Plasma lipidomics are associated with adiposity in overweight or obese but otherwise healthy non-diabetic adults

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Background

- Adiposity is a major risk factor for dyslipidaemia and chronic diseases including type 2 diabetes and cardiovascular disease.
- Novel lipidomics methods are providing new insights into the role of lipid metabolism in chronic diseases.
- Limited studies have examined the relationship between adiposity and the plasma lipidome in humans.

Hypothesis

We hypothesized that increased total and central adiposity will be associated with dysregulation of certain lipid species or classes.

Aim

To examine whether adiposity measured by body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), or total percent body fat is associated with lipid species or classes in overweight or obese non-diabetic adults.

Study population

- 65 participants (41M / 24F):
 - healthy, non-diabetic adults (WHO guidelines)
 - age between 18 and 60 yrs
 - overweight or obese (BMI ≥ 25 kg/m²)
 - non-smokers and not taking medications or using illicit drugs
 - no chronic diseases or clinical or laboratory signs of acute or chronic inflammation

Methods

- Anthropometry: BMI, WC, WHR, and total percent body fat by dual X-ray absorptiometry (DEXA).
- Lipidomics analysis: Liquid chromatography electrospray ionization tandem mass spectrometry was used, which identified 459 lipid species across 26 lipid classes from the sphingolipid, glycerolipid, phospholipid, plasmalogen, and sterol lipid groups.
- Statistical analyses were performed on Matlab software. All analyses were adjusted for multiple testing using Benjamini Hochberg (BH) correction.

Results

Table 1. Sample characteristics

	Mean ± SD or n (%)
Male/ Female, <i>n</i>	41/24
Age (years)	31.3 ± 8.5
BMI (kg/m ²)	31.5 ± 5.3
WHR	1.1 ± 1.2
Body fat (%)	40.1 ± 8.7

- On univariable analyses, total percent body fat was inversely associated with eight different lipid classes including ceramides (Cer), gangliosides (GM3), diacylglycerols (DG), triacylglycerols (TG), lysoalkylphosphatidylcholine (LPC-O), alkylphosphatidylethanolamine (PE-O) and plasmalogens: alkenylphosphatidylcholine-P (PC-P) and alkylphosphatidylethanolamine-P (PE-P) (all $p < 0.05$ after BH correction; Figure 1).
- There were no associations between lipid classes or species and BMI, WC, or WHR (all $p > 0.05$).

Fig 1. Correlations between body fat and lipid classes

Fig 2. Relationship between body fat and lipids after adjustment for age and sex

- After adjusting for age and sex, only the plasmalogen lipid class PE-P remained inversely associated with total percent body fat ($\beta = -3.3$, $p = 0.03$; Figure 2).

Conclusions

- Our findings are consistent with previous studies showing that plasmalogen lipid classes are reduced in obesity.
- However, most previous studies have used indirect anthropometric measures such as BMI or WHR.
- Our data suggest that greater adiposity determined by body fat is more strongly related to reduced plasmalogen concentrations than BMI, WC, or WHR in overweight or obese non-diabetic adults.

References:

- Weir, et al. *J Lipid Res*, 2013
- Tonks et al., *Obesity*, 2016
- Pietiläinen, et al., *PlosOne*, 2007
- Hanamatsu et al., *Nutr. Diabetes*, 2014

Abbreviations:

- COH: cholesterol
- CE: cholesterol ester
- dhCer: dihydroceramides
- DHC: dihexosylceramides
- PC: phosphatidylcholine
- PC-O: alkylphosphatidylcholine
- PG: phosphatidylglycerol
- PI: phosphatidylinositol
- PS: phosphatidylserine
- SM: sphingomyelin
- THC: trihexosylcermides