Prevalence of Vitamin D Insufficiency among the Elderly Males Living in the Urban Areas of Khon Kaen Province in the Northeast of Thailand

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Background: *Vitamin D insufficiency among the elderly Thai women in the urban areas was higher than in the rural areas because of lifestyle differences. There are very few studies about vitamin D status among Thai elderly males.*
Objective: *To ascertain the vitamin D status in and prevalence of vitamin D insufficiency among the elderly Thai males living in the urban areas of Khon Kaen province, situated in Northeast, Thailand.*
Results: *The respective mean (SE) of calcidiol, β-CTx and PINP level for the elderly Thai males were 42.04 (1.22), 0.26 (0.02) and 37.39 (2.19) ng/mL. A calcidiol level under 40 ng/mL indicated vitamin D insufficiency and the prevalence of the elderly Thai males living in urban area of Khon Kaen province, Thailand was 48%. The respective correlations between PTH and calcidiol, β-CTx and PINP were -0.217, 0.640 and 0.393. The respective correlations between PTH and BMD of the trochanteric region and total femur were 0.198 and 0.199 ($p < 0.05$).*
Conclusion: *The prevalence of vitamin D insufficiency among the elderly males in Khon Kaen remained high and the bone biochemical markers were at a low enough level to cause low bone turnover and low BMD.*

Keywords*: Calcidiol, Elderly males, Vitamin D Insufficiency, Urban*

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Vitamin D insufficiency among elderly Thai women in the urban areas was higher than in the rural areas (65.4% vs. 17.4% respectively) because of lifestyle differences[1]. The present study also revealed a high prevalence of vitamin D insufficiency among both post-[2] (60%), and pre-menopausal women[3] (77.81%) with an urbanized lifestyle. In the urbanized lifestyle, people tend to stay in the shade, sheltering from the sun to avoid: 1) getting overheated, 2) skin darkening and 3) skin cancer. Avoiding any exposure to the sun; however, will result in vitamin D insufficiency since the principle source of the vitamin D is what the body produces while the skin is exposed to the sun.

In Thailand, very few studies have been conducted on the vitamin D status among elderly males[4]. Therefore, the objective of the present study was to evaluate the vitamin D status by measuring the levels of serum calcidiol (25 (OH) D) and to ascertain the prevalence of vitamin D insufficiency among the elderly males living in the urban areas of Khon Kaen province in Northeast, Thailand.

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Material and Method

One hundred healthy elderly males averaging 70.7 years of age were enrolled in the present study. None of the participants took any kinds of medicine affecting bone metabolism before the screening. At the screening visit, an overnight fasting blood sample was collected and kept frozen (-20°C) until it was analyzed. The serum liver function and renal function, blood sugar, and cholesterol were determined by the standard laboratory methods. The subjects who had any abnormal levels in their blood chemistry tests were excluded.

Serum PINP, or the representative bone formation marker, and serum β-CTx, or the bone resorption marker were measured by using electrochemiluminescence (ECLIA) on an Elecsys 2010.

The % CV of the PINP and the β-CTx in pooled human sera were between 2.3-3.7 and 1.6-4.7, respectively.

The serum intact parathyroid hormone and calcidiol samples were measured by using the electrochemiluminescence (ECLIA) technique on an Elecsys 2010. The % CV of the PTH and calcidiol in pooled human sera were between 4.3-5.9 and 6.9-9.9, respectively.

The bone mineral density of the proximal femur in all participants was measured by using dual energy x-ray absorptiometry on a Prodigy, Lunar Corp, USA with a precision error of 1-2% at Srinagarind Hospital, Khon Kaen University.

Statistical analysis

The population sample number of 100 elderly male cases was derived from the assumption that the prevalence of vitamin D insufficiency among elderly males was 40%, and 10% of the error was acceptable at a p-value < 0.05.

The mean (SE), the median (SE), the minimum and maximum of the demographic and the clinical characteristic baseline were reported including: age, weight, height, BMI, calcidiol, PTH, bone formation and bone resorption markers and the alkaline phosphatase levels.

The student t-test was used to compare the differences of the means of the continuous variables such as the alkaline phosphatase, bone biochemical markers and the PTH levels between the normal and vitamin D insufficiency groups. The Pearson's correlation was used to show the association between the groups. For hypothesis testing, a p-value < 0.05 was required for statistical significance.

Results

The clinical characteristic baseline of all participants was presented in Table 1. The level of calcidiol which resulted in a significantly higher level of PTH was 40 ng/mL; that is, the level indicating vitamin D insufficiency. The prevalence of vitamin D insufficiency among urbanized elderly males was 48% (Fig. 1). Table 2 showed the correlations of PTH and calcidiol, PINP, β-CTx and BMD. The calcidiol correlated only with PTH but not with any of the other parameters.

Discussion

It is well accepted that Vitamin D insufficiency in the elderly is one of the most important factors for the development of osteoporosis and fractures, especially of the femoral neck[6-9]. There is currently no consensus on what level of serum 25 (OH) D would be

Table 1. Characteristic baseline of the participants (n = 100 cases)

	Mean (SE)	Median (SE)	Minimum	Maximum
Age (n = 100)	70.73 (0.62)	71.00 (0.62)	60	84
Weight (n = 100) kg	58.63 (1.05)	56.50 (1.05)	37.00	84.00
Height (n = 100) cm	160.31 (0.57)	160.00 (0.57)	145.00	173.00
BMI (n = 100) kg/m^2	22.75 (0.35)	22.68 (0.35)	15.20	31.62
PTH (n = 100) pg/mL	24.80 (1.93)	24.57 (1.93)	1.20	79.40
Calcidiol (n = 100) ng/mL	42.04 (1.22)	40.35 (1.22)	12.66	75.04
Alk Phos (n = 100) u/L	72.69 (1.91)	70.00 (1.91)	35.00	142.00
PINP# (n = 100) ng/mL	37.39 (2.19)	33.40 (2.19)	5.00	105.70
β-CTx* (n = 100) ng/mL	0.26 (0.02)	0.25 (0.02)	0.01	1.09

PINP = 58.1 (48.00-68.60), * β-CTx = 0.412 (0.359-0.464)

Table 2. Pearson's correlations of PTH, calcidiol, PINP, β-CTx and BMD

Pearson's correlation	Calcidiol	β-CTx	PINP	BMD-femoral neck	BMD-trochanter	BMD-total femur
PTH	-0.217	0.640	0.393	0.182	0.198	0.199
p-vlaue	0.03	< 0.001	< 0.001	0.07	0.048	0.048
n = 100						

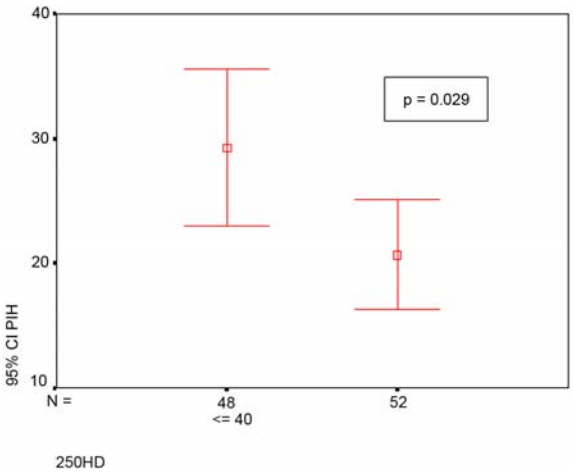

Fig. 1 Comparison of the mean ± 95% CI of PTH between calcidiol level ≤ 40 ng/mL and calcidiol level > 40 ng/mL. The student's t-test confirmed a significant difference between them ($p < 0.05$).

optimal; the range of suggestions is between 10 and 40 ng/mL[10-14]. The difference in recommendations may be attributed to global latitude, population ethnic characteristics and different assay methods for calcidiol.

According to the present study, the serum calcidiol level was measured using the electrochemiluminescence (ECLIA) technique on an Elecsys 2010 and the level for vitamin D insufficiency was 40 ng/mL which was 5 ng higher than the authors' previous studies[1,2,14] on vitamin D insufficiency in the elderly women measured by using the radioimmunoassay (RIA) technique on a DiaSorin, USA. When the value of the calcidiol level of 40 ng/mL by ECLIA technique was converted to a calcidiol value measured by the RIA technique (using the formula published by Leino et al 2008)[15], the calcidiol level was 38.1 ng/mL which was slightly higher than the vitamin D insufficiency found among elderly Thai women (35 ng/mL) measured by using the RIA technique.

The calcidiol level had a modest negative correlation with PTH ($r = -0.217$; $p = 0.03$) and no correlation with any other parameters. PTH had a modest positive correlation with BMD especially at the trochanteric region ($r = 0.198$; $p = 0.048$) and total femur ($r = 0.199$; $p = 0.048$) but not for femoral neck. It is noteworthy because PTH represents the bone resorption hormone and it has had a moderate correlation with β-CTx-the bone resorption marker ($r = 0.640$; $p < 0.001$) which, in turn has had a modest correlation with PINP-the bone formation marker ($r = 0.393$; $p < 0.001$).

According to the baseline of characteristics in the present study, there were lower levels of bone turnover markers: both bone resorption and formation markers compared with the normal young adult Thai males, *i.e.* between 20-45 yrs of age[5] indicating that most Khon Kaen males at the age of 60 and over had low bone turnover and reduced bone formation and trabecular thinning rather than that there was increased resorption and loss of connectivity. Testosterone, GH, and IGF-1 deficiency may decrease periosteal expansion during growth to aging and reduced bone formation in the BMU during aging[16].

Vitamin D is only one factor for osteoporosis while hypogonadism may be the major risk factor for lowered bone turnover, reduced bone formation and senile osteoporosis in males.

Conclusion

The prevalence of vitamin D insufficiency in elderly Khon Kaen males remained high; the bone biochemical markers were at low enough levels enough to cause low bone turnover and low BMD in elderly males.

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Potential conflicts of interest

None.

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ความชุกของภาวะขาดวิตามินดีในบุรุษสูงอายุที่อาศัยอยู่ในเขตเมืองจังหวัดขอนแก่นประเทศไทย

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***ภูมิหลัง**: สตรีสูงอายุในเขตเมืองมีความชุกของการขาดวิตามินดีสูงกว่าเขตชนบท เนื่องจากความแตกต่างของการใช้ชีวิตมีการศึกษาน้อยมากเกี่ยวกับภาวะของวิตามินดีของบุรุษสูงอายุ*

***วัตถุประสงค์**: ศึกษาหาสภาวะของวิตามินดีในกระแสเลือดและความชุกของการขาดวิตามินดีในบุรุษสูงอายุที่อาศัยอยู่ในเขตเมือง จังหวัดขอนแก่นประเทศไทย*

***ผลการศึกษา**: ค่าเฉลี่ย (ค่าความคลาดเคลื่อนมาตรฐาน) ของระดับวิตามินดี β-CTx และ PINP ในกระแสเลือดของบุรุษสูงอายุไทยเท่ากับ 42.04 (1.22) 0.26 (0.02) และ 37.39 (2.19) ng/mL ตามลำดับ และพบว่าระดับของการขาดวิตามินดีอยู่ที่ 40 ng/mL โดยมีความชุกของการขาดวิตามินดีเท่ากับร้อยละ 48 ค่าสัมประสิทธิ์แห่งความสัมพันธ์ระหว่างระดับของพาราไทรอยด์และวิตามินดี β-CTx และ PINP เท่ากับ -0.217, 0.640 และ 0.393 ตามลำดับ และค่าสัมประสิทธิ์แห่งความสัมพันธ์ ระหว่างระดับของพาราไทรอยด์ และค่าความหนาแน่นของมวลกระดูกที่ตำแหน่ง trochanter และ total femur เท่ากับ 0.198 และ 0.199 ($p < 0.05$) ตามลำดับ*

***สรุป**: ความชุกของภาวะขาดวิตามินดีในบุรุษสูงอายุที่อาศัยอยู่ในเขตเมือง จังหวัดขอนแก่น ประเทศไทยยังคงอยู่ในระดับสูง และพบว่าค่าการสร้างและการสลายกระดูกอยู่ในระดับที่ต่ำกว่าปกติ แสดงถึงสภาวะการหมุนเวียนของกระดูกที่ต่ำ ซึ่งเป็นสาเหตุหนึ่งของมวลกระดูกที่ต่ำในบุรุษผู้สูงอายุ*