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Vitamin D status in Asia

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As early as the 1970's, studies clearly showed that migrant populations from Asian countries, when exposed to higher latitudes, were unable to maintain optimal vitamin D levels [1-3]. Frank rickets and osteomalacia were not uncommon in these migrants. More recently, studies carried across different countries in South and South East Asia showed, with few exceptions, widespread prevalence of hypovitaminosis D, in both sexes and all age groups of the population.

Several studies have demonstrated low serum vitamin 25(OH)D levels in populations across India [4-6]. In North India (27°N), 96% of neonates [7], 91% of healthy school girls [8], 78% of healthy hospital staff [4] and 84% of pregnant women [7] were found to have hypovitaminosis D. The criteria used for defining hypovitaminosis D in most of the studies was a serum 25(OH)D level below 50nmol/L.

A major concern is the high prevalence of hypovitaminosis D among pregnant women and children. Maternal serum 25(OH)D levels correlated negatively with PTH levels and positively with cord blood 25(OH)D levels [7]. Seasonal variation in serum 25(OH)D levels reflected as winter hypovitaminosis D has been demonstrated in several studies [9, 10]. Air pollution probably also plays a role in large cities [11]. Hypovitaminosis D is equally prevalent among rural and urban subjects [7] but in some studies urban subjects are found to be more deficient [8, 12].

In South India (13°N), hypovitaminosis D is equally prevalent among different population groups [12, 13]. In a population-based study showing the inverse relationship between measured serum 25(OH)D levels and PTH levels, vitamin D levels were significantly higher in rural compared to urban subjects [14].

Similar data have been obtained from Pakistan, most disturbingly from infants [15, 16]. In Bangladesh (24°N), hypovitaminosis D is common in women regardless of age, lifestyle and clothing [17]. Prevalence of hypovitaminosis defined as 25(OH)D levels below 37.5nmol/L was 38% in Bangladeshi women from high income group and increased slightly to 50% in women from low income groups [18]. In Sri Lanka (7°N), mean 25(OH)D among healthy females was 35.3nmol/L and 40.5% of them had 25(OH)D values below 25nmol/L [19].

High prevalence of hypovitaminosis D in South Asia can be explained by skin pigmentation and traditional clothing. Air pollution and limited outdoor activity further compounds this problem in the urban population.

Vitamin D status of the population in South-East Asian countries has received relatively less attention. However, the problem seems to be less severe [20, 21]. Most studies used serum 25(OH)D level of 75nmol/L as the cut-off. Prevalence of hypovitaminosis D (25(OH)D <75nmol/L) in postmenopausal women was 47% in Thailand, 49% in Malaysia, 90% in Japan and 92% in South Korea [22]. The mean serum 25(OH)D concentration was 48nmol/L in premenopausal women from Indonesia (6°S) and Malaysia (2°N) [23]. In the Oslo immigrant study prevalence of hypovitaminosis D was higher in those born in Pakistan and lower in those born in Vietnam compared to the other ethnic groups. Fatty fish intake and cod liver oil supplements were important determinant factors of vitamin D status in the groups studied [24]. One small study in Thailand showed high serum levels of 25(OH)D [21], possibly related to its geographical location close to the equator. Further studies are needed to confirm this. To some extent these variations can be attributed to the differences in serum 25(OH)D assay methodology in various studies.

Rickets appears to be common in Mongolia and China (40°N) [25], and this is probably related both to poor vitamin D status and low calcium intake. In a study from north China (Beijing), 89% of Chinese adolescent girls had hypovitaminosis D (serum 25(OH)D <50nmol/L) [26] and 48% of old men had severe hypovitaminosis D/frank vitamin D deficiency (<25nmol/L) [27]. Among postmenopausal women serum 25(OH)D level was found to be lower amongst the Malays (44±11nmol/L) than the Chinese (69±16nmol/L) [28]. The relatively lower serum 25(OH)D level among Malays can be explained by their skin pigmentation, lower outdoor activity levels or greater fat mass. In Hong Kong, the mean serum 25(OH)D was 71±27nmol/L in adults over 50 years of age [29] but hypovitaminosis D was common among elderly patients with fracture neck of femur [30]. In bottle-fed infants of Hong Kong (on vitamin D fortified milk), serum 25(OH)D levels were normal at 18 months [31]. A dual-centred study in China showed that more than 90% of young women in Beijing and Hong Kong had 25(OH)D levels ≤50nmol/L. However, the mean values were much lower in the north (Beijing) as compared to the south (Hong Kong) (34 versus 9nmol/L; $p<0.001$) and 40% compared to 18% of young women in Beijing and Hong Kong respectively had 25(OH)D levels ≤25nmol/L [32].

Hypovitaminosis D in Japan (35°N) is more common in inactive elderly (mean 30nmol/L) and women younger compared to older than 30 years of age (mean 34nmol/L) [33]. Overall the vitamin D status in Japan is relatively better to the regions in South Asia and positively related to fish consumption [33-35]. Prevalence of hypovitaminosis D (<30nmol/L) in women over 30 years old is only 10.3% [33] and in active elderly (25(OH)D <75nmol/L) is below 5% [34].

This widespread prevalence of vitamin D deficiency/insufficiency has a deleterious effect on bone mineral homeostasis and peak bone mass achieved, and may subsequently reflect as low bone mineral density [4, 26, 31, 36]. Intervention studies with vitamin D supplements are underway in several of these populations.

For further information, the reader is referred to:

A. Mithal, D.A. Wahl, J-P. Bonjour et al. on behalf of the IOF Committee of Scientific Advisors (CSA) Nutrition Working Group. Global vitamin D status and determinants of hypovitaminosis D (2009) *Osteoporosis International, in press*

References

1. Arneil GC (1975) Nutritional rickets in children in Glasgow. Proc Nutr Soc 34:101-109.

2. Dunnigan MG, Paton JP, Haase S, et al. (1962) Late rickets and osteomalacia in the Pakistani community in Glasgow. Scott Med J 7:159-167.

3. Holmes Am Enoch BA, Taylor JL, Jones ME (1973) Occult rickets and osteomalacia amongst the Asian immigrant population. Q J Med 42:125-149.

4. Arya V, Bhambri R, Godbole MM, Mithal A (2004) Vitamin D status and its relationship with bone mineral density in healthy Asian Indians. Osteoporos Int 15:56-61.

5. Vupputuri MR, Goswami R, Gupta N, et al. (2006) Prevalence and functional significance of 25-hydroxyvitamin D deficiency and vitamin D receptor gene polymorphisms in Asian Indians. Am J Clin Nutr 83:1411-1419.

6. Zargar AH, Ahmad S, Masoodi SR, et al. (2007) Vitamin D status in apparently healthy adults in Kashmir valley of Indian subcontinent. Postgrad Med J 83:713-716.

7. Sachan A, Gupta R, Das V, et al. (2005) High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. Am J Clin Nutr 81:1060-1064.

8. Puri S, Marwaha RK, Agarwal N, et al. (2008) Vitamin D status of apparently healthy schoolgirls from two different socioeconomic strata in Delhi: relation to nutrition and lifestyle. Br J Nutr 99:876-882.

9. Goswami R, Gupta N, Goswami D, et al. (2000) Prevalence and significance of low 25-hydroxyvitamin D concentrations in healthy subjects in Delhi. Am J Clin Nutr 72:472-475.

10. Malhotra N, Mithal A, S. G, Godbole MM (2008) Effect of vitamin D supplementation on the bone health parameters of healthy young Indian women. Osteoporos Int 19 (Suppl 1):S29-S207.

11. Agarwal KS, Mughal MZ, Upadhyay P, et al. (2002) The impact of atmospheric pollution on vitamin D status of infants and toddlers in Delhi India. Arch Dis Child 87:111-113.

12. Harinarayan CV, Ramalakshmi T, Prasad UV, et al. (2007) High prevalence of low dietary calcium, high phytate consumption, and vitamin D deficiency in healthy south Indians. Am J Clin Nutr 85:1062-1067.

13. Harinarayan CV (2005) Prevalence of vitamin D insufficiency in postmenopausal South Indian women. Osteoporos Int 16:397-402.

14. Harinarayan CV, Ramalakshmi T, Prasad UV, Sudhakar D (2008) Vitamin D status in andhra pradesh: A population based study. Indian J Med Res 127:211-218.

15. Atiq M, Suria A, Nizami SQ, Ahmed I (1998) Vitamin D status of breastfed Pakistani infants. Acta Paediatr 87:737-740.

16. Rashid A, Mohammed T, Stephens WP, et al. (1983) Vitamin D state of Asians living in Pakistan. Br Med J 286:182-184.

17. Islam MZ, Akhtaruzzaman M, Lamberg-Allardt C (2006) Hypovitaminosis D is common in both veiled and nonveiled Bangladeshi women. Asia Pac J Clin Nutr 15:81-87.

18. Islam MZ, Lamberg-Allardt C, Karkkainen M, et al. (2002) Vitamin D deficiency: a concern in premenopausal Bangladeshi women of two socio-economic groups in rural and urban region. Eur J Clin Nutr 56:51-56.

19. Rodrigo MD (2007) Peak bone mass measured by phalangeal BMD and its association with nutritional status, socioeconomics status and physical activity: a community based cross sectional study in Galle district, Sri Lanka. In. Extract from PHD thesis (unpublished).

20. Chailurkit L-O, Rajatanavin R, Teerarungsikul K, et al. (1996) Serum vitamin D, parathyroid hormone and biochemical markers of bone turnover in normal Thai subjects. J Med Assoc Thai 79:499-504.