Rev Paul Pediatr. 2014;**32(3)**:229–235.

REVISTA PAULISTA DE PEDIATRIA

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ORIGINAL ARTICLE

Contribution of anthropometric characteristics to pubertal stage prediction in young male individuals☆

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Received 7 November 2013; accepted 2 February 2014

KEYWORDS
Anthropometry;
Puberty;
Sexual maturity;
Discriminant analysis

Abstract
Objective: To identify the contribution of anthropometric variables to predict the maturational stage in young males.
Methods: Cross-sectional study that enrolled 190 male subjects aged between eight and 18 years, randomly selected from public and private schools in Natal, Northeast Brazil. Thirty-two anthropometric variables were measured following the recommendations of the International Society for the Advancement of Kineanthropometry (ISAK). The assessment of sexual maturation was based on the observation of two experienced experts, who identified the pubertal development according to Tanner guidelines (1962).
Results: The anthropometric variables showed a significant increase of their values during the advancement of pubertal development ($p<0.05$). The following variables showed the best value for prediction of maturational groups: sitting height, femoral biepicondylar diameter, forearm girth, triceps skinfold, tibiale laterale and acromiale-radiale bone lenghts. These variables were able to estimate the pubertal stages in 76.3% of the sujects.
Conclusion: The anthropometric characteristics showed significant differences between the moments of maturational stages, being found, representatively, seven variables that best predict the stages of sexual maturation.

DOI refers to: 10.1590/1984-0462201432313
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PALAVRAS-CHAVE
Antropometria;
Puberdade;
Maturidade sexual;
Análise discriminante

Contribuição das características antropométricas na predição dos estádios de maturação puberal de jovens do sexo masculino

Resumo
Objetivo: Identificar a contribuição de variáveis antropométricas para a predição do estádio maturacional em jovens do sexo masculino.
Métodos: Estudo transversal, sendo investigados 190 sujeitos do sexo masculino, com idades entre 8 e 18 anos, selecionados aleatoriamente em escolas públicas e privadas de Natal. Foram selecionadas 32 variáveis antropométricas, todas avaliadas de acordo com as recomendações da International Society for the Advancement of Kineanthropometry (ISAK). A avaliação da maturação sexual se baseou na observação de dois especialistas experientes, que identificaram o desenvolvimento da genitália, segundo as recomendações propostas por Tanner (1962).
Resultados: As variáveis antropométricas apresentaram um aumento significativo no decorrer do avanço do desenvolvimento puberal ($p<0,05$). As variáveis de altura tronco-cefálica, diâmetro biepicôndilo femural, perímetro de antebraço, dobra cutânea de tríceps, alturas ósseas tibial e acrômio-radial apresentaram a melhor relação para predição dos grupos maturacionais, sendo responsáveis por estimar os estádios puberais com índice de 76,3% de chance de acerto.
Conclusão: As características antropométricas apresentaram diferenças significativas entre os momentos dos estádios maturacionais, sendo encontradas, de forma representativa, sete variáveis que melhor predizem os estádios de maturação sexual.

Introduction

Puberty is defined as the stage of development that transforms the child's body into the adult's one, with physical and hormonal changes that culminate in sexual maturation and reproductive capacity.[1-3] Its onset can be used as an important analysis tool, as it occurs at an specific time and is regulated by genetic, environmental, and neuroendocrine mechanisms.[4,5]

The most often used method for clinical assessment of pubertal development was proposed by Tanner, based on the observation of secondary sexual characteristics, with five maturational stages. In males, this method is based on the characteristics of genital and pubic hair and genitalia development itself, with stage 1 representing the prepubertal, and stage 5, the postpubertal.[6,7] Although it is widely used in the monitoring of biological maturation, the method has some disadvantages that may compromise its use in services outside the doctor's office. Most commonly, the embarrassment of the evaluated individual or lack of privacy in the chosen environment can compromise the course of the evaluation process, and thus become a limiting factor for its use.[8,9]

In an attempt to decrease these limitations, some studies have proposed the use of self-assessment, using illustrative photographs of the main aspects of each maturational stage, allowing for a supplementary visual identification so that the assessed individual can identify with the picture that most resembles his current maturational stage. However, national and international studies have shown, in general, a low reliability of this method, which also has the limitation of promoting situations of embarrassment to individuals.[6,10-13]

Given this perspective, studies have demonstrated that morphological changes are common during puberty in males, as the increased production of sex hormones have a significant association with the modification of some body measurements.[14,15] Thus, the analysis of anthropometric and body composition parameters can be considered an important tool to monitor pubertal development, as changes in the external body morphology are related to advancing stages of sexual maturation.[16-18]

Among the methods used to verify the association between these variables, multivariate analysis can be acknowledged as the best one, as it can provide an estimate of the contribution of each anthropometric characteristic for predicting the stages of pubertal maturation, taking into account the existence of interrelations of all the variables.[19] The best statistical test to attain this objective is discriminant analysis, which, similarly to multiple linear regression, verifies the level of association between the variables and creates a prediction equation for a non-metric variable based on metric variables.

In this context, this study aimed to identify the anthropometric variables that best predict the differences between the sexual maturation stages.

Methods

This was a cross-sectional study of 190 male subjects aged 8 to 18 years, randomly selected from public and private schools in Natal, RN, Brazil. The schools were chosen by convenience, according to the four city regions (North, South, East, and West). Subsequently, the research was