ADIPOCYTE SIZE IN OBESITY WITH AND WITHOUT METABOLIC SYNDROME

J. Koskimies¹, S. Heinonen¹, S. Jukarainen¹, V. Ek¹, A. Hakkarainen², N. Lundbom², J. Borén³, K. Pietiläinen¹,
M-R. Taskinen¹, S. Söderlund¹, N. Matikainen¹

¹ Research Programs’ Unit Clinical and Molecular Metabolism, University of Helsinki, Helsinki, Finland; ² Department of Radiology, University of Helsinki, Helsinki, Finland; ³Department of Molecular and Clinical Medicine, University of Gothenburg, Gothenburg, Sweden

BACKGROUND AND AIMS

➤ In obesity, adipocyte size and number increase, which can lead to dysfunctional adipose tissue associated with metabolic disorders, such as insulin resistance, dyslipidemia and ectopic fat accumulation

➤ The aim of this study was to investigate

- Whether adipocyte size increases in obesity with metabolic syndrome (MetS)
- Whether adipocyte cell size associates with adverse metabolic changes

➤ We studied 54 obese subjects without MetS (BMI 27-40kgm⁻²), 47 obese subjects with MetS (BMI 27 – 40 kgm⁻²), and 30 healthy subjects with normal BMI < 25 kgm⁻²

➤ The subjects were classified according to BMI and ATPIII criteria (NCEP Panel) for MetS

METHODS

➤ Liver, subcutaneous and visceral fat depots were measured with MRI spectroscopy

➤ Mean subcutaneous abdominal adipocyte size in µm of each subject was measured from fat cell biopsies under a light microscope

RESULTS

	Normal weight	Obese no MetS	MetS
Age, years	42 ± 16	47 ± 13	59 ± 9#, †
BMI, kgm ⁻²	22.5 ± 1.4	30.3 ± 3.8*	30.7 ± 3.2#
Waist, cm	79 ± 9	103 ± 10*	111 ± 8#, †
SystRR, mmHg	128 ± 21	134 ± 17	141 ± 14#
Fat cell diameter, µm	78 ± 13	97 ± 14*	94 ± 16#
Liver fat, %	0.6 ± 0.3	4.1 ± 4.5*	11.0 ± 8.0#, †
VAT, cm ³	503 ± 515	2122 ± 1118*	3062 ± 934#, †
SAT, cm ³	2502 ± 1008	4139 ± 1540*	4259 ± 1394#
HbA1c, mmol/mol	34 ± 3	35 ± 4	43 ± 8#, †
HDL, mmol/L	1.8 ± 0.5	1.4 ± 0.4*	1.3 ± 0.5#
LDL, mmol/L	2.8 ± 0.7	3.2 ± 0.8	3.1 ± 0.9
Triglycerides, mmol/L	0.8 ± 0.3	1.2 ± 0.6*	1.8 ± 0.9#, †
Glucose, mmol/L	5.3 ± 0.5	5.4 ± 0.4	6.8 ± 1.9#, †
Insulin, pmol/L	31 ± 16	67 ± 36*	106 ± 52#, †
HOMA-IR	1.1 ± 0.6	2.3 ± 1.3*	4.9 ± 2.9#, †

Table 1. Characteristics of the study subjects (n = 131). Mean ± SEM

Post hoc tests after analysis of variance, p < 0.05

* Between Normal weight and Obese no Mets, # between Normal weight and MetS, † between Obese no MetS and MetS

Variable	Fat cell diameter	
	r	p
BMI	0.378	0.001
Waist	0.362	0.002
Liver fat	-0.061	0.623
VAT	0.309	0.010
SAT	0.425	0.000
F-insulin	0.222	0.068
S-TG	-0.103	0.403
HDL	-0.106	0.389
Gluc 0	0.210	0.086
Ins 0	0.222	0.069
Gluc AUC	0.016	0.873
Ins AUC	0.062	0.536
HOMA-IR	0.251	0.039

Table 2. Determinants of fat cell diameter –correlation with metabolic parameters adjusted for age and gender. Significant determinants are bolded.

Fat cell distribution

Figure 1. Percentual distribution of the mean fat cell size in normal weight, obese without MetS and MetS subgroups.

Predictor variables	Std. Coefficient	SEM	p
Gender	-0.172	4.365	0.131
Age	0.072	0.175	0.615
HOMA-IR	-0.027	0.858	0.836
VAT	0.337	0.002	0.031

Table 3. Determinants of fat cell size in multivariate regression analysis.

Figure 2. Relationship between adipocyte diameter and visceral adiposity tissue in subjects with and without MetS. Fat cell diameter and VAT correlate in subjects without MetS but not in subjects with MetS.

CONCLUSIONS

- Adipocyte size increases with adiposity in subjects with normal BMI and in obese subjects without MetS
- In obesity, adipocyte size is not further affected by the presence of MetS
- Current results are in line with the concept that with saturation of fat cell storage capacity, lipid overflow is associated with visceral fat accumulation and multiple adverse metabolic changes