

# Association Between Household Size, Residential Area, and Osteoporosis: Analysis of 2008–2011 KNHANES

Sung-Woo Kim<sup>1</sup>, Kwi-Hyun Bae<sup>1</sup>, Jae-Han Jeon<sup>1</sup>, Yeon-Kyung Choi<sup>1</sup>, Mi-Kyung Kim<sup>2</sup>, Hye-Soon Kim<sup>2</sup>, Hyun-Ae Seo<sup>3</sup>, Eui Hyun Kim<sup>3</sup>, Keun-Gyu Park<sup>1</sup>

<sup>1</sup> Division of Endocrinology and Metabolism, Department of Internal Medicine, Kyungpook National University School of Medicine, Daegu, South Korea

<sup>2</sup> Division of Endocrinology and Metabolism, Department of Internal Medicine, Keimyung University School of Medicine, Daegu, South Korea

<sup>3</sup> Division of Endocrinology and Metabolism, Department of Internal Medicine, Daegu Fatima Hospital, Daegu, South Korea

## Introduction and objectives

The prevalence of single-person households has rapidly increased in Korea. Individuals living alone and in rural areas may have a higher risk of various metabolic diseases due to differences in lifestyle. However, few studies have investigated the association of household size and residential area with health-related problems. **This study aimed to evaluate the association of household size and residential area with risk of osteoporosis in postmenopausal women.**

## Method

This cross-sectional study enrolled 3058 postmenopausal women from the 2008–2011 Korea National Health and Nutrition Examination Survey (KNHANES). We examined the association between bone mineral density (BMD) and household size and residential area.

## Results

### 1. Baseline characteristics of participants

	Postmenopausal women (n=3058)		P value
	Rural residents (n=969)	Urban residents (n=2089)	
Age, y	65.2±0.3	62.4±0.2	<0.001
BMI, kg/m <sup>2</sup>	24.1±0.1	24.2±0.1	0.233
Systolic BP, mmHg	129.7±0.6	127.7±0.4	0.002
Diastolic BP, mmHg	78.2±0.3	78.2±0.2	0.926
Fasting glucose, mg/dL	99.7±0.7	101.1±0.5	0.269
Total cholesterol, mg/dL	200.1±1.2	202.0±0.8	0.313
Vitamin D, ng/mL	19.8±0.2	17.7±0.2	<0.001
PTH, pg/mL	70.7±1.1	68.6±0.7	0.133
Age at menopause, y	48.5±0.2	49.7±0.1	<0.001
Number of pregnancies, n	5.2±0.1	4.8±0.1	<0.001
Food intake, g/day	1023.9±16.4	1153.2±14.2	<0.001
Nutrient support			
Total energy intake, kcal/day	1554.1±18.2	1568.2±13.8	0.630
Protein intake, g/day	50.3±0.9	53.3±0.6	0.005
Fat intake, g/day	19.9±0.5	24.2±0.4	<0.001
Calcium intake, mg/day	400.4±9.7	441.5±9.3	0.012
Working hours, h/week	27.7±0.8	15.2±0.5	<0.001
Physical activity (high/moderate/walk), n, %	109/137/245 (11.2%/14.1%/25.2%)	241/180/634 (11.5%/8.6%/30.3.0%)	0.202
Heavy alcoholics, n, %	12 (1.2%)	23 (1.1%)	0.740
Cigarette smoking (current/ex), n, %	22/43 (2.3%/4.4%)	93/76 (4.5%/3.6%)	0.029
DM, n, %	108 (11.1%)	278 (13.3%)	0.094
HTN, n, %	406 (41.9%)	796 (38.1%)	0.046
Anti-hypertensive drug use, n, %	355 (36.6%)	686 (32.8%)	0.103
Thyroid disease, n, %	53 (5.5%)	179 (8.6%)	0.003
History of cancer, n, %	40 (4.1%)	85 (4.1%)	0.916
Number of people per households, n	2.4±0.0	2.8±0.0	<0.001
Single-person households, n, %	188 (19.4%)	276 (13.2%)	<0.001
Osteoporosis, n, %	406 (41.9%)	646 (30.9%)	<0.001
Vertebral fracture, n, %	17 (1.8%)	20 (1.0%)	0.091

All data are expressed as unweighted mean ± standard error or number (%). All P values were obtained using the Student's t-test or Chi-square test. Abbreviations: BMI, body mass index; BP, blood pressure; PTH, parathyroid hormone; DM, diabetes mellitus; HTN, hypertension

### 3. BMD according to household size and residential area

	Rural area		Urban area	
	Single	Two-more	Single	Two-more (Ref)
Lumbar spine BMD				
Unadjusted	0.734±0.012 **	0.800±0.007 *	0.778±0.007 **	0.821±0.004
Adjusted	0.786±0.016 **	0.807±0.015	0.819±0.015	0.816±0.014
Total femur BMD				
Unadjusted	0.716±0.010 **	0.783±0.006	0.741±0.006 **	0.788±0.003
Adjusted	0.754±0.012	0.769±0.011	0.769±0.010	0.761±0.010
Femoral neck BMD				
Unadjusted	0.574±0.009 **	0.634±0.005	0.586±0.005 **	0.639±0.003
Adjusted	0.619±0.011	0.630±0.010	0.624±0.010	0.624±0.009

\*P<0.05 (statistical significance). \*\*P<0.01 (statistical significance)

### 2. General characteristics of participants stratified by household size and residential area

	Rural		Urban	
	Single (n=194)	Two-more (n=775)	Single (n=297)	Two-more (n=1792) (Ref)
Age, y	69.8±0.6 **	64.0±0.3 **	68.2±0.5 **	61.5±0.2
BMI, kg/m <sup>2</sup>	23.8±0.3	24.2±0.1	24.6±0.2 *	24.2±0.1
Systolic BP, mmHg	131.4±1.2 **	129.3±0.6 **	132.0±1.1 **	127.0±0.4
Diastolic BP, mmHg	78.5±0.8	78.1±0.4	78.4±0.6	78.2±0.2
Fasting glucose, mg/dL	100.2±1.5	99.5±0.8	101.8±1.2	100.9±0.6
Total cholesterol, mg/dL	199.5±2.6	200.3±1.3	200.8±2.2	202.2±0.9
Vitamin D, ng/mL	20.8±0.5 **	19.5±0.2 **	18.4±0.4	17.6±0.2
PTH, pg/mL	74.4±2.6 *	69.7±1.2	71.7±1.7	68.1±0.8
Age at menopause, y	48.0±0.37 **	48.7±0.17 **	49.0±0.31 **	49.8±0.10
Number of pregnancies, n	5.7±0.17 **	5.1±0.08 **	5.4±0.18 **	4.7±0.06
Food intake, g/day	900.9±31.6 **	1055.0±18.7 **	976.0±35.2 **	1182.6±15.4
Nutrient support				
Total energy intake, kcal/day	1438.4±34.8 **	1583.3±20.9	1457.4±34.7 **	1586.6±15.0
Protein intake, g/day	44.2±1.5 **	51.8±1.0	47.7±1.5 **	54.2±0.7
Fat intake, g/day	16.1±0.9 **	20.9±0.6 *	20.1±1.1 **	24.9±0.4
Calcium intake, mg/day	377.6±25.6 *	406.1±10.3 *	410.2±20.0	446.7±10.3
Working hours, h/week	18.0±1.6	30.1±0.9 **	9.8±1.1 **	16.1±0.6
Physical activity (high/moderate/walk), n				
Heavy alcoholics, n, %	5 (2.6%)	7 (0.9%)	5 (1.7%)	18 (1.0%)
Cigarette smoking (current/ex), n, %	14/4 (7.2%/2.1%)	29/18 (3.7%/2.3%)	18/23 ** (6.1%/7.7%)	58/70 (3.2%/3.9%)
DM, n, %	23 (11.9%)	85 (11.0%)	47 (15.8%)	231 (12.9%)
HTN, n, %	87 (44.8%) *	319 (41.2%) *	148 (49.8%) **	648 (36.2%)
Anti-hypertensive drug use, n, %	80 (44.2%) *	280 (36.1%)	133 (44.8%) **	597 (33.3%)
Thyroid disease, n, %	6 (3.1%) **	47 (6.1%) *	21 (7.1%)	158 (8.8%)
History of cancer, n, %	10 (5.2%)	36 (4.6%)	16 (5.4%)	85 (4.7%)
Osteoporosis, n, %	114 (58.8%) **	307 (39.6%) **	130 (43.8%) **	555 (31.0%)
Vertebral fracture, n, %	4 (2.1%)	14 (1.8%)	6 (2.0%)	17 (0.9%)

All data are expressed as unweighted mean ± standard error or number (%). All P values were obtained using the Student's t-test or Chi-square test.

### 4. Osteoporosis and fracture risk according to household size and residential area

	Rural area		Urban area	
	Single	Two-more	Single	Two-more
Osteoporosis of lumbar spine				
Unadjusted	3.155 ** (2.143–4.646)	1.383 * (1.064–1.797)	1.633 ** (1.194–2.233)	1 (Ref)
Model 1	1.622 * (1.045–2.517)	1.152 (0.874–1.517)	0.853 (0.592–1.229)	1 (Ref)
Model 2	1.667 * (1.083–2.565)	1.137 (0.861–1.502)	0.879 (0.610–1.266)	1 (Ref)
Vertebral fracture				
Unadjusted	3.518 (0.880–14.054)	2.617 * (1.099–6.228)	2.675 (0.976–7.336)	1 (Ref)
Model 1	1.884 (0.362–9.813)	1.848 (0.756–4.515)	1.265 (0.444–3.608)	1 (Ref)
Model 2	1.963 (0.347–11.107)	1.865 (0.783–4.442)	1.309 (0.447–3.839)	1 (Ref)

Model 1: adjusted for age, body mass index, number of pregnancies, duration of menopause, systolic blood pressure, parathyroid hormone, vitamin D levels, hypertension, and thyroid disease.

Model 2: adjusted for age, body mass index, number of pregnancies, duration of menopause, systolic blood pressure, parathyroid hormone, vitamin D levels, hypertension, thyroid disease, working hours, physical activity, heavy alcoholics, smoking status, daily food intake, and nutrient support.

Data were analyzed by the complex samples logistic regression model.

All data are expressed as odds ratio (95% confidence interval).

\*P<0.05 (statistical significance). \*\*P<0.01 (statistical significance).

## Conclusions

Individuals in rural single-person households had significantly lower BMD and greater odds of osteoporosis in lumbar spine than urban households with two or more individuals. The results of this study suggest that individuals living in rural single-person households may benefit from more careful screening for osteoporosis.

