Influence of Prematurity and Low Birthweight on Peak Bone Mass

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INTRODUCTION

Intrauterine weeks 36-38 with rapid transplacental mineral transfer are crucial for skeletal development[1]. Prematurity and low birthweight may therefore lead to a subnormal peak bone mass[2,3].

OBJECTIVES AND METHODS

We wanted to evaluate peak bone mass in young adults born preterm (< 37 week) with very low birthweight (VLBW,< 1500g), and small for gestational age (SGA,< 10th percentile) at term, compared with term-born controls with normal birthweight (≥ 10th percentile). This was a hospital-based follow-up study with three groups examined at 26-28 yrs. of age.

❑ 52 VLBW (mean birthweight (BW) 1227±240g, mean gestational age (GA) 29.1±2.6 week)

❑ 59 SGA (BW 2940±236 g, GA 39.6±1.2 week)

❑ 77 term-born controls (BW 3730±440g, GA 39.9±1.2 week)

❑ Outcome measures: bone mineral content (BMC) and bone mineral density (BMD) at spine, femoral neck, hip and whole body, and trabecular bone score (TBS) assessed by DXA[4]

❑ Other variables: current height and weight, previous fractures, smoking, physical activity, calcium and vitamin D intake, serum analyses of bone markers: P1NP, CTX, sclerostin and Dkk1

RESULTS

The VLBW group reported less physical activity (*p*=0.042) and higher intake of calcium compared to controls (*p*<0.001). Vitamin D intake, smoking habits and frequency of previous fractures did not differ between the groups.

Anthropometric and DXA data are shown in table 1.
Both genders in the VLBW and females in the SGA group were significantly shorter compared to controls (data not shown).

The VLBW group exhibited lower BMC and BMD at all sites except at the lumbar spine. Femoral neck BMD was 6.7% lower in the VLBW group. When adjusted for height, weight, calcium intake and physical activity the difference in femoral neck persisted.

The SGA group displayed lower BMC at the lumbar spine, however, the difference was abolished when adjusted for the confounders.
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BMD was positively correlated with gestational age and each additional week of gestation resulted in 0.037 SD increase in femoral neck Z- score.

The frequency of osteopenia or osteoporosis was higher in both groups compared to controls (SGA *p*=0.045, VLBW *p*=0.014), fig 1.

No group differences were observed in bone quality as assessed by TBS. However, TBS was lower in those who had previous fractures (*p*=0.050). Also, males in both groups had lower TBS than females (*p*=0.008).

Fig 1:
Frequency of normal BMD, osteopenia/osteoporosis
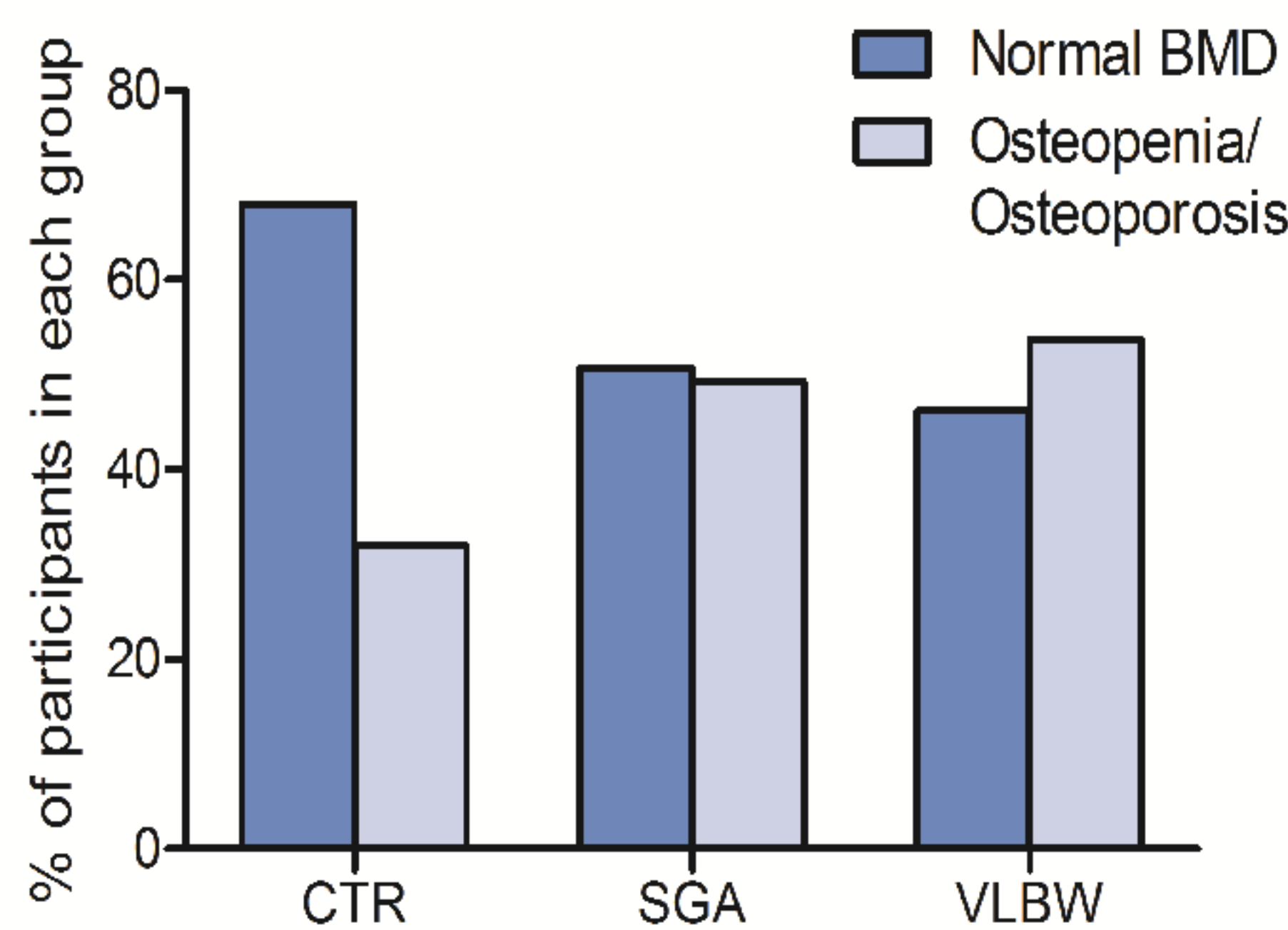
overall *p*=0.030 (Chi-square test)

Abbreviations:

VLBW = very low birthweight	DXA = dual x-ray absorptiometry
SGA = small for gestational age	BMC = bone mineral content
CTR = controls	BMD = bone mineral density
	TBS = trabecular bone score

Around 71% of the study population had suboptimal (<75nmol/L) 25OHD vitamin levels (*p*<0.001). No significant difference was observed between the groups (*p*=0.091).

Bone markers were similar between the groups, except for higher Dkk1 in the VLBW group compared to controls (*p*=0.030).

Table 1: Antropometric and DXA data

Characteristics	Controls (1) n=75	SGA (2) n=59	VLBW (3) n=52	*p* values 1 vs 2	*p* values 1 vs 3	*p* values 2 vs 3
Sex, female, n (%)	40(53.3%)	28(47.5%)	27(51.9%)		0.788¥	
Adult Weight, kg	75.9±15.4	71.7±15.3	72.8±16.2	0.281	0.516	0.933
Adult Height, m	1.75±0.10	1.72±0.10	1.71±0.10	0.092	0.105	0.933
Bone Mineral Content (g)						
Lumbar spine	68.8±11.5	63.4±12.2	62.7±13.8	**0.038**	**0.019**	0.943
Femoral neck	4.84±0.84	4.56±0.95	4.40±0.83	0.163	**0.018**	0.618
Total hip	39.96±8.3	37.73 ±9.7	36.89±8.9	0.325	0.141	0.875
Whole body total	2480±482	2316±374	2278±424	0.076	**0.030**	0.899
Bone Mineral Density (g/cm2)						
Lumbar spine	1.04±0.10	1.01±0.12	0.99±0.12	0.334	0.111	0.811
Femoral neck	0.89±0.12	0.87±0.14	0.83±0.10	0.421	**0.009**	0.213
Total hip	1.01±0.12	0.98±0.13	0.96±0.12	0.378	**0.049**	0.561
Whole body total	1.13±0.93	1.09±0.08	1.09±0.97	0.121	**0.042**	0.866
TBS lumbar spine	1.45±0.08	1.43±0.08	1.44±0.08	0.683	0.950	0.883

Values are given as mean ± SD. ANOVA, Significant if *p* <0.05, ¥Chi-square test.

CONCLUSIONS

Adults born premature with very low birthweight or small for gestational age at term displayed significantly shorter body height. Those born preterm with low birthweight also exhibited lower peak bone mass compared to term-born controls. This may imply an increased fracture risk in the future. Therefore, bone health must be a serious concern starting prenatally.

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