The Effects of Vitamin D and Sarcopenia on Bone Mineral Density in Korean woman
(KNHANES IV data)

Thein MK, Yang SW, Lee SH, Lee DJ, Kim BT
Department of Family Practice and Community Health
The Graduate School of Medicine, Ajou University

Introduction

A osteoporotic fracture has become a global health issue that cause tremendous impact on mortality as well as heavy socioeconomic burden.

Vitamin D is an essential hormone for absorption of calcium in intestine and mineralization of bone.

Previous studies suggested that **vitamin D may prevent fractures by improving muscle mass as well as via increasing bone density directly.**

Purpose

: to determine that the positive influence of vitamin D on BMD depends on its beneficial effects on muscle mass

Methods

This study is based up on the data acquired during the second year (2009) of KNHANES IV, cross-sectional and nationally representative survey conducted in 2009. 3820 women older than 20 years were included for the analysis.

Definition of osteoporosis

: T - score under -2.5 , measured by DXA (Hologic)

Definition of Sarcopenia

Appendicular Skeletal Mass (ASM)

: The sum of muscle mass in arms and legs measured by DXA

- Weight-adjusted ASM (total ASM divided by weight x 100)
- Height adjusted ASM (total ASM divided by height squared)

Type 1 sarcopenia

:from Mean (28.05%) to - 2 SD(24.23%) of reference population

Type 2 sarcopenia

:below - 2 SD(24.23%) of reference population

Serum 25(OH)D levels

• Divided by 3 group

1.Normal

: above 20ng/dl (50nmol/L)

2.Insufficiency

10-20 ng/dl (25nmol/L)

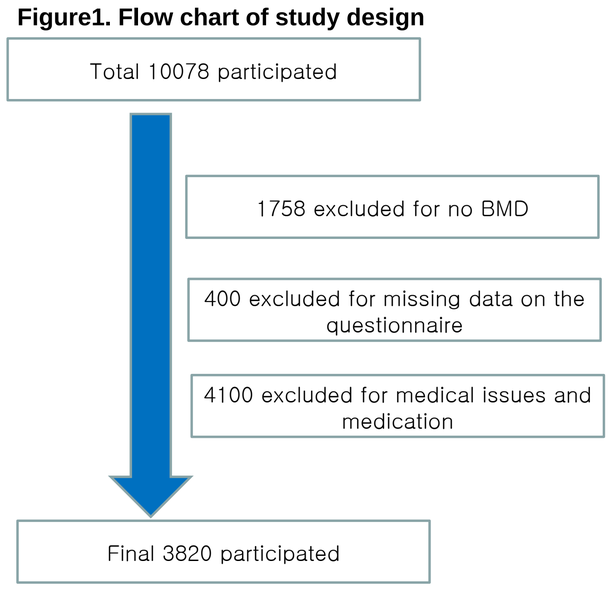
3.Deficiency

below 10ng/dl (25nmol/L)

Statistical analysis

The mean and standard deviation values were grouped into 2 and compared according to sarcopenia status by independent T test. The odd ratios of sarcopenia and vitamin D deficiency on bone mineral density(BMD) and Vitamin D deficiency on BMD, unadjusted and adjusted for multiple levels were analyzed by logistic regression tests.

Figure1. Flow chart of study design



Results

Table 1. Comparison Between Women with and without Sarcopenia

(MeanSD)

	Non-sarcopenic Women (n=3642)	Sarcopenic Women (n=178)
Age	48.7	60.5**
Height (cm)	156.6	150.8**
Weight (kg)	56.4	62.8**
BMI (kg/m^2)	23.0	27.6**
Total fat (g)	18291.18	26546.77**
Total fat percentage (%)	32.0	42.0**
ASM (g)	15911.34	15293.83**
Weight adjusted ASM (%)	27.8	21.9**
Height adjusted ASM (kg/m^2)	0.6087	0.4738**
Vitamin D (ng/ml)	17.2	16.0*
Whole body BMD (g/cm^2)	1.091	1.0461.350**
Lumbar spine L 1-4 BMD (g/ cm^2)	0.903	0.874*
Femoral neck BMD	0.701	0.651**
Total femur BMD	0.853	0.813**
Daily protein intake (g)	55.8	45.8**
Daily calcium intake (g)	436.69	380.23
Moderate exercise (%)	14.3	12.9

** : P value <0.01
* : P value <0.05

Table 2. Correlations Among vitamin D, muscle mass and Bone Mineral density

		Vitamin D	Weight Adjusted ASM	Height Adjusted ASM	Whole body BMD	Lumbar spine BMD	Femoral Neck BMD	Total Femur BMD
Vitamin D	unadjusted		-0.010	0.048**	-0.008	-0.037**	-0.021	0.020
	adjusted		0.039	0.056*	0.060	0.042	0.066**	0.093**
Weight Adjusted ASM	unadjusted			0.094**	0.076**	0.033**	0.066**	0.014**
	adjusted			0.644**	0.124**	0.024	0.082**	0.048*
Height Adjusted ASM	unadjusted				0.163**	0.187**	0.218**	0.267**
	adjusted				0.197**	0.216**	0.246**	0.316**
Whole body BMD	unadjusted					0.527**	0.495**	0.495**
	adjusted					0.657**	0.602**	0.596**
Lumbar spine BMD	unadjusted						0.542**	0.537**
	adjusted						0.640**	0.662**
Femoral Neck BMD	unadjusted							0.699**
	adjusted							0.859**
Total Femur BMD	unadjusted							
	adjusted							

** : P value <0.01
* : P value <0.05
Adjusted for age, menstrual status, daily calcium intake and physical activity

Table 3. Odds Ratios for Severe Sarcopenia according to vitamin D level

		Vitamin D level		
		Sufficiency >20 ng/ml (26.7%)	Insufficiency 10-20 ng/ml (63.6%)	Deficiency <10 ng/ml (9.7%)
Odds Ratio For type 2 sarcopenia	Model 1	1 (ref)	1.41 (0.84-2.37)	2.57** (1.34-5.02)
	Model 2	1 (ref)	1.762* (1.02-3.04)	3.90** (1.89-8.05)
	Model 3	1 (ref)	1.79 (0.92-3.45)	4.72** (2.01-11.1)

** : P value <0.01
* : P value <0.05
Model 1: Unadjusted
Model 2: Adjusted for age and BMI
Model 3: Adjusted for age, BMI, menstrual status, daily calcium intake and physical activity

Table 4. Odds Ratios for osteoporosis according to muscle mass

		Weight adjusted muscle mass		
		Normal >28.05% N=1512	Type 1 sarcopenia 24.23-28.05% N=1911	Type 2 sarcopenia <24.23% N=397
Osteoporosis At Lumbar spine	Model 1	1 (ref)	1.46 (0.94-2.29)	1.51 (0.73-3.12)
	Model 2	1 (ref)	1.46 (0.85-2.49)	1.35 (0.57-3.22)
	Model 3	1 (ref)	1.51 (0.85-2.69)	1.66 (0.67-4.10)
	Model 4	1 (ref)	1.50 (0.61-3.74)	1.51 (0.84-2.67)
Osteoporosis At Femoral Neck	Model 1	1 (ref)	1.38* (1.01-1.92)	2.25* (1.41-3.58)
	Model 2	1 (ref)	1.61* (1.05-2.47)	3.18**(1.66-6.09)
	Model 3	1 (ref)	1.56 (1.00-2.43)	2.71**(1.35-5.41)
	Model 4	1 (ref)	1.57* (1.01-2.45)	2.59**(1.29-5.21)
Osteoporosis At total femur	Model 1	1 (ref)	1.21 (0.84-1.75)	2.15* (1.29-3.60)
	Model 2	1 (ref)	1.66* (1.04-2.65)	4.10**(2.03-8.29)
	Model 3	1 (ref)	1.70* (1.04-2.79)	4.29**(2.03-9.05)
	Model 4	1 (ref)	1.72* (1.05-2.81)	3.96**(1.87-8.39)

** : P value <0.01
* : P value <0.05
Model 1: Unadjusted
Model 2: Adjusted for age and BMI
Model 3: Adjusted for age, BMI, menstrual status, daily calcium intake and physical activity
Model 3: Adjusted for age, BMI, menstrual status, daily calcium intake, physical activity, and vitamin D level

Summary

1. Vitamin D level is well correlated with height adjusted ASM, but not with Weight adjusted ASM.

2. Vitamin D level is well correlated with hip BMD, but not with spine BMD.

3. Vitamin D and sarcopenia are independent predictors for low bone density especially at Hip.

Conclusion

Though vitamin D and muscle mass share beneficial effects on bone mineral density, they have independent influence from each other on BMD.