Effectiveness of an Osteoporosis Intervention Among Older Adults Residing in Assisted Living Facilities

Stephen M. Setter, Cynthia F. Corbett, Tyler C. Higgins, David Alexander Sclar, Fred K. Viren

Objectives: To describe demographic and clinical risk factors for osteoporosis among persons aged 60 years and older residing in assisted living facilities and to compare the frequency of bone-mineral density (BMD) testing and initiation of pharmacotherapy for osteoporosis (prevention/treatment) in both a control and experimental cohort.
Design: Prospective cohort study.
Setting: Sixteen separate assisted living facilities from November 2001 through July 2002.
Participants: Assisted living facility ambulatory residents (N = 111) aged 60 years and older.
Intervention: Based on the subject's risk factors for osteoporosis and FRACTURE Index score (female subjects only), written recommendations were made from a multidisciplinary team to increase the percentage of residents evaluated (via central dual-energy x-ray absorptiometry [DEXA] scan) and/or treated for osteoporosis.
Main Outcome Measures: FRACTURE Index was calculated on all female participants and reported with BMD or without BMD results by convention. An investigator-developed osteoporosis risk-factor assessment questionnaire was used to evaluate risk factors present for each participant. Numbers of subjects being evaluated for osteoporosis via DEXA scan and numbers of subjects having pharmacotherapy altered to prevent or treat osteoporosis were recorded.
Results: One hundred eleven older adults (average age 84 [range 60–94], SD = 6.5 years) participated in the study. As a group the female cohort with no known previous diagnosis of osteoporosis were at high risk for fracture over the next five years as evidenced by an average FRACTURE Index score of 6.6 and 7.2 (control and intervention group, respectively) without BMD, and 9.9 and 10.3 (control and intervention group, respectively) with BMD, respectively. At study end, a significant number of participants in the intervention group had initiated the use of calcium or vitamin D supplements ($P = 0.016$ and $P = 0.031$, respectively). The initiation of bisphosphonates in eight subjects over the six-month study period was also significant ($P = 0.008$) in the intervention group. No significant changes in the use of calcium or vitamin D or specific osteoporosis therapies were realized in the control group. In the intervention group, physician contact did not result in a significant increase in the numbers of participants receiving a BMD evaluation.
Conclusion: As a whole, residents residing in assisted living facilities are at high risk of having osteoporosis and/or sustaining a fracture. When assessment of osteoporosis and fracture risk is communicated to a physician, use of therapies aimed to improve bone health increases. In this study, there was a significant increase in the use of calcium, vitamin D, and bisphosphonates in the intervention cohort. However, physician contact did not result in more participants receiving a BMD evaluation.
Key Words: Assisted living facility, Bone-mineral density testing, Fracture risk, Osteoporosis.
Abbreviations: BMMA = Bone Mass Measurement Act, BMD = bone mineral density, DEXA = dual-energy x-ray absorptiometry, SAFE = Survey of Activities and Fear of Falling in the Elderly.
Consult Pharm 2005;20:416–23.

Introduction

Osteoporosis is a silent condition that often remains undiagnosed until complicated by the presence of a fracture.[1,2] Less than one-third of individuals with osteoporosis have been diagnosed, and only one-seventh of American women with osteoporosis receive treatment.[1] Of women who have osteoporosis, 45% of those 50 years of age and older have a 40% lifetime risk of sustaining a fracture of the hip, vertebrae, or distal forearm.[3] Additionally, within a year of fracturing a hip, 20% of community-dwelling women and 40% of men die, about 60% never return to prefracture function, and 40% require long-term care.[4] Therefore, osteoporosis is associated with loss of independence and significant morbidity and mortality, particularly when left undiagnosed and untreated.

Older adults at risk of osteoporosis should be appropriately assessed and evaluated.[5] In particular, residents living in assisted living facilities often have not been screened or evaluated appropriately for many chronic age-associated diseases (e.g., osteoporosis). Data on the incidence and prevalence of osteoporosis in assisted living facilities are virtually nonexistent; however, it is well known that osteoporosis is underrecognized and undertreated in long-term care facilities.[6] Patients as well as their caregivers, nurses, and other health care providers

Stephen M. Setter, PharmD, CDE, CGP, DVM, is Assistant Professor, Department of Pharmacotherapy, College of Pharmacy; Washington State University/Elder Services, Spokane, Washington. **Cynthia F. Corbett, PhD, RN,** is Associate Professor, Intercollegiate College of Nursing/ Washington State University, Spokane, Washington. **Tyler C. Higgins, PharmD,** is Clinical Pharmacist, Saltzer Medical Group/Reddish Pharmacy, Nampa, Idaho. **David Alexander Sclar, BPharm, PhD,** is Professor of Health Policy and Administration and Director, Pharmacoeconomics and Pharmacoepidemiology Research Unit, Washington State University, Pullman, Washington. **Fred K. Viren, MD,** is Director, Osteoporosis Detection and Treatment Center, Spokane, Washington. Endocrinology and Internal Medicine, and Director, Osteoporosis Detection and Treatment Center, Spokane, Washington.

For Correspondence: Stephen M. Setter, PharmD, CDE, CGP, DVM, Assistant Professor, Department of Pharmacotherapy, College of Pharmacy, Washington State University/Elder Services, 5125 North Market Street, Spokane, WA 99217-6131; 509-489-9283; Fax: 509-458-7459; E-mail: ssetter@smhca.org.

Acknowledgment: Funding was provided by Washington State University and Procter & Gamble Co.

may not recognize that osteoporosis can often be a crippling or fatal condition in older adults. According to recent literature, physicians often do not implement pharmacotherapeutic guidelines for the management of patients at risk of or with osteoporosis.[7] Furthermore, many health care professionals need to be made aware of the Bone Mass Measurement Act (BMMA) and its implications in diagnosing and monitoring osteoporosis.[8]

Osteoporosis or low-bone mass (formerly known as osteopenia) results in more than 1.5 million fractures per year, costing the U.S. health care system more than $13.8 billion.[9] The number of fractures is expected to rise by 100,000 during the next 20 years. One large epidemiological study of community-dwelling residents found that 55% of women between the ages of 70 to 79 and 73% of those 80 years of age or older had a bone mineral density (BMD) 2.0 standard deviations (SD) below the young-adult mean, placing them at increased risk for sustaining a fracture.[10] Low BMD and advanced age are related to increased risk of fracture.[11]

More than one million Americans currently reside in an estimated 20,000 assisted living facilities.[12,13] Residents in assisted living facilities more closely resemble community-dwelling elders in that they tend to cook, clean, and perform the activities of daily living more independently than those in long-term care facilities. Among senior housing options, assisted living facilities accounted for the greatest growth between 1991 and 1998; there was a 49.4% increase in the number of properties and a 115% increase in the number of available beds.[12] An additional 150% increase in the number of assisted living facilities is expected by 2030.[12] The average age of assisted living residents is 84 years, and nearly 80% of residents are women.[3] Consequently, as a population, persons residing in assisted living facilities are likely to be at high risk for osteoporosis.

A goal of assisted living facility administrators is to help residents maintain independence and an acceptable level of quality of life. An important aspect of this is to facilitate appropriate identification, diagnosis, and treatment of chronic and potentially crippling diseases such as osteoporosis. Additionally, as pharmacists become more involved in pharmaceutical care issues regarding residents of assisted living facilities, research is needed to study the impact that pharmacists—along with other members of the health care team—have on the identification and treatment of people with chronic conditions residing in this environment. A study to test an osteoporosis intervention intended to increase the number of assisted living facility residents evaluated and, when appropriate, treated for osteoporosis is reported in this paper.

Conceptual Model

The Cox Interaction Model of Client Health Behavior offers a conceptual framework for studying chronic disease prevention and treatment in community-based populations, in contrast to acute largely directed by health care professionals. This is because of the technical competency required during care, and prevention and management of chronic illness, primarily is under the auspices of the affected individual; health care providers act in supportive roles.[14] Osteoporosis prevention and treatment falls into the category of chronic illness, and the proposed research can be guided by the model developed by Cox. Philosophic assumptions of the model that make it ideal for studying client behavior in a community-based setting include:

- Clients' ability to make responsible choices about health behavior
- Clients make choices that are affected both by their own unique characteristics and the interventions of health care professionals
- Clients are given maximal responsibility for their health behavior within the limitations of their internal and external resources.

The model proposes a bidirectional methodology to measure changes in health behaviors and outcomes. As such, the clients' background and cognitive variables (Element of Client Singularity) will influence the intervention (Elements of Client Professional Interaction) as well as serve as the outcome measures after the intervention (Elements of Health Outcome).

Methods

Design

A prospective 12-month trial involved two groups—intervention and control, identified as group A and B, respectively. All assisted living facilities in a 15-mile radius of the primary investigator were identified (N = 28). Every identified assisted living facility was approached to participate, with 16 agreeing to take part in this research study. These 16 assisted living facilities

were matched for residents' average age, gender, private-pay versus government subsidy, and length of stay. They then were assigned randomly as intervention (Group A = 8 assisted living facilities) or control facilities (Group B = 8 assisted living facilities).

Sample

A total of 111 residents (n = 60 Group A; n = 51 Group B) who met the inclusion criteria of being 60 years of age or older and ambulatory—excluding those with a terminal illness or a diagnosis of dementia—were enrolled. Of the total population available to enroll from (total census of facilities participating), 17.5% of the residents were enrolled in Group A, and 9.2% of the total available were enrolled in Group B.

Study Protocol

Written informed consent was obtained from each participant and the Institutional Review Board of Washington State University approved the study. All residents at participating facilities were invited to attend an interactive educational program and were notified by a program flier, a weekly announcement posted on the facility calendar, and/or information in a facility newsletter. Some residents were individually asked by the activity director to attend the interactive educational program. Residents in all facilities received educational programs on the safe use of prescription and over-the-counter (OTC) medications. Residents in Group A facilities (intervention group) also received an investigator-developed educational program focused on osteoporosis ("Osteoporosis and You: What You Need to Know and Do"). All persons who attended the educational programs were invited to participate in the research project. Once enrolled, the following data were gathered: demographic characteristics (e.g., age, gender, race) and number and type of osteoporotic/fracture risk factors (e.g., fracture history, family history [see Table 1]). A complete health and drug history was also obtained during the initial study visit. Each female participant was evaluated using the FRACTURE Index as described by Black (see Table 2). This tool was designed as a screening tool to assess the risk of fractures in postmenopausal women and is useful in identifying postmenopausal women who are at high risk of hip, nonvertebral, and vertebral fractures over the subsequent five years and for whom further clinical assessment and intervention are most warranted.

Additionally, the Survey of Activities and Fear of Falling in the Elderly (SAFE) Scale was completed[15]; however these data are not presented in this report.

Intervention

In the Group A facilities (intervention), primary care providers of residents at high risk for osteoporosis received a written recommendation to consider BMD testing and/or appropriate pharmacotherapy (see Appendix). Additionally, study participants were educated about their specific risk factors and the purpose of BMD testing and potential therapies. The importance of adequate intake (dietary or otherwise) of calcium and vitamin D was also reinforced. All research participants (Groups A and B) were reassessed via face-to-face interview at three and six months after study enrollment to determine whether BMD testing had been done and/or if there were any changes in pharmacotherapy specifically related to bone health. When available, facility medical administration records were used to verify medication regimens. Many subjects self-administered their medications, and in this instance drug regimen data were gathered via subject self-report or by direct observation of the medications in the subjects' living space.

Research Instruments

The investigator-developed Health and Medication History form was used to document demographic, drug, and medical history information as well as to document additional osteoporosis risk factors and fracture risks not covered in the FRACTURE Index (Table 1 has a list of these additional risk factors). The FRACTURE Index as developed by Black et al.[5] and the SAFE score as developed by Lachman and colleagues[15] were also used. The FRACTURE Index can be determined one of two ways: with or without BMD data.

Data Analysis

Univariate and multivariate statistical tests were employed. Based on normality of data, chi-square or t-test (or nonparametric equivalent) statistics were used for direct comparisons.

Results

The sample consisted of 111 participants with a mean age of 84 years (range 60 to 94, SD = 6.5 years). The

Table 1. Baseline Demographic and Osteoporosis Risk Factors of Female Subjects

Characteristic	Control Group	Intervention Group	*P*-Values
Female	76 % (n = 39)	92% (n = 55)	0.03
Mean age (years)	82.9 (61–94)	84.8 (63–92)	NS
Age >80 years[a] (range)	74 (29)	84 (46)	NS
Previous diagnosis of osteoporosis	41 (16)	27 (15)	NS
Family history of osteoporosis[a]	31 (12)	27 (15)	NS
Mother had hip fracture after age 60[b]	10 (4)	11 (6)	NS
Participant had any fracture after age 60[b]	46 (18)	49 (27)	NS
Prolonged inactivity or bed rest[a]	13 (5)	13 (7)	NS
Uses arms to stand up from a chair[b]	15 (6)	20 (11)	NS
Weighs <125 pounds[b]	39 (15)	40 (22)	NS
Smoker[b]	0	2 (1)	NS
Diagnosis of hyperthyroidism[a]	0	0	
Regular use of:			
Benzodiazepines[a]	13 (5)	22 (12)	NS
Anticonvulsant[a]	5 (2)	4 (2)	NS
Corticosteroid[a]	8 (3)	4 (2)	NS
Self-rated health[a]:			
Good	67 (26)	53 (29)	NS
Fair	31 (12)	42 (23)	NS
Poor	3 (1)	5 (3)	NS
Regular use of:			
Calcium	61 (24)	55 (30)	NS
Vitamin D	67 (26)	56 (31)	NS
Calcitonin	3 (1)	11 (6)	NS
Bisphosphonate	28 (11)	7 (4)	0.007
SERM	5 (2)	5 (3)	NS
Estrogen	23 (9)	25 (14)	NS
Previous BMD	41 (16)	24 (13)	NS
FRACTURE Index Score	w/o BMD 6.6 (+/-1.7)	w/o BMD 7.2 (+/-1.4)	NS
(No previous diagnosis of osteoporosis)	w/ BMD 9.9 (+/-2.3)	w/BMD 10.3 (+/-3.3)	NS
New BMD	0	2 (1)	NS

Abbreviations: BMD = bone mineral density, NS = not significant, SERM = selective estrogen receptor modulator (e.g., raloxifene).
[a] Risk factors for osteoporosis or fracture (FRACTURE Index items excluded)
[b] FRACTURE Index items

Table 2. Fracture Index Questions and Scoring

		Point Value
1.	What is your current age?	
	a. Less than 65	0
	b. 65–69	1
	c. 70–74	2
	d. 75–79	3
	e. 80–84	4
	f. 85 and older	5
2.	Have you broken any bones after age 50? Yes/No	1/0
3.	Has your mother had a hip fracture after age 50? Yes/No or Don't Know	1/0
4.	Do you weigh 125 pounds or less ? Yes/No	1/0
5.	Are you currently a smoker? Yes/No	1/0
6.	Do you usually need to use your arms to assist yourself in standing up from a chair? Yes/No or Don't know	2/0
	Total: _____	

If you have a current bone density (BMD) assessment, then answer next question.

BMD results: Total Hip T-score

7.	≥ –1	0
8.	Between –1 and –2	2
9.	Between –2 and –2.5	3
10.	< –2.5	4
	Total: _____	

majority (98%) were Caucasian and female (78%), and 28% (n = 31) had a known diagnosis of osteoporosis. The only significant differences between the control (n = 51) and intervention (n = 60) groups at baseline was that there were significantly more women in the intervention group, compared with the control group (Table 1). Note that the table reports baseline demographic and osteoporosis risk factor only of the female subjects because too few men were enrolled to provide meaningful analysis. Female participants in both groups had a high degree of risk for osteoporosis and/or fracture. The majority of participants were over the age of 80 (80%), with 48% of all female participants having had experienced a fracture since the age of 60. Characteristics placing the female participants at a high risk of osteoporosis and fracture included advanced age, a family history of osteoporosis (29%), and a weight of less than 125 pounds (39%). The entire female population studied (control and intervention group) that had not had a prior diagnosis of osteoporosis and over the next five years were at high risk of fracture. In the control group of females without a prior diagnosis of osteoporosis, FRACTURE Index average scores of 6.6 (+/- 1.7) and 9.9 (+/- 2.3) without BMD and with BMD, respectively, indicate a high risk of fracture over the following five years. Likewise the intervention group (females without a prior diagnosis of osteoporosis) also was in the highest fracture risk category as evidenced by the average FRACTURE Index scores of 7.2 (+/- 1.4) and 10.3 (+/- 3.3), without BMD and with BMD, respectively. Only 31% (29) of all female participants had a prior BMD test performed. Regarding drug therapy at baseline, 61% and 67% of the control group and 55% and 56% of the intervention group were consuming additional calcium or vitamin D as a supplement, respectively. Table 1 lists the numbers of females in the control and intervention cohorts at baseline who were taking medications that can improve bone health or prevent and/or treat osteoporosis. As shown, significantly more participants in the control group were taking a bisphosphonate at baseline.

At three and six months following the intervention, participants were evaluated for changes in pharmacotherapy (e.g., use of vitamin D, calcium, selective estrogen receptor modulators, bisphosphonates) and whether BMD testing had been done. At the three-month evaluation, more people in the intervention group had initiated calcium as compared with the control group ($P = 0.016$). At study end, a significant number of participants in the intervention group had initiated the use of additional vitamin D ($P = 0.031$). The initiation of a bisphosphonate over the six-month study period was significant in the intervention group ($P = 0.008$). Over the study period, no significant changes in osteoporosis therapies were observed in the control group. There was no significant difference in the number of people in the intervention versus control group who had received BMD testing (1 versus 0). As an aside, no male patients received additional pharmacotherapy or received a BMD evaluation. Four subjects (one male and three females) in the control group (three died and one relocated) and five females

Table 3. Summary of Medication Usage by Females at Baseline and at Study End

Regular Use of Medications	Control		Intervention	
	Baseline n = 39 (%)	Study End n = 36 (%)	Baseline n = 55 (%)	Study End n = 50 (%)
Calcium[1]	24 (62%)	24 (67%)	30 (55%)	37 (74%)
Vitamin D[2]	26 (67%)	27 (75%)	31 (56%)	37 (74%)
Calcitonin	1 (3%)	1 (3%)	6 (11%)	4 (8%)
Bisphosphonate[3]	11 (28%)	12 (33%)	4 (7%)	12 (24%)
SERM	2 (5%)	4 (11%)	3 (5%)	4 (8%)
Estrogen	9 (23%)	7 (19%)	14 (25%)	13 (26%)

P values for intervention group
[1] $P = 0.016$.
[2] $P = 0.031$.
[3] $P = 0.008$.
Abbreviation: SERM = selective estrogen receptor modulator.

(four died and one relocated) in the intervention group were lost to follow-up.

Discussion

Improving bone health in patients at risk of osteoporosis is critical if fractures are to be avoided. Therefore, identifying those at risk of developing osteoporosis and subsequent fracture is paramount. The role of non-BMD risk factors plays a significant and independent role in the prediction of hip fracture.[16] The Study of Osteoporotic Fractures demonstrated that a number of risk factors were predictive of hip fracture risk in Caucasian women over age 65 years.[16] The FRACTURE Index score can be used in older females to assist with meaningful information regarding risk of fracture and help with the decision to receive further evaluation on osteoporosis. Once identified as being at risk, the patient would need to be evaluated further, and the score obtained from this index can assist the patient and practitioner regarding this need. Appropriate evaluation, before fracture occurs, is a challenge. Often even after fractures take place, inadequate evaluation ensues.[17]

The population studied as a whole tended to possess multiple risk factors for osteoporosis. Among these were advanced age, presence of preexisting fracture, weight under 125 pounds, and family history of osteoporosis. The relationship between age and risk of hip fracture is very strong,[18] and age is the most important single component of the FRACTURE index.[5] In this study, the average age of the female participants was 84, identifying as a group a very important risk factor for osteoporosis and fracture. The FRACTURE Index can be used either with or without BMD testing by older postmenopausal women or their clinicians to assess the five-year risk of hip and other osteoporotic fractures. It also could be useful in determining the need for further evaluation for osteoporosis. It is recommended by Black et al. that postmenopausal women with a total score of 4 or above without BMD, or a score of 6 or above with BMD on the FRACTURE Index, should undergo further evaluation by a physician.[5] In this study, the average FRACTURE Index scores were over these recommended levels. Actually, the average FRACTURE Index scores for each female cohort placed those evaluated in the highest risk category for fracture over the ensuing five years.

In this study, the number and type of risk factors as well as the FRACTURE Index score were communicated to the primary provider for the intervention group. While many participants were at high risk of fracture, only one participant received a BMD test during the six-month study period. It is possible that written communication is not the ideal way to communicate the need for further bone-health evaluation. The use of calcium and vitamin D supplements significantly increased in the intervention group, as did the use of bisphosphonates. From the data it is apparent that these decisions were

made apart from the use of the BMD test. Nonetheless, the increases in the use of supplements and prescribed pharmacotherapy increased in the intervention group. The use of prescribed medications and supplements for the most part remained unchanged in the control group.

Limitations to this study included possible selection bias in that those willing to participate may have been motivated by a concern about their bone health. This may partially explain why a higher percentage of the total available population was enrolled in the intervention cohort. Also, there may have been initial facility self-selection bias in that the facilities that are more proactive in their residents' health may have been more likely to volunteer to be included in this study. The groups were not evenly matched in regard to gender, use of a bisphosphonate and FRACTURE Index score at baseline—all which may have favored the initiation of a change in therapy in the intervention group. When changes in therapy were realized, the initiating factor (e.g., participant education, physician contact) resulting in the medication change was not determined. In addition, medical history and FRACTURE Index information were obtained via participant self-report. The socioeconomic and/or education level of the residents was not gathered, and if significant differences among the cohorts existed in this regard, this could have influenced the outcomes reported in this study.

Conclusion

As a whole, residents residing in assisted living facilities are at high risk of having osteoporosis and sustaining a subsequent fracture. Educating residents on osteoporosis and further assessment for osteoporosis risk fractures and fracture risk using the FRACTURE Index score, which then is communicated to the physician, can positively impact the use of therapies to improve bone health in assisted living facility residents. Increased use of BMD testing to evaluate osteoporosis was not helped by written communication of the risk factors or by reporting of FRACTURE Index score. This study confirms that residents of assisted living facilities require further assessment of their bone health; this represents an opportunity for pharmacists to advocate for and aid assisted living facility residents in receiving further evaluation for the presence of osteoporosis.

Appendix. Pertinent Information from Sample Prescriber Letter

Dear Dr._____:

Your patient, **Patient Name**, has agreed to participate in a funded study aimed at increasing awareness of osteoporosis in residents of assisted living facilities. Published research has shown the risk factors listed below are related to an increased risk of osteoporosis and/or fracture. Your patient may be at higher than average risk for osteoporosis and/or fracture because of the factors checked.

- ☐ Age greater than 80
- ☐ Broken bone after age 50
- ☐ Maternal hip fracture after age 50
- ☐ Weight of 125 pounds or less
- ☐ Current smoker
- ☐ Use of arms to rise from a chair
- ☐ Self-rated health as fair or poor
- ☐ Regular oral corticosteroid use
- ☐ Family history of osteoporosis

A FRACTURE Index has been developed and published by Black et al. Your patient's FRACTURE Index score is _____, indicating a five-year hip fracture risk of _____%, vertebral fracture risk of _____%, and nonvertebral fracture risk of _____%.

Recommendations for consideration include:

- BMD testing if not already performed
- Calcium/vitamin D supplementation if inadequate from dietary intake
- Appropriate pharmacotherapy, if deemed necessary by your evaluation and assessment

References

1. Osteoporosis Task Force. American Association of Clinical Endocrinologists: 2001 medical guidelines for clinical practice for the prevention and management of postmenopausal osteoporosis. Endocr Pract 2001;7:293-312.
2. Chestnut CH III. Osteoporosis, an under diagnosed disease. JAMA 2001;286:2865-6.
3. Melton LJ, Chrischilles EA, Cooper C et al. Perspective: how many women have osteoporosis? J Bone Min Res 1992;7:1005-10.
4. Field-Munves E. Making evidence-based decisions for the treatment of osteoporosis. Consult Pharm 2001;16 (suppl B):s6-s14.
5. Black DM, Steinbuch M, Palermo L et al. An assessment tool for predicting fracture risk in postmenopausal women. Osteoporos Int 2001;12:519-28.
6. Baran RW, Kiel DP, Patterson H et al. Diagnosis and treatment of osteoporosis in long-term care facilities. Consult Pharm 1998;6:685-99.
7. Freedman KB, Kaplan FS, Bilker WB et al. Treatment of osteoporosis: are physicians missing an opportunity? J Bone Joint Surg 2000;82-A:1063-70.
8. Watts NB. Understanding the bone mass measurement act. J Clin Densitom 1999;2:211-7.
9. Ettinger B, Black DM, Nevitt MC et al. Contribution of vertebral deformities to chronic back pain and disability. J Bone Miner Res 1992;7:449-56.
10. Looker AC, Johnston CC, Wahner HW et al. Prevalence of low femoral bone density in older U.S. women from NHANES III. J Bone Miner Res 1995;10:796-802.
11. Hui SL, Slemenda CW, Johnston CC Jr. Age and bone mass as predictors of fracture in a prospective study. J Clin Invest 1988;81:1804-9.
12. Raymond G. Senior living: beyond the nursing home. Am Demogr 2000;22:58-63.
13. Typical assisted living resident—ALFA's 1998 overview of the assisted living industry. Available at: http://www.alfa.org/public/articles/details.cfm?id=10.
14. Cox C. An interaction model of client health behavior: theoretical prescription for nursing. Adv Nurs Sci 1982;5:41-56.
15. Lachman ME, Howland J, Tennstedt S et al. Fear of falling and activity restriction: the survey of activities and fear of falling in the elderly (SAFE). J Gerontol 1998;53B:43-50.
16. Cummings SR, Nevitt MC, Browner WS et al. Risk factors for hip fracture in white women. N Engl J Med 1995;332:767-73.
17. Bellantonio S, Fortinsky R, Prestwood K. How well are community-living women treated for osteoporosis after hip fracture? JAM Geriatr Soc 2001;49:1197-204.
18. Bolognese M. Effective pharmacotherapeutic interventions for the prevention of hip fractures. Endocrinologist 2002;12:29-37.