Women’s Preferences for Prevention of Bone Loss

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ABSTRACT. Objective. Despite the serious consequences of osteoporosis, few women use pharmacologic measures to prevent postmenopausal bone loss. We used an interactive computerized questionnaire to examine women’s preferences for prevention of osteoporosis.

Methods. We administered a choice-based conjoint analysis survey (CBCA) to consecutive early postmenopausal women in a shopping center. The questionnaire was constructed to measure preferences for pharmacologic and nonpharmacologic measures to prevent postmenopausal bone loss. Women were also given the option of choosing “none,” i.e., to defer or refuse all options. Utilities were calculated based on a Hierarchical Bayes model using Monte Carlo-Markov chain algorithms. We performed simulations based on women’s values for specific treatment characteristics to estimate choice.

Results. A total of 212 women agreed to complete the survey (42% participation rate). Between 18% and 47% of the women surveyed (mean age 52 ± 5 yrs) were predicted to choose once-weekly medications to prevent postmenopausal bone loss, assuming treatment confers an absolute lifetime risk reduction in fractures of at least 10%.

Conclusion. In this CBCA survey, which derived preferences based on how women make tradeoffs between specific treatment characteristics, a significant percentage of women were willing to use once-weekly medications to prevent postmenopausal bone loss. (J Rheumatol 2005;32:1086–92)

Key Indexing Terms:
OSTEOPOROSIS
PATIENT ACCEPTANCE OF HEALTHCARE

In the United States today, 8 million women have osteoporosis. The estimated national direct expenditure for osteoporotic fractures is over $38 billion per year. More importantly, osteoporotic fractures result in significant functional impairment, decreased quality of life, and increased mortality. After one year, 40% of hip fracture survivors are unable to walk independently, 80% can no longer perform activities such as shopping or driving, and about one-third become permanent nursing home residents.

Women of all ethnic backgrounds are at significant risk for developing osteoporosis. Roughly 52% of non-Hispanic white and Asian women, 35% of non-Hispanic Black women, and 49% of Hispanic women have low bone mass. The impact of this major public health problem is expected to increase exponentially as the population ages.

Several interventions are available to decrease the risk of fractures in persons with established osteoporosis (i.e., T score ≤ −2.5), but there is no cure for this disease. Further, although currently available pharmacologic options decrease the risk of fractures by about 50%, a corresponding 50% of fractures continue to occur despite treatment. Accordingly, primary prevention measures to prevent bone loss may be one of the best strategies to manage the public health impact of this disorder.

Many measures, including calcium and vitamin D supplementation, regular weight-bearing exercise, and avoidance of tobacco and excessive alcohol, have essentially no risk, and are universally recommended for all women to prevent bone loss and maintain bone health. US Food and Drug Administration (FDA)-approved drug therapies for prevention of postmenopausal osteoporosis include bisphosphonates, hormonal therapy, and raloxifene. However, the recent results from the Women’s Health Initiative study raise concerns regarding the use of hormonal therapy for prevention of osteoporosis in the general population.

Despite the serious consequences of osteoporosis, few early postmenopausal women are currently using FDA approved pharmacologic measures to prevent bone loss. Limited use of these medications is in part due to uncertainty regarding the longterm benefits of pharmacotherapy in women without established osteoporosis. Because the decision to take medications to prevent bone loss or not is dependent on personal values, health beliefs, and preferences for near-term and longterm outcomes, primary prevention decisions should include women’s preferences.

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This issue is especially important given the growing number of studies finding that physicians’ and patients’ values and priorities differ11-14. We used an interactive computerized questionnaire to ascertain women’s preferences for prevention of osteoporosis and to determine whether the availability of a once-yearly bisphosphonate infusion might increase the number of women choosing pharmacologic measures to prevent postmenopausal bone loss.

**MATERIALS AND METHODS**

*Participants.* We recruited early postmenopausal women in a supermarket serving persons of diverse sociodemographic backgrounds. Older women with established osteoporosis were not recruited for this study since our objective was to examine preferences for primary prevention of bone loss (in contrast to treatment preferences for established osteoporosis). To ensure that we recorded the opinions of both working (day or evening shift) and non-working women, we conducted interviews during daytime hours as well as evenings and weekends.

Women were approached by a medical resident and asked to participate in a research study examining women’s opinions about osteoporosis. Eligible women included those with recent onset (< 36 months) natural menopause who could read and understand English. No personal identifying information was collected.

*Prevention preferences.* Preferences for pharmacologic prevention of bone loss were assessed using an interactive computer choice-based conjoint analysis (Sawtooth Software®, Sequim, WA, USA) questionnaire. Conjoint analysis is a well validated tool used to understand consumer preferences that has been recognized as a valuable means of assessing patient preferences for healthcare5-18.

Studies have found that this technique produces internally consistent responses, and that it is a reliable and valid method of measuring preferences18-21. The reliability of respondent input has been demonstrated by examining stability of preferences over different data collection methods. The internal validity of this technique has been confirmed in cross-sectional studies by assessing the ability of the model to predict ranking of a specified set of profiles, and prospective studies have found that conjoint analysis is able to predict actual choices at a later date20,21.

Choice-based conjoint analysis (CBCA) assesses preferences by asking respondents to choose a preferred option from a set of hypothetical choices. This technique is favored over other preference measures by many researchers, because choosing from a small number of alternative items is a simple and natural task that reflects what consumers actually do when deciding between multiple choices19. In addition, unlike other approaches, CBCA permits inclusion of a “None” option, which allows patients to choose the real option of refusing or deferring treatment.

**CBCA questionnaire.**

*Characteristics and levels.* Conjoint analysis assumes that each option is a composite of different characteristics, and that each characteristic represents one of a number of levels. Levels refer to the range of estimates for each characteristic. The characteristics and levels of the prevention measures included in the questionnaire are described in Appendix 1. Brand names were not included so as not to bias the respondents toward or away from specific options.

The questionnaire was designed to measure preferences for prevention of postmenopausal bone loss using once-weekly oral medications, annual infusions, daily vitamin supplementation, and weight-bearing exercise across a range of possible risk and benefits. Because of the results from the Women’s Health Initiative Study we did not include characteristics to represent estrogen2. Similarly, although it is approved for the prevention of osteoporosis, we felt it was premature at this time to include raloxifene until the risk and benefits of this medication are better elucidated22-24.

**Choice tasks.** Conjoint analysis derives preferences by asking respondents to make tradeoffs between the characteristics of the options under consideration. We designed the questionnaire to present respondents with 12 choice sets, each composed of 3 treatment alternatives and a “None” option, which allowed respondents to refuse all options. An example is provided in Appendix 2.

We planned to recruit 200 women based on other studies that have shown stable utility estimates for the number of characteristics and levels included in this study25.

We used the software’s complete enumeration strategy to construct the choice sets. This strategy constructs options by randomly assigning levels to each option. The complete enumeration method conforms to 3 main principles: (1) Minimal overlap: each level is shown as few times as possible in a single task. (2) Level balance: each level is shown roughly an equal number of times across the choice tasks. (3) Orthogonality: the level of one characteristic is chosen independently of the levels of other characteristics, so that each characteristic level’s effect can be reliably estimated. However, the questionnaire was programmed to avoid unrealistic combinations. Thus, exercise was never paired with a risk of either gastrointestinal (GI) or flu-like adverse effects.

*Analyses.* Utilities (patient values for the characteristics studied) were calculated based on a Hierarchical Bayes model using Monte Carlo-Markov Chain algorithms26. We calculated the relative importance of the characteristics studied by dividing the range of utilities for each characteristic by the sum of ranges, and multiplying by 100. The relative importances reflect the extent to which the difference between the best and worst levels of each characteristic influenced women’s decisions to choose a particular option.

Using CBCA, we performed simulations to predict choices for a range of options for each respondent. In conjoint analysis, options are defined based on the levels of each characteristic. CBCA generates a predicted overall score for each option based on individual respondents’ estimated values for specific treatment characteristics. The option with the highest estimated utility, i.e., the option that is most consistent with each individual respondent’s values, is regarded as that respondent’s predicted choice.

To check the internal consistency of the questionnaire, we used CBCA to predict preferences for 2 hypothetical options, in which one option was clearly superior to the other. The first option was described as a pill taken once per week, associated with 25% reduction in lifetime risk of fractures, and having no added risk of side effects. The second option was described as a pill taken once per week, associated with 10% reduction in lifetime risk of fractures, and having an added risk of GI side effects (“Side effects are uncommon, but may include stomach upset or constipation”). The model predicted that almost all women (95%) would choose the dominant option, 3% would choose “None,” and only 2% would choose the inferior treatment option. Because there are limited data on the longterm benefits related to prevention strategies, we examined predicted choices for a range of possible outcomes in the simulations (see Appendix 1a). We constructed the base-case scenario to model the “worst-case scenario” for currently available pharmacologic options (once-weekly bisphosphonates). In this scenario, medications (representing bisphosphonates) were described as having no additional benefit over nonpharmacologic options, and as being the only option associated with a possible risk of adverse effects (Appendix 1a). An absolute risk reduction of 10% was chosen, a priori, as the smallest expected benefit, and all options were described as decreasing the lifetime risk of fractures from 50% to 40%.

We subsequently conducted sensitivity analyses to examine how changing specific characteristics affected women’s preferences (Appendix 1a). Specifically, given that calcium (in recommended doses to prevent bone loss) can cause GI symptoms, we performed a simulation in which both once-weekly medications and daily vitamins were associated with an uncommon risk of GI adverse effects. We also performed a simulation in which neither weekly medications nor daily vitamins were associated with a risk of adverse effects because several studies have not observed an increased risk of GI adverse effects with weekly bisphosphonates27-30. Last, we performed simulations to examine women’s predicted choices if
bisphosphonates were associated with an added benefit over vitamins and exercise, and to examine whether adding the option of having a once-yearly infusion affected women’s predicted choices (Appendix 1b).

Associations between treatment preferences and patient characteristics were examined using t test and chi-square statistics for continuous and categorical variables, respectively. The protocol was approved by the Human Investigations Committee at our institution.

RESULTS

Respondent characteristics. Two hundred twelve women agreed to complete the survey (42% participation rate). Of these, 6 reported having a bone mineral density (BMD) result indicating osteoporosis and therefore were excluded from the analyses. The mean (± SD) age of the study sample was 52 ± 5 years. Fifty-one percent were college graduates. The ethnic distribution was 74% Caucasian, 23% Black, and 3% other. Fifty percent reported having had a BMD test. Eighty-three percent of women reported that they were currently taking vitamins, 47% were performing weight-bearing exercises, 18% were using hormone therapy, and 6% (12 women) reported using a bisphosphonate to prevent bone loss. Thirteen percent (n = 27) stated that they were using none of the preceding measures to prevent bone loss.

Women’s predicted choices for available options (Table 1). The descriptions of the medications included in these simulations are listed in Appendix 1a. In the base-case scenario, 18% of the women surveyed were predicted to choose a once-weekly medication associated with a low risk of GI side effects over vitamins and exercise. Only 3% of the women surveyed were predicted to refuse all options. When both weekly medications and daily vitamins were described as having a small added benefit over the other options (15% compared to 10% decrease in lifetime risk of fractures), up to 47% preferred weekly medications depending on the risk of GI side effects. Thus, depending on the risk and efficacy of alternative treatments, we found that 18% to 47% of the women surveyed were predicted to choose a weekly medication.

We found no association between race, education, or having had a BMD test and treatment preference.

Women’s predicted choices for annual infusions (Figure 1). Figures 1B through 1D depict the influence of adding a once-yearly infusion to available options on women’s choices (Figure 1A depicts the distribution of choices for the base-case scenario). The descriptions of the medications included in these simulations are listed in Appendix 1b. Adding a once-yearly infusion (with an uncommon risk of a brief self-limited flu-like illness) had little influence on the distribution of women’s predicted choices (Figure 1B). Describing both medications as being associated with either a small (Figure 1C) or moderate added benefit (Figure 1D) did not significantly increase the number of women willing to choose an annual infusion.

Relative importance of specific treatment characteristics. The relative importance of the variation of the characteristics studied is illustrated in Figure 2. Women’s preferences were most strongly influenced by the range of possible routes of administration (44%) and benefits (40%) included in the questionnaire, while the range of adverse effects had much less effect (16%) on women’s choices.

DISCUSSION

In this CBCA survey, which predicted choices based on how early postmenopausal women make tradeoffs between specific treatment characteristics, a significant percentage of

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Table 1. Women’s predicted choices for prevention of postmenopausal bone loss.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Option 1 (Weekly medication)</th>
<th>Option 2 (Daily vitamins)</th>
<th>Option 3 (Exercise)</th>
<th>Option 4 (None)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-case</td>
<td>18.0 ± 2.7</td>
<td>39.3 ± 3.4</td>
<td>39.8 ± 3.4</td>
<td>2.9 ± 1.2</td>
</tr>
<tr>
<td>Assuming both weekly medications and vitamins are associated with a risk of GI adverse effects</td>
<td>30.1 ± 3.2</td>
<td>19.9 ± 2.8</td>
<td>46.6 ± 3.5</td>
<td>3.4 ± 1.3</td>
</tr>
<tr>
<td>Assuming neither weekly medications nor vitamins are associated with a risk of GI adverse effects</td>
<td>35.4 ± 3.3</td>
<td>25.2 ± 3.0</td>
<td>36.9 ± 3.4</td>
<td>2.4 ± 1.1</td>
</tr>
<tr>
<td>Assuming weekly medications have a small added benefit over the other options and both are associated with a risk of GI adverse effects</td>
<td>38.8 ± 3.4</td>
<td>12.6 ± 2.3</td>
<td>45.6 ± 3.5</td>
<td>2.9 ± 1.2</td>
</tr>
<tr>
<td>Assuming weekly medications have a small added benefit over the other options and neither are associated with a risk of GI adverse effects</td>
<td>47.1 ± 3.5</td>
<td>18.0 ± 2.7</td>
<td>32.5 ± 3.3</td>
<td>2.4 ± 1.1</td>
</tr>
</tbody>
</table>

GI: gastrointestinal.
participants were willing to use once-weekly medications to prevent postmenopausal bone loss and subsequent osteoporotic fractures, assuming treatment confers an absolute lifetime risk reduction in fractures of at least 10%. In addition, our results suggest that adding an annual infusion to existing options might not significantly influence the distribution of women’s predicted choices for weekly oral medications, daily vitamins, and exercise.

The relative importances of the characteristics studied lend insight into why a convenient annual infusion was not
viewed favorably by the women interviewed. In this study, early postmenopausal women were strongly influenced by the different routes of administration included in the questionnaire, and when given a choice, those women willing to consider medications strongly preferred taking a pill once a week rather than having an infusion in a doctor’s office.

Strengths of this study include the sampling strategy employed and methods used to derive predicted choices. To obtain a community based sample we recruited early postmenopausal women in a shopping center. The study was purposely performed during weekdays and weekends, and at various times during the day and evening, to ensure that we recruited women from diverse sociodemographic backgrounds with various occupations. We also attempted to decrease selection bias by approaching women ourselves. We felt that this approach would yield a more generalizable sample compared to a strategy in which interviewers wait for interested participants to approach them at a table framed by health education posters.

We chose to use CBCA to derive early postmenopausal women’s predicted choices because CBCA requires respondents to make choices based on tradeoffs between specific treatment characteristics as opposed to ratings of specific options. Construction of preferences based on explicit tradeoffs minimizes biases associated with the context in which choices are presented and decreases the influence of individual provider preferences. In addition, careful consideration of the tradeoffs involved in complex decisions has been shown to improve the quality of decision-making, since choices based on explicit tradeoffs are less likely to be influenced by heuristics (errors in reasoning) that can lead to poor decisions.31,32

CBCA also allows the investigator to include a “None” option. This feature allows patients to choose the real option of refusing or deferring treatment. In addition, CBCA uses an interactive format that engages patients’ attention and results in greater gains in knowledge compared to standard educational materials. Most importantly, CBCA has a strong theoretical basis, obtains high levels of internal consistency, and, by using Hierarchical Bayes analysis, is able to derive preferences at the individual respondent level.26

Our results must be interpreted in view of the limitations of the study. Given the methods used, we were not able to obtain information to describe nonparticipants. We were therefore not able to determine whether there were any significant differences between women who agreed to complete the survey versus those who refused. The setting in which the study was conducted limited the amount of information that could be included in the questionnaire. Ideally, the descriptions of the specific treatment characteristics would have been more detailed. Most notably, we did not include the need to take bisphosphonate on an empty stomach and to refrain from eating for the following 30 minutes, which presumably would have decreased the strength of preference for bisphosphonates. In addition, preferences were predicted for hypothetical options, given the limited data available regarding the long-term outcomes of primary prevention strategies.

In reality, early postmenopausal women may choose to use several options concurrently to prevent bone loss. We were only able to predict a single preferred choice. Therefore, only those women whose values predicted that they would choose a weekly medication over exercise and vitamins were counted as choosing a pharmacologic option. This limitation, however, would be expected to result in an underestimation of the number of women willing to use weekly medications. This study examined preferences for bone loss among early postmenopausal women only. We would expect that older women with increased fracture risks would have stronger preferences for effective options.

In summary, we found that the current limited use of available pharmacologic options for prevention of osteoporotic fractures may not be consistent with early postmenopausal women’s preferences. Possible reasons for this discrepancy include lack of awareness, cost, and/or lack of physician support for this practice. In addition, we found that the majority of women were willing to adopt measures to prevent postmenopausal bone loss, thereby emphasizing the need to ensure adequate education for women at risk. Further research to understand women’s preferences for prevention of osteoporotic-related fractures is required to promote educational programs and direct resources toward interventions most likely to be adopted by women, and consequently to have a positive influence on public health.

ACKNOWLEDGMENT
We thank the staff at Sawtooth Software for their technical support and the managers of Shop-Rite for allowing us to conduct this study.
### Appendix 1A. Treatment descriptions for simulations performed.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Option 1 (Weekly medication)</th>
<th>Option 2 (Daily vitamins)</th>
<th>Option 3 (Exercise)</th>
<th>Option 4 (None)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-case</td>
<td>Weekly medication Risk of fractures decreased by 10% Possible GI AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>None</td>
</tr>
<tr>
<td>Assuming both weekly medications and vitamins are associated with a risk of GI AE</td>
<td>Weekly medication Risk of fractures decreased by 10% Possible GI AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% Possible GI AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>None</td>
</tr>
<tr>
<td>Assuming neither weekly medications nor vitamins are associated with a risk of GI AE</td>
<td>Weekly medication Risk of fractures decreased by 10% No added risk of AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>None</td>
</tr>
<tr>
<td>Assuming weekly medications have a small added benefit over the other options and neither are associated with a risk of GI AE</td>
<td>Weekly medication Risk of fractures decreased by 15% No added risk of AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>None</td>
</tr>
</tbody>
</table>

GI: gastrointestinal, AE: adverse effects.

### Appendix 1B. Treatment descriptions for simulations performed.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Option 1 (Weekly medication)</th>
<th>Option 2 (Daily vitamins)</th>
<th>Option 3 (Exercise)</th>
<th>Option 4 (Annual infusion)</th>
<th>Option 5 (None)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base-case with added option of an annual infusion (Figure 1B)</td>
<td>One pill per week Risk of fractures decreased by 10% Possible GI AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>Annual infusion Risk of fractures decreased by 10% Possible flu-like illness</td>
<td>None</td>
</tr>
<tr>
<td>Assuming medications have a small added benefit over the other options (Figure 1C)</td>
<td>One pill per week Risk of fractures decreased by 15% Possible GI AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>Annual infusion Risk of fractures decreased by 15% Possible flu-like illness</td>
<td>None</td>
</tr>
<tr>
<td>Assuming medications have a moderate added benefit over the other options (Figure 1D)</td>
<td>One pill per week Risk of fractures decreased by 25% Possible GI AE</td>
<td>Daily vitamins Risk of fractures decreased by 10% No added risk of AE</td>
<td>Exercise Risk of fractures decreased by 10% No added risk of AE</td>
<td>Annual infusion Risk of fractures decreased by 25% Possible flu-like illness</td>
<td>None</td>
</tr>
</tbody>
</table>

GI: gastrointestinal, AE: adverse effects.

### REFERENCES

Appendix 2. The questionnaire presented respondents with 12 choice sets, each composed of 3 treatment alternatives and a “None” option.

Each of these options prevents the bone loss that occurs after menopause. If these were your only options which would you choose?

You go to your doctor's office to get a 15 minute infusion once a year. You perform weight bearing exercise three times per week. You take one pill once a week first thing in the morning.

This will decrease your lifetime risk of fractures from 50% to 25%. This will decrease your lifetime risk of fractures from 50% to 10%. This will decrease your lifetime risk of fractures from 50% to 40%.

Side-effects are uncommon, but may include stomach upset or constipation. No added risk of side-effects. Side-effects are uncommon, but may include a brief flu-like illness after starting the medication.