

BMI Correlates Positively with Hair Cortisol, whereas Excessive Body Fat Correlates Positively with Hair Cortisol: Salivary Cortisol and Fasting Insulin Concentrations in Prepubertal Girls

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OBJECTIVES

Chronic stress and increased adiposity have been associated with each other in children and adults. Further studies are needed, however, to evaluate both the directionality of this association and the mediating metabolic mechanisms. This study investigates the interrelations between body composition parameters, indices of the stress response, such as hair and salivary cortisol levels, and, metabolic mediators, such as insulin.

METHODS

- 26 obese prepubertal girls (BMI 24.7 ± 3.4 Kg/m²) and 24 normal weight prepubertal girls (BMI 16.9 ± 1.7 Kg/m²), aged 5-10 years
- Anthropometrics (Table 1)
- Body composition analysis using an advanced bioimpedance apparatus (BIA-ACC, Biotekna, Venice, Italy) (Table 2)
- Scalp hair samples from the posterior vertex were collected to measure hair cortisol concentrations. Cortisol was extracted overnight in methanol, followed by solid phase extraction. Quantification of cortisol was performed using a Waters Xevo TQ-S LC-MS/MS system. Fasting blood samples were withdrawn for serum cortisol and insulin measurements.
- Five serial saliva samples over a weekend day (8:30, 12:00, 15:00, 18:00, 21:00) were also collected for cortisol measurements.

PARTICIPANTS

Table 1. Anthropometric characteristics of the participants

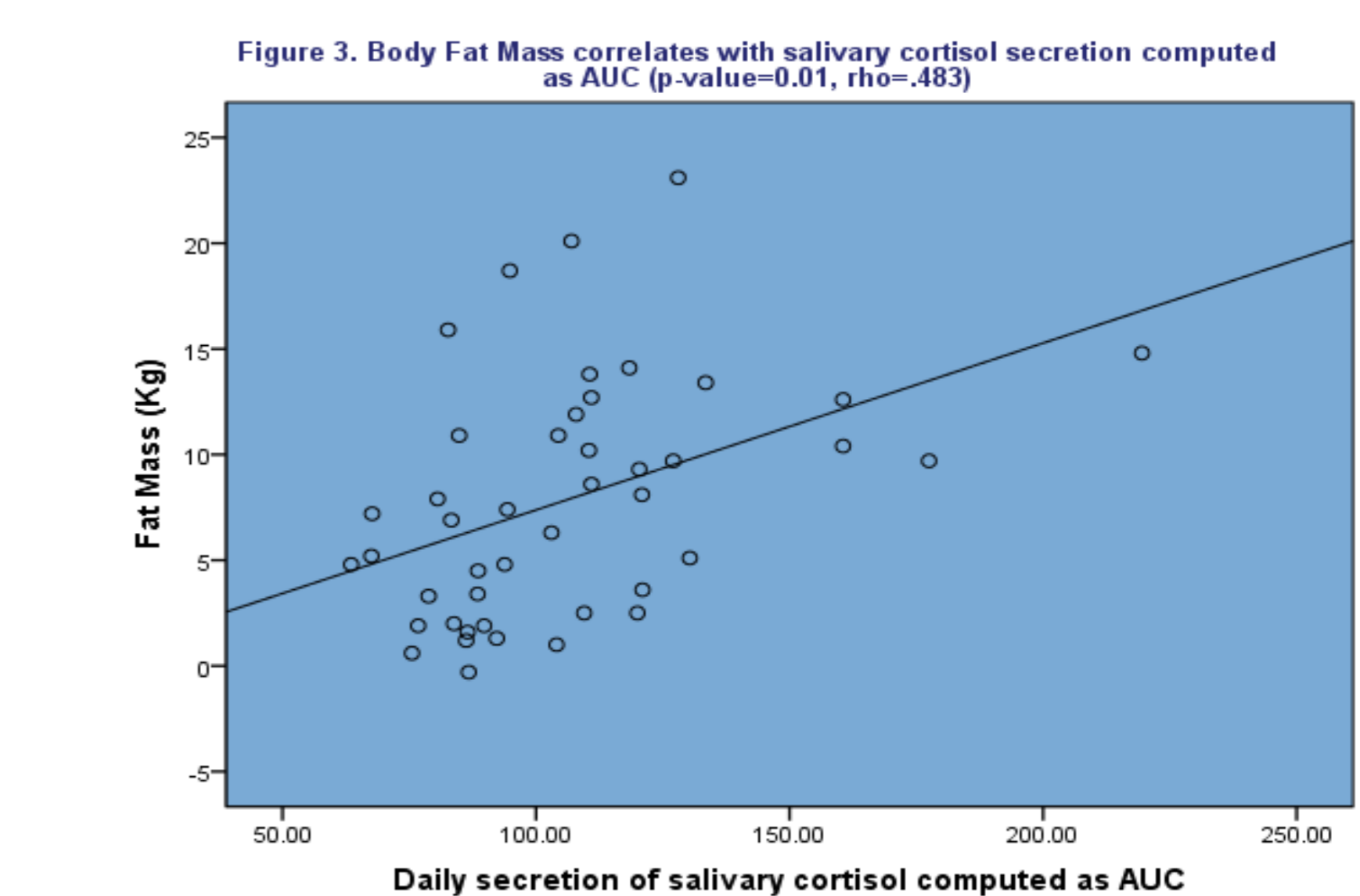
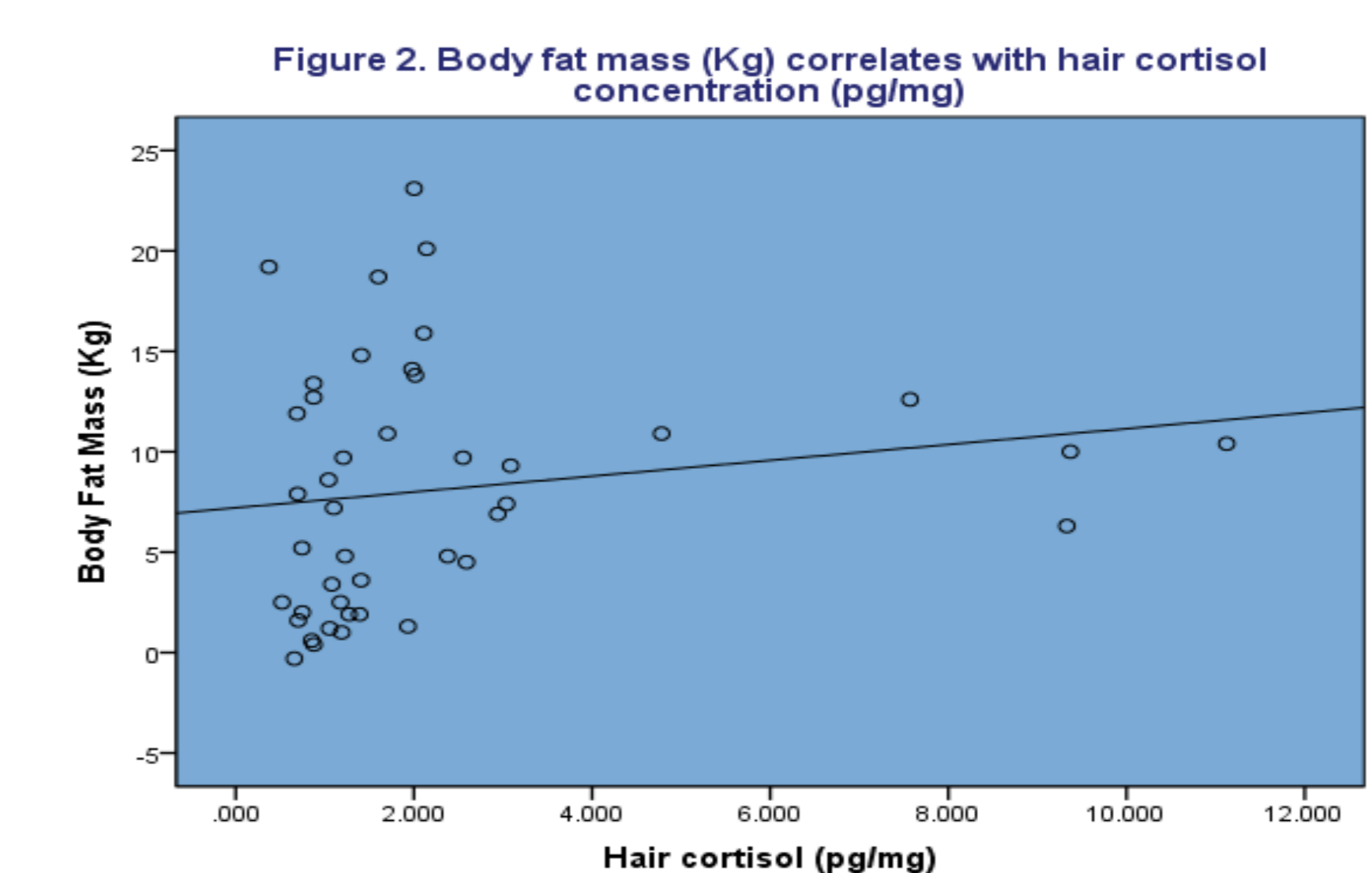
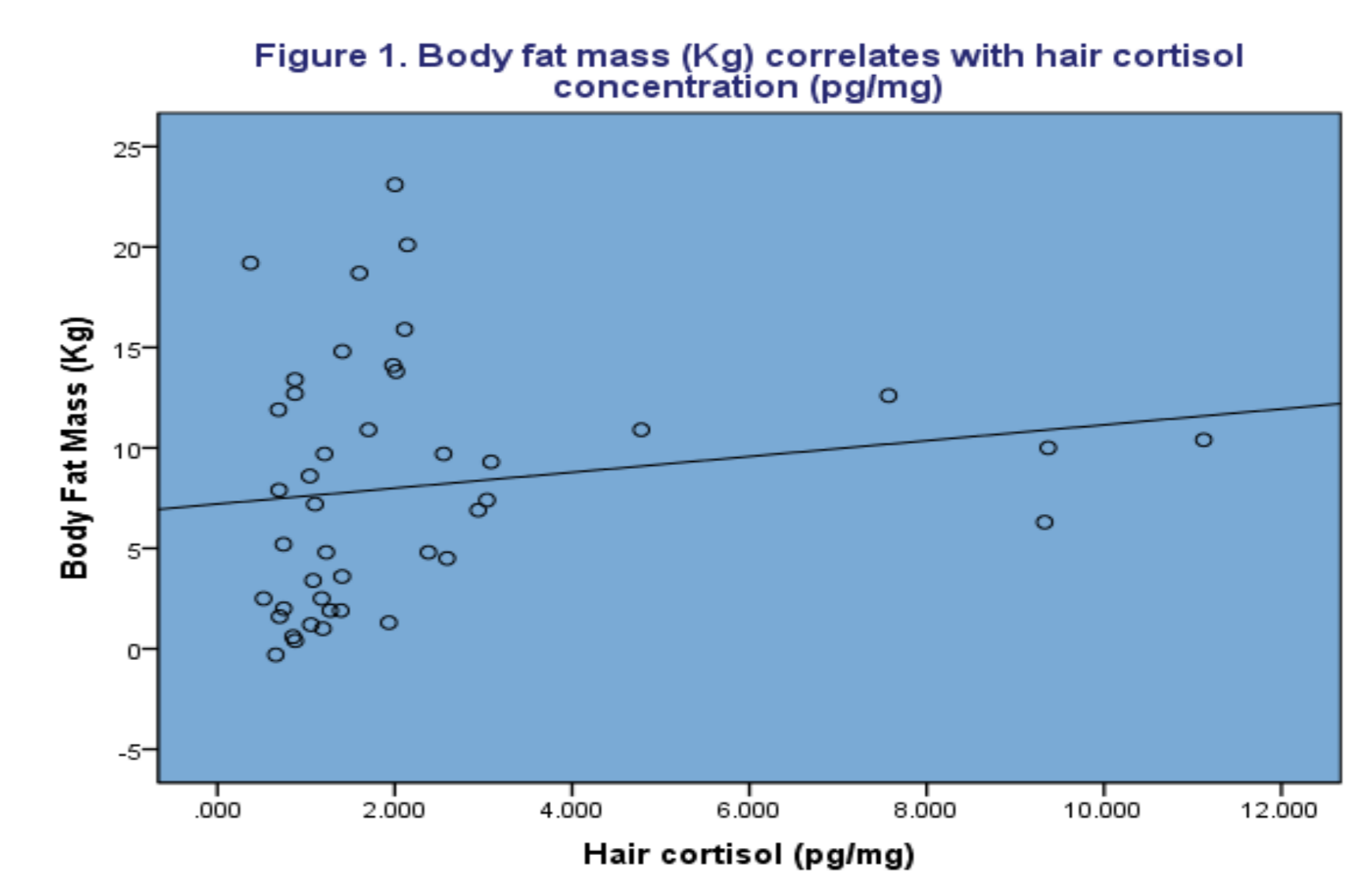
	Normal weight children (N=24)	Children with obesity (N=26)	Total (N=50)	p-value
Body weight (Kg)	28.6±5	41.6±8.5	35.36±9.6	<0.001
Height (m)	1.29±0.085	1.29±0.081	1.29±0.089	0.867
BMI (Kg/m ²)	16.9±1.67	24.7±3.35	20.93±4.72	<0.001
Waist circumference (cm)	59.9±5.7	78.5±7.9	68.36±11.49	<0.001
Hip circumference (cm)	70.7±6.01	84.92±6.6	77.12±9.49	<0.001
Waist to hip ratio	0.85±0.05	0.92±0.05	0.88±0.07	<0.001
Systolic blood pressure (mmHg)	96.3±12	112.46±11	105.11±14	<0.001
Diastolic blood pressure (mmHg)	64.05±9.5	72.29±9.1	68.55±10	0.006

Table 2. Results of body composition analysis with multifrequency bioimpedance assessment

	Normal weight children (N=24)	Children with obesity (N=26)	Total (N=50)	p-value
Fat mass (kg)	3.3 ±2.4	12.6±4.3	8.1 ±5.9	<0.001
Fat mass percentage (%)	14.1 ±5.9	29.8±4.6	24.3±9	<0.001
Fat free mass (kg)	25.5±3.5	28.7±4.5	27.2±4.3	0.007
Fat free mass percentage (%)	89.4±6.4	70.2±4.6	79.4±11.1	<0.001
Abdominal fat (kg)	4.1±3.11	15.8±5.37	10.2±7.3	<0.001
Skeletal muscle percentage (%)	23.3±2.1	29.3±2.4	16.2±2.2	<0.001
Total body water (%)	56.2±4.9	46.8±3.3	51.3±6.3	<0.001

RESULTS

Body fat mass, both as an absolute value in Kg and as a percentage (%) of total body mass was positively associated with morning fasting insulin ($p<0.01$, $p<0.05$)(Figure 1), while body fat mass(Kg) also correlated positively with hair cortisol ($p<0.05$) (Figure 2). Skeletal muscle both as an absolute value in Kg and as a percentage (%) of total body was positively associated with morning fasting insulin ($p<0.01$) and serial salivary cortisol excretion [computed as the area under the curve (AUC), $p<0.01$] but not with hair cortisol. Body fat mass, both as an absolute value in Kg and as a percentage (%) of BW positively correlated with serial salivary cortisol [computed as the area under the curve (AUC), $p<0.01$] (Figure 3).



CONCLUSIONS

The positive correlations between total body fat mass and hair and salivary cortisol suggest that long-term activation of the hypothalamic-pituitary-adrenal axis is associated with excessive fat accumulation in the subcutaneous adipose tissue and possibly in the skeletal muscle and elevated fasting insulin levels in prepubertal girls.

