# Continuous glucose monitoring parameters in insulin-treated type 2 diabetic patients: relationships with obesity and body composition

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#### Background and aim:

Obesity and associated insulin resistance can modify daily blood glucose fluctuations in patients with diabetes.

The aim of our study was to determine the relationships between obesity, body composition and daily dynamics of glucose, assessed by continuous glucose monitoring (CGM), in patients with type 2 diabetes treated with insulin.

#### Materials and Methods:

One hundred and thirty six insulin-treated patients with type 2 diabetes were examined. Real-time or blinded CGM was performed using *Medtronic* CGM devices in hospital settings. Time in ranges and a panel of glucose variability (GV) parameters were derived from CGM recordings.

### **Results:**

Patients with obesity did not differ from those with body mass index (BMI) <30 kg/m<sup>2</sup> by age, diabetes duration and other anthropometric and laboratory characteristics

#### CLINICAL AND LABORATORY CHARACTERISTICS OF TYPE 2 DIABETIC PATIENTS WITH AND WITHOUT OBESITY

Parameter	BMI <30	BMI <30 BMI <u>&gt;</u> 30	
	kg/m <sup>2</sup>	kg/m <sup>2</sup>	
	(n=43)	(n=93)	
Sex, m/f	18/25	31/62	0.002
Age, years	63 (62; 68)	63 (57; 69)	0.41
Diabetes duration, years	16 (10; 20)	17 (11; 20)	0.55
Duration of insulin therapy, yrs	6.5 (3; 10)	7 (4; 11)	0.36
Daily insulin dose, IU/kg	0.61 (0.34; 0.71)	0.6 (0.46; 0.8)	0.39
Triglycerides, mmol/l	1.86 (1.23; 2.63)	2.01 (1.43; 2.83)	0.18
Uric acid, µmol / L	323 (269; 380)	347 (257; 409)	0.39
UACR, mg/mmol	1.95 (0.6; 9)	2.3 (0.7; 9.4)	0.78
Cholesterol, mmol /l	4.53(3.51;5.6)	4.95(4.43;5.8)	0.1
LDL cholesterol, mmol /l	2.59(1.89;3.63)	3.05(2.6;3.7)	0.08
eGFR, ml/min/1,73m <sup>2</sup>	67(56;84)	65(53.5;80)	0.51

eGFR, estimated glomerular filtration rate; UACR, urinary albumin-tocreatinine ratio; Data are shown as medians (25; 75 percentiles). • Patients with obesity, as compared to those without, demonstrated reduced TBR, LBGI, LI and MAG values.

Parameter	BMI < 30 kg/m <sup>2</sup>	BMI >30 kg/m <sup>2</sup>	Р	
	(n=43)	(n=93)	-	
HbA1c, %	8.22	8.96		
-	(7.89; 9.29)	(8.03; 10.03)	0.07	
Mean glucose,	0.2 (7.2, 0.4)	8.33	0.43	
mmol/l	8.2 (7.2; 9.4)	(7.45; 9.52)		
TIR, %	53.3	54.7	0.61	
	(41.6; 74.7)	(33.5; 72.2)	0.01	
TAR, %	42.0	43.0	0.36	
	(19.9; 56.32)	(23.3; 63.8)	0.30	
TBR, %	2.6 (0.5;6.6)	0.0 (0.0; 2.36)	<0.001	
SD, mmol/l	2.4 (1.7; 2.5)	1.9(1.3; 2.0)	0.21	
MAGE, mmol/l	4.3 (3.6; 5.9)	4.1(3.3; 5.1)	0.08	
CONGA, mmol/l	6.6 (5.9; 7.6)	7.0 (6.1; 7.9)	0.31	
Ll, a.u.	2.9 (1.5; 4.3)	2.1 (1.3; 3.0)	0.04	
HBGI, a.u.	6.0 (3.1; 8.9)	5.6 (3.2; 8.1)	0.92	
LBGI, a.u.	1.4 (0.87; 1.89)	0.62 (0.19; 1.35)	<0.001	
MAG, mmol/l/h	1.9 (1.6; 2.4)	1.7 (1.4; 1.9)	0.03	

Data are shown as medians (25; 75 percentiles). p<0,05

TIR, Time In Range; TAR, Time Above Range; TBR, Time Below Range; SD, Standard Deviation; MAGE, Mean Amplitude of Glucose Excursions; CONGA, 2-hour Continuous Overlapping Net Glycemic Action; LI, Lability Index; HBGI, High Blood Glucose Index; LBGI, Low Blood Glucose Index; MAG, Mean Absolute Glucose. We also found some negative correlations between total fat mass and SD, LI, HBGI, MAGE and MAG indices. The same way, truncal fat mass, android and gynoid fat mass demonstrated inverse correlations with these GV parameters.

#### CORELATION BETWEEN TOTAL FAT MASS AND MAGE IN PATIENTS WITH TYPE 2 DIABETES



#### CORRELATIONS BETWEEN CGM-DERIVED GV PARAMETERS AND FAT MASS PARAMETERS IN PATIENTSWITH TYPE 2 DIABETES

Parameter	Total fat mass	Truncal fat mass	Android fat mass	Gynoid fat mass
HbA1c	r= -0.23	r=-0.27	r=-0.24	r=-0.28
	p=0.14	p=0.08	p=0.13	p=0.07
SD	r=-0.53	r=-0.45	r=-0.44	r=-0.56
	p=0.0008	p=0.004	p=0.004	p=0.0002
MAGE	r=-0.38	r=-0.39	r=-0.38	r=-0.37
	p=0.02	p=0.02	p=0.02	p=0.02
CONGA	r=-0.16	r=-0.15	r=-0.18	r=-0.18
	p=0.32	p=0.35	p=0.24	p=0.25
ы	r=-0.51	r=-0.5	r=-0.47	r=-0.47
	p=0.0008	p=0.001	p=0.002	p=0.002
HBGI	r=-0.33	r=-0.33	r=-0.33	r=-0.33
	p=0.04	p=0.04	p=0.04	p=0.04
LBGI	r=-0.29	r=-0.25	r=-0.23	r=-0.3
	p=0.06	p=0.12	p=0.14	p=0.04
MAG	r=-0.57	r=-0.56	r=-0.55	r=-0.52
	p=0.0001	p=0.0002	p=0.0002	p=0.0006

Mann-Whitney test

## **Conclusions:**

• These data demonstrate the association between obesity, body composition and CGM parameters in insulin-treated type 2 diabetic subjects.

• The presence of obesity and accumulation of adipose tissue is associated with reduced GV and diminished risk of hypoglycemia.

• The effect of obesity on GV and the risk of hypoglycemia could be mediated by insulin resistance.