Differences in Bone Mineral Density and Lifestyle Factors of Postmenopausal Women Living in Bangkok and Other Provinces

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Abstract

Decreased bone mineral density (BMD) with age is an increasing health problem, especially for postmenopausal women. Multiple factors have been reported to affect BMD including both genetic and environmental factors such as calcium intake and physical activity. For Thailand, people residing in different regions may differ in BMD due to these factors. However, there is a paucity of data concerning this issue.

The objectives of this study were to identify the lifestyle factors which may influence BMD and to investigate the association between BMD and these factors in postmenopausal women who have been living in Bangkok and other provinces in Thailand.

Subjects consisted of 466 postmenopausal women aged 46-90 years including 236 Bangkokians (116 early postmenopausals and 120 late postmenopausals) and 230 non-Bangkokians (134 early postmenopausals and 96 late postmenopausals). All were healthy and ambulatory. BMD was measured by dual energy X-ray absorptiometry (DEXA, Expert XL). Calcium intake was assessed by food-frequency questionnaire. Data were expressed by mean ± SEM.

There were 22 per cent (n=52), 5.9 per cent (n=14), and 4.2 per cent (n=10) of postmenopausal Bangkokians while 13.9 per cent (n=32), 4.3 per cent (n=10), and 2.2 per cent (n=5) of postmenopausal non-Bangkokians who had low BMD at spine, femoral neck, and at both sites, respectively. Spine BMD (SPBMD) and femoral neck BMD (FNBMD) increased significantly across the quartiles of calcium intake in both groups of subjects ($P<0.05$) and a significant difference was found between the lowest and the highest quartiles of calcium intake ($P<0.05$). Moreover, BMD at both regions was shown to be correlated with calcium intake, exercise and sunlight exposure in these subjects ($P<0.001$). Further analysis revealed higher BMD at spine (0.992 ± 0.02 *vs* 0.945 ± 0.02 g/cm^2, $P<0.05$) and at femur (0.780 ± 0.01 *vs* 0.740 ± 0.01 g/cm^2, $P<0.05$), calcium intake (348.9 ± 12.7 *vs* 316.3 ± 8.0 mg/day, $P<0.05$), exercise (2.8 ± 0.1 *vs* 2.4 ± 0.1 h/wk, $P<0.001$) and sunlight exposure (2.9 ± 0.06 *vs* 1.9 ± 0.04 h/day, $P<0.001$) were found in late postmenopausal women in other provinces than their counterparts in Bangkok. Nevertheless, no significant difference of BMD at both sites, calcium intake and exercise was found in the early postmenopausal groups of these two areas.

Conclusions: There were significant differences in BMD and lifestyle factors between late postmenopausal women in Bangkok and other provinces. Environmental factors especially calcium intake, exercise and sunlight exposure, may influence BMD in late postmenopausal Thai women.

Key word : Bone Mineral Density, Lifestyle Factors, Postmenopausal Women

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It is known that Asian populations have lower bone mineral density (BMD) than those in Western countries(1-3). Multiple factors were reported to affect BMD including genetic and environmental factors. Contributing factors affecting BMD such as physical activity and calcium intake may be significant in the young and middle aged(4-5). Also, these factors may influence BMD in the elderly(6). For Thailand, people residing in different regions may differ in BMD due to these factors. However, data concerning this issue are scarce.

Both cross-sectional studies(7-9) and longitudinal study(10) of age and menopause related bone loss have been investigated. An epidemiological study reported that age-specific hip fracture increased exponentially in Thai people after the age of sixty (11). In addition, the longevity of the population has continued to increase from 51.4 years in 1947 and is projected to be 70.8 years in 2000 in women(12). From these observations, osteoporosis may become an increasing health problem in Thailand in the near future.

The objectives of this present study were to compare BMD and calcium intake of early and late postmenopausal women who have been living in the Bangkok metropolitan area and other smaller urban areas of Thailand, to investigate an association between BMD and lifestyle factors in these subjects and to identify factors which may account for differences between these two populations.

MATERIAL AND METHOD

Subjects participating in this study were part of those who were sifted in the screening program of the prevention and treatment of osteoporosis project in the year 1996. Subjects consisted of 466 postmenopausal women aged 46-90 years including 236 Bangkokians and 230 non-Bangkokians, classified according to years since menopause (ysm) into early postmenopausal group (ysm $\leq$ 5 years) and late postmenopausal group (ysm $\geq$ 10 years). There were 116 and 134 early postmenopausal women and 120 and 96 late postmenopausal women in Bangkok and other provinces, respectively. Non-Bangkokian volunteers, people who were born, grew up and settled in provinces except Bangkok and surrounding areas and have continued to live there for at least the past five years, came from many provinces of the northern part (Chiang Mai, Phichit, Phitsanulok), the southern part (Surat Thani, Phuket), the northeastern part (Nakhon Ratchasima, Khon Kaen, Nakhon Phanom), the eastern part (Chon Buri, Rayong) and the central part (Nakhon Sawan, Lop Buri, Ratchaburi). All subjects were healthy and ambulatory volunteers and did not take any medication affecting calcium and bone metabolism. Informed consents were received from all participants. They were interviewed to collect data including age, menarche, menopausal age, lifetime estrogen exposure (menopausal age-menarche), exercise, sunlight exposure, alcohol consumption, cigarette smoking, parity, gravidity, education, occupation and income. Exercise was estimated in the number of hours per week used in both light, moderate and active exercise which were not routine pursuits. Sunlight exposure assessed in the duration of direct sunlight exposure to the subjects in a day (h/d). Calcium intake was assessed by food-frequency questionnaire. Height

Table 1. Characteristics of the subjects (mean ± SEM).

	BKK (n=236)	Other provinces (n=230)	P
Age, years	58.2 ± 0.5	57.7 ± 0.4	NS
Weight, kg	58.2 ± 0.6	58.7 ± 0.6	NS
Height, cm	152.7 ± 0.3	152.5 ± 0.3	NS
BMI, kg/m^2	24.9 ± 0.2	25.2 ± 0.2	NS
SPBMD, g/cm^2	1.017 ± 0.01	1.057 ± 0.01	0.018
FNBMD, g/cm^2	0.800 ± 0.01	0.833 ± 0.01	0.009
Calcium intake, mg/day	355.6 ± 7.6	383.5 ± 10.7	0.034
Menarche, years	13.6 ± 0.1	13.6 ± 0.1	NS
Menopause, years	49.7 ± 0.2	49.8 ± 0.2	NS
Ysm, years	8.5 ± 0.4	7.9 ± 0.4	NS
Estrogen time, years	36.1 ± 0.2	36.2 ± 0.2	NS
Exercise, h/wk	2.9 ± 0.1	3.2 ± 0.1	0.001
Sunlight exposure, h/day	2.0 ± 0.03	3.1 ± 0.04	<0.001

BMI = body mass index
SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density
Ysm = years since menopause

and weight were measured with a heightmeter and the accurate weighing scale with hospital gowns and without shoes. BMD was measured by dual energy X-ray absorptiometry (DEXA, Expert XL) at the AP spine (L2-4) and left femur. Coefficient of variation (CV) for *in vivo* measurements at the spine and femoral neck (three volunteers similar to subjects in age, weight and menopausal status had measurements taken five times in five consecutive days of measurements) were 1.1 per cent and 2.0 per cent, respectively. The SPSS statistical package was used for data analysis. Descriptive analyses were performed and differences between groups were assessed by *t*-test and oneway analysis of variance with Scheffes' test. Pearson's correlation coefficients were determined the correlations between BMD and body composition as well as lifestyle factors. Various factors, including weight, height, dietary calcium intake, exercise, sunlight exposure, menarche, menopausal age, total lifetime of estrogen exposure, years since menopause, were firstly considered to establish a regression model to identify risk factors that affected and contributed to BMD for each population group at each skeletal site.

RESULTS

Descriptive data of the subjects are shown in Table 1. Comparing data between Bangkok and other provinces, significantly lower L2-4 spine (SPBMD) femoral neck BMD (FNBMD), calcium intake, exercise and sunlight exposure were found in Bangkokians than non-Bangkokians, whereas no significant difference in age and body composition (weight, height, BMI) was found between these two groups.

More than 90 per cent of subjects had consumed very little alcohol in their lifetime and had never smoked, thus, these data were not analyzed in this study.

When subjects were arranged by menopausal status into early and late postmenopausal groups, no significant difference in all variables except menarche and sunlight exposure between early postmenopausal groups in Bangkok and other provinces (Table 2). However, significant differences in BMD at spine and femoral neck, calcium intake, menarche, exercise and sunlight exposure were found in late postmenopausal groups of these two different areas (Table 3).

Using the mean - 2.5 SD value of spine (L2-4) and femoral neck BMD of young adults as a cut-off point for the diagnosis of osteoporosis[13], data was compared between the early and late postmenopausal women in Bangkok and other provinces who had osteoporosis (Table 4).

Positive relationship between BMD and calcium intake, exercise and sunlight exposure was found (Table 5).

SPBMD and FNBMD increased significantly across the quartiles of calcium intake (P

Table 2. **Characteristics of early postmenopausal women in Bangkok and other provinces (mean ± SEM).**

	BKK (n=116)	Other provinces (n=134)	P
Age, years	52.8 ± 0.3	53.4 ± 0.3	NS
Weight, kg	58.9 ± 0.8	59.2 ± 0.7	NS
Height, cm	154.2 ± 0.5	153.1 ± 0.4	NS
BMI, kg/m^2	24.8 ± 0.3	25.3 ± 0.3	NS
SPBMD, g/cm^2	1.092 ± 0.02	1.102 ± 0.01	NS
FNBMD, g/cm^2	0.862 ± 0.01	0.870 ± 0.01	NS
Calcium intake, mg/day	396.2 ± 12.0	408.3 ± 15.7	NS
Menarche, years	13.0 ± 0.1	13.6 ± 0.1	<0.001
Menopause, years	49.9 ± 0.2	50.4 ± 0.2	NS
Ysm, years	8.5 ± 0.4	7.9 ± 0.4	NS
Estrogen time, years	36.9 ± 0.2	36.8 ± 0.2	NS
Exercise, h/wk	3.4 ± 0.1	3.5 ± 0.1	NS
Sunlight exposure, h/day	2.1 ± 0.04	3.2 ± 0.06	<0.001

BMI = body mass index
SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density
Ysm = years since menopause

Table 3. **Characteristics of late postmenopausal women in Bangkok and other provinces (mean ± SEM).**

	BKK (n=120)	Other provinces (n=96)	P
Age, years	63.6 ± 0.5	63.7 ± 0.6	NS
Weight, kg	57.5 ± 0.8	58.1 ± 0.9	NS
Height, cm	151.3 ± 0.5	151.7 ± 0.5	NS
BMI, kg/m^2	25.0 ± 0.3	25.2 ± 0.4	NS
SPBMD, g/cm^2	0.945 ± 0.02	0.992 ± 0.02	0.036
FNBMD, g/cm^2	0.740 ± 0.01	0.780 ± 0.01	0.015
Calcium intake, mg/day	316.3 ± 8.0	348.9 ± 12.7	0.025
Menarche, years	14.3 ± 0.1	13.6 ± 0.1	<0.001
Menopause, years	49.6 ± 0.2	49.1 ± 0.2	NS
Year since menopause, years	14.0 ± 0.5	14.6 ± 0.5	NS
Estrogen time, years	35.4 ± 0.2	35.5 ± 0.2	NS
Exercise, h/wk	2.4 ± 0.1	2.8 ± 0.1	0.001
Sunlight exposure, h/day	1.9 ± 0.04	2.9 ± 0.06	<0.001

BMI = body mass index
SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density

<0.001) and a significant difference was found between the lowest and highest quartile of calcium intake in both early and late postmenopausal group (Table 6).

There was a tendency to increase in BMD at the spine and femur across the quartiles of exercise in early and late postmenopausal women (Table 7).

A stepwise multiple regression procedure was adapted to determine the effect of variables associated with spine and femoral neck BMD. Regression coefficients were shown in Table 8, 9.

DISCUSSION

Calcium intake of postmenopausal Thai women was lower than the RDA. This finding is in

Table 4. Number and proportion* of subjects with osteoporosis.

Osteoporotic site	BKK				Other provinces			
	Early		Late		Early		Late	
	N	%	N	%	N	%	N	%
SPBMD	10	8.6	42	35.0	5	3.7	27	28.1
FNBMD	5	4.3	9	7.5	4	3.0	6	6.3
both sites	4	3.4	6	5.0	1	0.9	4	4.2

* percentage distribution within group
SPBMD = spinal bone mineral density ≤ 0.88 g/cm^2
FNBMD = femoral neck bone mineral density ≤ 0.59 g/cm^2

Table 5. Correlation coefficients of calcium intake, exercise, sunlight exposure and BMD in all subjects.

	SPBMD	FNBMD
Calcium intake	0.52[a]	0.39[a]
Exercise	0.39[a]	0.36[a]
Sunlight exposure	0.26[a]	0.24[a]

SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density
[a] $p < 0.001$

accordance with a study in postmenopausal women in the United States showing an average of only 475-575 mg of calcium a day(14). A study of Heaney, et al indicated that an increase in calcium intake to between 1.5 and 2.0 g/day would be required to maintain a zero calcium balance since calcium absorption does not increase after menopause, rather it appears to decrease(15). In addition, calcium intake was negatively related to age ($r = -0.33$, $P < 0.001$) in this study. Increased dietary calcium intake should be recommended in elderly postmenopausal women whose diet is usually low in calcium(16).

Table 8 compares the distribution of food sources of calcium intake between postmenopausal women in Bangkok and other provinces. The majority of calcium source in Bangkokians was milk and other dairy products, whereas, that of non-Bangkokians was vegetables and fruit. The results suggest that calcium from vegetable source may be absorbed quite well in Thais. An earlier study(17) supported that calcium absorption from kale is good when compared to milk although a previous study (18) reported that absorption of calcium may be decreased by spinach due to the formation of insoluble calcium oxalate. Though the major contribution of calcium was milk and dairy products, calcium intake as per cent derived from milk in postmenopausal Bangkokians (28%) was much less than in a U.S. population (62-65%)(19).

This study revealed that there was no difference between BMD at both sites, calcium intake and exercise in early postmenopausal groups of the two different areas. On the other hand, significant differences in these factors are found in late postmenopausal women. These differences may be caused by environmental factors such as birthplace, where the subjects grew up, lifestyle, dietary differences and overall nutrition during the developmental years(20). It appears that calcium intake and exercise played a major role in decreasing bone loss in late postmenopausal groups in this study.

In the early postmenopausal years, bone loss is predominantly related to the cessation of estrogen production. Any effect of calcium on bone status is likely to be difficult to identify because of the much greater effect of estrogen deficiency (21). Recent studies on the effect of estrogen on bone mass reported that estrogen can preserve bone mass (22,23).

It is known that calcium absorption efficiency decreases with age(24). Under normal conditions, the efficiency of intestinal calcium absorption is regulated to meet the body's needs for calcium. Normally, calcium absorption increases when dietary calcium is low and decreases when dietary calcium is high. This adaptation plays a major role in maintaining calcium balance(25). However, in the elderly when dietary calcium is restricted, the effficiency of intestinal calcium absorption hardly increases(26). After menopause, for any intake, absorption is

Table 6. BMD at spine and femoral neck (mean ± SEM) with quartiles of calcium intake.

Quartiles (Q) of calcium intake (mg/d)	SPBMD (g/cm^2)	FNBMD (g/cm^2)
Early postmenopausal women		
Q1 (155-304)	0.979 ± 0.02[a]	0.788 ± 0.01[a]
Q2 (305-347)	1.059 ± 0.02[a]	0.876 ± 0.01[a]
Q3 (348-451)	1.128 ± 0.02[a]	0.904 ± 0.02[a]
Q4 (452-1,200)	1.223 ± 0.02[b]	0.870 ± 0.01[b]
Late postmenopausal women		
Q1 (157-278)	0.911 ± 0.02[a]	0.722 ± 0.02[a]
Q2 (279-308)	0.934 ± 0.02[a]	0.747 ± 0.02
Q3 (309-372)	0.954 ± 0.02[a]	0.757 ± 0.02
Q4 (373-810)	1.066 ± 0.02[b]	0.805 ± 0.02[c]

SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density
[a] significant difference from Q4 at the 0.05 level
[b] significant difference from Q1, Q2, Q3 at the 0.05 level
[c] significant difference from Q1 at the 0.05 level

Table 7. BMD at spine and femoral neck (mean ± SEM) with quartiles of exercire.

Quartiles (Q) of exercise (h/wk)	SPBMD (g/cm^2)	FNBMD (g/cm^2)
Early postmenopausal women		
Q1 (0-3.0)	1.052 ± 0.02	0.825 ± 0.01[a, d]
Q2 (3.1-3.5)	1.121 ± 0.02	0.897 ± 0.01[c]
Q3 (3.6-4.0)	1.141 ± 0.03	0.892 ± 0.02
Q4 (4.1-6.8)	1.127 ± 0.02	0.904 ± 0.02[c]
Late postmenopausal women		
Q1 (0-1.9)	0.914 ± 0.02[a]	0.737 ± 0.02[a]
Q2 (2.0-2.4)	0.943 ± 0.02[a]	0.724 ± 0.02[a]
Q3 (2.5-3.0)	0.972 ± 0.02[a]	0.767 ± 0.01
Q4 (3.1-6.0)	1.078 ± 0.02[b]	0.825 ± 0.02[c, d]

SPBMD = spinal bone mineral density
FNBMD = femoral neck bone mineral density
[a] significant difference from Q4 at the 0.05 level
[b] significant difference from Q1, Q2, Q3 at the 0.05 level
[c] significant difference from Q1 at the 0.05 level
[d] significant difference from Q1 at the 0.05 level

about 14 mg less than before the absence of estrogen(24).

The effect of dietary calcium on BMD is still debatable. However, a previous study showed that calcium supplementation may preserve bone density in elderly osteoporotic women(27). Our results revealed a significant relationship between calcium intake and both BMD regions; therefore, higher calcium intake may be related with a lower risk of fracture(28).

A study in two Yugoslav populations differed by an approximate 2-fold difference in calcium intake and found that bone mass was higher in the high calcium area(29). The results of this present study supported this evidence.

Furthermore, positive correlation was found between exercise and BMD of spine and femoral neck in our study (Table 5), similar to a previous study(30). Relationship between fitness and spine BMD was found in young women with higher cal-

Table 8. Regression coefficients of BMD in Bangkokian subjects.

Variables	L2-4 spine	Femoral neck
Calcium intake	5.47×10^{-4} (0.35)	NS
Calcium intake^2	NS	1.63×10^{-7} (0.13)
Exercise	0.059 (0.33)	NS
Menarche^3	-3.95×10^{-5} (-0.13)	-3.01×10^{-5} (-0.14)
Weight	0.004 (0.17)	NS
Weight^3	NS	2.65×10^{-7} (0.20)
Sunlight exposure^2	NS	0.009 (-0.11)
ysm	NS	-0.008 (-0.38)
constant	0.54	0.83
	R = 0.64	R = 0.61
	$R^2 = 0.41$	$R^2 = 0.37$

Standard regression coefficients are in parentheses.
NS, not significant at the 0.05 level

The predictive equations for BMD in Bangkokian are;

BMD at spine (g/cm^2) = 0.54 + 5.47 x 10^{-4} calcium intake (mg/d) + 0.059 exercise (h/wk) -3.95 x 10^{-5} menarche^3 (yr) + 0.004 weight (kg)

BMD at femur (g/cm^2) = 0.83 + 1.63x10^{-7} calcium intake^2 (mg/d) -3.01 x 10^{-5} menarche^3 (yr) + 2.65 x 10^{-7} weight^3 (kg) + 0.009 sun^2 (h/d) -0.008 ysm (yr)

Table 9. Regression coefficients of BMD in non-Bangkokian subjects.

Variables	L2-4 spine	Femoral neck
Calcium intake	0.001 (1.08)	0.003 (3.27)
Calcium intake^2	NS	-3.87×10^{-6} (-5.48)
Calcium intake^3	-5.41×10^{-10} (-0.61)	1.85×10^{-9} (2.65)
Exercise	NS	0.024 (0.19)
Exercise^2	0.003 (0.13)	NS
Menopause^2	NS	5.42×10^{-5} (0.11)
Estrogen time	0.02 (0.22)	NS
Height	NS	0.005 (0.19)
Sunlight exposure	0.04 (0.15)	NS
ysm	NS	-0.004 (-3.11)
constant	-0.03	-0.64
	R = 0.69	R = 0.66
	$R^2 = 0.48$	$R^2 = 0.43$

Standard regression coefficients are in parentheses.
NS, not significant at the 0.05 level

The predictive equations for BMD in non-Bangkokian are;

BMD at spine (g/cm^2) = -0.03 + 0.001 calcium intake (mg/d) -5.41 x 10^{-10} calcium intake^3 (mg/d) + 0.003 exercise^2 (h/wk) + 0.02 estrogen time (yr) + 0.04 sunlight exposure (h/d)

BMD at femur (g/cm^2) = -0.64 + 0.003 calcium intake (mg/d) -3.87 x 10^{-6} calcium intake^2 (mg/d) + 1.85 x 10^{-9} calcium intake^3 (mg/d) + 0.024 exercise (h/wk) + 5.42 x 10^{-5} menopause^2 (yr) + 0.005 height (cm) -0.004 ysm (yr) cium intake(31). Lifestyle as a young adult may help to increase bone mass. Previous studies also reported a positive effect of exercise on BMD in postmenopausal women(32,33). Basically, exercise serves to delay the rate of bone loss(34). However, an earlier study also reported that whenever physical activity is reduced, bone mass decreases(35); therefore, increased exercise may lead to increase in bone mass.

Although there was a difference in sunlight exposure in early postmenopausal women in different areas, no significant difference in BMD at both regions was found. It may be due to adequate sunlight exposure. Accordingly, this factor had no effect on BMD in Thais. A recent study indicated that serum 25-OH-D level increased with advancing age(36).

Finally, the result from stepwise multiple regression pointed that there were many factors affecting BMD in these subjects.

In conclusion, this study demonstrated that bioavailability of calcium source other than milk and dairy product in the Thai diet may be sufficient. Also, there is evidence to support the literature that differences in lifestyle can affect BMD especially in the late postmenopausal group. Consequently, change in lifestyle pattern may be beneficial for late postmenopausal women particularly in Bangkok. These findings will encourage people to have more concern about their daily lifestyle and thereby decrease the incidence of osteoporosis.

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ปัจจัยในการดำรงชีวิตที่มีผลกระทบต่อความหนาแน่นของกระดูกในสตรีวัยหมดประจำเดือนในกรุงเทพมหานครและต่างจังหวัด

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การศึกษาเกี่ยวกับปัจจัยที่มีอิทธิพลต่ออัตราการลดลงของความหนาแน่นของกระดูกในวัยสูงอายุโดยเฉพาะอย่างยิ่งในสตรีไทยวัยหมดประจำเดือนยังมีน้อย วัตถุประสงค์ของการศึกษานี้คือ เพื่อศึกษาปัจจัยในการดำรงชีวิตต่อความหนาแน่นของกระดูกในสตรีวัยหมดประจำเดือนในกรุงเทพมหานครเปรียบเทียบกับต่างจังหวัด

อาสาสมัครประกอบด้วยสตรีวัยหมดประจำเดือนที่มีสุขภาพแข็งแรง 466 คน อายุ 46-90 ปี ในจำนวนนี้อาศัยอยู่ในกรุงเทพมหานคร 236 คน (116 คน หมดประจำเดือนระยะต้น (<5 ปี) และ 120 คน หมดประจำเดือนระยะปลาย (>10 ปี)) และอาศัยอยู่ต่างจังหวัด 230 คน (134 คน หมดประจำเดือนระยะต้นและ 96 คนหมดประจำเดือนระยะปลาย) อาสาสมัครทุกคนได้รับการประเมินแคลเซี่ยมในอาหารต่อวัน ตอบแบบสอบถามเกี่ยวกับการดำรงชีวิตและวัดความหนาแน่นกระดูก

ความถี่ของสตรีวัยหมดประจำเดือนในกรุงเทพมหานครที่มีความหนาแน่นของกระดูกต่ำที่กระดูกสันหลัง, กระดูกสะโพกและทั้ง 2 บริเวณคือ 22%, 5.9%, 4.2% ในขณะที่ความถี่ในสตรีวัยหมดประจำเดือนต่างจังหวัดคือ 13.9%, 4.3% และ 2.2% ตามลำดับ ความหนาแน่นของกระดูกสันหลังและกระดูกสะโพกสูงขึ้นตามปริมาณแคลเซี่ยมที่รับประทานในสตรีทั้งสองกลุ่ม ($p<0.05$) และพบความแตกต่างของความหนาแน่นของกระดูกในสตรีที่รับประทานแคลเซี่ยมน้อยที่สุด (ควอไทล์ต่ำสุด) และสูงสุด (ควอไทล์สูงสุด) นอกจากนี้ความหนาแน่นของกระดูกทั้งสองบริเวณยังมีความสัมพันธ์กับปริมาณแคลเซี่ยมที่รับประทาน, การออกกำลังกายและระยะเวลาการถูกแสงแดด ($p<0.001$) เมื่อเปรียบเทียบกับสตรีในกรุงเทพมหานคร สตรีวัยหมดประจำเดือนระยะปลายที่อาศัยอยู่ต่างจังหวัดมีความหนาแน่นของกระดูกสันหลังสูงกว่า (0.992 ± 0.2 เปรียบเทียบกับ 0.9 ± 0.02 g/cm^2, $p < 0.05$), มีความหนาแน่นของกระดูกสะโพกสูงกว่า (0.780 ± 0.01 เปรียบเทียบกับ 0.740 ± 0.01 g/cm^2, $p<0.05$), รับประทานแคลเซี่ยมมากกว่า (348.9 ± 12.7 เปรียบเทียบกับ 316.3 ± 8.0 mg/ต่อวัน, $p<0.05$), ออกกำลังกายมากกว่า (2.8 ± 0.1 เปรียบเทียบกับ 2.4 ± 0.1 ชม.ต่อสัปดาห์) และมีระยะเวลาในการถูกแสงแดดนานกว่า (2.9 ± 0.06 เปรียบเทียบกับ 1.9 ± 0.04 ชม.ต่อวัน, $p<0.001$) แต่ไม่พบความแตกต่างของความหนาแน่นของกระดูกและในปัจจัยเหล่านี้ในสตรีวัยหมดประจำเดือนระยะต้น

โดยสรุปปัจจัยในการดำรงชีวิตที่มีอิทธิพลต่อความหนาแน่นของกระดูกในสตรีไทยวัยหมดประจำเดือนระยะปลายคือปริมาณแคลเซี่ยมที่ได้รับต่อวัน, การออกกำลังกายและระยะเวลาที่ถูกแสงแดด

คำสำคัญ : ความหนาแน่นของกระดูก, ปัจจัยในการดำรงชีวิต, สตรีวัยหมดประจำเดือน

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