

An Assessment of Postmenopausal Women's Adherence to Calcium With Vitamin D Supplements

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ABSTRACT

Introduction: No information is available on the long-term adherence to calcium with vitamin D in women in a general medical practice.

Materials and Methods: We assessed in 412 postmenopausal women factors associated with adherence and reasons for nonadherence to supplemental calcium with vitamin D tablets after a counseling session.

Results: Approximately 49% adherence was achieved in all of the sampled subjects during a 10-year period and 37% in subjects with intention-to-treat. Those followed for the entire 10 years had a 46% adherence. Forgetting to take supplements, perceiving supplements as unimportant, not recalling the counseling session, and gastrointestinal intoler-

ance constituted the set of major reasons for nonadherence. Postmenopausal women with previous fractures, higher socioeconomic groups, musculoskeletal disorders, and receiving current or past glucocorticoid therapy were significantly more adherent than women without such characteristics.

Conclusion: Long-term adherence to supplemental calcium with vitamin D after counseling was slightly different than the adherence with prescription items after counseling. Symptomatic conditions are associated with higher adherence.

INTRODUCTION

Adequate consumption of calcium and vitamin D has been advocated by National Institute of Health (NIH) Consensus Conferences for over 2 decades to preserve bone health.¹⁻³ Additionally, the Institute of Medicine in 1997 recommended that individuals aged 50 or older receive at least 1,200

Table 1. The distribution of women in the medical office registry in 1992 aged 50 years and older.

	n
Office registry	658
Exclusions	116
Not counseled	72
Adequate calcium intake	26
Relative medical contraindications	8
Dementia	7
Loss of medical record	3
Intention-to-treat	542
Died over the 10-year period	100
Lost to follow-up	30
Evaluated after 10 years	412

mg/d of calcium as well as a vitamin D intake of 400 IU/day for those aged 51 to 70 years and 600 IU/day for those older than 70 years.⁴ In spite of these recommendations, the mean dietary calcium consumption for elderly women in the NHANES 1999-2000 sample was 660 mg/d.⁵ Furthermore, less than 10% of older adults in the past decade met vitamin D requirements by food alone.⁶ To accomplish higher intakes, individuals require either more solar exposure plus a diet higher in these items or supplementation by calcium with vitamin D tablets. Time constraints make individualized dietary counseling in the primary health provider’s office often impractical, whereas community-based education programs and market place strategies would likely be more reasonable. On the contrary, recommending calcium with vitamin D supplements can be easily accomplished by the individual practitioner.

Based on recommendations from the 1984 NIH Consensus Conference,¹ we initiated in 1991 a program of calcium supplementation with vitamin D in a group of community-based postmenopausal women who were seen in a general medical practice for a variety of illnesses. The goal of this study was to

assess the long-term adherence to recommended supplements following counseling after a 10-year period and ascertain the attributable factors.

PATIENTS AND METHODS

Counseling

Postmenopausal women were questioned about the quantities of milk, cheese, yogurt, and soy consumed daily in the medical office; those whose calcium intake was estimated to be 1,000 mg/d or more were not counseled. Patients who fell below this threshold received a counseling session of approximately 2 to 3 minutes consisting of the consequences on bone health from inadequate dietary intakes, average deficits of intakes nationally, and recommended intakes based on the 1984 NIH Consensus Conference.¹ After counseling, patients were given recommendations to take a tablet consisting of 600 mg of calcium carbonate with 200 IU of vitamin D twice daily with meals.

Population

Of the 658 women aged 50 years and older in the office registry who visited the office for a variety of illnesses from 1991 through 2001, 542 (82%) received counseling as well as calcium with vitamin D supplement recommendations. As the study progressed, we were only able to assess 412 of these after the 10-year period (Table 1). All patients were ambulatory and home based with a mean age \pm SD of 71.3 \pm 12.3 years at the follow-up evaluation. The racial composition of the study group was 399 Caucasians and 13 African Americans.

Adherence

The extent of adherence was then graded as adherent in those who took supplements more than 80% of the time, all the time, or “hardly ever miss a dose.” To assess the reasons for nonadherence, we divided this group of women into no

Table 2. Reasons offered for nonadherence by 212 postmenopausal women who were prescribed calcium supplements after counseling. Values exceed 212 since some women responded with more than 1 reason.

	No Compliance	Irregular Compliance
Consume adequate amounts dietary calcium	40	1
Forget	36	13
Not important	30	3
Do not recall counseling	14	2
Palatability	14	1
Inconvenient	13	2
Constipation	11	2
Dysphagia	2	—
Fear of kidney stones	3	—
Dyspepsia and nausea	3	2
Too many medications	6	3
Expensive	3	—
Afraid of it	1	1
Makes feet hurt	1	—
Good bone density	1	—
Reason not stated	2	4

compliance (never took supplements or took them less than 20% of the time) or irregular compliance (took supplements several times a month but less than 80% of the time, missed over a period of several weeks, months, or years but then resumed intakes). Patients who did not volunteer adherence or admitted nonadherence were questioned about the primary reasons regarding this circumstance.

During a time span of 12 months starting in 2001, we assessed the adherence to recommended supplements during the previous 10 years on return visits by an interview system that had been routinely practiced for 33 years by the leading author, an internist. On an office visit for an established problem, the type and dose of current medications (both prescription and non-prescription items) were initially volunteered by the patient to an office assistant. This information was then coded by a checkmark for each item on the permanent medication list in the chart. If the patient volunteered cal-

cium tablets during this query, the frequency of adherence was noted. However, further assessment of calcium tablets was not investigated if this item was not mentioned during the patient's voluntary submission of medications until sometime during the physician's examination. At that time the patient was asked by the physician: "Have you told me every single pill that you take?" A review done in this manner was felt not to indict the patient's response and least likely bias the outcomes.

Statistics

After determining the various reasons for no adherence or poor adherence, we combined these 2 groups as nonadherent for statistical analysis with the adherent group.

The χ^2 test was employed to ascertain which of the 26 demographic and clinical variables were associated with adherence. The Mantel-Haenszel χ^2 test was used in instances to apply a pooled odds ratio across a strata of 4-fold

Table 3. Multiple logistic regression model with 4 explanatory variables.

Variable	Coefficient (β)	Standard Error	Wald χ^2	P Value	Odds Ratio	95% Confidence Intervals
Intercept	-2.763	0.674	16.80	—	—	—
Socioeconomic	0.596	0.212	7.93	0.005	1.86	1.199 to 2.746
Fracture history	0.722	0.212	11.60	0.0007	2.06	1.359 to 3.12
Glucocorticoid treatment	0.868	0.395	4.83	0.028	2.38	1.098 to 5.168
Musculoskeletal treatment	0.969	0.329	8.65	0.0033	2.64	1.382 to 5.024

tables. Several variables were then modeled in a test of multiple logistic regression with forward selection to determine which ones were predictors of regular supplement adherence. After significant regressors were determined, entry in and out of non-significant regressors was performed to ascertain whether they had any effect on the model.

All assumptions pertaining to particular statistic tests were observed prior to the application of tests to the data. The data were analyzed using the Statistical Analysis System (SAS).

RESULTS

Of the 542 women we counseled with intention-to-treat, only 412 (76%) were able to be evaluated after the 10-year period. The adherence rate with a median follow-up of 9 years (mean \pm SD of 7.05 \pm 3.31 years) was about 46%; however, only one-half of those were followed for the entire 10 years and had about 49% adherence (Figure 1). The adherence rate of the entire sample fell to 37% when we included women with intention-to-treat. The various reasons for nonadherence by no compliance or irregular compliance are listed in Table 2.

When comparing dichotomous variables, adherent women when compared to nonadherent women had higher socioeconomic status (21% vs 10.8%; $P < 0.01$), consumed alcohol more than twice weekly (20% vs 12.7%; $P < 0.05$),

experienced a fracture (48.5% vs 30.6%; $P < 0.001$), received bone remedial treatment (60% vs 49.5%, $P < 0.05$), received 7 or more prescribed medications (27% vs 16.9%, $P < 0.05$), 5 or more yearly visits (15.5% vs 9.9%; $P < 0.05$), taken glucocorticoid therapy for 3 or more months (16.5% vs 5.7%; $P < 0.001$), and musculoskeletal disorders (23.8% vs 10.8%; $P < 0.001$). Adherent and nonadherent women did not differ among age groups 50-64 years and over 65 years (27% vs 33%; NS), smokers (21.5% vs 19.3%; NS), in educational status based on no high school, high school, or more than high school education (6.5%, 44.5%, 49% vs 6.1%, 51.9%, 42%; NS), in having a family history of osteoporosis (30% vs 28.3%; NS), by over-the-counter supplements consumed other than calcium-vitamin D tablets (30.5% vs 39.6%; NS), in follow-up since initiating counseling of 2-5 years or greater than 5 years (19.5% vs 16.5%; NS), in body mass index in kg/m² of <18.5, 18.5-25.99, 25.99-29.99, or 30 and over (6%, 38.5%, 31.5%, 24% vs 1.9%, 33.5%, 39.6%, 25%; NS), whether 1, 2, 3, 4, or 5 and more co-morbidities were being treated (20%, 45%, 24.5%, 9%, 1.5% vs 19.3%, 43.4%, 27.8%, 8.5%, 1%; NS), and with the use of a plastic pill reminder box (45.5% vs 37.7%; NS). Additionally, when the subjects were evaluated for the primary reason for an office visits, no differences were noted

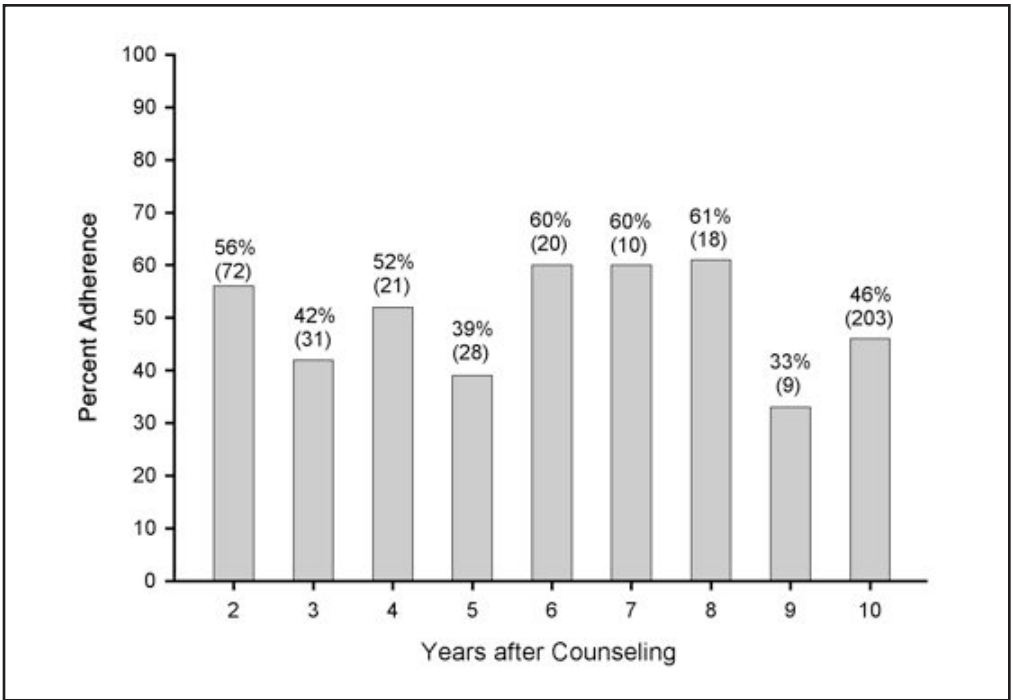


Figure 1. Proportion of women adherent to calcium with vitamin D tablets after counseling at various time intervals over a 10-year period. Values in parentheses indicate number of women.

between adherence and nonadherence in the following conditions: coronary artery disease (5.5% vs 4.7%; NS); congestive heart failure (5.0% vs 5.1%; NS); hypertension (25% vs 28.8%; NS); pulmonary disease (5% vs 6.6%; NS); malignancy (4.5% vs 1.9%; NS); and other unspecified disorders (19.5% vs 21.2%; NS). Those individuals primarily receiving treatment for diabetes mellitus, however, were more likely to be nonadherent than adherent to supplements (20.8% vs 11.5%; $P < 0.05$). When tested in a multiple logistic regression analysis in Table 3, only 4 variables remained significant. We further examined the 10.9% of 412 women who had received glucocorticoids for 3 or more months and found 62% of them had office visits for musculoskeletal problems, whereas the remaining 38% were treated primarily for respiratory and gastrointestinal problems.

DISCUSSION

We found the long-term adherence to calcium with vitamin D supplements after counseling in office-based postmenopausal women with a variety of illness to be slightly higher than the approximately 35% adherence noted in individuals receiving prescription drugs.⁷ Those followed for the entire 10 years had a 45.8% adherence, whereas the entire cohort with a mean \pm SD of 7.05 \pm 3.31 years and a median of 9 years of follow-up displayed 48.5% adherence. This is lower than the 57% over 5 years and the 59% over 7 years reported in randomized trial patients using calcium with or without vitamin D tablets.^{8,9} When including those with intention-to-treat, our adherence fell to 36.9%. Furthermore, we determined adherence by interview, which can overestimate adherence by 10%.¹⁰ Therefore, it is quite likely that our actual adherence in

those with intention-to-treat was under 30%.

Only 4 of the broad array of variables tested were significantly associated with regular adherence. Although educational status was not a predictor, socio-economic status was; this is in agreement with others.^{7,11} The variables of a musculoskeletal disorder, personal history of fracture, and receiving glucocorticoid therapy we noted as significant factors of adherence are probably reflective of underlying symptomatic problems. In this instance, the perception of an actual disease being present rather than preventive intervention of an asymptomatic disorder most likely motivated adherence. Others have found that patients receiving prescription items for different conditions, such as hypertension and hyperlipidemia, are more likely to comply if they perceive or experience an illness associated with disorder, whereas healthier patients are less likely to do so.^{7,11-13}

The most common cause of nonadherence was forgetting to take the tablet; this has been noted in previous studies for missed medications.^{14,15} Furthermore, the other causes listed (perception of calcium intake being adequate, inability to recall the counseling session, and not appreciating calcium with vitamin D as being important to future health) questions the value and content of our counseling session. Poor palatability and other gastrointestinal complaints observed in over 20% of our sample are also frequently recognized as causes for poor adherence with calcium tablets.¹⁶

Of the many clinical variables, the failure of advancing age to influence adherence in our patients differs from previous reports^{17,18}; however, our cohort had a high mean age and 41% of them were aged 75 years or older. Although a weekly pill box to simplify dosing has been shown to improve short-term com-

pliance,¹⁸ we were unable to verify any benefit over a 10-year span. Prepared pill organizers with various alarms for dosing appear promising.¹⁹ Contrary to the findings of others, neither the number of yearly return visits nor comorbidities had an effect on outcomes.^{7,11,13,15,20,21}

The inability to demonstrate any differences in the length of time patients were followed may have been related to our mortality (18.5%) or those who failed to follow up (7.9%).

Although clinical trials have shown supplemental calcium with vitamin D to have a beneficial effect on bone mineral density, fracture reduction appears less conclusive.^{9,22,23} Two reports conducted in individuals with a mean age over 70 years and using 700 IU or more of vitamin D daily with calcium indicated a significant fracture reduction in nonvertebral as well as hip sites.^{22,23} A recent study (RECORD trial) could not confirm these findings over a 5-year period; however, only about 42% of subjects were compliant after 24 months.²⁴ Additionally, the Women's Health Initiative clinical trial was also unable to substantiate any significant fracture reduction.²⁵ On the other hand, those enrolled in this trial differed since their mean age was considerably younger (62 years) and only 400 IU of daily vitamin D was employed.

The main limitation in this study was the failure to examine adherence in a control group who did not receive counseling. Also, we did not include handouts with our counseling session. Most but not all of earlier randomized controlled trials have indicated that counseling and handouts produced a significant effect on increasing short- and long-term compliance.²⁶⁻²⁹ Additionally, an office assistant rather than the physician was the initial reviewer of medications taken over the 10-year period; this could potentially affect adherence rates since

the physician would be able to more closely reinforce compliance and its long-term commitment for future health care. Furthermore, we did not include cognitive abilities and depression, a major cause of poor adherence, in our assessment variables. Finally, no assessment was made whether nonadherence resulted in adverse outcomes (eg, clinical fractures, bone mineral density, biochemical markers of bone turnover).

In conclusion, the long-term adherence to recommended calcium with vitamin D supplements after a counseling session was low but slightly higher than that observed with prescription items. Methods such as individual or group counseling are time consuming and may not be practical with high patient volumes. Physicians need to become familiar and involved with the multiple causes involved in the complexity of nonadherence. Recent guidelines from the National Osteoporosis Foundation advised adults aged 50 years or older to have daily intakes of 1,200 mg calcium and 800-1,000 IU of vitamin D.³⁰ The applications of a social marketing campaign in the United States, especially through television and radio, to improve adherence may have a potential role in raising public awareness regarding not only the updated recommendations of calcium and vitamin D intake, but also dietary deficits noted in the NHANES study as well as consequences of poor intakes. Such agendas have reported success in promoting supplements in other countries and should be investigated in this country.^{31,32}

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REFERENCES

1. Consensus conference: osteoporosis. *JAMA*. 1984;252:799-802.
2. NIH Consensus Conference: optimal calcium intake. *JAMA*. 1994;272:1942-1948.
3. NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy. *JAMA*. 2001;285:785-795.
4. Institute of Medicine (IOM). *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D and Fluoride*. Washington, DC: National Academy Press; 1997.
5. Ervin RB, Wang CY, Wright JD, et al. Dietary intake of selected minerals for the United States population: 1999-2000. *Adv Data*. 2004;341:1-5.
6. Moore C, Murphy MM, Keast DR, et al. Vitamin D intake in the United States. *J Am Diet Assoc*. 2004;104:980-983.
7. Benner JS, Glynn RJ, Mogun H, et al. Long-term persistence in use of statin therapy in elderly patients. *JAMA*. 2002;288:455-461.
8. Prince RL, Devine A, Dhaliwal SS, et al. Effects of calcium supplementation on clinical fracture and bone structure. *Arch Intern Med*. 2006;166:869-875.
9. Jackson RJ, LaCroix AZ, Gass M, et al. Calcium plus vitamin D supplementation and the risk of fractures. *N Engl J Med*. 2006;354:669-683.
10. Liu H, Golin CE, Miller LG, et al. A comparison study of multiple measures of adherence to HIV protease inhibitors. *Ann Intern Med*. 2001;134:968-977.
11. Avorn J, Monette J, Lacour A, et al. Persistence use of lipid-lowering medications. *JAMA*. 1998;279:1458-1462.
12. Jackevicius CA, Mamdani M, Tu JV. Adherence with statin therapy in elderly patients with and without acute coronary syndromes. *JAMA*. 2002;288:462-467.
13. Chapman RH, Benner JS, Petrella AA, et al. Predictors of adherence with hypertensive and lipid-lowering therapy. *Arch Intern Med*. 2005;165:1147-1152.
14. Choo PW, Rand CS, Inui TS, et al. Validation of patient reports, automated pharmacy records, and pill counts with electronic monitoring of adherence to antihypertensive therapy. *Med Care*. 1999;37:846-857.

15. Dunbar-Jacob J, Stephens-Mortimer MK. Treatment of adherence in chronic disease. *J Clin Epidemiol.* 2001;54:57S-64S.
16. Grant MM, Avenell A, Campbell MK, et al. Oral vitamin D3 and calcium for secondary prevention of low-trauma fractures in elderly people: a randomised placebo controlled trial. *Lancet.* 2005;365:1599-1600.
17. Morrell RW, Park DC, Kidder DP, et al. Adherence to antihypertensive medications across a life span. *Gerontologist.* 1997;37:609-619.
18. Park DC, Morrell RW, Frieske D, et al. Medication adherence behaviors in older adults: effects of external cognitive supports. *Psychol Aging.* 1992;7:252-256.
19. Heneghan CJ, Glasziou P, Perera R. Reminder packaging for improving adherence to self-administered long-term medications. *Cochrane Database Syst Rev.* 2006;(1):CD005025.
20. Haynes RB, McKibbin KA, Kanani R. Systemic review of randomised trials of interventions to assist patients to follow prescriptions for medications. *Lancet.* 1996;348:383-386.
21. Eagle K, Kline-Rogers E, Goodman S, et al. Adherence to evidence-based therapies after discharge for acute coronary syndromes. An ongoing, prospective, observational study. *Am J Med.* 2004;117:73-81.
22. Dawson-Hughes B, Harris SS, Krall EA, et al. Effect of calcium and vitamin supplementation on bone density in men and women 65 years of age or older. *N Engl J Med.* 1997;337:660-676.
23. Chapuy MD, Arlot ME, Duboeuf F, et al. Vitamin D3 and calcium to prevent hip fractures in elderly women. *N Engl J Med.* 1992;327:1637-1642.
24. Grant AM, Avenell A, Campbell MK, et al, for the RECORD Trial Group. Oral vitamin D3 and calcium for secondary prevention of low-trauma fractures in elderly people (Randomised Evaluation of Calcium Or vitamin D, RECORD): a randomised placebo-controlled trial. *Lancet.* 2005;365:1621-1628.
25. Jackson RD, LaCroix AZ, Gass M, et al. Calcium plus vitamin D supplementation and the risk of fractures. *N Engl J Med.* 2006;354:669-683.
26. McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions. *JAMA.* 2002;288:2868-2879.
27. Peterson GM, McLean S, Millingen KS. A randomized trial of strategies to improve patient compliance with anticonvulsive therapy. *Epilepsia.* 1984;25:412-417.
28. Raynor DK, Booth TG, Blenkinsopp A. Effects of computer generated reminder charts on patients' compliance with drug regimens. *BMJ.* 1993;306:1158-1161.
29. Dunbar-Jacob J, Burke LE, Rohay JM, et al. Comparability of self-report, pill count, and electronic monitoring of adherence data. *Controlled Clin Trials.* 1996;12(Suppl 2):80S.
30. National Osteoporosis Foundation. National Osteoporosis Foundation's Updated Recommendations for Calcium and Vitamin D3 Intake. <http://www.nof.org/prevention/calciumandvitaminD.htm>. Accessed June 1, 2007.
31. Warnick E, Dearden KA, Slater S, et al. Social marketing improved the use of multivitamin and mineral supplements among resource-poor women in Bolivia. *J Nutr Educ Behav.* 2004;36:290-297.
32. Chew F, Palmer S. Television health promotion in four countries. *Nutrition.* 2005;21:634-638.