Inadequate dietary calcium intake in elderly patients with hip fractures

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ABSTRACT

Introduction: Calcium supplementation and pharmacotherapy are recommended in the preventive management of osteoporosis. Many previous studies report of underdiagnosis and undertreatment of osteoporosis among elderly patients with hip fractures. We undertook this study to determine the dietary calcium levels in our local elderly population who were admitted with hip fractures.

Methods: 77 patients, between the ages of 60 and 98 years of age, and admitted to our department between January 2001 and September 2001 for hip fractures, were studied. The dietary calcium intakes of these patients were determined by a food frequency questionnaire and a detailed diet history. Bone mineral density (BMD) studies were performed on 55 of these patients to confirm the diagnosis of osteoporosis.

Results: The mean daily calcium intake was found to be 650 mg. Only six of our hip fracture patients (7.8 percent) had a daily calcium intake above the recommended levels of 1,000 mg per day. For the 55 patients who had BMD performed, only one patient had a BMD within the normal range. 34 patients (64.2 percent) had hip T-scores in the osteoporotic range and 18 patients (33.9 percent) had hip T-scores in the osteopenic range. We found that the patients with BMD in the osteoporotic and osteopenic ranges had no significant difference in the dietary calcium intake.

Conclusion: The dietary calcium intake of our elderly patients with hip fractures is insufficient. They would benefit from dietary education and calcium supplements to prevent deterioration in bone density and subsequent osteoporotic fractures.

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INTRODUCTION

Osteoporosis is a disabling condition that is of particular importance in ageing Asian communities. Both calcium supplementation and pharmacotherapy are recommended in the preventive management of osteoporosis.[1] Many studies report of under-diagnosis and under-treatment of osteoporosis among elderly hip fracture patients.[2,3] The current recommended daily intake of calcium for these patients is 1,200 mg/day based on the US guidelines[4,5] and 1,000 mg/day based on the Singapore recommended dietary allowance.[6] We undertook this study to determine the daily dietary intake of calcium of elderly patients, and correlate the calcium intake of these patients with their bone mineral density (BMD) studies.

METHODS

Between May 2001 and September 2001, all patients with hip fractures, aged 60 years and older, and admitted to our hospital with proximal femur fracture, were enrolled into our study. Patients with a pathological fracture secondary to metastasis, as well as patients with dementia and unable to participate in our interview process, were excluded. We recruited 77 patients of both genders, who were older than 60 years of age and who were presented with a radiological diagnosis of neck of femur, intertrochanteric or subtrochanteric fracture. With the assistance of our dietetic department, the daily dietary intakes of these patients were determined by a Food Frequency Questionnaire (FFQ) and a detailed diet history. The FFQ is a questionnaire documenting consumption of 37 food items, such as dairy products, seafood, meat, vegetables and desserts, with the portions of individual food types specified (Appendix I). The detailed diet history records the frequency of food consumption to obtain a 24-hour record of daily food intake. Both the questionnaire and diet history were conducted by the dieticians as an interview process.

With the assistance of the software Dietplan 6, developed by University of Salford and used by all United Kingdom National Health Services Hospitals, the nutrient values of different types of food were

used to estimate each patient's calorie consumption and daily dietary intake of calcium. BMD studies (where possible) were performed on these patients to determine the bone density of these patients. BMD studies were performed on 52 patients who agreed to have the investigation performed, or who were fit enough to have the BMD studies performed. Statistical analysis was carried out with the Statistical Package for Social Sciences version 12.0 (SPSS Inc, Chicago, IL, USA). The various clinical predictors of inpatients hospital costs were studied.

RESULTS

We studied 77 patients between the ages of 60 years and 98 years, with a mean age of 77.9 years. We had 58 females (75.3%) and 19 males (24.7%). The patients consisted of 63 Chinese (81.8%), 10 Malay (13%), three Indian (3.9%) and one (1.3%) Eurasian. 41 (53%) patients and 36 (47%) patients were admitted for intertrochanteric fractures and neck of femur fractures, respectively. The mean daily calcium intake was found to be 650 mg. The lowest daily intake was 199.8 mg/day and the highest daily calcium intake was 1,351.3 mg. Only six of our hip-fracture patients (7.8%) had a daily calcium intake above our local recommended level of 1,000 mg/day. 25 of our patients (32.5%) had a daily calcium intake of less than 500 mg/day. The breakdown of calcium intake of our patients is shown in Fig. 1.

We studied the various possible predictors of low calcium intake, such as age, gender, ethnic group and calorie intake. We did not find a correlation between age and calcium intake. We found that our male patients had a mean daily calcium intake of 599 mg/day and female patients had a mean daily calcium intake of 665 mg/day. This difference in dietary calcium intake between the genders was not found to be statistically significant. We did not find a significant correlation between a low calorie intake and low calcium intake. Our Chinese patients had the lowest mean calcium and calorie intake of all the ethnic groups. This difference was found to be statistically significant when compared to patients of other ethnic backgrounds ($p = 0.03$). The breakdown of calcium intake and calorie intake among the various ethnic groups are shown in Table I.

52 of these hip fracture patients had BMD studies performed. The remaining had either declined, or were unfit for the BMD studies to be performed. Based on the WHO criteria for BMD scores, we found that in our cohort of 52 patients with BMD studies performed, 18 (35%) patients had hip T-scores in the osteopenic range, and 34 (65%) patients had hip T-scores in the osteoporotic range (Fig. 2). Both these groups of patients had similar daily dietary oral calcium intake of 660 mg/day, with no significant differences between the two groups. In addition, we also found that in our 52 hip fracture patients with bone densitometry performed, the diagnosis of osteoporosis varied according to

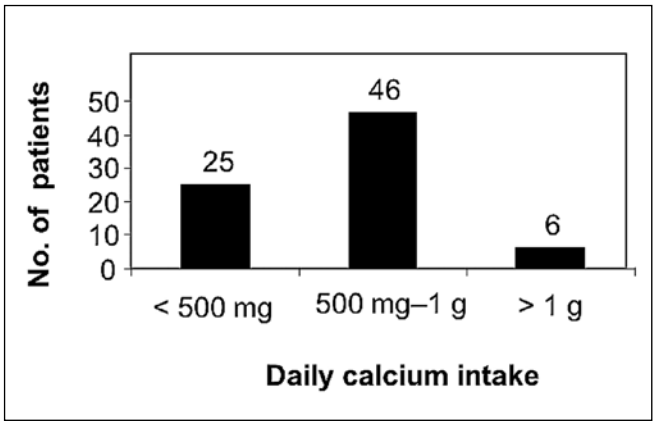

Fig. 1 Bar chart shows breakdown of calcium intake of our patients.

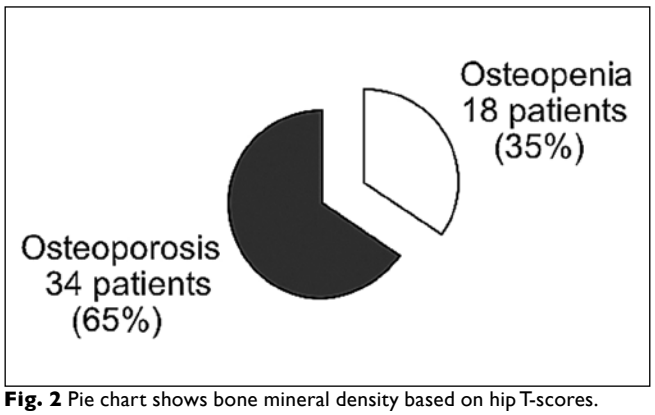

Fig. 2 Pie chart shows bone mineral density based on hip T-scores.

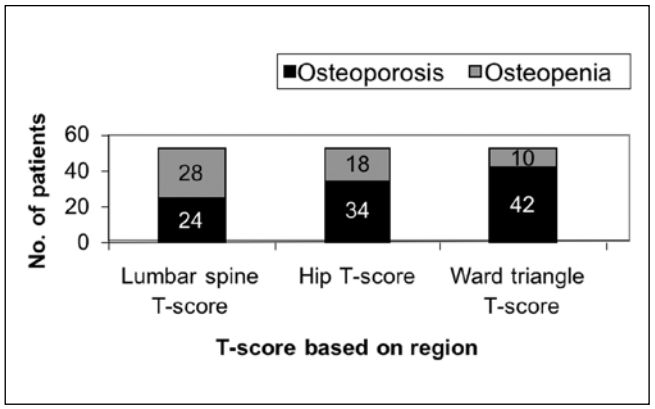

Fig. 3 Bar chart shows comparison of bone mineral density according to region.

Table I. Ethnic breakdown of our study population with mean calcium and calorie intakes.

Ethnic group	No. of patients (%)	Mean calcium intake (g)	Mean calorie intake (kCal)
Chinese	63 (81.8)	609.3	1,324
Malay	10 (13)	835.0	1,565
Indian	3 (3.9)	901.6	1,555
Eurasian	1 (1.3)	575.0	1,986

the site studies. Our cohort of 52 patients had three sites—lumbar vertebra, hip and Wards triangle—studied. We found that osteoporosis was diagnosed in 81% of patients if the Wards triangle T-score was used, 65% of patients if the hip T-score was used, and only 46% if the lumbar vertebra T-score was used. The comparison of bone density according to the region is shown in Fig. 3.

DISCUSSION

The population-based study in 1979 by Matkovic et al revealed that the community that had a substantially higher calcium intake also had greater bone mass and fewer femoral fractures.[7] Kanis found that calcium supplements in excess of 1 g daily have been found to slow the rate of bone loss in postmenopausal women and decrease that the risk of hip fractures.[8] Dawson-Hughes et al found that dietary supplementation with calcium and vitamin D reduced bone loss over a three-year study period, and reduced the incidence of non-vertebral fractures.[9,10] The Cochrane Database System review in 2004, by Shea et al, of 15 trials representing 1,806 participants, showed that calcium was more effective than a placebo in reducing total bone loss after two or more years of treatment.[11]

In the Asian context, Ho et al found that a high dietary calcium intake exceeding 900 mg/day had a beneficial effect in preventing bone loss in Asian postmenopausal women.[12] From these various sources, the evidence for adequate dietary calcium intake, as well as the value of calcium supplementation, in the prevention of bone mass loss and osteoporotic fractures have been established. Physiologically, in the later decades of life, calcium absorption is impaired. When oral calcium intake is lower than the recommended levels, the skeleton is "mined" for calcium to ensure adequate serum calcium levels for homeostatic functions.[13] In the animal study using rats, Chen et al showed that in rats with low dietary calcium intake, the whole body BMD, femoral weight and femoral trabacular bone decreased when compared to rats with normal calcium intake.[14]

It has also been shown that the Asian diet, especially in the elderly, is low in calcium. A study published in 2004 found that an elderly Thai rural population had a mean daily calcium intake of 236 mg/day.[15] The mean daily oral calcium intake of our patients was approximately 650 mg/day. The higher mean daily calcium intake in our patients can be attributed to our study population being an urban, city population, as compared to the Thai study, which was based on a rural population. Nevertheless, 93% of our patients with hip fractures still have a daily calcium intake lower than the recommended daily calcium intake. In addition, our daily calcium intake is still lower than figures quoted in Western literature: mean calcium intake of between 655 mg/day and 735 mg/day, depending on gender and race.[16] This is likely attributable to the higher amounts of dairy products that are consumed in the Western diets, compared to Asian diets. We have also found that even among our Asian study cohort, there is a variation between the races, with the Chinese having a significantly lower oral calcium intake in their diet.

98% of patients who had a BMD done, had a low BMD T-score of less than -1, i.e. in the osteopenic or osteoporotic range. McCabe et al[16] and Illich et al[17] reported a significant relationship between dietary calcium and bone density. We did not establish such a relationship between patients' present dietary calcium intake with their BMD results. However, based on their BMD results, it is still imperative for all hip fracture patients to receive dietary counselling and be started on calcium supplementation. Interestingly, in our cohort of patients treated for osteoporotic hip fractures, our comparison of BMD findings at the three regions suggests that the use of hip T-scores, when compared to T-scores in the Wards triangle, would underdiagnose patients with osteoporosis. This corroborates with previous findings, such as the one by Varney et al, which reported that the classification of osteoporosis and osteopenia in postmenopausal women is dependent on site-specific analysis.[18]

Finally, it has also been shown that patients, after sustaining osteoporotic fractures, do increase their calcium and dairy intake as recommended by their primary physicians as part of the treatment plan.[19] As such, in the face of a growing ageing population, orthopaedic surgeons are well positioned in primary preventive care by initiating calcium and anti-resorptive therapy to prevent further deterioration in bone density. In conclusion, 98% of our patients admitted with hip fractures had a lower than recommended daily calcium intake. 98% of patients had a low BMD score of less than -1. We found that our Chinese patients had a significantly lower dietary calcium intake, when

compared to patients from other ethnic groups. Based on BMD findings, all hip fracture patients would benefit from dietary education and calcium supplements to prevent deterioration in bone density and subsequent osteoporotic fractures.

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APPENDIX I. Food frequency questionnaire conducted on all patients in the study to determine their daily dietary intake.

Name:_____ Phone:_____ IC:_____

Part A

Food item	Portion	Number of times eaten			
		Per day	Per week	Per month	Never or rarely
Milk and milk products					
1. Condensed/evaporated milk	1 dessertspoon (D1)				
2. Powdered milk	1 glass(G1)/mug (M1)				
3. Carton milk(fresh/reconstituted milk)	1 glass(G1)/mug (M1)				
4. Cheese slices	1 slice (F1)				
5. Bandung	1 glass(G3)				
6. Horlicks/Ovaltine or Milo	1 mug (M1)				
7. Ice-cream or yoghurt drinks	2 scoops of ice-cream (S1)/ 1 pack				
Beancurd					
8. Tauhu goreng	1 usual food court serving				
9. All types of beancurd (e.g.taukwa, tauhoo, tauhuay, etc.)	1 square(F2) or 1 bowl (B4)				
10. All types of soya bean drinks	1 glass(G2)				
Fish and seafood					
11. Ikan bilis	1 dessertspoon (D1)				
12. Tinned fish (e.g. sardines and salmon)	1 dessertspoon (D1)				
13. Shrimps or prawns/crabs	2 prawns(F3) or 4 shrimps or 1 dessertspoon of crab meat (D1)				
14. Sotong	1 piece (F4)				
15. All other fish	2 small fish (F5) or 1 fillet (F6)				
Rice					
16. Fried rice with eggs	1 rice bowl (B1) or plate(P1)				
17. All other rice	1 rice bowl (B1) or plate(P1)				
Noodles					
18. Fried noodles, mee rebus, kway chap or laksa	1 usual food court serving				
19. All other noodles (dry/soup) or instant noodles	1 usual food court serving				
Meat/poultry					
20. Meat/poultry eaten curried style	3 small pieces				
21. Meat/poultry eaten tandoori style	3 small pieces				
22. All other meat/poultry	1 palm-sized piece (F7/F8/F9)				
Green leafy vegetables					
23. Dark green types (e.g kai lan, spinach (bayam), chye sim, broccoli or watercress)	1 heaped serving spoon (S2)				
24. Pale green types (e.g. common cabbage, cauliflower, beansprouts or lettuce,)	1 heaped serving spoon (S2)				
Desserts					
25. Chendol/ice kachang/red bean soup/ green bean/tau suan.	1 usual food court serving				
26. Bubor chacha, cheng teng, ice jelly	1 usual food court serving				
27. Beans (eg. red kidney bean, soya beans, chickpeas, dahl, baked beans) exclude beans not eaten as dessert	1 dessertspoon (D1)				
28. Nuts (e.g. peanuts, mixed nuts, cashew nuts, almonds)	half a bowl (F10)				
29. Red bean bun, curry puff, kaya bun, yam cake, assorted kueh, popiah	1 piece				
Desserts					
30. Prawn crackers	1 packet (60 g) (F11)				
31. Fried mashed carrot cake with eggs	1 plate (P1)				
32. Cakes	1 piece (F12)				
Fast foods					
33. McDonald's Big Mac, Egg McMuffin, Sausage McMuffin, or Burger King Whopper burger with cheese	1 sandwich				
34. Burger King Cheeseburger, Junior Whopper burger with cheese or McDonald's Cheeseburger	1 sandwich				
35. McDonald's Fillet-O-Fish, Hamburger or Burger King Whopper burger	1 sandwich				
36. Pizza	1 slice				
Eggs					
37. All eggs (but not those already included in the above fast foods, fried mashed carrot cake and fried rice)	1 whole egg				