

## Inflammatory mediators in overweight adolescents: association with insulin sensitivity, body composition and metabolic syndrome

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The insulin-resistance (IR) metabolic syndrome (MetS) leads to high CVD risk in adult life and has been associated with an early state of chronic low-grade inflammation (CLGI). The aim of the present study was to determine the association between a state of CLGI and insulin sensitivity, body composition and MetS prevalence in overweight adolescents. The study included 158 adolescents (BMI ≥ 85th percentile; eighty-six men) between 13 and 16 years of age, who were assessed for BMI, body composition (% body fat mass (BFM) and % free-fat mass (FFM) by pletysmography, prevalence of MetS for three or more variables (waist circumference (WC) ≥ 90th percentile; HDL-cholesterol ≤400 mg/l; TAG ≥ 1100 mg/l; blood arterial pressure ≥ 90th percentile; fasting glucose ≥100 mg/d), HOMA-IR (glucose × insulin/22.5) and the state of inflammation by C-reactive protein (CRP). Pearson correlation and  $\psi^2$  were used to study associations between variables, OR to calculate risk and ANOVA and Tukey test to compare averages between groups. The median and ranges of CRP levels (mg/l) were 0.7 (range 0.04–9.1) in males and 0.7 (range 0.04–6.2) in females. CRP showed a correlation with BMI ( $P<0.05$ ), WC ( $P<0.02$ ), % BFM ( $P<0.05$ ), % FFM ( $P<0.05$ ), fasting insulin ( $P<0.001$ ) and HOMA ( $P<0.001$ ).

**Table 1.** Pearson correlation for CRP with variables of metabolic and cardiovascular risk

Variable	CRP	
	<i>r</i>	<i>P</i>
BMI	0.158	<0.05
WC	0.199	<0.02
% BFM	0.168	<0.05
% FFM	0.169	<0.05
Fasting insulin	0.269	<0.001
HOMA	0.259	<0.001

CRP was significantly ( $P<0.01$ ) associated with an anthropometric and metabolic cardiovascular risk profile. The prevalence and the risk of abdominal obesity (WC ≥ 90th percentile), IR (HOMA ≥ 3.3) and MetS were significantly higher (63%, OR 3.0; 43%, OR 4.1; 26%, OR 4.1 respectively) in adolescents with CRP levels ≥ 1.12 mg/l (≥ tertile 2).

**Table 2.** Anthropometric, cardiovascular and metabolic profile across the CRP tertile distribution

CRP ...	<Tertile 1 (<0.43 mg/l)		Tertile 1–2 (0.43–1.12 mg/l)		>Tertile 2 (>1.12 mg/l)		<i>P</i>
	Mean	SD	Mean	SD	Mean	SD	
BMI (kg/m <sup>2</sup> )	2.0	0.5**	2.4	0.8	2.5	1.1	<0.01
WC (cm)	88.1	6.5**	92.5	7.4	95.4	10.8	<0.01
TBF (%)	35.4	6.4	37.6	7.6	40.4	7.0††‡‡	<0.01
FFM (%)	64.3	6.9	62.5	7.9	59.7	6.9††‡‡	<0.01
HDL (mg/l)	505	101	467	104	459	113†	<0.05
TAG (mg/l)	995	495	1129	687	1271	697††	<0.01
HOMA	1.9	1.2	2.3	1.3†	3.4	2.6‡‡‡	<0.001

Mean values were significantly different from those for tertile 1–2 and >tertile 2: \*\* $P<0.05$ . Mean values were significantly different from those for <tertile 1: † $P<0.05$ , †† $P<0.01$ . Mean values were significantly different from those for tertile 1–2: ‡ $P<0.05$ , ‡‡ $P<0.05$ .

These results confirm that (1) PCR levels in overweight adolescents are associated with a greater cardiovascular and metabolic risk and (2) IR involves inflammatory processes that may play an early role in the development of cardiovascular lesions.