Bone Health in Adolescents born Small for Gestational Age

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BACKGROUND

Subjects born small for gestational age (SGA) are at higher risk for impaired metabolic function and disturbed hormonal profile later in life and about 10% of children born SGA do not catch-up in height. All these factors may influence bone mineral density.

AIM

To evaluate bone mineral density in adolescents born SGA in comparison to adolescents born appropriate for gestational age (AGA) and it's relation to size at birth, increase in BMI, waist to height ratio, fat mass percent and leptin concentration in adolescence.

RESULTS

Characteristics of study children are presented in **Table 1.** There were no differences in calcium, phosphate, PTH, vitamin D, IGF-1, leptin levels and fat mass percent between SGA and AGA groups, even when SGA children of short and normal stature were analyzed separately.

BMD Z-score was comparable in SGA and AGA groups. However, **short SGA children had lower BMD Z-score compared to AGA** (-0.75±0.36 vs. 0.18±0.11, p=0.018). There was no significant difference in BMD Z-score in normal statured SGA compared to short SGA and AGA children (-0.06±0.12, p=0.071 and p=0.146, respectively).

In a univariate analysis, BMD Z-score in adolescence was directly related to **birth length standard deviation score (SDS**), **birth weight SDS** (r=0.268, p=0.007 and r=0.289, p=0.003, respectively) and **BMI SDS in 6 years of age** (r=0.415, p=0.002) and **BMI in adolescence** (r=0.479, p<0.001). There was a direct association between BMD Z-score and **waist to height ratio**, **leptin concentration** and **fat mass percent** in adolescence (r=0.312, p=0.001; r=0.223, p=0.024 and r=0.242, p=0.027; respectively).

Multiple regression model was constructed, including factors without significant in-between correlation. Model and coefficients are presented in **Table 2.**

CONCLUSION

During puberty, parameters related to BMD did not differ between SGA of normal stature and AGA children. However, short SGA children had lower BMD Z-score compared to AGA. BMI SDS at 6 years of age and BMI in adolescence were the most important predictor of BMD Z-score in adolescence.

METHODS

Subjects: 103 adolescents (47 SGA and 56 AGA) born SGA or AGA, from a prospective long term follow-up cohort, constructed in 1998-2000. At the time of examination, the mean age of study children was 12.5±0.1 years.
Definition of catch-up: Children born SGA who reached above -2SD in height were defined as SGA of normal stature, and those with height below -2SD were defined as SGA of short stature.
Analyzes: Serum calcium, phosphate, parathormone (PTH), insulin-like growth factor 1 (IGF-1) and leptin concentrations, bone mineral density (BMD) (determined by dual-energy X-ray absorptiometry (DXA) (Hologic Discovery)) and fat mass percent (measured using bioelectric impedance (Jawon Medical BODYPASS X SCAN BIA)).
Standardization: Comparisons were adjusted for sex, age and pubertal stage. Vitamin D and PTH comparisons were additionally adjusted for the month of the year when blood samples were taken.

Table 1. Characteristics of study children (mean±SEM or median [interquartile range]; * - χ2 test; ** - adjusted for sex, age and pubertal stage)

	SGA (n=49)	AGA (n=56)	P value
Sex, boys/girls (%)	50/50	52/48	0.907*
Gestational age (weeks)	38.7±0.2	39.2±0.2	0.122
Birth weight SDS	-2.40±0.08	0.40±0.13	<0.001
Birth length SDS	-1.54±0.13	0.60±0.12	<0.001
Birth BMI (kg/m2)	11.0±0.2	13.6±0.2	<0.001
In adolescence			
Age (years)	12.3±0.2	12.6±0.1	0.087
Height (cm)	151.2±1.6	158.8±1.0	<0.001
Height SDS	-0.14±0.18	0.78±0.12	<0.001
Weight (kg)	41.5±1.4	49.3±1.4	<0.001
Weight SDS	-0.27±0.21	0.62±0.14	0.001
BMI (kg/m^2)	17.9±0.4	19.5±0.5	0.012
BMI SDS	-0.27±0.19	0.26±0.16	0.030
Pubertal stage (according to Tanner)	2 [1-3]	3 [2-3]	0.127*
Waist to height ratio	0.435±0.004	0.423±0.003	0.012**
Fat mass (%)	17.1±0.6	15.9±0.5	0.161**

Table 2. Associations between BMD z-score and perinatal and postnatal factors

	B	95% CI	P value
Pubertal stage	0.075	-0.110-0.260	0.419
Birth length SDS	0.033	-0.129-0.196	0.683
Birth weight SDS	0.026	-0.190-0.242	0.807
BMI SDS at 6 years of age	0.185	0.002-0.369	**0.048**
BMI in adolescence	0.101	0.028-0.175	**0.008**
Total Model's **r2 =0.312, p<0.001**			

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