

Predictive Value of IAP 2015, IAP 2007 and WHO Growth Charts in Identifying Pathological Short Stature

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Objective: To compare the diagnostic accuracy of IAP 2015, WHO and IAP 2007 growth charts in identifying pathological short stature in Indian children.

Methodology: The predictive value of the growth charts for pathological short stature was assessed in 500 (266 boys) short subjects (age 5-17.9 years) presenting to our pediatric endocrine clinic.

Results: WHO, IAP 2015, IAP 2007 criteria classified 500, 410 (82%) and 331 (66.2%) subjects short respectively. A total of 218 (43.6%) subjects had a pathological cause. Two out of 90 subjects short by WHO criteria but normal as per IAP 2015 had a

pathological cause (2.2%) whereas 38 out of 79 subjects short as per WHO and IAP 2015 criteria but normal by IAP 2007 had pathological short stature. The diagnostic measures of IAP 2015 and IAP 2007 charts in identifying pathological short stature showed a sensitivity 99.1% and 81.7%, negative predictive value 97.8% as against 76.3%, positive predictive value 52.7% and 53.8%, and specificity of 31.2% and 45.7%, respectively.

Conclusions: IAP 2015 growth charts are superior in identifying pathological growth failure compared to WHO and IAP 2007.

Keywords: Growth chart, Growth failure, Validation.

Short stature is the one of the most common complaint presenting to a pediatrician. Most short children have a physiological cause not requiring extensive evaluation, a substantial proportion; however, have a serious underlying cause [1]. Differentiating physiological from pathological short stature is pivotal to allow a rational evaluation where growth charts are used as a non-invasive tool.

Currently used growth charts for Indian children include WHO, IAP 2007 and IAP 2015 [2-5]. Significant impact of ethnicity and environmental factors on growth makes country specific charts desirable. The Indian Academy of Pediatrics (IAP) growth monitoring committee in 2007 recommended growth charts developed from major urban affluent zones of India in 1989-91 [3]. These were replaced by IAP 2015 charts based on collated data of 33,148 Indian children of age 5 to 18 years across 14 centers [5]. The use of WHO criteria has shown to classify greater number of children as short compared to IAP 2015 and IAP 2007 charts [6,7]. These studies have; however, not addressed predictive value of these criteria in identifying pathological short stature [8,9]. We conducted this study to compare WHO, IAP 2007 and IAP 2015 criteria to identify pathological short

stature in children and adolescents between the age of 5 and 18 years.

METHODS

Case records of children and adolescents between 5-18 years of age presenting to the pediatric endocrine clinic of our hospital with short stature from January 2015 to December 2018 were reviewed after institutional ethics committee approval. Height was measured using a portable stadiometer (Model 213, Seca scale, Germany) up to an accuracy of 1 mm. Subjects were asked to stand on the platform with heels together, toes apart and back of the occiput, shoulder blades, buttocks and heels in contact with the backboard. Readings were taken in triplicate and averaged. The stadiometer was calibrated daily with Seca Calibration Rod. Weight was measured using Seca Scale till 100 grams which was calibrated daily.

The anthropometric parameters were converted to Z-score using WHO Anthroplus software, and macros derived from IAP 2007, and IAP 2015 growth charts. Children with height Z-score less than -2 as per WHO criteria were evaluated for etiology of short stature as per institutional protocol. The work-up included a

comprehensive clinical examination and screening tests (complete blood count, alanine aspartate transferase, creatinine, free T4, thyroid stimulating hormone, tissue transglutaminase antibody, and serum electrolytes) in all and further work-up as required (karyotype in girls, growth hormone stimulation test, genetic tests, venous blood gas, etc.). Subjects with normal work-up and growth velocity over a six-month period were diagnosed as physiological short stature. Children short by WHO but normal by IAP 2007 and 2015 criteria were excluded from the study if their weight SDS was below -2 as per the IAP 2007 or 2015, indicating the need for evaluation irrespective of height. A sample size of 340 was required considering a prevalence of pathological short stature of 33% [10], 95% confidence and a standard error of 0.05.

Data were analyzed using the IBM Statistical Package for Social Sciences (SPSS version 25.0, SPSS, Inc) for Macintosh, and expressed as mean (standard deviation) and frequency (percentage). Sensitivity, specificity, positive predictive value, negative predictive values and likelihood ratio of IAP 2015, IAP 2007 criteria were calculated. P value less than 0.05 was considered significant.

RESULTS

Seven hundred and forty children (377 boys) presented with a concern of short stature to our clinic during the study period. Forty children with incomplete data and 190 with normal stature were excluded. The WHO, IAP 2007 and IAP 2015 criteria labelled 510 (72.6%), 410 (58.2%) and 331 (47%) subjects short, respectively. Ten subjects labelled short by WHO, and normal by IAP 2007 and IAP 2015 were excluded as their weight z-score was below -2 by IAP 2007 or IAP 2015 criteria. The final analysis was performed in 500 subjects (266 boys) with mean (SD) age of 11.8 (3.1) years. The height z-score was above -2 in 90 (18%), between -2 to -3 in 245 (49%), and below -2 in 165 (33%) as per IAP 2015 criteria.

A pathological cause of short stature was identified in 218 (43.6%) and included celiac disease (83, 16.6%), growth hormone deficiency (78, 15.6%), hypothyroidism (33, 6.6%), Turner syndrome (8, 1.6%), chronic illness (8, 1.6%) and other syndromes (8, 1.6%). Among the 218 subjects, 216 (99%) were short by IAP 2015 and 178 (81.6%) by IAP 2007 criteria. Ninety subjects short by WHO criteria had normal stature as per IAP 2015. A pathological cause was identified in 38 of the 79 subjects (48.1%) short as per both WHO and IAP 2015 but normal by the IAP 2007 criteria. The sensitivity, specificity, negative predictive value and positive predictive value specificity of IAP 2015 and 2007 in identifying pathological short stature are shown in **Table I**.

Table I Diagnostic Performance of IAP 2007 and IAP 2015 Criteria for Identifying Pathological Short Stature (N=500)

Diagnostic measure	IAP 2007	IAP 2015
PPV	53.8%	52.7%
NPV	76.3%	97.8%
Sensitivity	81.7%	99.1%
Specificity	45.7%	31.2%
Positive likelihood ratio	1.5	1.4
Negative likelihood ratio	0.4	0.03

PPV: Positive predictive value; NPV: Negative predictive value.

Identification of one child with pathological cause would have required evaluation of 45 subjects short by WHO but normal by IAP 2015.

DISCUSSION

Findings of our study suggest that IAP 2015 criteria have the best diagnostic accuracy in identifying pathological short stature in Indian children and adolescents. The use of WHO criteria causes unwarranted work-up in a substantial number of subject, while that of IAP 2007 misses pathological causes.

Studies have shown a higher prevalence of short stature as per WHO charts compared to IAP 2007 and IAP 2015 in privileged school children around Pune, and New Delhi [6,7]. These studies; however, did not evaluate predictive accuracy of these charts for pathological short stature. The present study demonstrated that IAP 2015 criteria correctly reduced the number of Indian children with short stature requiring evaluation. The use of IAP 2007 growth charts lowered the number of subjects requiring evaluation at the cost of missed pathology in many.

To the best of our knowledge, this is the first study determining the predictive accuracy of currently available growth charts in India in identifying pathological short stature. The conduct of the study in a pediatric endocrine clinic may have increased the proportion of subjects with pathology. Retrospective analysis of case records represents another limitation of this study. However, a protocol-based evaluation by a single pediatric endocrinologist across the study period and review of structured records ensured diagnostic categorization in most of the cases.

Our observations suggest a superior diagnostic accuracy of IAP 2015 over IAP 2007 and WHO growth charts in identifying pathological short stature. Further studies looking into the predictive accuracy of these criteria in identifying pathological short stature in different clinical settings are required.

WHAT THIS STUDY ADDS?

- IAP 2015 criteria have superior diagnostic accuracy in identifying pathological short stature in Indian children compared to WHO and IAP 2007.

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Ethical clearance: Regency Hospital Limited Institutional ethics committee; RHC-IEC-16036 dated September 11, 2019.

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