

Association between Muscular Strength and Low Bone Mineral Density in Older Women



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ABSTRACT

PURPOSE: Loss of bone mineral density (BMD) and accompanying negative outcomes (e.g., fracture) is a major health concern in older women. To prevent low BMD, hormone replacement therapy (HRT) is commonly used. Muscular strength is another possible protective factor of BMD. However, the data on the associations of muscular strength with BMD combined with HRT are limited. **METHODS:** 235 older women (mean age 71.4 years) participated in the study. Participants' handgrip strength was measured using a hand dynamometer. BMD was measured by a dual-energy x-ray absorptiometry, and low BMD was defined as t-score below -1.0. Odds ratios (ORs) and 95% confidence intervals (CIs) of low BMD by tertiles (lower, middle, and upper) of handgrip strength were calculated using logistic regression after adjusting for age, heavy alcohol consumption, physical inactivity, bone supplement/medication, body mass index, and HRT. A joint analysis by handgrip strength and HRT on low BMD was also performed. **RESULTS:** There were 107 (46%) low BMD cases. Compared to the lower handgrip strength group, ORs (95% CIs) of having a low BMD was 0.33 (0.16-0.66) in the upper handgrip strength group. In the joint analysis, ORs (95% CIs) for low BMD were 0.52 (0.28-0.96) in strong (middle and upper tertiles) and no HRT group, and 0.19 (0.05-0.67) in strong and HRT groups, compared to the weak and no HRT group. **CONCLUSION:** Higher handgrip strength was associated with lower prevalence of low BMD in older women. A stronger (additive) association of having higher handgrip strength and taking HRT with lower BMD was observed.

INTRODUCTION

To our knowledge, there was no study on the association of MS with BMD, considering the presence of hormone replacement therapy, in older women.

METHODS

Participants:

- 235 older women aged 65 years or older (mean age 71.4) free of cancer treatment in past five years and major medical issues (e.g., stroke) that would interfere physical activity.

Muscular Strength (MS) and Hormone Replacement Therapy (HRT):

- MS (kg) was assessed by handgrip strength test using a hand dynamometer. The test was conducted three times on both sides and then three grip strength values were averaged. Between two averaged values, a greater value was used as participants' MS.
- Participants were classified into MS tertiles (Reference: lower tertile).
- Participants were also classified into four groups based on their MS level and HRT use (i.e., weak&no HRT, strong&no HRT, weak&HRT, and strong&HRT groups).
- Information of HRT use was collected by a medical history questionnaire.

Bone Mineral Density (BMD):

- Bone mineral density was measured by DXA.
- Low BMD was defined as t-score < -1.0.
 - ✓ Among 235 participants, 107 (45.5%) had low BMD.



Statistical Analysis:

- Logistic regression was used to investigate the association between MS and BMD, independent of HRT use, adjusting for age, alcohol consumption, physical inactivity, supplement/medication for bone health, body mass index, and HRT.
- Logistic regression was used to investigate the combined associations of MS and HRT with low BMD, adjusting for the same potential confounders in the preceding logistic regression.

RESULTS

Table 1. Participant characteristics by handgrip strength

Characteristic	All	Tertiles of Handgrip Strength			P value
		Lower	Middle	Upper	
N	235	78	79	78	-
Age (year)	71.4 (5.4)	72.8 (6.1)	70.8 (4.9)	70.7 (4.9)	0.026
Body Mass Index (kg/m²)^a	26.6 (5.3)	26.3 (4.5)	26.0 (5.6)	26.8 (4.3)	0.535
Handgrip Strength (kg)	27.3 (7.4)	19.9 (2.7)	26.5 (5.6)	35.5 (5.7)	<.001
Whole-Body Bone Mineral Density (g/cm²)	1.05 (0.1)	1.03 (0.09)	1.04 (0.11)	1.09 (0.10)	0.001
T-score^b	-0.7 (1.3)	-1.0 (1.2)	-0.8 (1.4)	-0.2 (1.3)	0.001
Heavy Alcohol Consumption, n (%)^c	24 (10.0)	5 (6.4)	6 (7.6)	13 (16.7)	0.068
Physical Inactivity, n (%)^d	118 (50.2)	37 (47.4)	36 (45.6)	45 (57.7)	0.264
Bone Supplement/Medication, n (%)^e	181 (77.0)	66 (84.6)	57 (72.2)	58 (74.4)	0.141
Hormone Replacement Therapy, n (%)	22 (9.0)	5 (6.4)	11 (13.9)	6 (7.7)	0.224

Data are mean (SD) or %.

^a Weight in kilograms divided by height in meters squared.

^b T-score = standard deviation difference in bone mineral density (g/cm²) compared with young (age=20-29), white female from the National Health and Nutrition Examination Survey, 2012.

^c Defined as >7 drinks/week.

^d Defined as <5,000 steps/day.

^e Includes calcium, vitamin D, and/or medications to stimulate bone growth.

Table 2. Odds ratios of low bone mineral density according to tertiles of handgrip strength

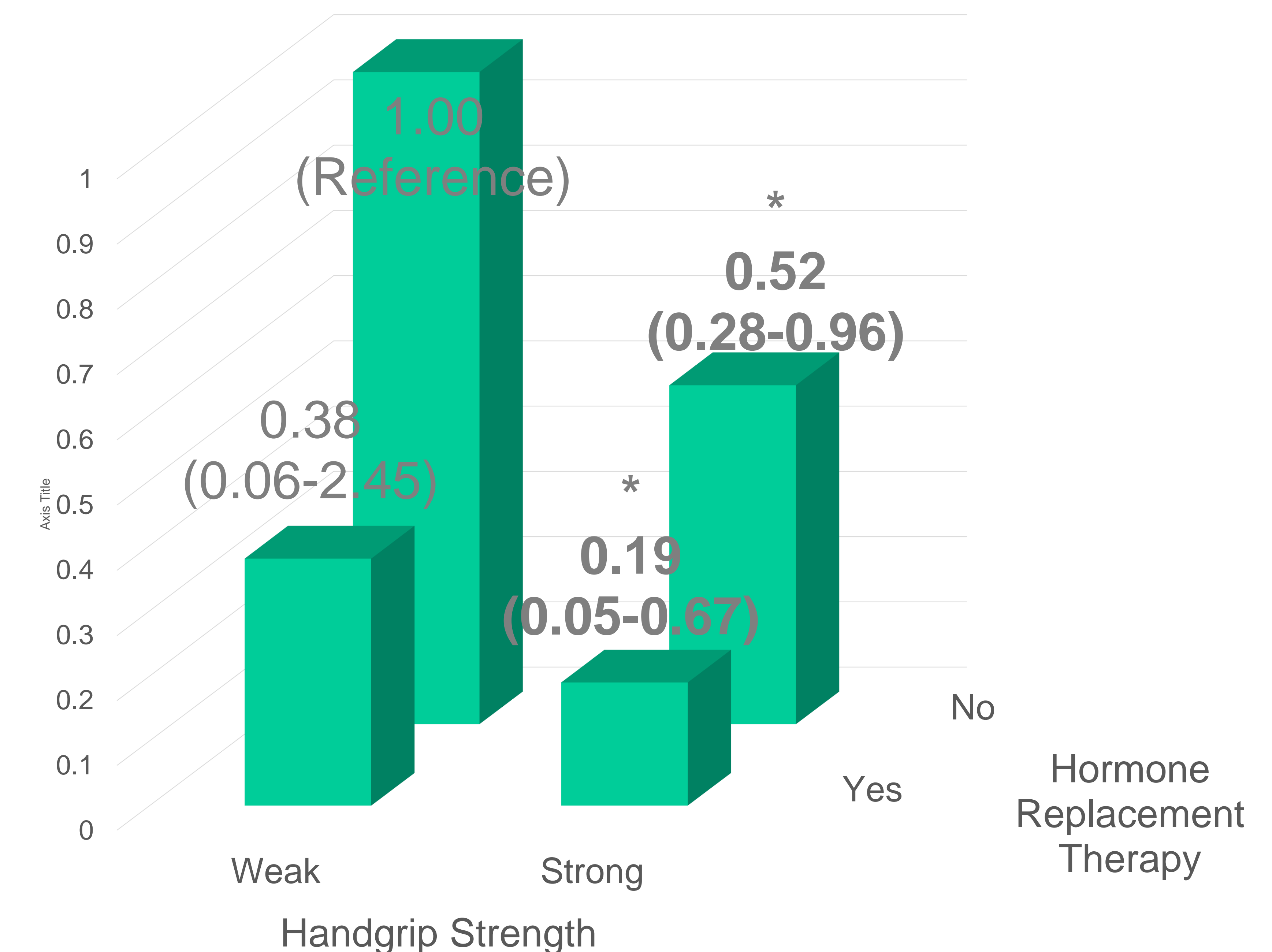
Handgrip Strength	N	Case	Model 1 (OR 95% CI)	Model 2 (OR 95% CI)	Model 3 (OR 95% CI)
Lower	78	44	1.00 (reference)	1.00 (reference)	1.00 (reference)
Middle	79	39	0.72 (0.38-1.36)	0.74 (0.38-1.43)	0.80 (0.41-1.56)
Upper	78	24	0.33 (0.17-0.64)	0.33 (0.17-0.66)	0.33 (0.16-0.66)
P for linear trend			0.001	0.002	0.002
Per 1-kg increase in handgrip strength			0.93 (0.89-0.96)	0.92 (0.89-0.97)	0.92 (0.88-0.96)

CI, confidence interval. OR, odds ratio.

Model 1: adjusted for age (years).

Model 2: adjusted for model 1 plus heavy alcohol consumption (>7 drinks/week, yes or no), physical inactivity (< 5,000 steps/day, yes or no), supplement/medication for bone health (yes or no), body mass index (kg/m²), Model 3: adjusted for model 2 plus hormone replacement therapy (yes or no).

Figure 1. Odds ratios of low bone mineral density by combined categories of handgrip strength and hormone replacement therapy (HRT)



The model was adjusted for age, heavy alcohol consumption (>7 drinks/week), physical inactivity (< 5,000 steps/day), supplement/medication for bone health (yes or no), and body mass index (kg/m²). Low bone mineral density was a t-score < -1.0.

"Weak" was the lower third and "strong" was the upper two thirds of handgrip strength. The number of individuals (cases of low bone mineral density) in the "weak and no HRT," "strong and no HRT," "weak and HRT," and "strong and HRT" groups were 73 (42), 140 (59), 5 (2) and, 17 (4), respectively.

CONCLUSIONS

1. Greater muscular strength was significantly associated with lower prevalence of low BMD, independent of HRT use, in older women.
2. Having greater muscular strength and using HRT together shows the lowest prevalence of low BMD in the combined analysis by handgrip strength and hormone replacement therapy.