

Bone mineral density in relation to medical and lifestyle risk factors for osteoporosis in premenopausal, menopausal and postmenopausal women in general practice

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SUMMARY

Background. Interest in the prevention of osteoporosis is increasing and thus there is a need for an acceptable osteoporosis prevention programme in general practice.

Aim. A study was undertaken to identify a cohort of middle-aged women attending a general practice who would be eligible for a longitudinal study looking at bone mineral density, osteoporosis and the effectiveness of hormone replacement therapy. This study aimed to describe the relationship between medical and lifestyle risk factors for osteoporosis and the initial bone density measurements in this group of women.

Method. A health visitor administered a questionnaire to women aged between 48 and 52 years registered with a Belfast general practice. The main outcome measures were menopausal status, presence of medical and lifestyle risk factors and bone mineral density measurements.

Results. A total of 358 women out of 472 (76%) took part in the study which was conducted in 1991 and 1992. A highly significant difference was found between the mean bone mineral density of premenopausal, menopausal and postmenopausal women within the narrow study age range, postmenopausal women having the lowest bone mineral density. A significant relationship was found between body mass index and bone mineral density, a greater bone mineral density being found among women with a higher body mass index. Risk factors such as smoking and sedentary lifestyle were common (reported by approximately one third of respondents) but a poor relationship was found between these two and all the other risk factors and bone mineral density in this age group.

Conclusion. Risk of osteoporosis cannot be identified by the presence of risk factors in women aged between 48 and 52 years. In terms of a current prevention strategy for general practice it would be better to take a population-based approach except for those women known to be at high risk of osteoporosis: women with early menopause or those who have had an oophorectomy.

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Introduction

INTEREST in the prevention of osteoporosis is increasing among general practitioners¹ but the way ahead is unclear. There is increasing pressure¹ for general practitioners to establish osteoporosis risk factor screening and/or bone mineral density screening programmes and to prescribe hormone replacement therapy. However, there are no results from scientific trials assessing the effectiveness of such programmes in preventing fractures in elderly women.² The causes of osteoporosis are multifactorial, the only definite risk factors being advancing age and the menopausal state.^{3,4}

Fractures in postmenopausal women are an important cause of morbidity, mortality and personal and social cost⁵ — all good reasons to make prevention a priority. The introduction of health promotion as an integral part of general practice is making family doctors think about their role in the prevention of osteoporosis as well as other major diseases.

The purpose of this study was to identify the prevalence of the medical and lifestyle risk factors for osteoporosis in a group of women aged between 48 and 52 years registered with a health centre in Belfast, to measure their bone mineral density and to identify the relationship, if any, between bone mineral density and these risk factors. It was hoped that the results might point the way ahead to an acceptable osteoporosis prevention programme for use in general practice. It was also the intention (although not part of the study reported here) to follow up this group of women over a period of years, to measure their bone mineral density at intervals, study their use of and the effect of hormone replacement therapy and measure the development of osteoporosis and the incidence of fractures.

Method

Women aged between 48 and 52 years were identified from the age-sex register of a practice of 21 046 patients in south Belfast, and invited to attend an interview with a research health visitor during a 12-month period between 1991 and 1992. This age group was chosen because the majority of women reach the menopause during these years. A questionnaire seeking information on medical history (menopausal status, body mass index (kg m^{-2}), family history of osteoporosis, gynaecological history, number of pregnancies, and whether currently taking hormone replacement therapy), and lifestyle factors (alcohol intake, smoking status, consumption of dairy products and exercise^{3,4}) was administered by C G who asked the questions and then recorded the responses. A sedentary lifestyle was defined as using a car as the main means of transport, jogging or cycling for less than five minutes a day, walking less than five miles per week and taking no strenuous physical exercise. A positive family history was recorded when the women had a first degree woman relative who had sustained a fracture of the hip or wrist or developed a curvature of the spine

as a result of osteoporosis. A diet having a poor dairy products content (and therefore being low in calcium) was recorded if less than half a pint of milk per day was drunk, with cheese, yoghurt, icecream or milk pudding taken once a week or less.

Bone mineral density of L2–L4 vertebrae, which is the most relevant site to measure in this age group, was measured following the interview with the health visitor using Hologic 1000® (Hologic Incorporated) dual energy x-ray absorptiometry. One measurement was carried out for each woman. Patients were subsequently offered lifestyle advice by the health visitor and the opportunity to take hormone replacement therapy if their bone mineral density was below the mean for age matched women.

The significance of differences in mean bone mineral density between premenopausal women (those women still having menstrual periods), menopausal women (those whose last menstrual period had been between two and six months ago) and postmenopausal women (women whose last menstrual period had been more than six months ago) was assessed by analysis of variance. The relationship between bone mineral density and a number of medical and lifestyle risk factors was investigated using multiple regression analysis.

Results

A total of 472 women were identified and invited to take part in the study by a letter from their general practitioner. Of these, 358 (75.8%) agreed to participate, of whom 103 (28.8%) were premenopausal, 43 (12.0%) were menopausal and 211 (58.9%) were postmenopausal (menopausal status not known for one woman).

One hundred and sixteen women were current smokers (32.4%), 111 had a sedentary lifestyle (31.0%) and 81 women had a family history of osteoporosis (22.6%).

Seventy three women (20.4%) were taking hormone replacement therapy. Hysterectomy and/or total oophorectomy had been performed on 72 women (20.1%), 60 (16.8%) had had no pregnancies, 42 (11.7%) had a diet low in dairy products, 19 (5.3%) had a body mass index of less than 20 and 12 (3.4%) reported consuming more than 14 units of alcohol per week. Further analysis was not carried out on the alcohol intake risk factor.

The relationship between menopausal status, age and bone mineral density (excluding the 73 women taking hormone replacement therapy and the 72 women who had had a hysterectomy and/or total oophorectomy) is shown in Table 1. The results of an analysis of variance showed that for the total group of 233 women there was a highly significant difference between the bone mineral density of the premenopausal, menopausal and postmenopausal women, bone mineral density being lowest among postmenopausal women.

The relationship between bone mineral density and risk factors for the same group of women is shown in Table 2. Mean bone mineral density was significantly higher for women with a body mass index over 25 for the total group and for the group of premenopausal women. Mean bone mineral density of women with sedentary lifestyles was marginally higher than that of women with non-sedentary lifestyles but none of the differences was statistically significant. When strenuous physical exercise and walking more than five miles a week were studied in greater detail, it was found that the 46 postmenopausal women who walked more than five miles per week had a mean bone mineral density of 0.94 g cm⁻² compared with a mean of 0.89 g cm⁻² among the nine postmenopausal women who walked less than one mile per week. However, this difference was not statistically significant. The mean bone mineral density was 0.92 g cm⁻² among the 73 postmenopausal women who never indulged in strenuous physical exercise, 0.93 g cm⁻² among the 10 women who exercised once a week and 0.92 g cm⁻² among those 21 women who exer-

Table 1. Bone mineral density in relation to age and menopausal status.^a

Age (years)	Mean bone mineral density (g cm ⁻²) of women who were		
	Premenopausal	Menopausal	Postmenopausal
48 (n = 38)	1.02	0.94	0.96
49 (n = 45)	1.05	0.96	0.89***
50 (n = 50)	1.04	1.00	0.93*
51 (n = 49)	1.00	0.96	0.92
52 (n = 51)	1.03	0.93	0.92*
Total (n = 233)	1.03	0.96	0.92***

n = number of women in group. ^aExcluding women who had had a hysterectomy and/or total oophorectomy, and women on hormone replacement therapy. *P<0.05, ***P<0.001.

cised twice a week or more. Again, the differences were not statistically significant.

In order to establish that the effects of individual risk factors were independent, a multiple regression analysis of all risk factors was undertaken with bone mineral density as the dependent variable. This analysis showed that only menopausal status and body mass index were independently related to bone mineral density. There was also a statistically significant interaction between these two factors ($F = 4.59$, degrees of freedom 2, 227, $P < 0.01$).

Discussion

The study has shown that risk factors for osteoporosis were common in this group of women. However, the relationship of these risk factors with actual bone mineral density measurement in this age group has not been shown to be sufficiently specific to identify those at high risk of developing osteoporosis and subsequent fractures. Similar results were found in a London study published in 1989⁶ and in a Netherlands study published in 1990.⁷

Previous studies have shown that among premenopausal women bone mineral density is similar in smokers and non-smokers, but that some years after the menopause a lower bone mineral density becomes apparent in smokers.⁸⁻¹⁰ This finding was supported by the present study although the present results were not statistically significant. One study has shown the bone mineral density in female twins aged between 27 and 73 years who smoked was significantly lower than their non-smoking twin sisters.¹¹

Exercise programmes have been shown to increase bone mineral density, reversing the normal postmenopausal loss of bone seen in women who do not exercise.¹²⁻¹⁴ Another study has shown that women who exercised at least three times a week had a higher mineral bone density than sedentary women at all ages from 20 to 80 years.¹⁵ The present study showed that the mean bone mineral density of women with sedentary lifestyles was the same as or higher than that of women with a non-sedentary lifestyle in premenopausal, menopausal and postmenopausal subgroups. A possible explanation is that those women who claimed to undertake regular physical exercise were perhaps not estimating their level of activity accurately, which is always a problem with this type of study where there is no corroboration of what subjects report. When more specific details of vigorous activity were asked about (activity which produced breathlessness, perspiration or increased heart rate), far fewer women reported that they undertook physical activity at that level. However, mean bone mineral density of postmenopausal women did show an increase with increasing levels of strenuous activity.

A growing body of controlled trials is indicating the benefits

Table 2. Bone mineral density in relation to risk factors and menopausal status.^a

Risk factor	Mean bone mineral density (g cm ⁻²) of women who were			
	Premenopausal	Menopausal	Postmenopausal	Total
Body mass index				
<20 (n = 12)	0.98	0.98	0.91	0.94
20 and 25 (n = 88)	0.98	0.94	0.90	0.94
>25 (n = 133)	1.08***b	0.97	0.93	0.99**c
Exercise				
Sedentary (n = 65)	1.06	0.99	0.92	0.98
Non-sedentary (n = 168)	1.02	0.95	0.92	0.96
Dairy product content of diet				
Low (n = 26)	0.99	0.91	0.94	0.96
Normal (n = 207)	1.04	0.97	0.92	0.97
Smoking status				
Smoker (n = 72)	1.05	1.00	0.91	0.96
Ex-smoker (n = 31)	1.08	0.96	0.90	0.97
Non-smoker (n = 130)	1.02	0.94	0.93	0.97
Family history of osteoporosis^d				
Yes (n = 46)	1.01	0.94	0.93	0.96
No (n = 163)	1.02	0.96	0.92	0.96
No. of pregnancies				
0 (n = 41)	0.98	0.91	0.92	0.94
1+ (n = 192)	1.04	0.98	0.92	0.98

n = number of women in group. ^aExcluding women who had had a hysterectomy and/or total oophorectomy, and women on hormone replacement therapy. ^bDifference in body mass index among premenopausal women: ***P<0.001. ^cDifference in body mass index among all women: **P<0.01.

^dData not known for 24 patients.

of calcium.^{16,17} Food frequency questionnaires are generally accepted as being inaccurate at estimating calcium intake. For this reason, analysis of diet was limited to reported consumption of dairy products. Although relatively few of the 358 women studied (12%) reported a low intake of dairy products, it was shown to have a deleterious effect on bone mineral density in the premenopausal and menopausal groups of women.

While the shortcomings of subjective assessments of risk factors are recognized, it is clear that decreased bone mineral density and the risk of osteoporotic fractures cannot be predicted accurately from medical and lifestyle risk factors, except for premature menopause, a factor known to put women at high risk of osteoporosis.^{18,19} Single measurements of bone mineral density are not thought to be useful screening tests for predicting future hip fractures or for most vertebral fractures because differences in bone mineral density between people who subsequently have a fracture and those who do not are too small to discriminate between them.²⁰ An alternative way of screening women would be to measure the rate of bone loss by regular screening to identify those who have rapid bone loss. However, there are few studies to show the predictive value of this.²¹ General practice would be the ideal place to carry out such studies but access to bone density measurements is limited and may not be a practical proposition unless ultrasound techniques are validated and become available.

How then do we proceed in general practice with regard to an osteoporosis prevention programme? There are two possible approaches: either to offer all menopausal women hormone replacement therapy or to try to reduce risk factors for osteoporosis in the whole practice population of women, from birth onwards. As it is generally accepted that the position with regard to longterm risks of hormone replacement therapy is not sufficiently clear to recommend that its use should be universal,²² the

population-based approach would appear to be the best option at present. In addition, as the risk of falling (affected by factors such as poor eyesight, poor mobility, cognitive impairment, medication and inadequate facilities) also determines whether an elderly woman suffers a fracture,^{23,24} preventive measures must be addressed in this field.

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