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Premature Graying, Balding, and Low Bone Mineral Density in Older Women and Men

The Rancho Bernardo Study

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Objective: The authors report the association of balding or graying with BMD in older adults. **Method:** BMD was measured at the spine, hip, and total body in 1,207 participants. Of these, 508 women and 380 men responded to a 1986 survey about balding patterns; in 1994, all participants answered questions about graying. **Results:** Among men, 10.7% reported graying, and 51.1%, balding; 9.9% of women reported graying, and 9.5%, balding. Models were adjusted for age, body mass index, alcohol consumption, smoking, exercise, calcium supplements, diuretics, glucocorticoids, thyroid hormone, and estrogen. **Conclusion:** Graying was not significantly associated with BMD in either group. Balding men averaged 5% lower total body BMD ($p \leq 0.05$), and balding women had ~24% higher mean hip BMD ($p \leq 0.05$). Graying and balding women reported a higher proportion of current estrogen use; balding women reported more use of glucocorticosteroids. Balding women using estrogen may explain the higher BMD.

Keywords: *graying; balding; bone mineral density*

Premature graying and/or balding hair have been proposed as potential markers for the identification of persons at risk for osteoporosis. Results from previous studies examining the utility of prematurely gray hair (defined as almost all hair gray by age 40) as a risk marker for a variety of chronic conditions have been inconsistent: Orr-Walker, Evans, Ames,

Clearwater, and Reid (1997) reported in women, and Rosen, Holick, and Millard (1994) reported in both women and men, a positive association between prematurely gray hair and low bone mineral density (BMD), but Beardsworth, Kearney, Steel, Newman, and Purdie (1999) failed to find any association with BMD in women.

Balding is another observable potential marker of those at risk of many hormone-mediated conditions, including osteoporosis. No published studies have reported the relation between balding and low BMD.

In the present study we examine the association of premature graying or balding with BMD in a community-based sample of older men and women.

Method

Participants

Between 1972 and 1974, 82% of adult residents of Rancho Bernardo (a community in southern California) participated in a survey of heart disease risk factors. This cohort has been followed with annual mailed questionnaires and periodic clinic visits. A survey mailed to all surviving members of the cohort in 1985 (n = 5,088) included questions about balding. A total of 3,852 individuals responded (76%). Another mailed survey sent to all surviving members of the cohort in 1994 (n = 3,988), included questions about premature graying. A total of 2,770 individuals responded (response rate = 69%). Between May 1992 and December 1996, 1,781 members (n = 1,082 women, and n = 699 men) of the surviving noninstitutionalized cohort attended a research clinic visit where BMD was measured.

The 1,207 participants (n = 717 women and n = 490 men) aged 50 and older at the 1992 to 1996 clinic visit are the focus of this report. Among these individuals, information regarding balding was available for 508 women and 380 men, and information concerning premature graying was available for all of the 1,207 participants. This study was approved by the

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UCSD Committee on Protection of Human Subjects; all participants were ambulatory and gave informed consent.

Procedures

The 1994 mailed survey asked participants to indicate for each decade of their age (e.g., 20 to 29 years, 30 to 39 years, etc.) if their hair had a small amount of gray/white, was about half gray/white, and was all or nearly all gray/white. They were considered to be *prematurely gray* if they indicated that all or most of their hair was gray before they were 40 years of age. The 1986 mailed survey included drawings depicting different balding patterns and participants were asked to indicate which pattern best described the appearance of their hair, and to indicate during which age decade of their lives noticeable hair loss began (20s, 30s, etc.). *Balding* was defined as thinning of the hair in front, back, or all over the head.

At the 1992 to 1996 clinic visit, participants were asked standard questions concerning alcohol use, current smoking status, and exercise. Current use of medications and/or nutritional supplements was validated by examination of pills and prescriptions brought to the clinic for that purpose. Height and weight were measured in participants wearing light clothing without shoes. Body mass index (BMI), calculated as weight (kg) divided by height (m^2) was used as an estimate of obesity.

BMD (g/cm^2) was measured at the lumbar spine, femoral neck, total hip, and total body using dual energy X ray absorptiometry (DEXA). Precision error of this instrument at each site was approximately 1%. The DEXA machine was calibrated daily against a phantom, and all measurements were obtained by certified bone density technologists. Total hip BMD was the sum of the femoral neck, greater trochanter, and intertrochanter. Spine BMD was the mean of lumbar Vertebra 1 through 4. Total body BMD was the mean of 10 scanned regions of the body.

Statistical Analyses

For both men and women, differences in age-adjusted means for continuous variables were calculated using ANCOVA, and the Mantel-Haentzel chi-square for categorical variables. Age was examined as a continuous and a categorical variable (50 to 59, 60 to 69, 70 to 79, and ≥80 years). All BMD levels were normally distributed making transformations unnecessary. ANCOVA was used to compare BMD at each of four bone sites (femoral neck, total hip, spine, and total body), stratified by premature graying and

balding status after adjustment for age, BMI, current alcohol use (≥3 times/week), exercise (≥3 times/week), smoking status, use of calcium supplements, diuretics, glucocorticosteroids, and thyroid hormone, and current use of estrogen in women. Additional sex-specific ANOVAs were performed comparing BMD at each site after grouping participants as balding in front, in back, or all over the head. All statistical tests were two-tailed. Significant differences in mean values were determined using 95% confidence intervals (CIs) and p values. All analyses were performed using SAS Version 9.0.

Results

The 1,207 participants (490 men and 717 women) in the 1992 to 1996 clinic visit ranged in age from 50 to 98 years with a mean age of 70.7 (SD = 10.1) years for men and 71.6 (SD = 10.9) years for women. All participants who attended the 1992 to 1996 clinic visit provided information on premature graying. The 380 men and 518 women who had provided information on balding status 10 years earlier were similar in age at the clinic visit, with a mean of 70 (SD = 10.4) years for men and 70.4 (SD = 11.4) years for women. Overall, 10.8% of the men and 9.9% of the women reported premature graying, and 51.1% of the men and 9.5% of the women reported balding. Among the women, 47% were current estrogen users.

Among both men and women, there were no significant differences in mean age between those who were versus those who were not prematurely gray ($p > .10$; Table 1). However, as compared to those who were not prematurely gray, a significantly greater proportion of the prematurely graying men and women were currently less than 60 years of age (13.7% vs. 26.4% for men, and 13.8% vs. 38.0 % for women, $p < .001$). Conversely, a significantly lower proportion of men and women more than 80 years old reported being prematurely gray ($p < .001$). Additionally, a greater proportion of prematurely gray women reported current estrogen use as compared to those who were not prematurely gray (57.1% vs. 45.9%, respectively, $p = .07$).

Men and women who were balding did not differ significantly in mean age from those who were not balding ($p > .10$). However, a significantly greater proportion of men and women who were not balding were currently less than age 60 as compared to those who were balding (22.0% vs. 12.9% for men and 21.1% vs. 4.2% for women, $p < .001$). As compared to those who were not balding, a significantly greater proportion of balding women used glucocorticosteroids and estrogen replacement (0.4%

Table 1
Age-Adjusted Sample Characteristics by Prematurely Gray Hair Status and Balding Status for Men and Women, Aged 50 and Older: Rancho Bernardo, CA, 1992–1996

	All Hair Gray by Age 40				Balding (Thinning in Front, Back, or All Over)			
	Men		Women		Men		Women	
	Yes ($n = 53$)	No ($n = 437$)	Yes ($n = 71$)	No ($n = 646$)	Yes ($n = 194$)	No ($n = 186$)	Yes ($n = 48$)	No ($n = 460$)
Means								
Age	69.9	70.2	71.1	70.9	69.3	69.3	69.7	69.6
Body mass index	26.5	26.2	24.8	24.9	26.6	26.5	24.7	24.9
Proportions								
Age categories								
50-59 years	26.4	13.7***	38.0	13.8***	12.9	22.0****	4.2	21.1****
60-69 years	41.5	28.2	29.6	22.3	29.4	33.9	10.4	28.0
70-79 years	24.5	34.6	22.5	34.1	36.1	26.3	27.1	29.1
80+ years	7.6	23.6***	9.9	29.9***	21.7	17.7***	58.3	21.7****
Alcohol (≥3 drinks/week)	91.8	89.3	83.9	85.7	90.6	87.2	78.0	84.3
Current smoker	6.6	6.3	9.4	7.5	5.7	9.0	8.4	9.3
Exercise (≥3 times/week)	69.6	79.4	73.5	71.0	78.8	77.3	69.7	69.7
Calcium supplements	17.5	17.3	51.8	51.4	17.9	14.0	57.3	47.3
Thiazides	17.7	10.2	15.0	20.2	10.4	9.6	21.9	19.0
Glucocorticosteroids	0.2	0.6	1.9	0.9	0.5	0.6	4.1	0.4***
Thyroid hormone	8.4	5.2	17.9	20.8	6.0	6.1	30.5	19.7
Current estrogen	—	—	57.1*	45.9*	—	—	68.8	50.7**

*$p = .0681$. **$p = .017$. ***$p \leq .01$. ****$p \leq .001$.

vs. 4.1%, $p < .01$, and 50.7% vs. 68.8%, $p = .017$, respectively). Among both men and women, there were no significant differences ($p > .10$) by premature graying or balding status in alcohol use, smoking, exercise, and use of calcium supplements, diuretics, and thyroid medication, or in men, use of glucocorticosteroids.

After adjusting for age, body mass index (BMI), smoking, exercise, and use of alcohol, calcium supplements, diuretics, glucocorticosteroids, thyroid medications and, in women only, estrogen, mean BMD levels at all four sites (femoral neck, hip, spine, and total body) did not differ by premature graying in either men or women (Table 2). Using the same model, men who were not balding had a 5% higher mean total body bone density compared to balding men (1.149 g/cm^2 vs. 1.095 g/cm^2, $p < 0.05$). The opposite was true for women, but the differences were observed at the femoral neck and total hip. Balding women had a 23% significantly higher mean BMD at the femoral neck and a 24% significantly higher total hip BMD than women who were not balding (femoral neck = 0.915 g/cm^2 vs. 0.740 g/cm^2 and total hip = 1.043g/cm^2 vs. 0.837 g/cm^2, respectively, $p < 0.05$).

Age and sex-specific ANOVAs with participants stratified into front, back, and all-over-head balding categories revealed no significant differences ($p > .10$) in mean BMD between categories at any of the four BMD sites. In men, those reporting balding onset by decade were normally distributed across the age categories; none reported balding before age 20, 8% during their 20s, 14% during their 30s, 28% during their 40s, 26% during their 50s, 15% during their 60s, 6% during their 70s, and 2% during their 80s. In women, those reporting balding onset by decade were similarly distributed; none reported balding before age 20, 2% during their 20s, none during their 30s, 9% during their 40s, 11% during their 50s, 37% during their 60s, 34% during their 70s, and 6% during their 80s. When stratified by decade of onset of balding, there were also no differences in BMD (data not shown).

Discussion

The results of the present study do not support the thesis that premature graying is a marker for low BMD. At all sites, there were no significant differences in BMD between those who were and were not prematurely gray.

Among men, balding was associated with a 5% difference in mean total body BMD. However, measurement of total body BMD is not considered to be a definitive measure of BMD, and is used more frequently only as a

Table 2
Multiply-Adjusted[a] Bone Mineral Densities (g/cm^2; Mean and Confidence Intervals) by Prematurely Gray[b] and Balding Status in Men and Women, Aged 50 Years and Older: Rancho Bernardo, CA, 1992–1996

	Men		Women	
Measurement Site	Prematurely Gray (n = 53)	Not Prematurely Gray (n = 437)	Prematurely Gray (n = 71)	Not Prematurely Gray (n = 646)
Femoral neck	0.824 (0.754, 0.896)	0.819 (0.786, 0.852)	0.728 (0.676, 0.780)	0.739 (0.713, 0.767)
Total hip	1.000 (0.931, 1.071)	0.955 (0.923, 0.987)	0.829 (0.783, 0.874)	0.840 (0.816, 0.864)
Lumbar spine	1.123 (1.070, 1.176)	1.109 (1.091, 1.128)	0.961 (0.919, 1.004)	0.957 (0.944, 0.970)
Total body	1.096 (1.032, 1.160)	1.132 (1.110, 1.155)	0.985 (0.927, 1.045)	0.965 (0.946, 0.985)
	Balding (n = 194)	Not Balding (n = 186)	Balding (n = 48)	Not Balding (n = 460)
Femoral neck	0.833 (0.783, 0.884)	0.810 (0.770, 0.850)	0.915 (0.752, 1.078)	0.740 (0.717, 0.763)*
Total hip	0.969 (0.919, 1.020)	0.963 (0.924, 1.003)	1.043 (0.885, 1.201)	0.837 (0.815, 0.859)*
Lumbar spine	1.119 (1.091, 1.147)	1.084 (1.055, 1.112)	0.916 (0.864, 0.967)	0.963 (0.947, 0.979)
Total body	1.095 (1.061, 1.130)	1.149 (1.114, 1.185)*	0.976 (0.904, 1.049)	0.961 (0.939, 0.984)

Note: Prematurely gray = almost entirely gray by 40 years of age.

a. Adjusted for age, body mass index, alcohol use (≥3 times per week), exercise (≥3 times per week), current smoking status, and current use of calcium supplement, diuretic, glucocorticosteroid and thyroid medication.

b. Adjusted for all of the above, plus current estrogen use.

*$p \leq .05$.

confirmation of findings at the spine and total hip (Fogelman & Blake, 2000). The association of higher BMD levels observed at the total body site in nonbalding men may be simply because of the confounding mixture of cortical and trabecular bone included in the total body bone density measurement itself. In this sample of men, balding was unrelated to BMD at the femoral neck, total hip, and lumbar spine. It is unlikely these results were because of recall bias and subsequent misclassification. A recent study by Taylor, Matassa, Leavy, and Fritschi (2004) has shown that self-report of balding in men, whether current or retrospective, is adequate when compared with a trained observer's assessment.

In contrast, significant differences in BMD in women between those who were and were not balding were observed at the femoral neck and total hip. These differences may be partially explained by the higher rates of glucocorticosteroid and estrogen use among the balding women. Glucocorticosteroids are associated with balding (Juricskay & Telegdy, 2000), and estrogen replacement therapy is associated with increased bone density (Morton, Barret-Connor, & Schneider, 1998). However, these differences remained significant after adjustment for these particular covariates.

The lack of association between premature graying and BMD is in accord with Beardsworth et al. (1999), who examined BMD at the lumbar spine and femoral neck in a small group of 52 prematurely gray-haired East Yorkshire women as compared to a sample of age-matched women who were not prematurely gray. However, Beardsworth et al. studied participants much younger than Rancho Bernardo women (mean age = 52.8) and included premenopausal women ($n = 20$), who are known to have relatively stable and higher BMD levels when compared with older, postmenopausal women.

Results of the present study are in contrast with those of two smaller studies that reported a positive association between premature graying and low BMD (Orr-Walker et al., 1997; Rosen et al., 1994). Orr-Walker et al. (1997), using the same definition as the present study, found significant associations of premature graying with low BMD at the femoral neck, trochanter, and total body in a sample of 293 healthy postmenopausal women. However, premature graying explained only 0.6% to 1.3% of the variance in BMD, which the authors attributed to the infrequency of premature graying in this population. Rosen et al. (1994) compared 36 men and women with osteopenia and 27 men and women without osteopenia and found a positive association between premature graying and low BMD at the lumbar spine. However, this small sample was recruited from a metabolic bone clinic (lumbar BMD *T*-score below −1.0).

Premature graying of the hair is associated with various disorders of the endocrine system. The actual pathophysiology of melanin depletion in hair follicles is unknown, although it has been shown that this trait is genetically determined, as is acquisition of bone mass (Rosen et al., 1994). Therefore, it is reasonable to hypothesize that premature graying might be a marker for a variety of genetic and nongenetic conditions, such as myocardial infarction (Schnohr, Lange, Nyboe, Appleyard, & Jensen, 1995), congestive heart failure, cancer, stroke, pneumonia/bronchitis, cirrhosis of the liver, GI problems, or premature mortality. However, autopsy studies have not shown an association between these disorders and premature graying (Glasser, 1991). Therefore, the key to the significance of premature graying, if any, may come with further understanding of the pathophysiology of melanin loss within the hair follicle itself.

To our knowledge, no previous studies have examined the relation of balding to bone loss. However, balding has been examined as a marker for myocardial infarction (Schnohr et al., 1995) because both conditions are related to androgen levels. Because BMD levels are associated with sex hormone levels (Schneider, Barrett-Connor, & Morton, 1997), a balding–BMD association is plausible.

The most common form of alopecia in men is believed to be because of excessive activity of androgens on the scalp where the hairs become miniaturized and pigment production is stopped (Hoffman, 2002). Other known and validated factors influencing the development of common baldness are few, but include polygenic inheritance patterning, higher levels of 5-alpha reductase, which is responsible for converting testosterone into a more potent androgen, and aging (Hamilton, 1951; Hoffman, 2002; Price, 2003; Severi et al., 2003). Many women with alopecia, however, have normal levels of circulating androgens. A recent trial of three treatments—cyproterone acetate (an antiatndrogen), flutamide (an androgen receptor blocker), and finasteride (inhibits 5-alpha-reductase activity), found only a modest improvement in alopecia with flutamide, but not cyproterone acetate or finasteride (Carmina & Lobo, 2003). In 2006, Iorizzo, Vincenzi, Voudouris, Piraccini, and Tosti reported some improvement of hair loss in women taking finasteride simultaneously with oral contraceptives. Therefore, differential associations with bone density and balding by gender might be observed, as is the case in the present study. Although free testosterone levels have not been associated with balding, androgen levels in the hair follicles themselves might be more predictive of bone density, especially when considered in conjunction with genetic factors for balding.

This study is advantageous, as the Rancho Bernardo cohort allows for control of many confounders associated with BMD, and this population has well-validated self-report accuracy (Criqui, Barrett-Connor, & Austin, 1978; Schneider et al., 1997). Information on current estrogen use, BMI, exercise habits, smoking, alcohol consumption, and use of thyroid medications, diuretics, glucocorticosteroids, and calcium supplements was available for use as covariates in the multivariate model. DEXA measurement, the gold standard for determination of bone mineral density (Schneider et al., 1997), was used to assess bone mass. In addition, the large sample size of this study makes it an important addition to the literature and indicates the likelihood of the stability of the estimates based on the data.

This study also has several limitations. Although participants in the Rancho Bernardo study were similar to Rancho Bernardo residents who chose not to participate (Criqui et al., 1978; Barrett-Connor & Kritz-Silverstein, 1999), the cohort consists of individuals who are middle class, relatively well-educated, and have good access to medical care. This homogeneity, while being advantageous with regard to less confounding because of low socioeconomic status, education, and/or the effect of limited health care on survival, also means the study results may not generalize to other cohorts (Garland, Friedlander, Barrett-Connor, & Khaw, 1992). The effects of endogenous estrogen on BMD may not have been adequately controlled, because estrogen levels were not measured continuously from early adulthood when they are presumed to have their maximum effect on a variety of body systems (Rogers, Hannon, & Eastell, 2000). Finally, an important limitation for older individuals, and particularly women who color their hair, is poor recall of the age when graying of their hair was "almost complete." In addition, accuracy or reliability for events over a span of 30 years may be questionable. Events like the extent of graying are gradual rather than discrete occurrences that may have affected recall, and thus there may have been some misclassification, though this is less likely in men, who generally do not color their hair.

In summary, the results of the present study observed no association of premature graying with BMD, and sporadic associations of balding status with BMD in men and women. Significantly higher femoral neck (23%) and total hip (24%) BMD in balding women may be associated with estrogen used by more than two thirds of this group of women compared with only one half of the nonbalding women. Future investigations should be aimed at understanding the mechanism of melanin depletion and ascertaining actual androgen levels within the hair follicle as a predictor of low BMD, as well as addressing differences in the pathophysiology of balding between men and women.

References

Barrett-Connor, E., & Kritz-Silverstein, D. (1999). Gender differences in cognitive function with age: The Rancho Bernardo Study. *Journal of the American Geriatrics Society*, *47*, 159-164.

Beardsworth, S. A., Kearney, C. E., Steel, S. A., Newman, J., & Purdie, D. W. (1999). Premature graying of the hair is not associated with low bone mineral density. *Osteoporosis International*, *10*(4), 290-294.

Carmina, E., & Lobo, R. A. (2003). Treatment of hyperandrogenic alopecia in women. *Fertility and Sterility*, *79*(1), 91-95.

Criqui, M. H., Barrett-Connor, E., & Austin, M. (1978). Differences between respondents and non-respondents in a population-based cardiovascular disease study. *American Journal of Epidemiology*, *108*(5), 367-372.

Fogelman, I., & Blake, G. M. (2000). Different approaches to bone densitometry. *Journal of Nuclear Medicine*, *41*(12), 2015-2025.

Garland, C. F., Friedlander, N. J., Barrett-Connor, E., & Khaw, K. T. (1992). Sex hormones and postmenopausal breast cancer: A prospective study in an adult community. *American Journal of Epidemiology*, *135*(11), 1220-1230.

Glasser, M. (1991). Is early onset of gray hair a risk factor? *Medical Hypotheses*, *36*(4), 404-411.

Hamilton, J. B. (1951). Patterned loss of hair in men: Types and incidence. *Annals of the New York Academy of Sciences*, *53*(3), 708-728.

Hoffman, R. (2002). Male androgenetic alopecia. *Clinical and Experimental Dermatology*, *27*, 373-382.

Iorizzo M., Vincenzi, C., Voudouris, S., Piraccini B., & Tosti, A. (2006). Finasteride treatment of female pattern hair loss. *Archives of Dermatology*, *142*, 298-302.

Juricskay, S., & Telegdy, E. (2000). Urinary steroids in women with androgenic alopecia. *Clinical Biochemistry*, *33*(2), 97-101.

Morton, D. J., Barrett-Connor, E., & Schneider, D. L. (1998). Nonsteroidal anti-inflammatory drugs and bone mineral density in older women: The Rancho Bernardo Study. *Journal of Bone and Mineral Research*, *13*(12), 1924-1931.

Orr-Walker, B. J., Evans, M. C., Ames, R. W., Clearwater, J. M., & Reid, I. R. (1997). Premature hair graying and bone mineral density. *Journal of Clinical Endocrinology & Metabolism*, *82*(11), 3580-3583.

Price, V. H. (2003). Androgenetic alopecia in women. *Journal of Investigative Dermatology Symposium Proceedings*, *8*(1), 24-27.

Rogers, A., Hannon, R. A., & Eastell, R. (2000). Biochemical markers as predictors of rates of bone loss after menopause. *Journal of Bone and Mineral Research*, *15*(7), 1398-1404.

Rosen, C. J., Holick, M. F., & Millard, P. S. (1994). Premature graying of hair is a risk marker for osteopenia. *Journal of Clinical Endocrinology & Metabolism*, *79*(3), 854-857.

Schneider, D. L., Barrett-Connor E. L., & Morton, D. J. (1997). Timing of postmenopausal estrogen for optimal bone mineral density: The Rancho Bernardo Study. *Journal of the American Medical Association*, *277*(7), 543-547.

Schnohr, P., Lange, P., Nyboe, J., Appleyard, M., & Jensen, G. (1995). Gray hair, baldness, and wrinkles in relation to myocardial infarction: The Copenhagen City Heart Study. *American Heart Journal*, *130*(5), 1003-1010.

Severi, G., Sinclair, R., Hopper, L. J., English, D. R., McCredie, M. R., Boyle, P., et al. (2003). Androgenetic alopecia in men aged 40-69 years: prevalence and risk factors. *British Journal of Dermatology*, *149*(6), 1207-1213.

Taylor, R., Matassa, J., Leavy, J. E., & Fritschi, L. (2004). Validity of self reported male balding patterns in epidemiological studies. *BMC Public Health*, *4*, 60.