

Supplement

Table S1: ICC between two readers and automated measurements showing a comparable measurement accuracy

	ICC (2, k)	p-value	95% CI of ICC Population values
R1 vs. R2	0.98	<.001	0.96 - 0.99
R1 vs. Algorithm	0.94	0.001	0.64 - 0.98
R2 vs. Algorithm	0.96	<.001	0.90 - 0.98

Figure S1: Boxplot of H_a (A) H_c (B) and H_p (C) showing an S-shaped distribution of vertebral heights

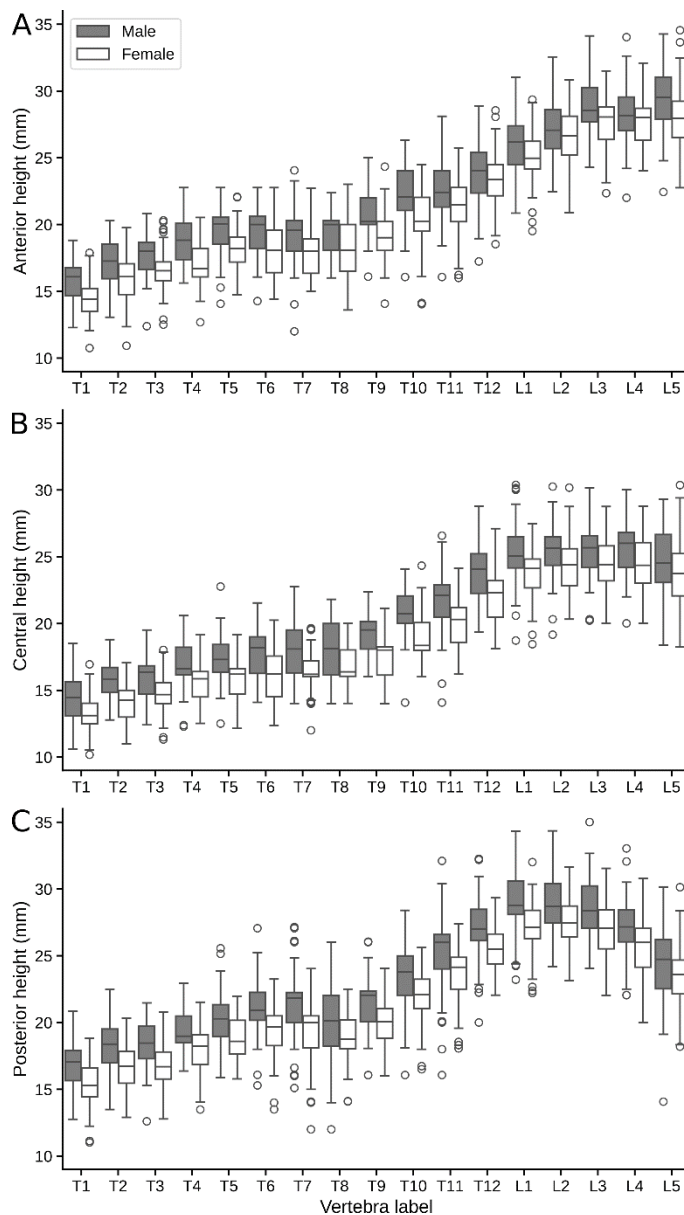


Table S2: Mean H_a , H_p , H_c and SD of male and female

	Anterior height (mm)		Central height (mm)		Posterior height (mm)	
	Mean $\pm$ SD		Mean $\pm$ SD		Mean $\pm$ SD	
	Male	Female	Male	Female	Male	Female
T1	15.74 $\pm$ 1.56	14.45 $\pm$ 1.45	14.51 $\pm$ 1.66	13.24 $\pm$ 1.44	16.82 $\pm$ 1.85	15.35 $\pm$ 1.65
T2	17.24 $\pm$ 1.64	15.89 $\pm$ 1.58	15.81 $\pm$ 1.50	14.09 $\pm$ 1.48	18.26 $\pm$ 1.91	16.69 $\pm$ 1.55
T3	17.82 $\pm$ 1.51	16.50 $\pm$ 1.54	16.05 $\pm$ 1.48	14.73 $\pm$ 1.52	18.45 $\pm$ 1.69	16.79 $\pm$ 1.63
T4	18.68 $\pm$ 1.68	16.94 $\pm$ 1.44	16.81 $\pm$ 1.63	15.57 $\pm$ 1.29	19.35 $\pm$ 1.55	17.99 $\pm$ 1.60
T5	19.63 $\pm$ 1.78	18.17 $\pm$ 1.61	17.48 $\pm$ 1.66	15.91 $\pm$ 1.47	20.31 $\pm$ 1.96	18.73 $\pm$ 1.58
T6	19.52 $\pm$ 1.88	18.07 $\pm$ 1.63	17.83 $\pm$ 1.81	16.20 $\pm$ 1.61	21.10 $\pm$ 2.11	19.40 $\pm$ 1.95
T7	19.17 $\pm$ 2.28	17.95 $\pm$ 1.60	18.06 $\pm$ 1.87	16.41 $\pm$ 1.43	20.89 $\pm$ 2.66	19.37 $\pm$ 2.32
T8	19.48 $\pm$ 1.57	18.26 $\pm$ 1.91	18.04 $\pm$ 1.86	16.86 $\pm$ 1.47	20.13 $\pm$ 2.79	18.90 $\pm$ 1.92
T9	20.61 $\pm$ 1.58	19.20 $\pm$ 1.76	19.16 $\pm$ 1.60	17.45 $\pm$ 1.56	21.63 $\pm$ 2.05	20.02 $\pm$ 1.73
T10	22.27 $\pm$ 2.02	20.39 $\pm$ 2.07	20.72 $\pm$ 1.65	18.67 $\pm$ 1.77	23.40 $\pm$ 2.28	22.01 $\pm$ 1.94
T11	22.53 $\pm$ 1.94	21.41 $\pm$ 2.00	21.86 $\pm$ 2.06	20.16 $\pm$ 1.62	25.31 $\pm$ 2.62	23.70 $\pm$ 1.99
T12	23.83 $\pm$ 2.31	23.37 $\pm$ 1.97	23.78 $\pm$ 1.93	22.03 $\pm$ 1.69	27.21 $\pm$ 2.15	25.48 $\pm$ 1.68
L1	26.06 $\pm$ 2.05	24.97 $\pm$ 1.82	25.31 $\pm$ 2.22	23.79 $\pm$ 1.73	29.16 $\pm$ 2.31	27.13 $\pm$ 1.78
L2	27.23 $\pm$ 2.22	26.63 $\pm$ 2.00	25.54 $\pm$ 2.01	24.35 $\pm$ 1.87	29.01 $\pm$ 2.17	27.62 $\pm$ 1.84
L3	28.78 $\pm$ 2.07	27.74 $\pm$ 1.94	25.45 $\pm$ 1.93	24.42 $\pm$ 2.01	28.63 $\pm$ 2.10	26.93 $\pm$ 2.16
L4	28.33 $\pm$ 2.23	27.74 $\pm$ 1.72	25.69 $\pm$ 1.93	24.58 $\pm$ 1.95	27.37 $\pm$ 2.21	25.79 $\pm$ 2.32
L5	29.23 $\pm$ 2.31	27.98 $\pm$ 2.13	24.75 $\pm$ 2.19	23.67 $\pm$ 2.37	24.41 $\pm$ 2.56	23.44 $\pm$ 2.36

Figure S2: Standardized residuals from ordinary least squares regression (A) and regression with random effects (B) showing improved fit by including random effects to the model.

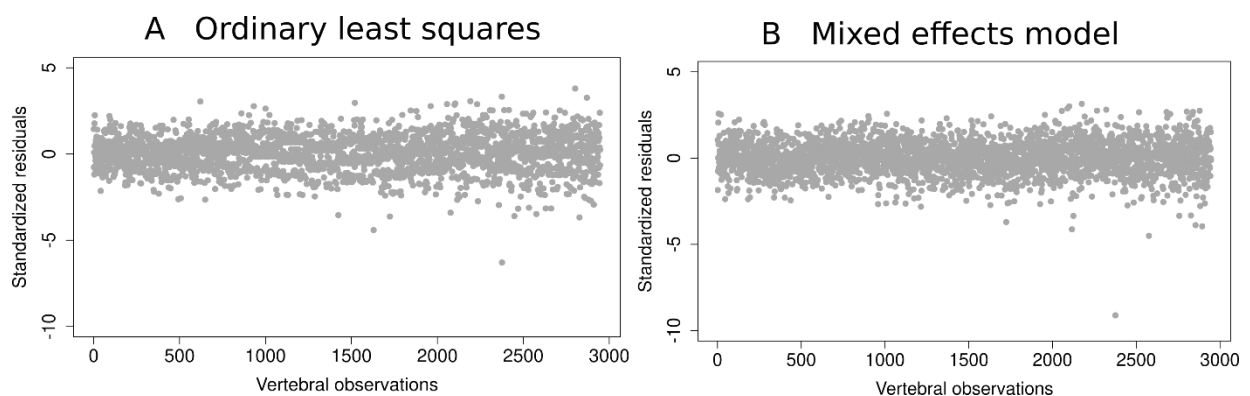


Table S3: AIC and BIC values for the different regression models with improved fit when including random effects into the model

	Anterior height		Central height		Posterior height	
	AIC	BIC	AIC	BIC	AIC	BIC
Ordinary least square regression (no random effects)	12966.36	12984.3	12779.88	12797.83	14210.86	14228.81
Mixed effects linear regression model	12404.54	12428.48	11691.97	11715.89	13744.9	13768.82
Ordinary least square regression with cubic splines (no random effects)	12338.1	12379.97	12143.18	12185.05	12987.14	13029.01
Mixed effects model with cubic spline regression	11462.6	11510.45	10413.53	10461.38	11926.48	11974.33

Table S4: Estimated parameters from cubic spline regression models for anterior heights

Mixed effects model with cubic spline regression			
	Estimates	Confidence Interval	p-value
Intercept	14.52	14.20 - 14.83	<.001
β1	4.74	4.18 - 5.30	<.001
β2	2.08	1.71 - 2.45	<.001
β3	8.61	8.19 - 9.03	<.001
β4	14.55	14.10 - 14.99	<.001
β5	13.37	13.02 - 13.71	<.001
b11 I(Male)	1.11	0.80 - 1.41	<.001
σ²	2.43	-	-
Marginal R²	0.82	-	-
Conditional R²	0.89	-	-

Table S5: Estimated parameters from cubic spline regression models for central heights

Mixed effects model with cubic spline regression			
	Estimates	Confidence Interval	p-value
Intercept	12.93	12.63 - 13.22	<.001
β1	4.27	3.82 - 4.73	<.001
β2	1.16	0.85 - 1.46	<.001
β3	9.76	9.42 - 10.10	<.001
β4	13.60	13.23 - 13.97	<.001
β5	10.60	10.32 - 10.89	<.001

b11 I(Male)	1.41	1.08 - 1.74	<.001
σ^2	1.61	-	-
Marginal R²	0.82	-	-
Conditional R²	0.91	-	-

Table S6: Estimated parameters from cubic spline regression models for posterior heights

Mixed effects model with cubic spline regression			
	Estimates	Confidence Interval	p-value
Intercept	14.99	14.64 - 15.33	<.001
β_1	5.43	4.82 - 6.03	<.001
β_2	1.03	0.63 - 1.43	<.001
β_3	11.46	11.01 - 11.92	<.001
β_4	15.51	15.03 - 15.99	<.001
β_5	8.10	7.73 - 8.47	<.001
b11 I(Male)	1.52	1.18 - 1.86	<.001
σ^2	2.82	-	-
Marginal R²	0.78	-	-
Conditional R²	0.86	-	-

Table S7: Sex-stratified cubic spline regression estimates for anterior heights

Male				Female		
	Estimates	Confidence interval	p-value	Estimates	Confidence interval	p-value
Intercept, β_0	15.62	15.20 - 16.03	<.001	14.46	14.11 - 14.82	<.001
β_1	4.98	4.20 - 5.76	<.001	4.87	4.17 - 5.57	<.001
β_2	1.49	0.92 - 2.07	<.001	1.14	0.62 - 1.66	<.001
β_3	10.41	9.78 - 11.04	<.001	10.77	10.20 - 11.33	<.001
β_4	13.94	13.32 - 14.57	<.001	14.42	13.88 - 14.97	<.001
β_5	13.54	13.01 - 14.06	<.001	13.31	12.86 - 13.77	<.001
σ^2	2.57	-	-	2.29	-	-
Marginal R²	0.80	-	-	0.84	-	-
Conditional R²	0.88	-	-	0.89	-	-

Table S8: Sex-stratified cubic spline regression estimates for central heights

Male				Female		
	Estimates	Confidence interval	p-value	Estimates	Confidence interval	p-value
Intercept, β_0	14.26	13.88 - 14.63	<.001	12.96	12.63 - 13.29	<.001
β_1	4.48	3.84 - 5.12	<.001	4.32	3.76 - 4.88	<.001
β_2	0.37	-0.10 - 0.84	0.12	0.49	0.07 - 0.91	0.02
β_3	12.33	11.81 - 12.85	<.001	11.56	11.10 - 12.01	<.001
β_4	11.81	11.29 - 12.32	<.001	12.46	12.02 - 12.90	<.001
β_5	10.73	10.29 - 11.16	<.001	10.76	10.39 - 11.13	<.001
σ^2	1.72	-	-	1.48	-	-

Marginal R²	0.80	-	-	0.83	-	-
Conditional R²	0.91	-	-	0.92	-	-

Table S9: Sex-stratified cubic spline regression estimates for posterior heights

	Male			Female		
	Estimates	Confidence interval	p-value	Estimates	Confidence interval	p-value
β_0	16.40	15.94 - 16.86	<.001	15.04	14.66 - 15.42	<.001
β_1	5.82	4.96 - 6.68	<.001	5.32	4.59 - 6.05	<.001
β_2	-0.27	-0.90 - 0.37	0.41	0.33	-0.21 - 0.87	0.24
β_3	14.55	13.86 - 15.25	<.001	13.81	13.23 - 14.40	<.001
β_4	12.80	12.80 - 13.49	<.001	12.46	11.89 - 13.03	<.001
β_5	8.10	7.52 - 8.68	<.001	8.37	7.90 - 8.85	<.001
σ^2	3.14	-	-	2.50	-	-
Marginal R²	0.75	-	-	0.80	-	-
Conditional R²	0.85	-	-	0.87	-	-

Figure S3: Sex differences of three vertebral regions defined by mixed model regression analysis in T1-T9, T10-L1, L2-L5 highlighting sex associated tendencies in the lower lumbar spine

