

Automated Greulich-Pyle bone age determinations in children with chronic endocrine diseases

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Conclusion

- BoneXpert™ allows an objective and time-saving bone age assessment in children with chronic endocrinopathies and is suitable to calculate valid PAH.
- BHI correlated with parameters of the 'gold standard' pQCT, but further studies are needed to validate BHI.

Objectives

Prediction of adult height is a standard procedure in paediatric endocrinology, but it is associated with considerable inter-rater variability. To compare the new adult height prediction (PAH) method by automated bone age determination (BoneXpert™, BX) with the conventional PAH method by Bayley Pinneau (BP) based on bone age determination according to Greulich & Pyle (GP). Furthermore, to assess measures of bone health by bone health index (BHI) and pQCT.

Patient and Methods

Height was determined in 82 patients (48 females) with chronic endocrinopathies at time of transition to adult care (near final height; NAH; 18.04 ± 3.0 years) and with 10.45 ± 2.12 years. In addition, bone mineral content, total bone mineral density and muscle cross sectional area were measured by pQCT and X-rays of the left hand were performed to obtain BHI and to assess bone ages (BA) according to GP (conventionally, cGP, mean of 3 experts) and by BX. PAH was calculated using BP and BX.

Table 1: Conventional bone age and determined by BoneXpert™

Diagnoses	Total	CAH	GHD	Panhypopituitarism	SGA	UTS
Sex (f/m)	82 (48/34)	15 (7/8)	22 (9/13)	10 (5/5)	17 (9/8)	18 (18/0)
CA (years)	10.45 ± 2.12	8.75 ± 1.60	11.16 ± 1.85	12.12 ± 2.02	9.66 ± 1.53	10.82 ± 2.22
cGP (years)	9.87 ± 1.78	11.06 ± 1.79	9.94 ± 1.99	9.80 ± 1.57	8.98 ± 1.43	9.66 ± 1.52
BX (years)	9.59 ± 1.86	10.78 ± 1.85	9.63 ± 2.08	9.6 ± 1.6	8.43 ± 1.45	9.67 ± 1.51
Δ cGP/BX (years)	0.23 ± 0.74	0.28 ± 0.69	0.31 ± 0.57	0.01 ± 0.97	0.54 ± 0.77	-0.01 ± 0.68

Table 2: PAH according to BP and BX in patients with accelerated BA (CAH, N=15) and delayed BA (Panhypopituitarism, N=10)

	CAH	Panhypo
NAH (f) (cm)	160.0 ± 1.4	161.5 ± 3.2
cPAH (f) (cm)	160.0 ± 3.2	162.5 ± 3.0
BX PAH (f) (cm)	162.2 ± 2.7	162.6 ± 1.4
NAH (m) (cm)	173.3 ± 2.6	170.4 ± 6.4
cPAH (m) (cm)	170.0 ± 3.6	173.6 ± 7.9
BX PAH (m) (cm)	177.5 ± 2.9	179.7 ± 2.8

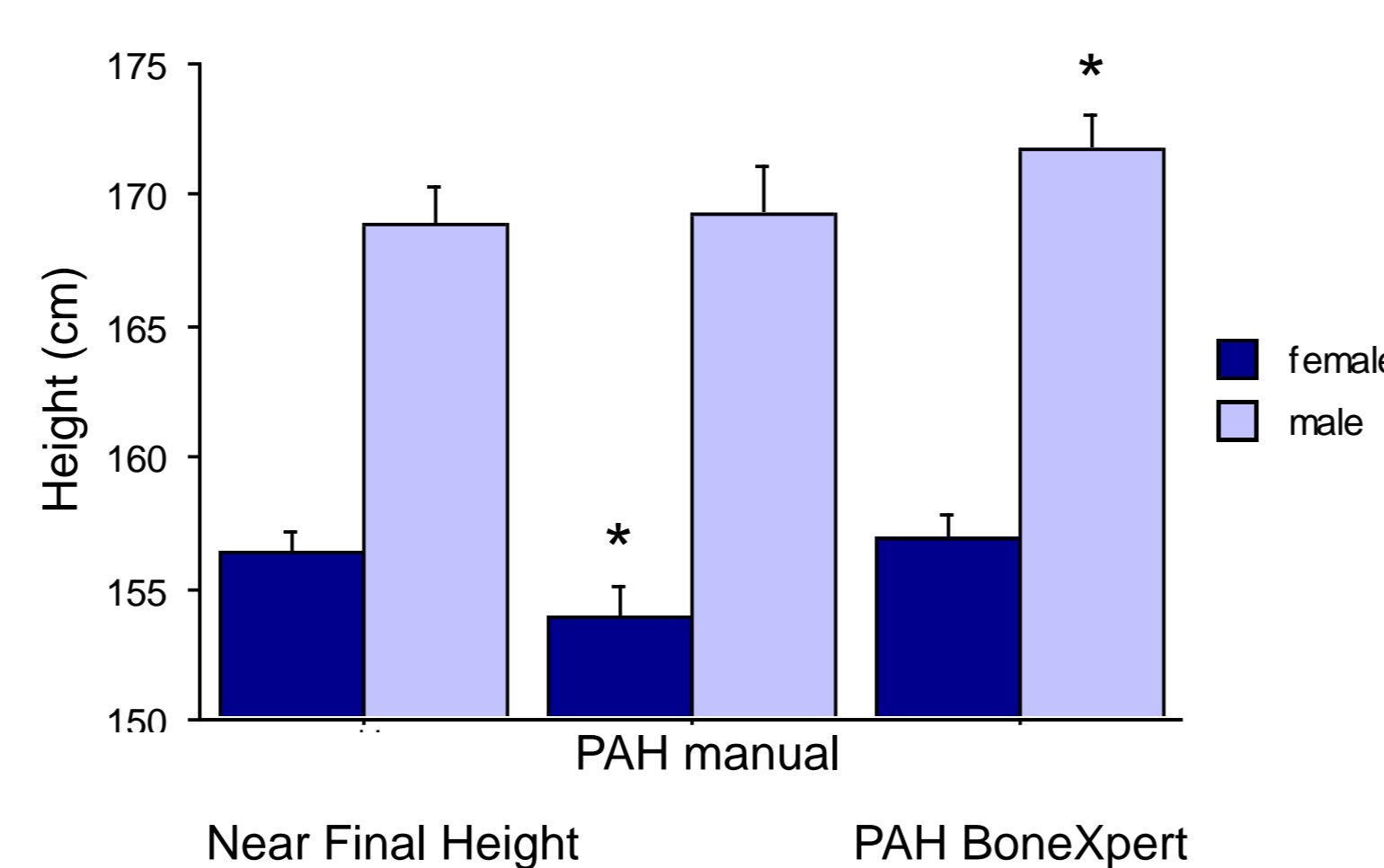


Fig. 1: PAH according to BP and BX

Results

- The conventional and the automatic BA determination revealed a mean difference of 0.23 ± 0.74 years ($p=0.0027$), negligible if bone age was retarded or accelerated (Tab. 1).
- The automated PAH by BX was 156.96 ± 5.50 cm in females, and 171.75 ± 6.70 cm in males, the latter overestimated NAH by 2.81 ± 4 cm (Fig. 1).
- In females PAH by BX was in a good accordance compared to NAH irrespective of bone age retardation or acceleration (Tab. 2).
- In males PAH by BX overestimated final heights if bone age was retarded (9.3 ± 5.9 cm) and slightly overestimated if BA was accelerated (4.2 ± 2.9 cm) (Tab. 2).
- The mean BHI-SDS was reduced in comparison to the reference population (SDS -0.72 ± 1.24).
- BHI correlated with bone mineral content ($r^2=0.5$; $p<0.0001$), total bone mineral density ($r^2=0.35$; $p<0.0001$), and muscle cross sectional area ($r^2=0.47$; $p<0.0001$) determined by pQCT and grip force ($r^2=0.29$; $p<0.0001$) determined by a hand dynamometer (Fig. 2).

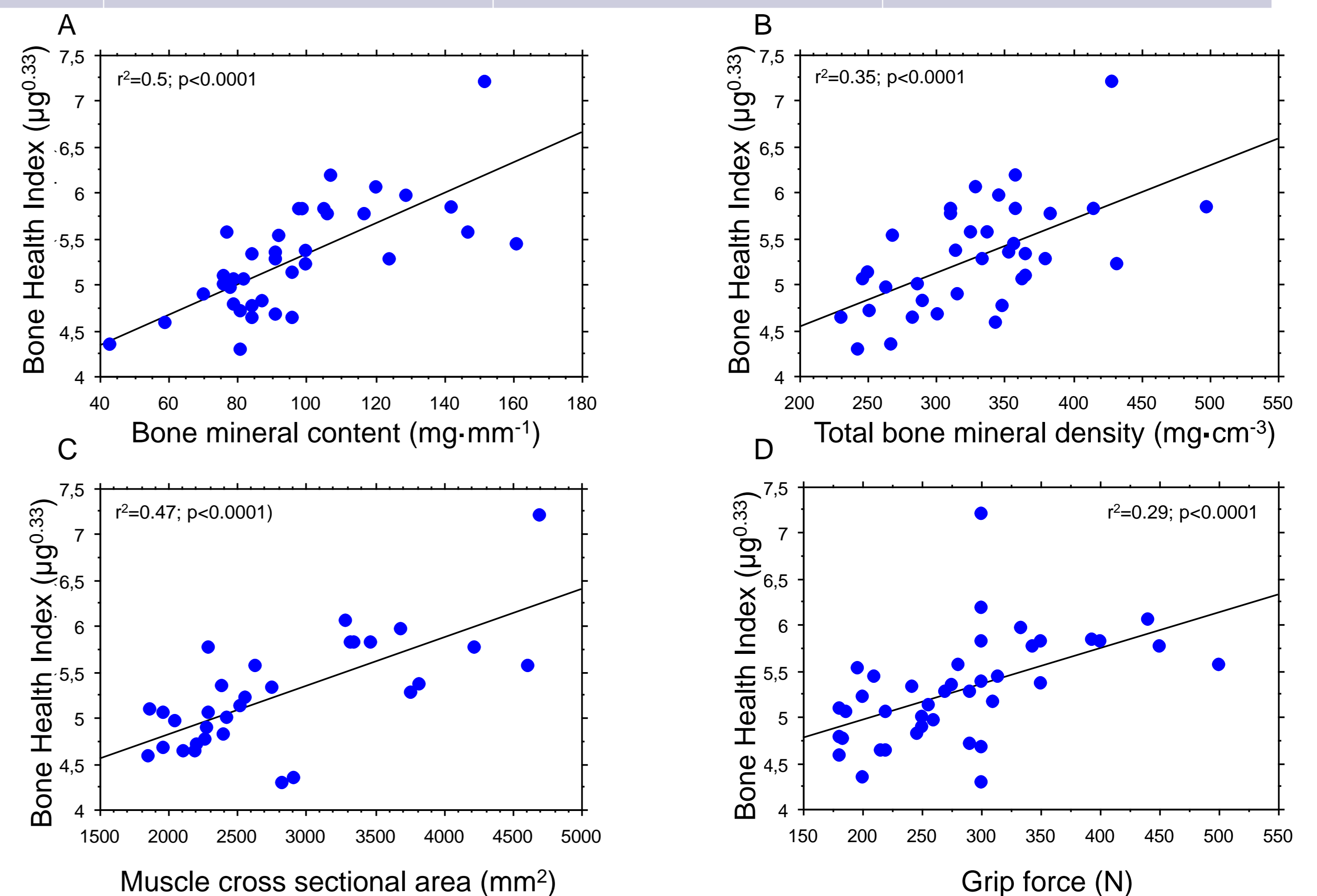


Fig. 2: BHI correlated with parameters of bone and muscle

Disclosure: H.H.T. is the owner of Visiana, which holds and markets the BoneXpert medical device for automated determination of bone age. All the other authors have nothing to disclose.

References

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