Relationship among internal-abdominal adiposity and subcutaneous-abdominal adipose tissues using ultrasound in eutrophic, overweight and obese pre-pubertal children

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Aims and objectives

Childhood obesity is defined by the World Health Organization (WHO) as an abnormal or excessive fat accumulation that causes health risks. In children the parameter used for the classification among normal weight, overweight or obese is the body mass index (BMI)\(^1\), according to their behavior in specific BMI chart versus age. Furthermore, obesity is the most common cause of insulin resistance, as is also related to dyslipidemia, type 2 diabetes mellitus and cardiovascular diseases in the long term\(^2-4\), becoming thus a worldwide serious problem in public health. Epidemiological studies\(^5-7\) have shown that the accumulation of fat in the abdomen is related to the pathogenesis of metabolic and cardiovascular diseases, also emphasizing the importance of the distribution of fat between the abdominal wall and intra-abdominal component\(^8\). This correlation in the pediatric population has not been clearly elucidated yet, and further studies of morphometric association with metabolic syndrome are needed.

Power et al.\(^9-10\) suggests that the ideal measurement method for assessing body fat distribution should contain some mandatorily characteristics: to be accurate in estimating the distribution of fat in each bay, to be precise with the lowest possible measurement error, having low cost, to be easy to perform, to be reproducible and, above all, non-invasive, and easily acceptable for the pediatric patient. Among the imaging methods used for this purpose there are the computed tomography, the magnetic resonance imaging (MRI) and the ultrasonography. Some authors describe the computed tomography (CT) as the gold standard for measuring the thickness of intra-abdominal fat and abdominal wall in adult patients\(^5,11-12\). However, in the pediatric population exposure to ionizing radiation, the need for sedation and refrigerated environment limit their use\(^13\). Other jobs\(^14-16\) suggest MRI as the method of choice but the high cost, and above all, the need for sedation and refrigerated environment are major limitations for use in children.

S. Semiz et al.\(^17\) as well as other authors\(^5-6,18\) have proposed ultrasonography as the ideal method for evaluating the distribution of intra-abdominal fat, especially for not using ionizing radiation nor sedation, for the rapid examination and excellent acceptance by children. Moreover, other authors\(^16, 19-21\) have shown a good correlation between the measurements obtained by ultrasonography compared with those of computed tomography, making the ultrasonography the eligible method for use in children.

The aim of this study was to demonstrate the behavior of abdominal fat distribution considering the Abdominal Subcutaneous Adipose Tissues (SCA-AT) and internal-abdominal adiposity (IA-AT) measured by ultrasonography in normal children, overweight and obese.
Methods and materials

Study conducted at the Department of Radiology of University Hospital of the State University of Rio de Janeiro, Brazil. Digital high-resolution ultrasonography was performed with children in the supine position without previous preparation, through at least three consecutive measurements at axial, in plane situated about 2cm below the emergence of the superior mesenteric artery without compression (Figure 1 and 2). The transducer frequency varies depending on the best visualization of tissue structures. All examinations were performed by two independent observers using manual measurements available in the equipment, blinded to the study design.

All the children were prepubertal, and healthy; they were evaluated and ranked by a team of pediatric endocrinologists by the score of body mass index. The classification of obesity was performed according to WHO; the criteria established for obesity was percentile greater than or equal to the 97th percentile, the BMI of overweight was greater than or equal to the 85th percentile and below the 97th percentile. Of 80 obese children, 40 were females and 40 were males. In the group of 18 overweight children, 5 were females and 13, males. Among the 31 normal weighted children, 17 were females and 14 were males.
**Fig. 1:** Measurement of thickness of the abdominal wall by ultrasonography. Axial abdomen cut about 2 cm below the emergence of the superior mesenteric artery. Markers in blue (+) show the limits determined by the skin and the anterior aspect of the linea alba.

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Fig. 2: Measurement of thickness of intra-abdominal fat by ultrasonography. Axial abdomen cut about 2 cm below the emergence of the superior mesenteric artery. Markers in blue (+) show the limits determined by the posterior surface of the linea alba and the anterior wall of the aorta (Ao). Inferior vena cava (IVC).

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Results

The median SCA-AT in normal children was 5.8, 9.8 in overweighted and 19.3mm (p-value <0.0001) in obese children, as shown in figure 3.

The median IA-AT was, respectively, 24.4, 29.0 and 39.8mm (p-value <0.001), as shown in figure 4.

For comparison of groups (BMI, SCA-AT and AT-IA) the Kruskall-Wallis test and post-test of Student-Newman-Keuls was used.
**Fig. 3:** Abdominal Subcutaneous Adipose Tissues - Median and standard deviation

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**Fig. 4:** Internal Abdominal Adiposity Tissue - Median and standard deviation

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Conclusion

Ultrasonography was able to demonstrate that the increase in weight in prepubertal children directly results in increased thickness of the subcutaneous tissue and in increased thickness of intra-abdominal fat, being both statistically significant correlations.
References


