmol/l)	1.31±0.25	1.37±0.28	1.61±0.43	1.83±0.23
LDL-C (mmol/l)	3.12±1.03	2.21±0.89*	2.89±0.73	2.46±0.84
CPEP (ng/ml)	4.26±4.24	2.03±1.6	3.65±3.08	1.28±0.77*
FERR (ng/ml)	143±169	87±52	47±29	104±258
RETN (ng/ml)	3.9±1.54	4.79±1.26	5.11±2.47	3.96±1.38
INS (µIU/ml)	11.64±8.89	8.58±6.98	9.82±5.5	4.32±2.39*
TNFA (pg/ml)	5.16±3.05	5.85±5.54	5.36±3.63	3.69±1.22
IL1A (pg/ml)	1.08±1.44	0.74±0.5	0.69±0.4	0.67±0.62
LEPT (ng/ml)	1.4±1.51	0.43±0.7*	2.45±2.76	0.45±0.38*
HOMA-IR	2.61±2.21	1.86±1.4	2.16±1.36	0.89±0.47*
QUICKI	0.34±0.03	0.37±0.05	0.35±0.03	0.4±0.04*

Biochemistry - Cytokines

	Male Low fitness	Male High fitness	Female Low fitness	Female High fitness
IL6	2.18±2.62	0.89±0.56	1.58±1.18	0.63±0.3*
EGF	39.44±34.46	34.22±23.86	43.01±21.15	33.13±25.13
IL1A	0.21±0.31	0.15±0.08	0.29±0.47	1.35±4.22
IL1B	0.9±0.87	1.7±3.93	1.1±0.96	1.12±0.98
IL2	1.35±1.23	1.53±1.27	1.61±1.33	1.81±0.91
IL4	1.91±0.5	1.73±0.42	2.05±0.67	2.48±1.31
IL8	10.31±9.76	6.41±2.48	8.98±10.54	6.02±3.03
IL10	0.66±0.27	1.23±1.1*	1.45±1.58	0.86±0.8
MCP1	218.67±101.17	209.15±101.13	248.96±112.12	154.26±79.83*
VEGF	65.3±64.32	81.11±55.71	84.06±76.79	141.06±127.54
IFNG	1.19±0.92	1.44±1.68	1.66±1.22	1.08±0.88
TNFA	4.27±2.09	4.01±2.14	3.45±1.26	3.05±1.36

Substrate Oxidation - males

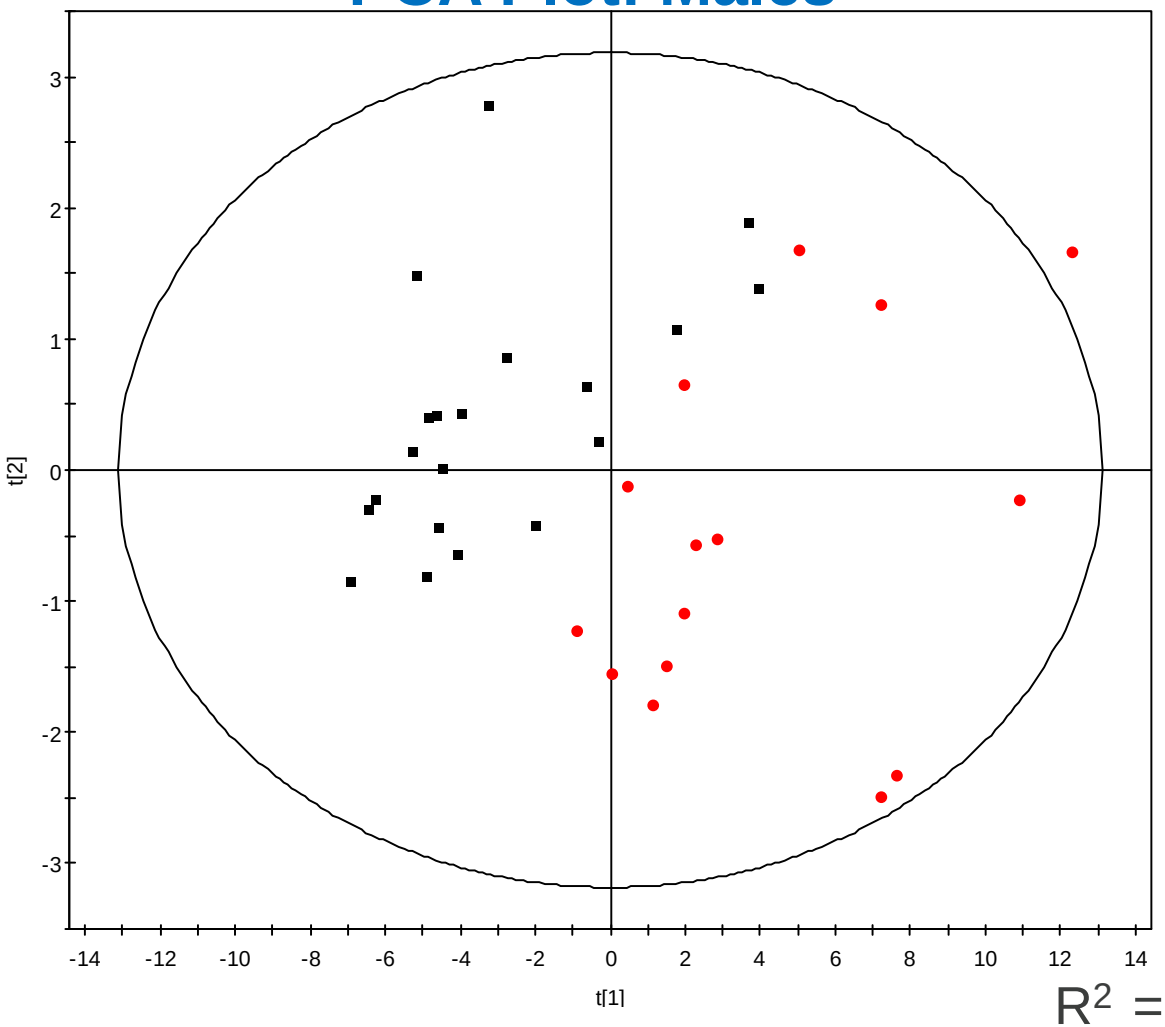
mg/min /ffm	Low fitness	High fitness
Fat Oxidation (15%)	0.231±0.194	0.296±0.141
Fat Oxidation (35%)	0.310±0.222	0.481±0.231*
Fat Oxidation (55%)	0.356±0.233	0.643±0.262
Carbohydrate Oxidation (15%)	1.254±0.509	1.147±0.419
Carbohydrate Oxidation (35%)	2.086±0.583	1.870±0.427
Carbohydrate Oxidation (55%)	3.129±0.694	3.181±0.916

Substrate Oxidation-females

mg/min /ffm	Low fitness	High fitness
Fat Oxidation (15%)	0.214 ± 0.123	0.326 ± 0.195
Fat Oxidation (35%)	0.328 ± 0.276	0.546 ± 0.198*
Fat Oxidation (55%)	0.248 ± 0.268	0.517± 0.261*
Carbohydrate Oxidation (15%)	1.478 ± 0.612	1.372 ± 0.619
Carbohydrate Oxidation (35%)	2.452 ± 1.254	2.017 ± 1.155
Carbohydrate Oxidation (55%)	3.615 ± 1.003	2.767 ± 0.952*

Metabolomic Analysis

PCA Plot: Males

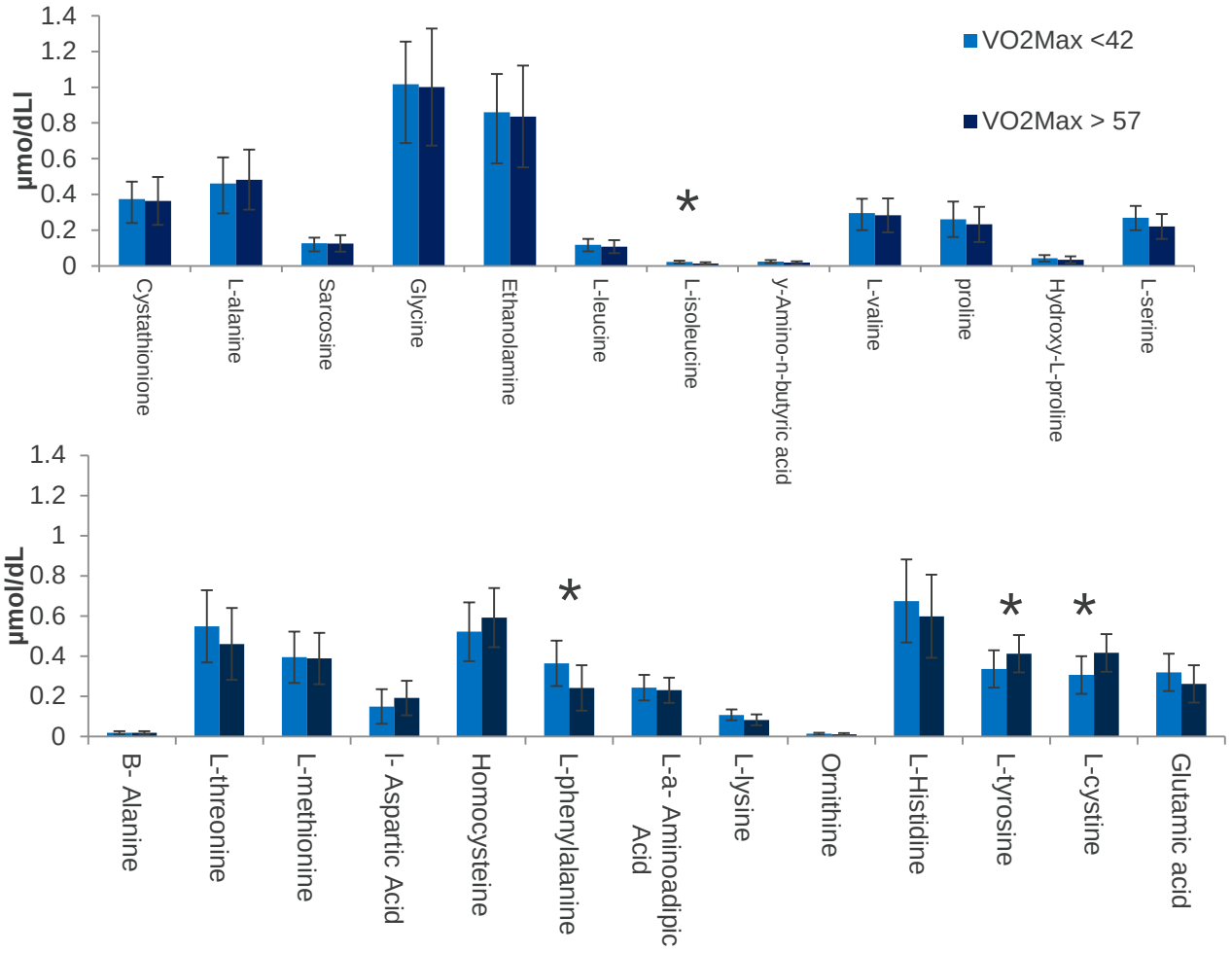


Males VO_2 Max < 42

Males VO_2 Max > 57

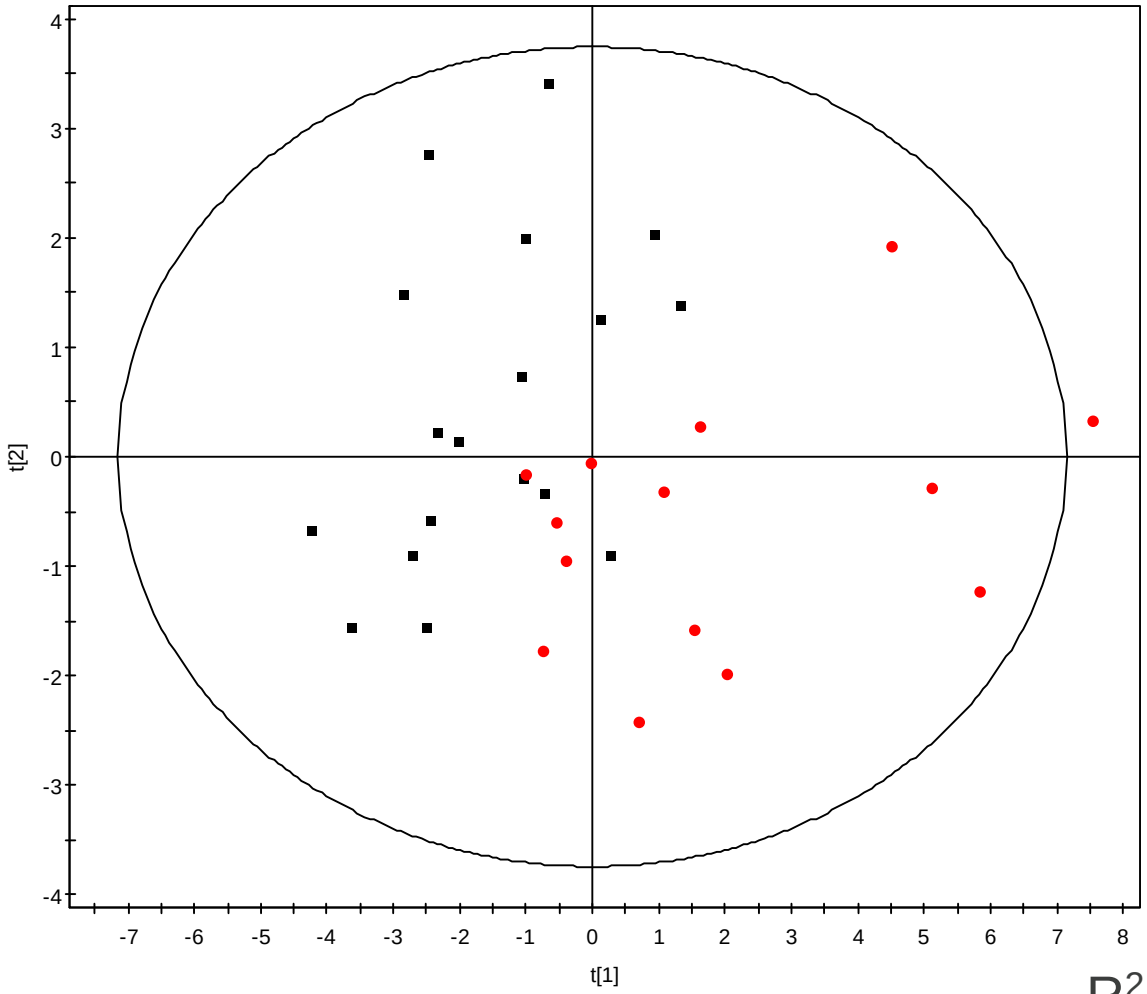
$R^2 = 0.948$, $Q^2 = 0.920$

Amino acid profiles - males



Metabolomic Analysis

PCA Plot: Females

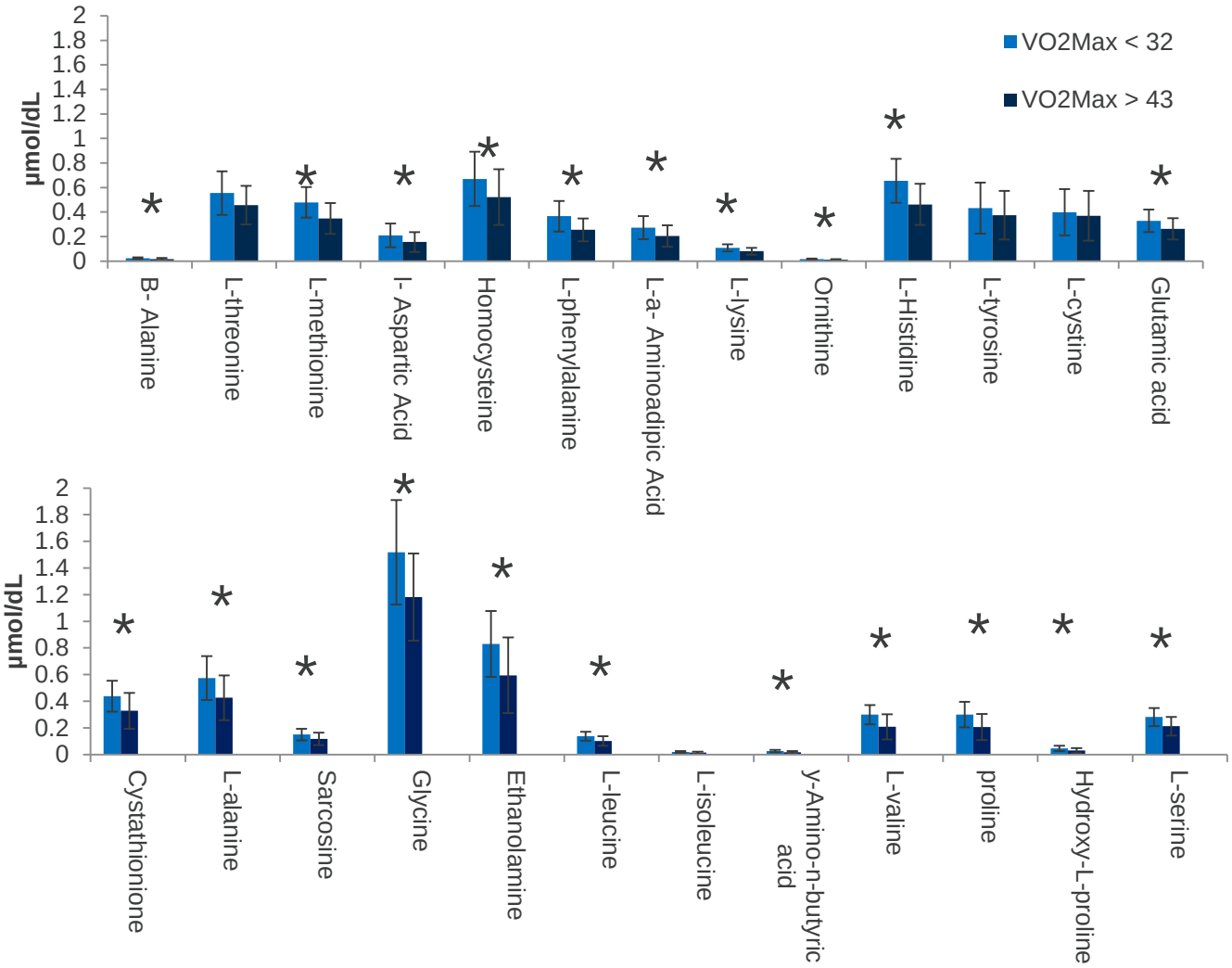


Females VO_2 Max < 42

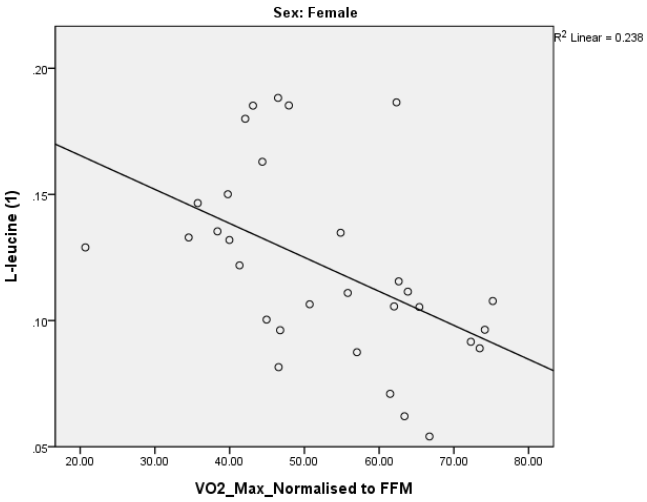
Females VO_2 Max > 57

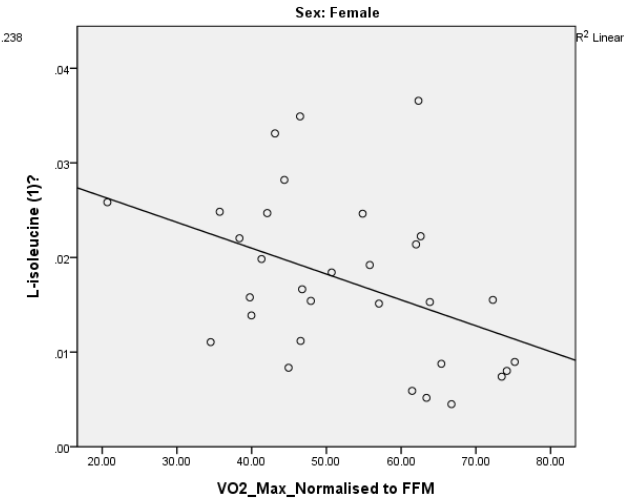
R^2 0.931 Q^2 0.661

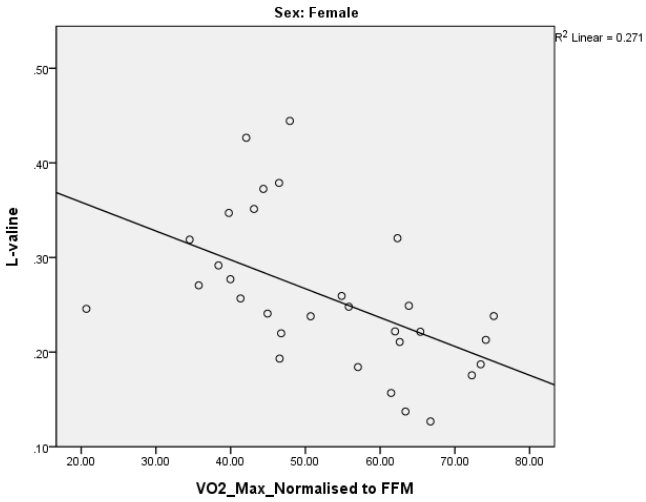
Amino acid profiles- females

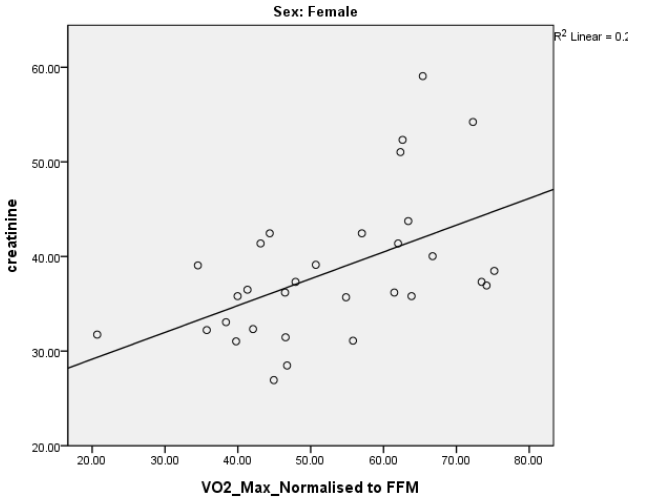


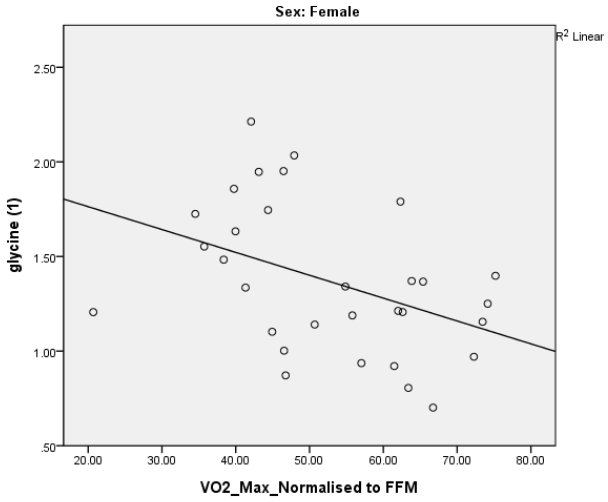
VO_{2max} and Amino Acid

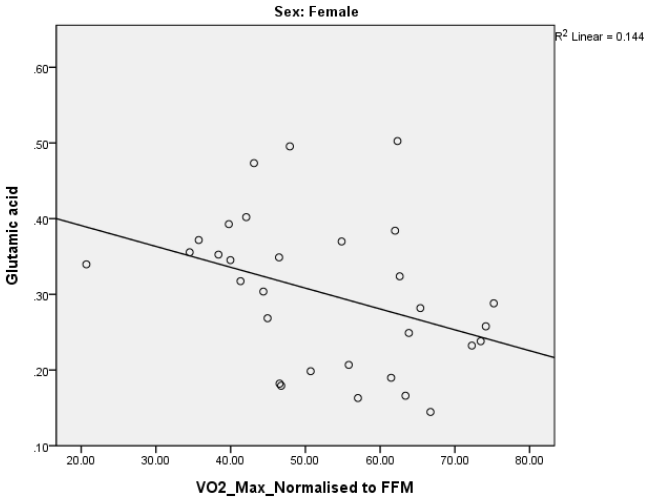




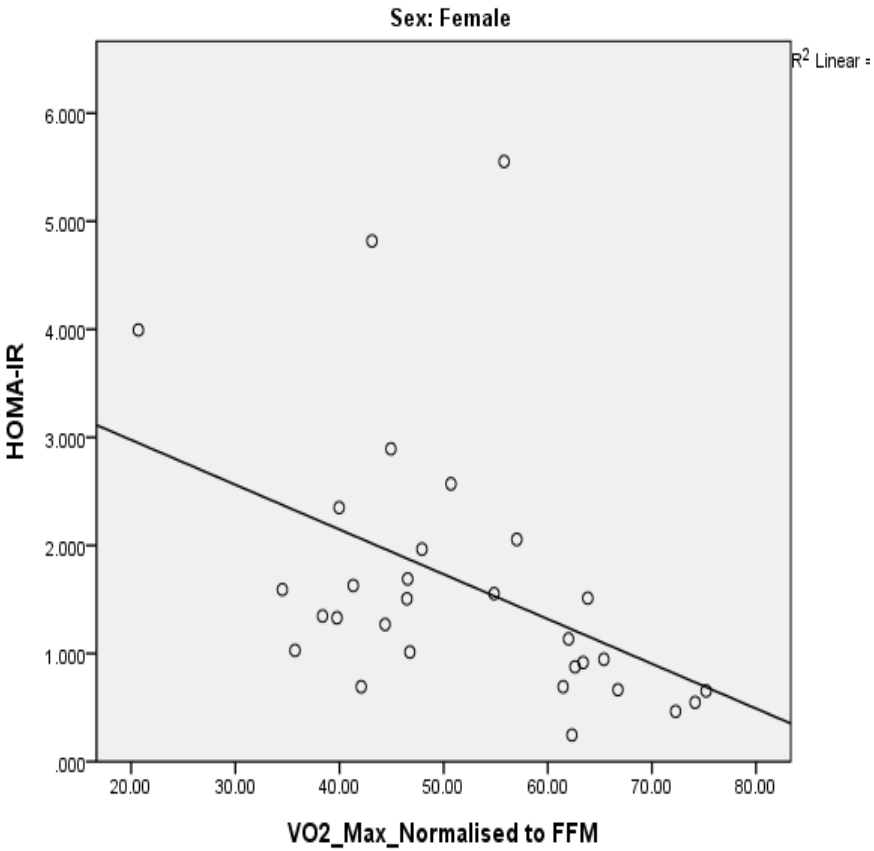


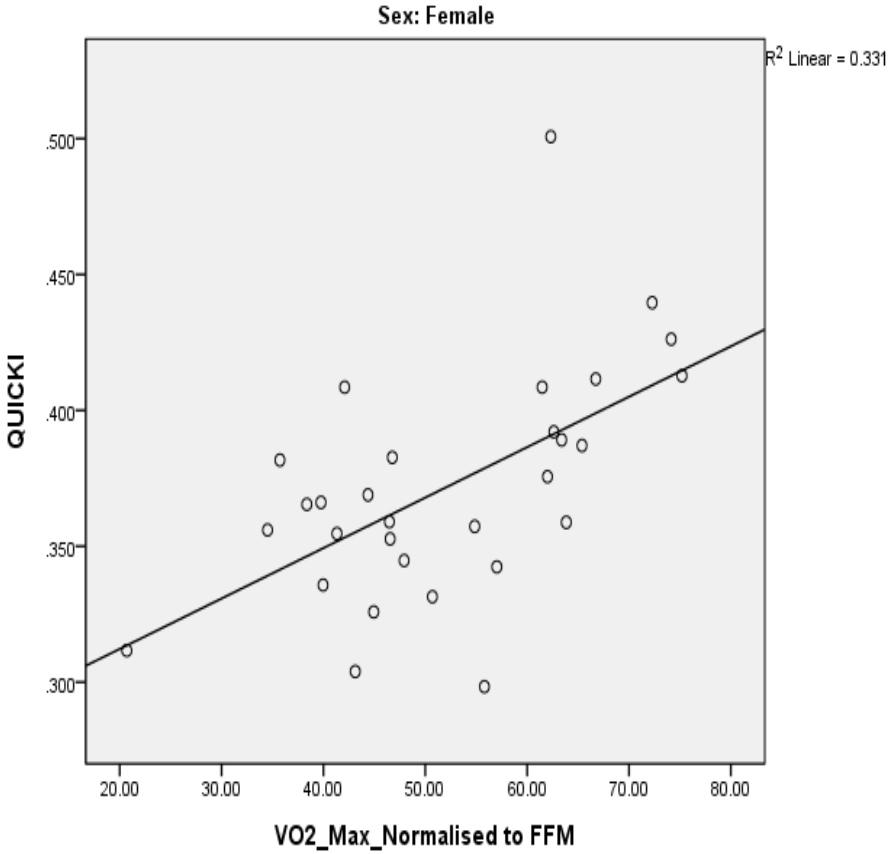






Correlations – VO_{2max} and Insulin resistance



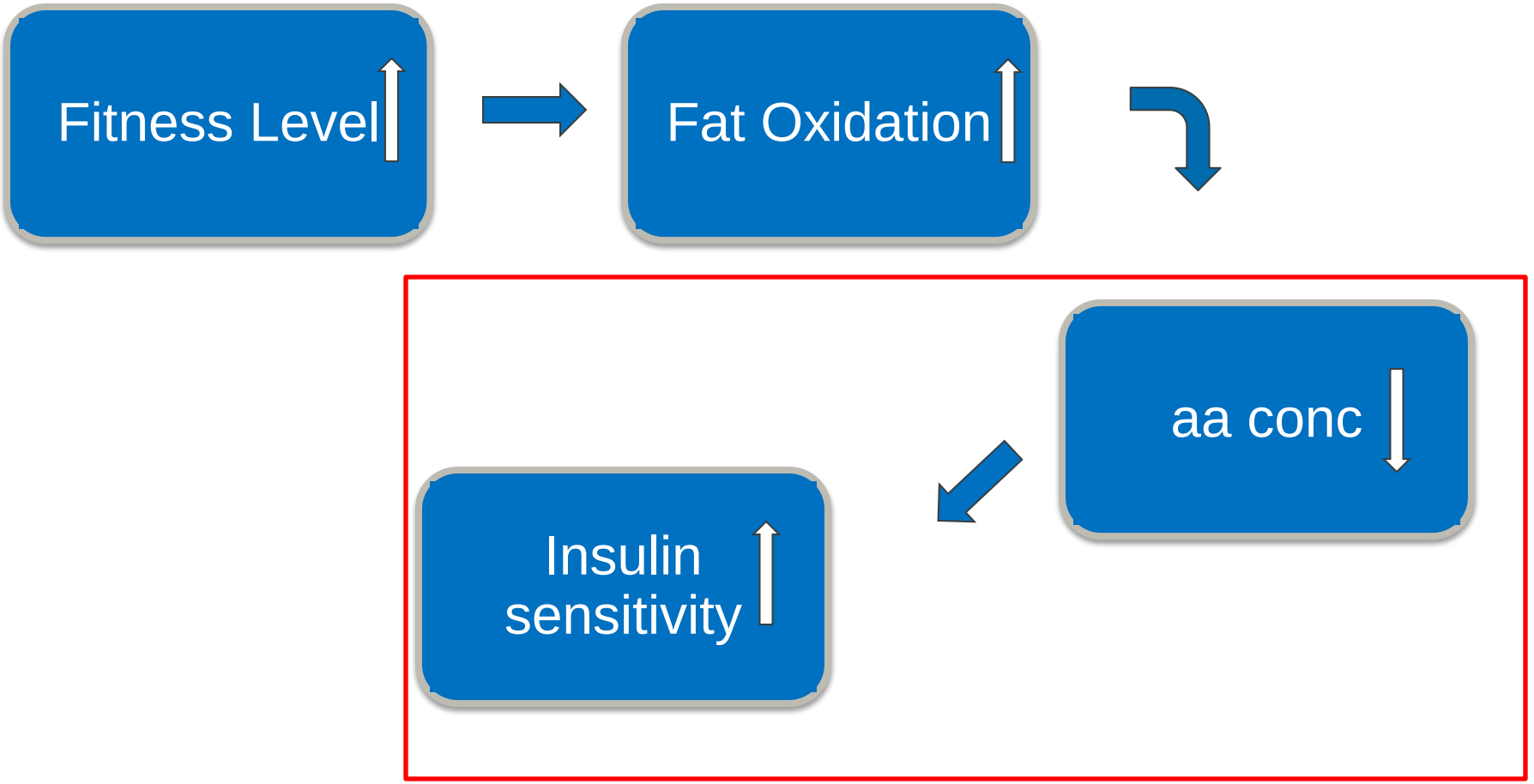


Conclusions

- This study demonstrates a relationship between fitness level and the amino acid profiles of healthy adults with the biggest impact shown in the female population.

- This study reveals the importance of fitness level when considering the pre-analytical factors that may influence the outcome of experiments in metabolomic studies.

Summary slide



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An Roinn Talmhaíochta, Iascaigh agus Bia

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