Osteoporos Int (2000) 11:460–466

Osteoporosis International

Original Article

Deterioration in Quality of Life Following Hip Fracture: A Prospective Study

A. G. Randell[1], T. V. Nguyen[1*], N. Bhalerao[1], S. L. Silverman[2], P. N. Sambrook[3] and J. A. Eisman[1]

[1]Bone and Mineral Research Program, Garvan Institute of Medical Research, St Vincent's Hospital, Sydney, Australia; [2]University of California Los Angeles, School of Medicine, Los Angeles, California, USA; [3]Department of Rheumatology, University of Sydney, Royal North Shore Hospital, Sydney, Australia

Abstract. To examine longitudinal change in health-related quality of life (HRQoL) following hip fracture in elderly subjects, 32 patients with hip fractures and 29 sex-matched non-fracture control subjects (mean ± SD age 82 ± 8 and 86 ± 6 years respectively) were enrolled in a prospective, case–control study. Fracture subjects completed a generic questionnaire, Short Form 36 (SF-36), and a disease-targeted measure, the revised Osteoporosis Assessment Questionnaire (OPAQ2), on two separate occasions, within 1 week of fracture and 12–15 weeks after fracture. Controls completed both questionnaires on two occasions 12 weeks apart. SF-36 scores were significantly correlated with OPAQ2 in comparable domains of Physical Function (r = 0.76), General Health (r = 0.70) and Mental Health/Tension (r = 0.86). Control subjects had stable scores with the OPAQ2 and SF-36. At 3 months after fracture there was a significant reduction in HRQoL in the SF-36 domains Physical Function (–51%), Vitality (–24%) and Social Function (–26%) and in the OPAQ2 domains Physical Function (–20%), Social Activity (–49%) and General Health (–24%). Hip fracture patients thus had a lower baseline HRQoL and experienced a significant deterioration in HRQoL after hip fracture on both the SF-36 and OPAQ2. HRQoL should be part of a comprehensive assessment of the costs of osteoporosis including fracture-associated morbidity.

Keywords: Hip fracture; Morbidity; Osteoporosis; Quality of life

Introduction

Hip fracture is perhaps the most dramatic consequence of osteoporosis in the elderly, as it is associated with excess mortality of 5–20% [1,2] and morbidity that usually results in costly hospital and lengthy rehabilitation procedures [3] in which quality of life (QoL) may be affected. However, the impact of hip fractures on QoL is not well established, even though it is believed that physical, psychological and social functions are affected to varying degrees [4,5]. Past studies on vertebral fracture subjects [6–8] have demonstrated lower QoL than in nonfracture subjects; however, the magnitude of change before and after hip fracture is unclear and can only be addressed by longitudinal studies.

QoL is a multidimensional variable, reflecting physical, social and psychological wellbeing, which is influenced by political, cultural, economic and spiritual viewpoints. Health-related QoL (HRQoL) questionnaires aim to assess changes in QoL incurred as a result of illness or treatment. Issues relating to validity, reliability and responsiveness of HRQoL measures remain to be investigated.

Recently a number of osteoporosis-targeted questionnaires have been developed to assess HRQoL changes resulting from this disease [9,10]. The Osteoporosis Quality of Life Questionnaire (OQLQ) [11] was developed to assess the HRQoL of women with vertebral fractures resulting from osteoporosis. The

*Present address: Wright State University School of Medicine, Dayton, Ohio, USA.

Correspondence and offprint requests to: A. Randell, Bone and Mineral Research Program, Garvan Institute of Medical Research, 384 Victoria Street, Darlinghurst, Sydney NSW 2010 Australia. Tel: +612 9295 8246. Fax: +612 9295 8241.

Osteoporosis Functional Disability Questionnaire (OFDQ) was developed to assess disability and pain among patients with vertebral fractures due to osteoporosis. It has been shown to be reliable, however, its validity has not been tested outside a rehabilitation intervention trial [12]. Recently the Quality of Life Questionnaire of the European Foundation for Osteoporosis (QualEFFO) [13] has been developed to assess HRQoL in European patients with established vertebral osteoporosis. This questionnaire is currently undergoing extensive reliability and validity testing. Finally, the Osteoporosis Assessment Questionnaire (OPAQ2) [14] is a comprehensive disease-targeted questionnaire based on the Arthritis Impact Measurement Scales Health Status Questionnaire 2 (AIMS2) [15] that has good reliability and internal consistency [16].

Since the OPAQ2 was designed to assess HRQoL in all types of osteoporotic patients, it was selected to assess the change in HRQoL following hip fracture in the present study. The SF-36 questionnaire is a generic questionnaire that has been comprehensively verified [17]. It has been employed to compare subjects both within and across diseases and has gained widespread use over recent years due to its practicality with respect to reduced respondent burden (much shorter to complete than past generic questionnaires) and reduced administrative burden (can be self-administered in most circumstances). It is widely used in general population studies, clinical trials and methodologic studies.

The aims of the present study were to (i) assess changes in HRQoL following hip fracture using both the SF-36 and OPAQ2 questionnaires, and (ii) compare the sensitivity between the two questionnaires in fracture subjects.

Materials and Methods

Subjects

Thirty-two hip fracture patients were recruited from two public hospitals in the Sydney metropolitan area. Inclusion criteria included low-trauma hip fracture, either sex, and date of birth prior to 1935. Exclusion criteria included language or cognitive difficulties and hip fracture due to metastatic cancer or major trauma (e.g., motor vehicle accidents). History of previous fractures, concomitant conditions and smoking status were identified from hospital records. Coexisting conditions were grouped into major (arthritis, back problems, cancer, stroke, heart disease and diabetes) and minor (asthma or hypertension) categories as suggested by the National Health Survey [18], reflecting the degree to which the coexisting condition has been demonstrated to affect HRQoL profiles. All patients completed both the SF-36 and OPAQ2 within 1 week of their admission and again at 12–15 weeks after fracture. For baseline data, patients were asked to provide information about their HRQoL prior to their fractures. The same trained interviewer administered the questionnaires and the order of their delivery was randomized. All patients were born prior to 1935 and only those capable of giving informed consent were invited to participate. Three fracture patients did not complete questionnaires at 3 month follow-up due respectively to death (1), lack of interest (1) and no forwarding address (1). The first patient was assigned the lowest possible score. The other 2 patients were omitted from follow-up analysis [19]. This study was approved by the St Vincent's Hospital Ethics Committee.

Twenty nine control subjects of similar age (matched within four years of date of birth) to fracture patients and matched for sex were selected from participants in the Dubbo Osteoporosis Epidemiology Study (DOES) [20]. All control subjects completed the SF-36 and OPAQ2 questionnaires at baseline and were followed up 3 months later. Two trained nurses administered the questionnaires. Subjects with cognitive or language difficulties were excluded and information concerning previous fractures, current coexisting conditions and smoking status were recoded at baseline. Two control subjects did not complete the questionnaire due to lack of a forwarding address.

Questionnaires

The SF-36 questionnaire comprises 36 questions (referred to as items); each item has between two and six response options, assessing eight distinct health concepts or domains (Table 1). One additional item measures self-reported health transition. The SF-36 has been found to be reliable by both self-administration and interview techniques, and takes about 5–15 min to complete.

The OPAQ2 is a revised version of OPAQ, a novel disease-targeted questionnaire designed to assess HRQoL in all types of osteoporotic patients. OPAQ2 comprises 67 items, grouped into 14 different health state scales (Table 1). Each health scale comprises between one and seven items with five response options (Likert scales: e.g., 0 = 'all days' to 4 = 'no days'). The 14 scales can be grouped into seven meaningful health domains for scoring purposes [16]. Internal consistency as assessed by Cronbach's alpha for OPAQ ranged between 0.72 and 0.92 [16]. The OPAQ2 can be administered using either interview or self-administered techniques, with most elderly people requiring 20–30 min to answer all questions.

Statistical Analysis

Statistical analysis began with the following reduction of data. For the SF-36, items within each domain were coded, scored and summed to derive the seven different domains, then transformed into a 1–100 scale where 0 indicated the worst possible HRQoL and 100, the best [17]. For the OPAQ2, responses were standardised into identical units and ranges (0–100), then classified into

Table 1. Domains and scales within SF-36 and OPAQ2

SF-36		OPAQ2	
		HEALTH DOMAINS	
Physical Function	(10)[a]	**Physical**	
		Walking/bending	(7)
		Standing/sitting	(3)
		Dressing/reaching	(3)
		Household tasks	(4)
		Transfers	(4)
Role Physical	(4)[a]	*Work*	(1)
		Symptoms	
Bodily Pain	(2)[a]	*Back pain*	(4)
Vitality	(4)[a]	*Fatigue*	(2)
General Health	(5)[a]	*General health*	(1)
		Social Support	(2)
Social Function	(2)[a]	**Social Activity**	(3)
		Psychological	
		Fear of falls	(5)
		Independence	(3)
Role Emotional	(3)	**Body Image**	(3)
Mental Health	(5)[a]	**Tension**	(5)
		OTHER DOMAINS	
Health Transition	(1)[a]	*Health transition*	(1)
		Overall transition	(1)
		Overall QoL	(1)
		Reasons for QoL change	(1)
		Current living situation	(1)
		SUMMARY SCORES	
8 independent scores		7 dependent scores	Total score

Domains are **bolded** and subscales *italicized*. The number of items in each domain or subscale is shown in parentheses.
For ease of comparison in this and other tables and figures, SF-36 and OPAQ2 domain scores are displayed in order, according to their ability to discriminate physical morbidity (Physical Function, Role Physical and Bodily Pain) through to psychological morbidity (Social Function, Role Emotional and Mental). The General Health and Vitality domains are displayed centrally as they correlate moderately with both Physical and Psychological domains in earlier studies.
Scoring for both questionnaires involved unweighted sum of items in domains, transformed to 0–100 range. The higher the score the better the HRQoL.
[a]Items which address similar domains in SF-36 and OPAQ2.

the seven domains. As domain scores are ordinal, a rank correlation method (Spearman's) was used to determine the relationship between SF-36 and OPAQ2 domains recorded by fracture patients at baseline.

Fracture and nonfracture groups were compared at baseline for each SF-36 and OPAQ2 domain using Student's unpaired *t*-tests. Within each group, the change between baseline and follow-up was tested by the Student's paired *t*-test.

To assess the sensitivity of the two questionnaires, a standardized response mean (SRM) [21] was calculated for each domain, as the mean change in score divided by its standard deviation. A higher SRM indicates greater change relative to its variability. Confidence intervals for SRMs were calculated using the jackknife technique described by Liang et al. [21].

Statistical issues concerning missing data in longitudinal studies involving multiple follow-up points have not been adequately addressed in the literature. When non-collection of follow-up data is unrelated to the subject's HRQoL (e.g., no forwarding address), it is reasonable for the data to be considered 'missing at random', and thus the subject omitted from follow-up analysis [19]. However, when missing data results from death or disease progression, it should be classified 'nonrandomly missing' and ideally assessed to reduce potential positive bias in HRQoL. Standard protocol for nonrandom missing data is not well established. In this study, of the 12 missing data points, 11 were classified as randomly missing and these subjects were omitted from follow-up analysis. The nonrandom missing data point was due to death following fracture and this subject was assigned the lowest possible score across all domains.

All statistical analyses were performed using the Statistical Analysis System (SAS/STAT user's guides, SAS Institute, Cary, NC).

Results

Subjects

The 32 hip fracture patients who volunteered to participate were 69% (n = 22) female, had a length of hospital stay of 14 ± 7 days (mean ± SD) and were aged 82 ± 8 years at the time of fracture. Control subjects were 72% female (n = 21) and on average 4 years older than their fracture counterparts (mean age 86 ± 6 years) (Table 2). OPAQ2 self-rated health questions found that 68% of fracture patients reported their health prior to fracture as good or better, and 62% reported no change in health during the previous 12 months. In contrast, 96% of control subjects rated their current health as good and 63% reported no change in health during the previous 12 months. At baseline, mean scores reported by fracture patients were lower than controls for all domains in both the SF-36 and OPAQ2 (Fig. 1). These differences were statistically significant in all domains,

Table 2. Physical and lifestyle characteristics of control subjects recruited from DOES

	Fracture patients (n = 32)	Control subjects (n = 29)
Women (%)	22 (69)	21 (72)
Mean age ± SD in years (range)	82 ± 8 (68–97)	86 ± 6 (68–98)
% with previous fractures	28	18
% with serious coexisting conditions[a]	59	59
% with moderate coexisting conditions[b]	28	30
% currently smoking	20	–
General health (% subjects responding 'good' or better)	68	96
Health transition over past 12 months (% subjects responding 'no change')	62	63

DOES, Dubbo Osteoporosis Epidemiology Study, Australia.
[a]Arthritis, back problems, cancer, stroke, heart disease or diabetes.
[b]Asthma or hypertension.

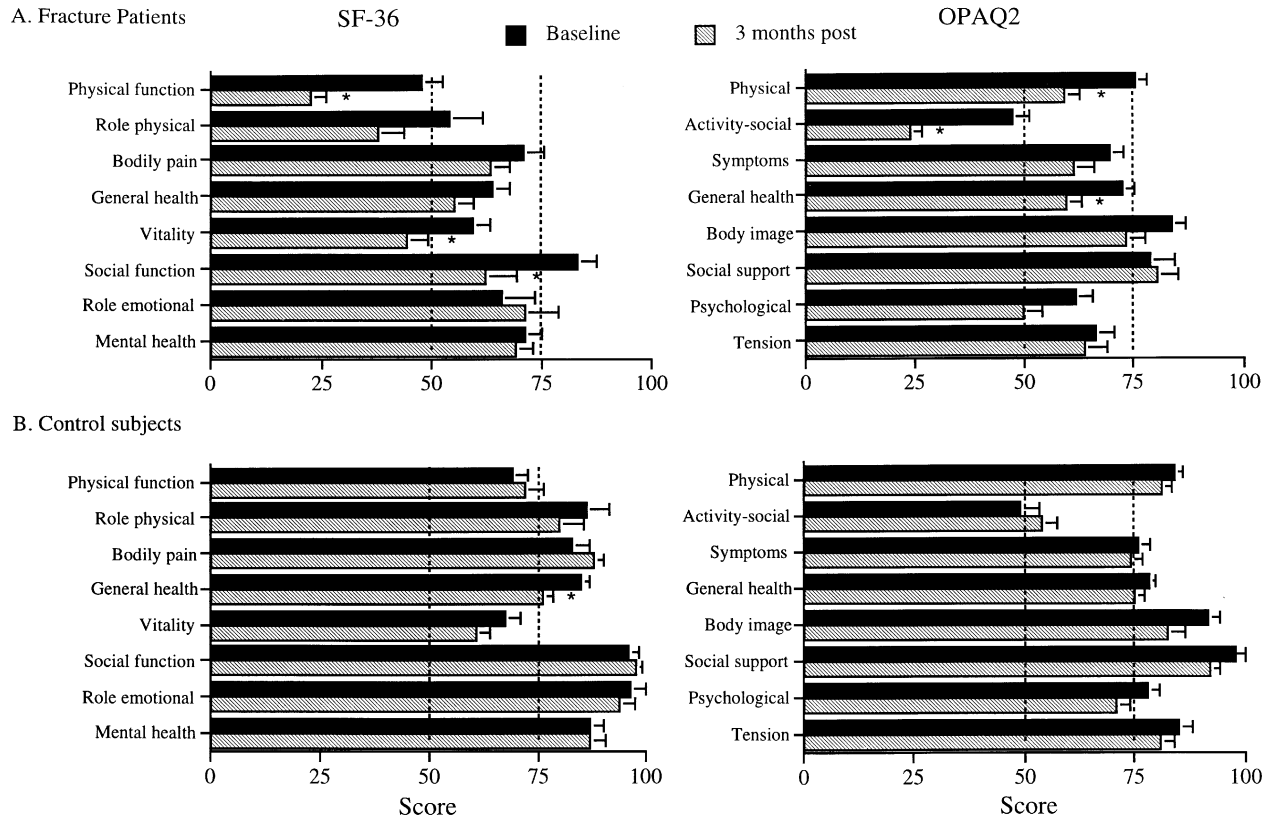

Fig. 1. Mean absolute SF-36 and OPAQ2 scores at baseline and 3 months after hip fracture, reported by fracture patients (**A**) and controls (**B**). *$p < 0.05$ between baseline and the 3 month assessment.

Table 3. Correlation between SF-36 and OPAQ2 domains and health scales

	SF-36 Physical			SF-36 General health		SF-36 Psychological		
	Physical Function	Role Physical	Bodily Pain	General Health	Vitality	Social Function	Role Emotional	Mental Health
OPAQ2								
Physical	**0.76**[c]	**0.51**[c]	**0.58**[c]	0.47[b]	**0.61**[c]	**0.49**[c]	**0.53**[c]	**0.61**[c]
Social Activity	**0.60**[c]	0.14	0.17	0.12	0.18	0.24[a]	0.06	0.26[a]
Symptoms	0.31[a]	**0.47**[c]	**0.63**[c]	0.38[b]	**0.58**[c]	0.30[b]	**0.53**[c]	**0.64**[c]
General Health	**0.51**[c]	0.37[b]	**0.54**[c]	**0.70**[c]	0.36[b]	0.21	0.28[a]	**0.43**[c]
Body Image	0.19	**0.44**[c]	0.36[b]	0.23	**0.55**[c]	0.29[a]	0.17	0.29[a]
Social Support	0.13	0.13	0.08	–0.00	0.10	0.18	0.34[b]	0.19
Psychological	**0.62**[c]	**0.50**[c]	**0.41**[c]	0.30[a]	**0.64**[c]	0.39[b]	**0.53**[c]	**0.59**[c]
Tension	0.34[b]	**0.51**[c]	**0.50**[c]	**0.43**[c]	**0.53**[c]	0.34[b]	**0.69**[c]	**0.86**[c]

[a]$0.01 < p < 0.05$; [b]$0.001 < p < 0.01$; [c]$\boldsymbol{p} < 0.001$ (highly significant and displayed in **bold**).
Values are correlation coefficients (Spearman's rank correlation).

except for SF-36 Body Pain and Vitality and OPAQ2 Social Activity, Symptoms, General Health and Body Image.

Relationship Between the SF-36 and OPAQ2

At baseline, the SF-36 domains such as Physical Function, Role Physical and Bodily Pain were all significantly correlated with OPAQ2 Physical ($r = 0.76$, 0.51 and 0.58, respectively; Table 3). These SF-36 physical domains also demonstrated moderate to strong correlation with OPAQ2 General Health, Psychological and Tension (0.34–0.62). SF-36 General Health correlated well with OPAQ2 General Health ($r = 0.70$). SF-36 Vitality was correlated with all OPAQ2 domains except Social Activity and Social Support (0.36–0.64). SF-36 psychological domains (Social Function, Role Emotional and Mental Health) correlated with OPAQ2 Psychological and Level of Tension (0.34–0.86). SF-36 Role

Emotional and Mental Health also had significant correlations with OPAQ2 Physical and Symptoms (0.53–0.64). Correlations between the SF-36 and OPAQ2 for control subjects were generally weaker than for fracture patients (range: $r = -0.15$ to 0.73).

Changes in HRQoL Following Hip Fracture

Among hip fracture patients there was a significant reduction in Physical Function (51%; $p < 0.0003$), Vitality (24%; $p < 0.02$) and Social Function (26%; $p < 0.01$) (as assessed by the SF-36) at 3 months after fracture (Fig. 1A). In this group of patients, significant decreases in Physical (20%; $p < 0.001$), Social Activity (49%; $p < 0.0001$) and General Health (24%; $p < 0.01$) were also observed using the OPAQ2 (Fig. 1A). In addition, the OPAQ2 recorded decreases for domains Body Image (11%), Psychological (17%) and Symptoms (10%), with the decreases reported in the former two domains approaching significance ($p = 0.06$ and $p = 0.07$, respectively). These changes were unaffected when the deceased patient was excluded from the analyses. Among the controls, no significant differences were reported between the baseline and 3 month data (Fig. 1B), with the exception of SF-36 General Health (11% decrease; $p < 0.01$). Compared with the controls, hip fracture subjects experienced significantly greater reduction in physical and social areas (by both the SF-36 and OPAQ2).

Sensitivity of the SF-36 and OPAQ2

With respect to the magnitude of size effects, SRM coefficients of 0.2 are considered small, 0.5 moderate and 0.8 or greater, large [22]. Among fracture subjects, moderate to large size effects were demonstrated for SF-36's Physical Function and OPAQ2's Physical (–0.72 and –0.80, respectively; Table 4). However, for Social Function the SF-36 score was less sensitive than the OPAQ2's Social Activity. In other domains, such as pain and psychological domains, no significant difference between the two questionnaires was found. Variances in SRMs estimated with the jackknife method indicated considerable overlapping of 95% confidence intervals across comparable domains (Table 4).

Discussion

Osteoporosis, with its ultimate consequence of fracture, is not surprisingly associated with a deterioration in role functioning and physical ability [23]. However, the psychological consequences of hip fracture have not been well established. This study suggests that subjects with hip fracture experience a significant deterioration in general health, psychological wellbeing and body image, in addition to impaired physical and social functioning.

Following hip fracture, significant decreases in HRQoL were reported across domains relating to physical and social functions, and OPAQ2 General Health, Body Image and Psychological domains. The strong correlation established between Physical Function and Social Activity scores ($r = 0.6$, $p < 0.001$; see Table 3) suggests that declines in body function may contribute to increased social isolation. Physical limitations resulting from fracture may well restrict social activity but decreased physical function may also contribute to lower self-esteem (Psychological) and hence poorer perception of Body Image, which in turn may result in a reduced desire to be seen in public. Control subjects demonstrated little change over a 3 month period (with the exception of SF-36 General Health, where HRQoL decreased significantly).

To our knowledge this is the first report of body image changes in patients with hip fracture. Additionally, the perception of significantly decreased General Health shown by the OPAQ2 ($p = 0.01$; Fig. 1) with the known morbidity and mortality of hip fracture is noteworthy.

Table 4. Quality of life changes assessed by SF-36 and OPAQ2

Domain	Pre-fracture score[a]	Post-fracture score[a]	Change in scores[a]	Standardized response mean[b]
Physical				
SF-36 (Physical Function)	45.5 ± 29.4	22.5 ± 19.7	–23.0 ± 32.0	–0.72 [–1.11, –0.18]
OPAQ2 (Physical)	74.6 ± 18.3	59.9 ± 19.0	–14.7 ± 18.3	–0.80 [–1.23, –0.35]
Pain				
SF-36 (Bodily Pain)	74.9 ± 26.8	68.7 ± 26.9	–6.2 ± 29.1	–0.21 [–0.43, 0.20]
OPAQ2 (Back Pain)	70.2 ± 27.3	65.0 ± 32.9	–5.2 ± 27.7	–0.19 [–0.43, 0.23]
Social				
SF-36 (Social Function)	83.8 ± 24.4	62.1 ± 40.1	–21.7 ± 37.7	–0.57 [–0.91, –0.20]
OPAQ2 (Social Activity)	46.4 ± 23.2	23.9 ± 15.1	–22.5 ± 21.8	–1.03 [–1.54, –0.33]
Psychological				
SF-36 (Mental Health)	70.5 ± 22.8	68.8 ± 24.0	–1.7 ± 18.4	–0.09 [–0.22, 0.27]
OPAQ2 (Tension)	65.2 ± 25.2	63.7 ± 28.5	–1.5 ± 24.8	–0.06 [–0.22, 0.34]

[a]Values are shown as means and standard deviations.
[b]Standardized response means, calculated as the mean change divided by its standard deviation, are shown with 95% confidence intervals in brackets.

The present findings imply that HRQoL can and should be assessed as an efficacy endpoint, along with established clinical endpoints in antifracture clinical trials.

Several studies have assessed the effect of hip fracture on functional status, [5] but most focus on identifying predictors of functional recovery after hip fracture [4,24,25]. None of these studies employed comprehensive generic SF-36 or disease-targeted questionnaires such as the OPAQ2 to assess functional recovery, and few used control groups. These studies report significant decreases in physical function (most commonly assessed through Activities of Daily Living (ADL) and Instrumental Activities of Daily Living) [5] and social function after hip fracture, supporting the findings of the present study. Wolinsky et al. [5] demonstrated that following hip fracture, subjects recorded a significantly increased number of difficulties in both basic ADL and household ADL. The HRQoL questionnaires used in this study validated these findings. In the OPAQ2, changes in physical function were mirrored by changes in Dressing/Reaching and Household Tasks, and social function by changes in Social Support and Social Activity. This is consistent with other studies, which have found that psychological factors have an impact on hip fracture recovery [26].

Similar SRMs to those demonstrated in this study have also been reported in previous studies [21,27,28] comparing size effects before and after knee and hip arthroplasty. Little difference was found between the sensitivity of short and long form questionnaires across various domains in these studies.

The SF-36 and OPAQ2 questionnaires selected for use in this study provide a comprehensive range of data from which to assess the impact of hip fracture on all domains encompassing HRQoL. Both questionnaires have a low respondent burden (in particular the SF-36) and are easy to administer and score. Such questionnaires may be more desirable than previously used methodologies that employ several specific tools targeting individual health domains. Additionally, although longer, the disease-targeted OPAQ2 appears to be more sensitive than the SF-36 when assessing osteoporotic hip fracture patients for social function.

Some potential limitations should be taken into account in interpreting the present findings. Although the study was longitudinal, the baseline assessment was made 1 week after fracture with patients asked to assess their 'pre-fracture' status. Secondly, the study was based on a relatively small number of fracture patients, which reduced its ability to discriminate between differences in SRMs. Thirdly, although the controls subjects were selected by date of birth they were 4 years older than the hip fracture patients. It would be expected this would bias against finding a significant difference but, despite their older age, baseline HRQoL was significantly higher than that of hip fracture patients across all domains of both the SF-36 and OPAQ2, suggesting the differences seen are indeed clinically important.

In summary, the present study's results have demonstrated that hip fracture patients in the 12–15 weeks after fracture, experience a rapid and significant deterioration in HRQoL. Both the SF-36 and the OPAQ2 were able to measure these changes. Assessment of the morbidity associated with osteoporotic fractures is essential for both clinicians developing effective treatment strategies and administrators evaluating their cost effectiveness. HRQoL should be part of a comprehensive assessment of the costs of osteoporosis including fracture-associated morbidity.

References

1. White BL, Fisher WD, Laurin CA. Rate of mortality for elderly patients after fracture of the hip in the 1980s. J Bone Joint Surg Am 1987;69:1335–40.
2. Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Survival experience of aged hip fracture patients. Am J Public Health 1989;79:274–8.
3. Randell AG, Sambrook PN, Nguyen TV, et al. Direct clinical and welfare costs of osteoporotic fractures in elderly men and women. Osteoporos Int 1995;5:427–32.
4. Jette AM, Harris BA, Cleary PD, Campion EW. Functional recovery after hip fracture. Arch Phys Med Rehabil 1987;68:735–40.
5. Wolinsky FD, Fitzgerald JF, Stump TE. The effect of hip fracture on mortality, hospitalization, and functional status: a prospective study. Am J Public Health 1997;87:398–403.
6. Leidig-Bruckner G, Minne HW, Schlaich C, et al. Clinical grading of spinal osteoporosis: quality of life components and spinal deformity in women with chronic low back pain and women with vertebral osteoporosis. J Bone Miner Res 1997; 12:663–75.
7. Nevitt M, Ettinger B, Black D, et al. The association of radiographically detected vertebral fractures with back pain and function: a prospective study. Ann Intern Med 1998;128:793–800.
8. Ross PD, Ettinger B, Davis JW, Melton LJ, Wasnich RD. Evaluation of adverse health outcomes associated with vertebral fractures. Osteoporos Int 1991;1:134–40.
9. McDowell I, Newell C. Measuring health: a guide to rating scales and questionnaires. New York: Oxford University Press, 1987:269–311.
10. Greendale GA, Silverman SL, Hays RD, et al. Health-related quality of life in osteoporosis clinical trials. Calcif Tissue Int 1993;53:75–7.
11. Cook DJ, Guyatt GH, Adachi JD, et al. Quality of life issues in women with vertebral fractures due to osteoporosis. Arthritis Rheum 1993;36:750–6.
12. Helmes E, Hodsman A, Lazowski D, et al. A questionnaire to evaluate disability in osteoporotic patients with vertebral compression fractures. J Gerontol 1995;50A:91–8.
13. Lips P, Agnusdei D, Caulin F, et al. The development of a European questionnaire for quality of life in patients with vertebral osteoporosis. Scand J Rheumatol Suppl 1996;103:84–8.
14. Silverman SL, Mason J, Greenwald M. The Osteoporosis Assessment Questionnaire (OPAQ): a reliable and valid self assessment measure of health related quality of life in osteoporosis. J Bone and Miner Res 1993;8:S343.
15. Meenan RF, Mason JH, Anderson JJ, Guccione AA, Kazis LE. AIMS2: the content and properties of a revised and expanded Arthritis Impact Measurement Scales Health Status Questionnaire. Arthritis Rheum 1992;35:1–10.
16. Randell AG, Bhalerao N, Nguyen TV, Sambrook PN, Eisman JA, Silverman SL. Quality of life in osteoporosis: reliability, consistency and validity of the Osteoporosis Assessment Questionnaire. J Rheumatol 1998;25:1171–9.

17. Ware JE, Snow KK, Kosinski MA, Gandek MS. SF-36 Health Survey: manual and interpretation guide. Boston, MA: Nimrod Press, 1993.
18. Australian Bureau of Statistics. National Health Survey: SF-36 population norms. Canberra: Australian Bureau of Statistics, 1995.
19. Fairclough DL, Gelber RD. Quality of life: statistical issues and analysis. In: Spilker B, editor. Quality of life and pharmacoeconomics in clinical trials. Philadelphia: Lippincott-Raven, 1996:427–35.
20. Nguyen TV, Sambrook PN, Kelly PJ, et al. Prediction of osteoporotic fractures by postural instability and bone density. BMJ 1993;307:1111–5.
21. Liang M, Fossel A, Larson M. Comparisons of five health status instruments for orthopedic evaluation. Med Care 1990;28:632–42.
22. Cohen JA. Statistical power analysis for the behavioral sciences. New York: Academic Press, 1977:8.
23. Gold DT. The clinical impact of vertebral fractures: quality of life in women with osteoporosis. Bone 1996;18:S185-9.
24. Koval KJ, Skovron ML, Polatsch D, Aharonoff GB, Zuckerman JD. Dependency after hip fracture in geriatric patients: a study of predictive factors. J Orthop Trauma 1996;10:531–5.
25. Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Predictors of functional recovery one year following hospital discharge for hip fracture: a prospective study. J Gerontol 1990;45:M101–7.
26. Mossey JM, Mutran E, Knott K, Craik R. Determinants of recovery 12 months after hip fracture: the importance of psychosocial factors. Am J Public Health 1989;79:279–86.
27. Katz JN, Larson MG, Phillips CB, Fossel AH, Liang MH. Comparative measurement sensitivity of short and longer health status instruments. Med Care 1992;30:917–25.
28. Katz LE, Anderson JJ, Meenan RF. Effect sizes for interpreting changes in health status. Med Care 1989;27:S178–89.

Received for publication 21 October 1999
Accepted in revised form 15 November 1999