Association of chronic stress, inflammation, body composition and dietary intake in Croatian university students

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Introduction: Chronic stress and low-grade chronic inflammation (LGCI) influence body composition and are key underlying factors in health and disease (1). New syndrome, osteosarcopenic obesity (OSO), signifies the simultaneous impairment of bone, muscle, and adipose tissues and has been associated with poor diet and metabolic derangements (2). Hyperactivation of the hypothalamic-pituitary-adrenal (HPA) axis associated with hypercortisolemia and LGCI disrupts the metabolism of bone, muscle and, adipose tissue (1). Some nutrients involved in preventing/alleviating OSO and LCGI include protein, calcium, magnesium, vitamin D, fiber and omega-3 fatty acids (3). The aim of this study was to examine the relations between chronic stress, LGCI, body composition and dietary intake in university students.

Materials and Methods: Participants (n=50) were undergraduate nutritional students [n=45 females (90%)]. Advanced bio-impedance devices, BIA-ACC® and PPG-Stress Flow® (BioTekna S.r.l., Marcon-Venice, Italy), were used to determine total bone mass (kg) and T-score; skeletal muscle (% FFM) and S-score; and fat mass (% of body weight), as well as extracellular water and HPA index (phase angle; reference value >3.5) as indicators of underlying LGCI and stress. Dietary intake was estimated by 24-hour recall and analyzed for macro- and micro-nutrients.

Results: Participants on average had adequate bone mass (based on T-score), % of body fat and intramuscular adipose tissue. The average skeletal muscle as a % of fat free mass was lower compared to reference values. Based on the HPA index and % of extracellular water, participants were in a state of chronic stress and with LGCI (Tables 1 & 2).

HPA index positively correlated with T-score (r=0.39, p=0.005), bone mass (r=0.44, p=0.001), % of skeletal muscle (r=0.57, p<0.001), and S-score (r=0.49, p<0.001), and negatively correlated with % of ECW (r=-0.44, p=0.002) (Table 2).

Positive correlation was found between HPA index and the intake of either total or animal proteins, calcium and riboflavin, with r ranging from 0.30-0.35, all p<0.05 (Table 3).

Total protein intake positively correlated with T-score (r=0.32, p=0.024), bone mass (r=0.36, p=0.010), % of skeletal muscle (r=0.37, p=0.008), and animal protein with S-score (r=0.34, p=0.017) (Table 3).

Discussion: Our results show that chronic stress, LGCI and body composition were interrelated in this young population and possibly augmented by higher protein and calcium intake. Screening for body composition dyshomeostasis, chronic stress and LGCI using innovative, non-invasive devices, along with assessing intake of some crucial nutrients, may provide quick and useful health information enabling prevention or early treatment of some linked disorders.

Table 1. Body composition and HPA axis index (mean ± SD)

Parameters	All[a] (n=50)	Women (n=45)	Referent values
Age (years)	23.1 ± 1.4	23.1 ± 1.4	
BMI (kg/m²)	22.1 ± 2.7	22.0 ± 2.8	18.5-24.9
Fat mass (%)	25.4 ± 5.2	25.7 ± 5.4	F 12-30; M 7-25
IMAT (%)	1.3 ± 0.3	1.3 ± 0.3	<1.5
T-score	-0.7 ± 0.7	-0.8 ± 0.6	>-1.0
Bone mass (kg)	3.3 ± 0.6	3.1 ± 0.4	F 3.6; M 4.7
SM (% FFM)	31.8 ± 4.2	30.7 ± 2.7	F >35; M >40
S-score	-0.6 ± 0.8	-0.7 ± 0.8	>-1.0
HPA axis index (PA°)	2.6 ± 0.9	2.4 ± 0.6	>3.5
ECW (% TBW)	46.1 ± 2.7	46.8 ± 1.9	40

[a] The correlational analyses were performed with entire population

Table 2. Spearman correlation coefficients between components of body composition and HPA index

Parameters	HPA index
FM (%)	-0.23
IMAT (%)	-0.06
T-score	0.39*
BM (kg)	0.44*
SM (% FFM)	0.57*
S-score	0.49*
ECW (%)	-0.44*

* statistical significance at p<0.05

Table 3. Spearman correlation coefficients between components of body composition, HPA index and dietetic parameters

Parameters	FM (%)	IMAT (%)	T-score	BM (kg)	SM (%)	S-score	HPA index
Energy (kcal)	-0.03	0.14	0.41*	0.41*	0.34*	0.26	0.27
Total proteins (g)	0.11	0.30*	0.32*	0.36*	0.37*	0.25	0.30*
Animal proteins (g)	0.14	0.32*	0.41*	0.46*	0.43*	0.34*	0.35*
Plant proteins (g)	-0.10	-0.02	0.00	0.02	0.06	-0.04	0.05
Calcium (mg)	0.03	0.12	0.13	0.15	0.21	0.12	0.30*
Vitamin B_2 (mg)	-0.14	0.03	0.23	0.27	0.27	0.18	0.30*

* statistical significance at p<0.05

BM = bone mass; ECW = extracellular water; FFM = fat free mass; FM = fat mass; IMAT = intramuscular adipose tissue; SM = skeletal muscle

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