

Effect of Adjusting for Tanner Stage Age on Short and Tall Stature Prevalence in US Youths

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Growth and syndromes



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OBJECTIVE

To evaluate the extent to which pubertal timing alters the classification of extremes of attained stature across race-ethnic groups of US youths.

METHODS

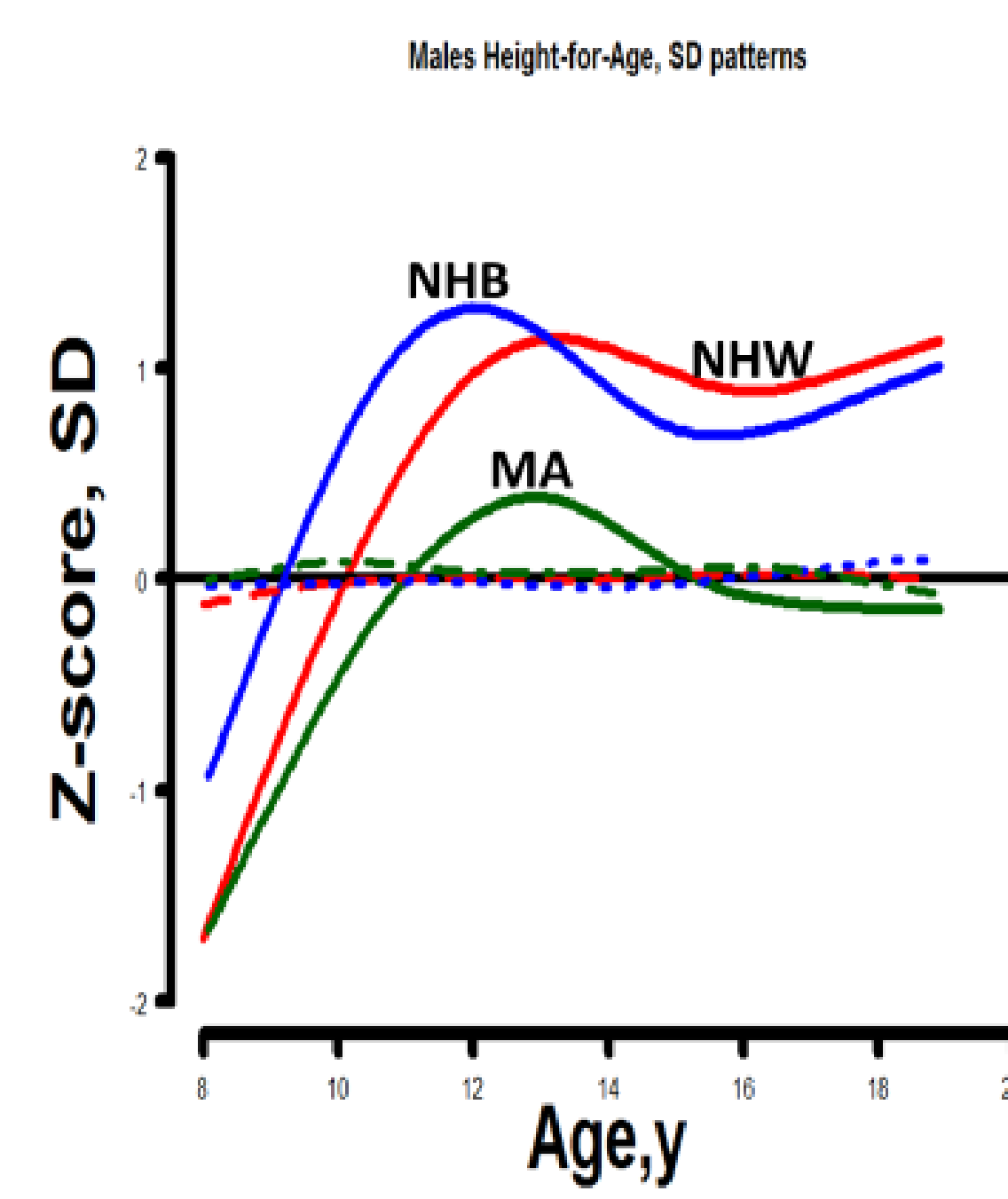
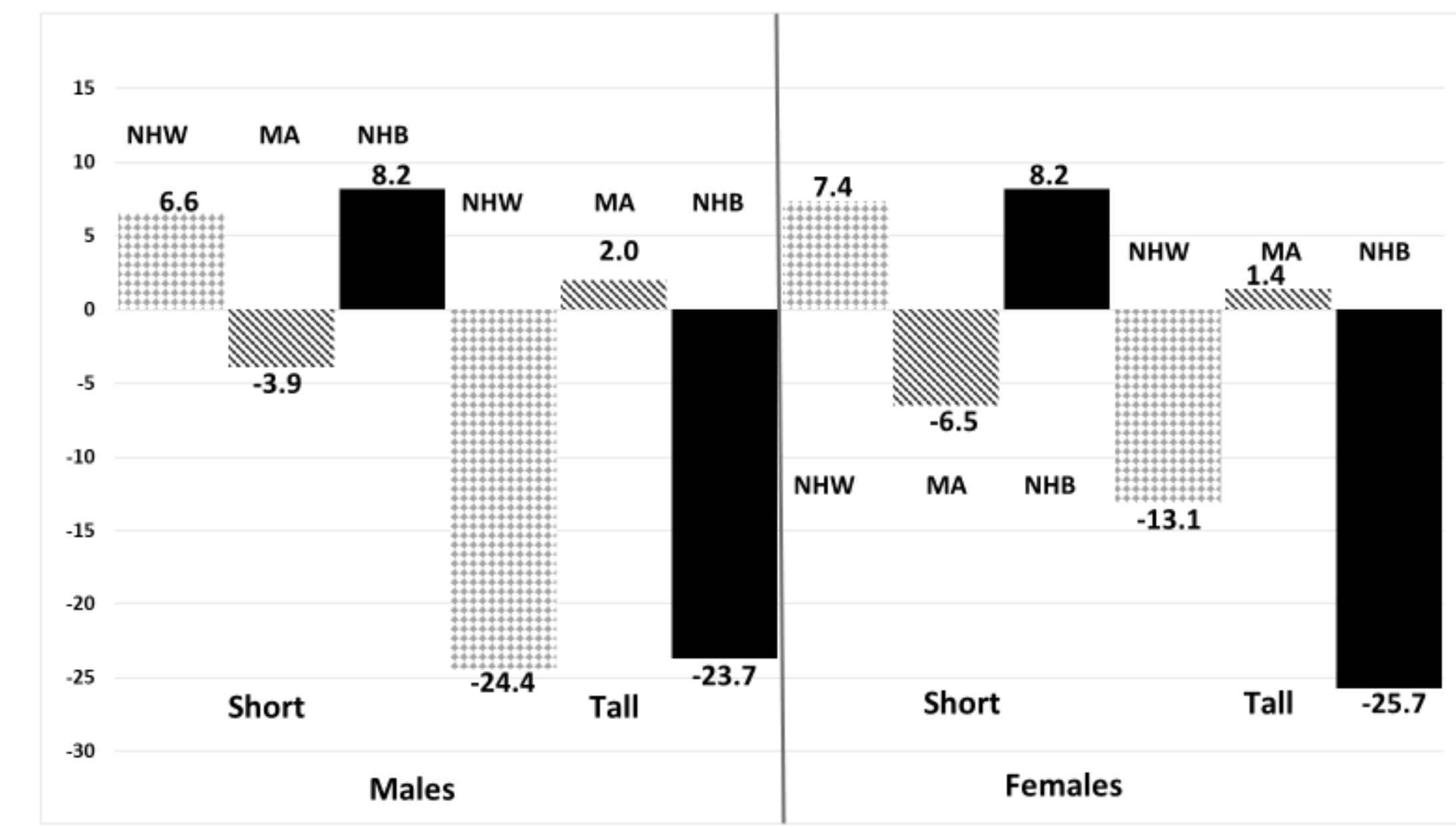
We performed analyses of anthropometry and Tanner staging data of 3206 cross-sectional national sample of youths ages 8–18y (53% male (n=1606), 72% Non-Hispanic White (NHW), 9% Mexican American (MA) and 19% Non-Hispanic Black (NHB). Specialized Tanner-stage-age growth models were used to derive Tanner-age adjusted Z-scores. The prevalence of short (<-1SD) and tall (>=+1SD) status was quantified after adjustment for Tanner stage-age height Z-scores (TSA_{HAZ}). We then examined average growth patterns with age splines across estimated Z-scores by sex and race/ethnicity.

RESULTS

Highly variable patterns of prevalence of shortness and tallness via chronologic-age height Z-score (CA_{HAZ}) was observed in results stratified by Tanner stages, race-ethnicity and sex. Tallness CA_{HAZ} prevalence was high among NHW and NHB males relative to MA (40.0 – 43.3, vs 20.5%) and in females, the ranking was (39.2% NHB > NHW 29.6 > MA 20.3, each p =0.0167). In both sexes, this pattern was eliminated with TSA_{HAZ}, with MA youth becoming statistically not different from their NHW and NHB peers on both stature indicators.

Table I. Population descriptive characteristics of a cross-sectional cohort US youths ages 8-18 years

Variables	Boys (n = 1606)				Girls (n = 1686)			
	Non-Hispanic white (n = 403)	Non-Hispanic black (n = 640)	Mexican American (n = 570)	P value	Non-Hispanic white (n = 442)	Non-Hispanic black (n = 646)	Mexican American (n = 598)	P value*
Age, y	14.3 (0.2)	14.1 (0.1)	14.5 (0.1)	.33	14.5 (0.2)	14.1 (0.1)	14.1 (0.2)	.910
Height, cm	164.6 (0.9)	162.2 (0.7)	160.5 (0.6)	.54	158.8 (0.6)	158.2 (0.5)	154.2 (0.6)	.450
Weight, kg	58.8 (1.4)	56.9 (1.0)	58.0 (0.8)	.72	54.3 (1.1)	56.5 (0.8)	54.0 (1.3)	.020
BMI, kg/m ²	21.1 (0.3)	21.0 (0.2)	22.0 (0.2)	.34	21.3 (0.3)	22.3 (0.2)	22.5 (0.4)	<.001
Health rating (% SE)	% (SE)	% (SE)	% (SE)	P value	% (SE)	% (SE)	% (SE)	P value
Excellent	48.8 (2.9)	34.2 (2.7)	23.0 (2.5)	<.001	52.0 (3.5)	34.1 (3)	32.2 (2.8)	<.001
Very good	31.6 (2.5)	27.6 (2.7)	24.7 (2.0)		27.1 (3.1)	31.3 (2.6)	20.2 (2.5)	
Good	18.2 (2.6)	30.9 (3.1)	39.1 (2.4)		18.1 (3.2)	27.3 (2.8)	30.4 (2.3)	
Fair	1.1 (0.5)	6.6 (1.2)	11.9 (2.8)		2.3 (0.9)	6.8 (1.7)	15.0 (1.6)	
Poor	0.3 (0.3)	0.6 (0.4)	1.3 (0.6)		0.5 (0.5)	0.6 (0.4)	2.2 (1.1)	
Poverty income ratio (% SE)								
Low	15.5 (2.5)	45.6 (3.7)	55.1 (2.4)	<.001	16.9 (2.8)	48.7 (2.7)	47.7 (2)	<.001
Medium	21.9 (2.6)	30.3 (2.6)	22.1 (2.3)		18.5 (3.0)	23.6 (2.2)	31.4 (2.3)	
High	62.6 (3.6)	24.1 (2.8)	22.8 (2.3)		64.6 (3.6)	27.6 (2.7)	21.0 (3.0)	
Maturation tempo								
Early pubertal onset (G2/B2 and <Tanner II population age at entry)	7.3 (1.4)	3.1 (0.7)	8.4 (1.21)	.002	4.7 (1.0)	5.2 (0.9)	4.0 (1.3)	.8342

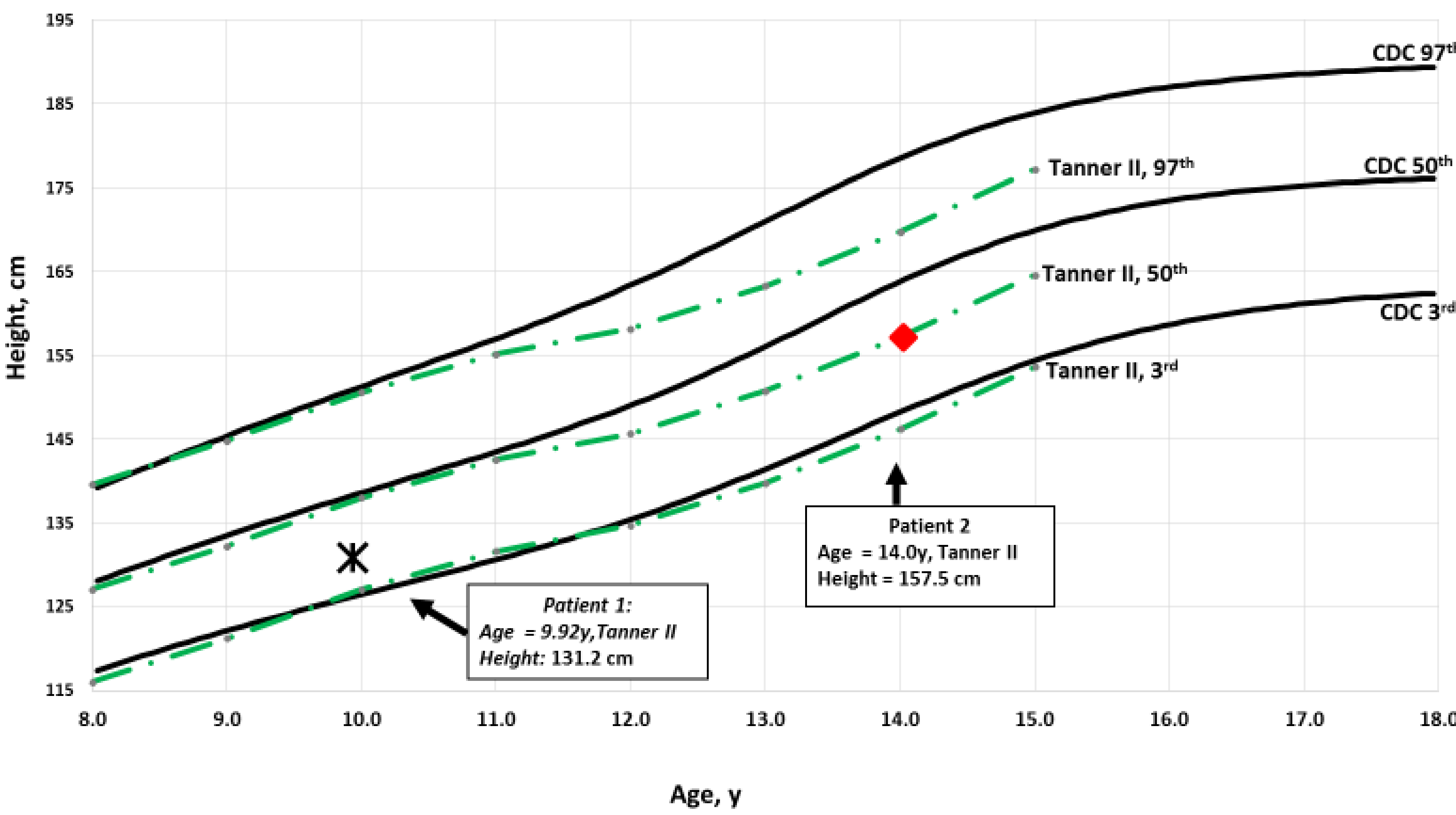


Smoothed Average Linear Growth Patterns Height-for-Age Z-scores by CA_{HAZ} compared to TSA_{HAZ}

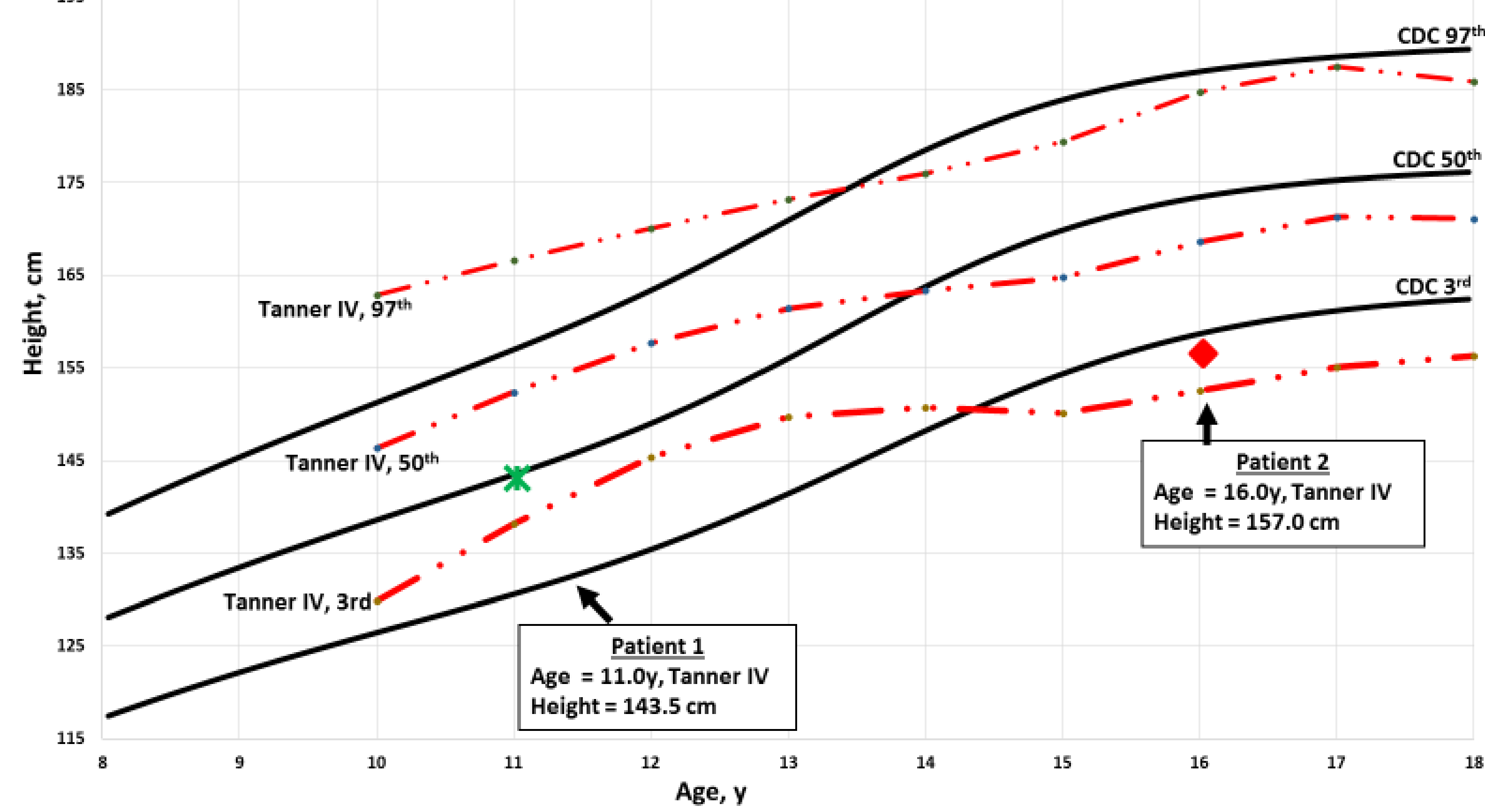
Following the CA_{HAZ} curves (solid lines), distinct race-ethnic curvatures in trends are apparent over the entire age spectrum across gender, with steeper slopes for MA and NHB. However, when growth of the same population is examined using the TSA_{HAZ}, patterns tracked along the median (SD 0.0) and depicted no residual age trends.

CLINICAL APPLICATION

Tanner II for MA Males



Tanner IV for MA Males



CONCLUSION

- Differences in timing of puberty between race-ethnic groups affects estimated prevalence of shortness and tallness of attained height.
- Considerable pubertal maturation effects remain uncaptured with age-conditioned height Z-scores.
- Adjustment for pubertal development might help isolate crucial determinants of attained stature and other aspects of body composition which may be most responsive to intervention programs in populations of youths.
- Development of Tanner Stage Height-for-Age (TSA Height) Curves may be useful for evaluating children with normal and pathologic variants of growth and pubertal timing.
- Adjustment for pubertal status may be useful in evaluating other auxologic parameters and assessing body composition and bone mineral density.

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