



ORIGINAL ARTICLE

## Lower waist circumference in mildly-stunted adolescents is associated with elevated insulin concentration<sup>☆</sup>



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### KEYWORDS

Waist circumference;  
Height;  
Insulin

### Abstract

**Objective:** Augmented waist circumference (WC) is associated with non-communicable diseases and could represent a valuable marker in screening for metabolic dysfunctions in subjects with insufficient linear growth. The objective of the present study was to determine whether biochemical and hemodynamic parameters and waist circumference vary between mildly-stunted and non-stunted adolescents from impoverished communities of São Paulo, Brazil.

**Methods:** The cross-sectional study involved 206 subjects, aged between 9 and 19 years and living in impoverished areas of São Paulo, Brazil. The sample population was divided according to height-for-age Z-score (HAZ) into stunted ( $-1 > \text{HAZ} \geq -2$ ) and non-stunted ( $\text{HAZ} \geq -1$ ) groups, and was sub-divided according to gender. Logistic regression analysis was employed to compare individuals with elevated (> 75<sup>th</sup> percentile) insulin concentrations. The receiver operating characteristic curves were constructed to determine WC cut-off points that could be used to identify stunted and non-stunted individuals with elevated insulin concentrations.

**Results:** WC cut-off points of 58.25 cm and 67.2 cm allowed for correct classification of 90.7% of stunted and 88.7% of non-stunted individuals in the studied population. While the sensitivity of the model was high for stunted and non-stunted subjects (98.8% and 97.2%, respectively), the specificity was modest (57.1% and 41.2%, respectively).

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**PALAVRAS-CHAVE**

Circunferência da cintura;  
Altura;  
Insulina

**Conclusion:** The results presented herein suggest that an increase in plasma insulin is one of the primary metabolic modifications in stunted individuals, and that this alteration could be identified at a lower WC cut-off point than in non-stunted counterparts.

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### Menor circunferência da cintura em adolescentes de baixa estatura leve está relacionada à concentração elevada de insulina

#### Resumo

**Objetivo:** A circunferência da cintura (CC) aumentada está relacionada a doenças não transmissíveis e pode representar um indicador valioso no exame de verificação de disfunções metabólicas em indivíduos com crescimento linear insuficiente. O objetivo deste estudo foi determinar se os parâmetros bioquímicos e hemodinâmicos e a circunferência da cintura variam entre adolescentes de baixa estatura leve e de estatura normal de comunidades pobres de São Paulo, Brasil.

**Métodos:** O estudo transversal envolveu 206 indivíduos com idades entre 9 e 19 anos que moram em áreas pobres de São Paulo, Brasil. A população da amostra foi dividida, de acordo com o escore z de estatura por idade (HAZ), em um grupo de baixa estatura ( $-1 > \text{HAZ} \geq -2$ ) e um de estatura normal ( $\text{HAZ} \geq -1$ ), e subdividida de acordo com o gênero. A análise de regressão logística foi empregada para comparar indivíduos com concentrações elevadas de insulina ( $> 75^\circ$  percentil). As curvas de característica de operação do receptor foram construídas para determinar os pontos de corte de CC que poderiam ser usados para identificar os indivíduos de baixa estatura e de estatura normal com concentrações elevadas de insulina.

**Resultados:** Os pontos de corte de CC de 58,25 e 67,2 cm permitiram a classificação correta de 90,7% de indivíduos de baixa estatura e 88,7% de indivíduos de estatura normal na população estudada. Embora a sensibilidade do modelo fosse alta para indivíduos de baixa estatura e de estatura normal (98,8% e 97,2%, respectivamente), a especificidade foi pequena (57,1% e 41,2%, respectivamente).

**Conclusão:** Os resultados apresentados neste instrumento sugerem que um aumento na insulina plasmática é uma das principais modificações metabólicas em indivíduos de baixa estatura, e que essa alteração pode ser identificada em um ponto de corte de CC menor que em pares de estatura normal.

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## Introduction

Irrespective of birth weight, children and adolescents with moderate/severe stunting are more prone to increased body fat (especially abdominal fat),<sup>1-4</sup> diminished rate of fat oxidation,<sup>5</sup> reduced resting and postprandial energy expenditure,<sup>1</sup> higher systolic and diastolic arterial pressure (SAP and DAP, respectively),<sup>6-8</sup> and lower production of insulin by the pancreas.<sup>9,10</sup> Alterations in these parameters are also aggravated by the presence of obesity.<sup>5</sup> A recent study on pre-adolescents and adolescents with mild stunting ( $-2 < \text{HAZ} < -1$ ) showed similar increase in SAP in comparison with their non-stunted peers.<sup>11</sup>

In addition, overweight adolescents with mild stunting presented significantly higher concentrations of plasma insulin, elevated glycemia, increased insulin resistance, and diminished pancreatic production of insulin in comparison with individuals of normal body mass index (BMI).<sup>12</sup> In these subjects, abdominal fat and waist circumference (WC) values were significantly higher in the mildly-stunted group than in the non-stunted control group.<sup>13</sup> It is evident from

these findings that individuals with mild stunting present physiological alterations that are very similar to those described earlier for individuals with moderate or severe stunting.

It is widely accepted that elevated WC values are strongly associated with increased risk of non-communicable diseases (NCDs).<sup>14-16</sup> The objective of the present study was to analyze physiological alterations, including SAP and DAP levels and concentrations of glucose, insulin, high- and low-density lipoprotein cholesterol (HDL-C and LDL-C, respectively), and triglycerides, in relation to the WC values of children and adolescents with mild stunting compared with their non-stunted counterparts.

## Subjects and methods

The study was submitted to and approved by the Committee of Ethics in Research of the Universidade Federal de São Paulo (No. 0284/08). Written informed consent was obtained from all participants, or their parents or legal

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