Cognitive Abilities and Academic Achievement in Youths with Short Stature Receiving Growth Hormone Therapy

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Background

Research suggests that short stature (SS) is associated with deficits in cognitive functioning or academic achievement and that youths with SS may exhibit academic under-achievement (i.e., lower than predicted performance based on cognitive abilities)

Several methodological issues hamper interpretation:

- The majority of studies exhibit a high risk of bias
- Studies have operationalized "intelligence" as a global score on either a traditional IQ test or on short forms
- IQ-achievement discrepancies have been documented using measures that were normed in different samples (i.e., IQ tests that may lead to overestimates of ability and achievement tests that may lead to underestimates of achievement)

Objectives

1. Examine if youth with SS score lower than population norms on IQ/achievement tests
2. Determine if youth with SS exhibit "underachievement" (i.e., lower than predicted achievement scores based upon tests of cognitive abilities)
3. Examine GH-treatment effects using a co-normed psychometric battery

Data Analysis Plan

Paired-sample t-tests were conducted to examine:

1. Within group changes in aptitude and achievement after one year
2. IQ-achievement discrepancies

Methods

- Participants: 131 youth with SS referred to pediatric endocrine clinics in 4 cities & average-height peers
- Youth were administered the Woodcock-Johnson Psycho-Educational Battery-Revised, WJ-R (co-normed IQ-achievement battery). Subscales include:
  - Aptitude: Broad Cognitive Ability
  - Achievement: Broad Reading, Broad Math, Math Reasoning, Broad Written Language, Broad Knowledge, and Skills
- Parents and youths completed medical histories and measures regarding experiences with SS

Demographic and Clinical Characteristics of the Sample

	GH-Treated (n = 69)	Average-Height (n = 58)
Age in years *M* (*SD*)	10.18 (2.60)	9.87 (2.27)
Male %	64.2	48.3
Female %	35.8	51.7
Hollingshead SES Index Score *M (SD)*	43.05 (13.79)	49.25 (9.23)
Race/Ethnicity (%)		
Non-Hispanic White	75.0	70.0
Hispanic Any Race	13.3	14.0
Black	3.3	12.0
Mixed Race or Other	8.4	4.0
Short Stature Diagnosis n (%)		
Growth Hormone Deficiency	44 (63.8)	---
Idiopathic Short Stature	13 (18.8)	---
Turner's Syndrome	8 (11.6)	---
Other	4 (5.7)	---

- No statistically significant differences in demographic, aptitude, nor achievement scores were observed between GH-treated youth who had growth hormone deficiency vs GH-treated youth with other conditions associated with SS

Results & Conclusions

IQ-Achievement Discrepancies

Domain	Baseline *t*	Baseline *p*	Baseline Effect size	Baseline Achievement Discrepancy	1-Year *t*	1-Year *p*	1-Year Effect size
GH-Treated (n = 44)							
Broad Reading	2.985	**.004***	.394	↑	.587	.560	.090
Broad Math	.934	.354	.130		.536	.595	-.079
Math Reasoning	3.184	**.002***	.396	↑	.397	.693	.053
Written Language	.142	.887	.020		2.357	.023	-.369
Broad Knowledge	2.538	.014	.278		.194	.847	-.023
Skills	1.570	.121	.193		1.066	.292	-.154
Average Height (n = 36)							
Broad Reading	.715	.477	.100		.509	.614	.086
Broad Math	.517	.607	.078		.394	.696	.07
Math Reasoning	2.890	**.005***	.403	↑	.022	.983	-.004
Written Language	5.667	**<.001***	-.702	↓	2.112	.042	-.368
Broad Knowledge	.089	.929	.012		.964	.342	-.15
Skills	.846	.401	-.108		2.334	.025	-.386

* With Bonferroni correction. Paired t-tests were conducted between BCA scores and each of the six academic achievement composite scores at baseline and follow-up

Within Group Changes After 1 Year

Domain	Baseline M	Baseline (SD)	1-Year M	1-Year (SD)	*t*	*p*	Direction	Effect size
GH-Treated (n = 44)								
Broad Cognitive Ability (BCA)	92.05	(18.44)	97.95	(18.91)	4.801	**<.001***	↑	.316
Broad Reading	99.00	(21.60)	99.51	(20.04)	.510	.612		.024
Broad Math	93.93	(22.85)	96.30	(17.85)	1.386	.173		.116
Math Reasoning	98.35	(16.74)	98.72	(14.89)	.314	.755		.023
Written Language	89.90	(23.02)	90.31	(21.44)	.242	.810		.018
Broad Knowledge	97.23	(13.69)	96.86	(12.76)	.368	.715		-.028
Skills	95.16	(17.64)	95.30	(16.70)	.160	.874		.008
Average Height (n = 36)								
Broad Cognitive Ability (BCA)	107.72	(13.99)	106.97	(12.66)	.617	.541		-.056
Broad Reading	110.33	(14.65)	108.08	(13.12)	1.900	.066		-.162
Broad Math	112.25	(17.74)	107.94	(14.84)	2.771	.009		-.264
Math Reasoning	116.33	(14.29)	106.92	(14.83)	6.593	**<.001***	↓	-.646
Written Language	99.03	(12.66)	102.08	(13.88)	1.998	.054		.230
Broad Knowledge	108.81	(12.80)	105.17	(11.22)	3.898	**<.001***	↓	-.302
Skills	107.89	(12.84)	102.11	(12.49)	6.084	**<.001***	↓	-.456

* With Bonferroni correction. Paired t-tests compared BCA with academic achievement scales at baseline and 1-year follow up

Discussion

IQ-Achievement Discrepancies

- Youths with SS appeared to be "overachieving" relative to their cognitive ability in two academic achievement domains
- Youths of average height appeared to be underachieving in one domain and overachieving in another

Within Group Changes After 1 Year

- Within group analyses demonstrated that the GH-treated group showed an increase in Broad Cognitive Ability (IQ) while the average-height group showed decreases in three academic achievement domains

Conclusion

- Findings for the sample of youth with SS (i.e., GH-treated) challenge prior research suggesting underachievement in this population
- The fact that the average-height comparison group did not follow the pattern observed in the GH-treated group suggests that observed changes are not due to maturation or practice effects

Acknowledgements

- For more information about this poster please email David E. Sandberg, dsandber@med.umich.edu
- Supported by a grant from the Genentech Foundation for Growth and Development Grant #97-110M

55ESPE 609--P1
Growth
Carlos Yeguez
DOI: 10.3252/pso.eu.55ESPE.2016
Poster presented at: ESPE 2016 PARIS
PosterSessionOnline.com