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The overweight increases circulating inflammatory mediators commonly associated with obesity in young individuals

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ABSTRACT

Obesity is a serious and growing world healthy problem affecting developed and developing countries. The new conception of obesity as a basal inflammatory condition has opened a new window of possibilities to identify inflammatory biomarkers to be used in the diagnosis or prognosis of obesity-associated comorbidities. This present work aims the identification of the adipokines (leptin and resistin), chemokines (CCL2, CCL5, CXCL16) and the BMP-2 and their association with the clinical, biochemical (fasting glucose, hemogram, cholesterol, T3, T4 and TSH) and anthropometric (weight, height, body circumferences, skinfold thickness and percentage of body fat) parameters in young adults (18–30 years old) presenting obesity and overweight. Our data showed increasing in anthropometric parameters and in the plasma inflammatory levels in those individuals presenting overweight and obesity. We observed a higher plasma levels of CCL2, CCL5, CXCL16, leptin and resistin in those overweigh and obese individuals. In addition, the CCL2, CCL5 presented a positive correlation with the body mass index and the body fat percentage. Assuming the obesity as a systemic inflammatory process, in this current study, the overweight individuals possess a close similar pattern of circulating inflammatory mediators which might be a potential risk of the development of obesity comorbidities. Further studies are still needed to precise the role of the biomarkers CCL2, CCL5, CXCL16 and BMP-2 in the clinical prognosis related to the overweight or obese individuals.

1. Introduction

The high fat distribution in human is a condition linked to the obesity with a strong relation in the etiology of chronic disturbances such as hypertension, stroke, type 2 diabetes, respiratory and coronary heart diseases [1]. The obesity is characterized by the imbalance between the consume of energy-dense diet and the absence of physical activity with high metabolic equivalent. Adipose tissue is defined as source of energetic management in mammalian body, but also has been pointed as a source of bioactive molecules capable to act on the homeostasis and pathological conditions contributing to a low-grade systemic inflammatory condition in individuals with the clinical state of the obesity [2].

Obesity in children and adults have been clearly associated with increased risk of development of chronic diseases and mortality [3]. Overweight and obese individuals have been associated with the high serum levels of TNF, IL-6, C-reactive protein, leptin and other markers of inflammation, all closely associated with cardiovascular and metabolic risk factors [4].

Reinforced by the modern sedentary lifestyle and the increased caloric intake food, the inflammatory and genetic mechanisms have also been proposed to explain the association of the obesity with the

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major chronic morbid diseases [5] opening a new critical view whether optimal body weight would necessary minimize the risk of mortality. In this context, inflammatory mediators have been emerged as promised markers of prognostic of the development of cardiovascular and metabolic disturbances in individuals with overweight and obesity assuming that during middle- and elevated phases of lifer this risk is clearly higher [6].

Given the magnitude and prevalence of obesity condition within the younger and adulthood and supported by the possible low, but increased grade of systemic inflammatory process in these individuals, the aim of this study was to investigate a young population (18–30 years old) from Ouro Preto city, MG, Brazil, associating the anthropometric and biochemical parameters with the inflammatory plasma mediators CCL2, CCL5, TNF, CXCL-16, IL-17, BMP-2, resistin and leptin with the potential risk to develop chronic obesity-related comorbidities.

2. Material and methods

2.1. Population

Forty-seven young male and female adults (18–30 years) classified as eutrophic, overweight (BMI above 25 kg/m^2) and obese (BMI above 30 kg/M^2), all students at the Federal University of Ouro Preto, MG, Brazil, constituted the volunteers of this study. Individuals presenting hypertension, diabetes, thyroid or renal disturbances or any other cardiac or systemic diseases and those using steroidal drugs were excluded from this study.

The consent form was signed by all the participants of the research and all the activities carried out here were previously approved by the Ethics Review Board of the Universidade Federal de Ouro Preto (CAAE: 07639512.0.0000.5150). After the blood collection, the volunteers underwent a complete clinical examination by a general physician and a nutritionist. After, the following laboratory tests performed: total blood count, free T4, TSH, glucose, cholesterol, VLDL, LDL, HDL and triglycerides.

2.2. Anthropometric and body composition parameters

The body weight was measured using a Tanita ® digital scale (model Bc 730), with the participants wearing light clothing and barefoot. The BMI was calculated by means of weight and waist circumference, as recommended by the World Health Organization (OMS). All participants had their body mass, triceps skinfold, arm, waist and hip circumferences measurements collected by a trained staff adhering to standardized protocols. The following parameters were evaluated in the anthropometric analysis: waist circumference (WC), hip circumference (HC), abdominal circumference (AC) and upper arm circumference (UAC) with a flexible and inelastic metric tape, divided into centimeters and subdivided into millimeters (accuracy of 1 mm). The thickness of the subcutaneous tissue was analyzed by measuring the following skinfolds: triceps (TRI), biceps (BI), subscapular (SUB), supra-iliac (SUPR), and, finally, the sum of them was used to calculate the percentage of total body fat (%TBF). All skinfolds and circumferences were performed in triplicate and the mean of this measures considered. All measures were done in a private room and conducted by an experienced nutritionist.

2.3. Biochemical analysis

The blood was collected between 7:00 and 9:00 AM from all study participants after 12–14 h overnight fasting. The blood sample was extract using the S-Monovette tubes (Sarstedt LTDA): one tube (5 mL each) for serum and other containing EDTA for plasma (4 mL). The samples were centrifuged (3500*g*, 4 °C, 10 min) and stored at −80 °C. All the blood analysis (cholesterol, VLDL, LDL, HDL, triglycerides and glycemia) were determined using with commercially available specific kits (Bioclin, Quibasa), at the certified Clinical Analysis Laboratory from the Pharmacy School at Universidade Federal de Ouro Preto, MG, Brazil, on the same day of the blood collection.

2.4. Immunoassay to inflammatory mediators.

Circulating levels of the inflammatory mediators CCL2, CCL5, CXCL16, leptin, resistin e BMP-2 were detected in plasma previously stored at -80 °C. The plasma levels of inflammatory biomarkers: CCL2, CCL5, CXCL16, leptin, resistin e BMP-2 were measure by enzyme-linked immunosorbent assay (ELISA). All samples were analyzed using the Peprotech ELISA kits (Ribeirão Preto, SP, Brazil) and were done simultaneously in triplicates as described by Ribeiro et al., 2016 [7].

2.5. Statistical analysis

The results are expressed as means ± SEM. The data were analyzed for Graph Pad InStat and Prism statistical programs (version 6.0, San Diego, CA, USA). It was used the Independent *t* test for normal distribution sample while the Mann-Whitney test was used in non-parametric data. The correlation was verified using Spearman test and results confirmed by linear regression test. The criterion for statistical significance was set at $p < 0.05$.

Table 1
Baseline anthropometric parameters of the eutrophic, overweight and obesity subjects.

	Eutrophic (n = 23)		Overweight (n = 18)		Obesity (n = 7)		*P*
	Median	IQ	Median	IQ	Median	IQ	
Body weight (Kg)	60.00	52.80–67.20	72.70	66.10–83.35	92.80	78.30–105.2	< 0.0001*
BMI (Kg/m^2)	21.55	19.47–22.90	26.00	25.52–27.40	33.68	31.16–34.31	< 0.0001*
Upper arm circumference (mm)	26.50	23.50–29.00	29.75	28.13–33.38	33.00	30.50–36.00	< 0.0008*
Triceps skinfold (mm)	14.20	8.00–19.02	20.43	14.63–23.03	23.60	21.30–31.40	< 0.0004*
Biceps skinfold (mm)	7.16	3.50–12.00	12.78	10.69–15.73	23.10	20.30–24.50	< 0.0004*
Subscapular skinfold (mm)	18.25	13.50–22.50	28.35	23.00–35.05	45.80	32.15–51.00	< 0.0001*
Supra-iliac skinfold (mm)	11.75	8.20–18.35	22.20	20.07–24.85	32.60	29.70–37.20	< 0.0001*
Abdominal circumference (cm)	80.00	77.60–88.00	91.00	86.73–97.00	111.5	93.00–114.2	< 0.0001*
Hip circumference (cm)	98.00	93.00–102.0	106.0	102.9–109.9	121.0	117.0–127.0	< 0.0001*
Waist circumference (cm)	76.50	70.80–82.00	85.75	79.90–91.13	107.5	95.00–109.7	< 0.0001*
Waist-to-hip ratio (cm)	0.78	0.73–0.85	0.80	0.78–0.85	0.88	0.78–0.94	0.0810
Body fat % (formula)*	24.00	18.00–29.00	36.00	33.00–39.25	45.90	44.08–58.25	< 0.0001*

Presented data: mean ± standard deviation or median (Q1-Q3) as parametria.
* Body fat was calculated from sum of 4 skinfolds (triceps, biceps, supra-iliac and subscapular).