Calcium and vitamin D status of female adolescents in Beijing

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Late-onset rickets in northern Chinese adolescents is known to be a major problem with prevalence as high as 13-24%. In addition to a limited vitamin D supply in winter, adolescent girls in Beijing have a low calcium intake of 350 mg/d. While vitamin D deficiency is known to be a cause of rickets, low calcium intake may enhance metabolic inactivation of vitamin D in the liver inducing vitamin D deficiency (1). Further, it is suggested that low calcium intake can cause rickets even if vitamin D supply is adequate (2). To test the hypothesis that low calcium intake is a major determinant of impaired bone calcification among Beijing adolescents, a cross-sectional study was conducted from September 1995 to March 1996 to determine the prevalence rates of rickets, subclinical deficiencies and all possible associated factors, by collecting data for over 1000 variables on 1200 girls, aged 12-14 yr, randomly selected from 13 middle schools in the Beijing area. Intakes of calcium, vitamin D and other nutrients over the past year were measured by means of a validated semiquantiative food frequency questionnaire. Other factors recorded were UV exposure, age, body weight and height, pubertal maturation, physical activity, socioeconomic status and health history. Outcome variables included signs and symptoms of rickets, plasma bone alkaline phosphatase (BALP), plasma 25(OH)D3 and 1,25(OH)D3, bone mineral density (BMD) of forearm, and X-rays of wrist and hand.

Item	Rural	Suburb	Urban
Bow leg (%)	17	22	24
Pain leg/joint (%)	9/17	17/10	13/13
Spasm in leg or foot (%)	23	26	20
BALP ≥ 250winter (%)	7/4	10/6	13/11
25(OH)D3<18 nmol/l summer/winter (%)	-	-	16/83
X-ray of wrist bone (% of typical rickets)	0	0	0
Menarche (% yes)	64	68	65
Tanner stage breast/Ppbic hair mean	3/2	3/2	3/2
CA intake median (mg/d)	250	332	406
UV dose summer/winter (mJ/cm^{2}UVB/day)	60/34	43/16	44/22
BMD at distal 1/3 radius (g/cm^2)	0.596*	0.619*	0.652*

*P<0.0001

The table summarises the preliminary descriptive results. X-rays showed no typical rickets signs, meaning that bow legs observed were sequelae of rickets in early childhood. However the results of symptoms, BALP and 25(OH)D3 indicate that prevalence rates of clinical and subclinical vitamin D deficiencies were about 10% in summer and 80% in winter. The results reveal a positive relationship between calcium intake and BMD by area.

Further multivariate analyses will be required to determine the relative importance of calcium, vitamin D and other variables in adolescent bone calcification and the results will assist to formulate recommendation for calcium intake for Chinese adolescents.

1. Fraser DR. Vitamin D. The Lancet 1995;345:104-7.
2. Pettifor JM. Dietary calcium deficiency. In: Glorieux FH. ed. Rickets. New York: Raven Press, 1991:123-38.