Calcif Tissue Int (2008) 82:288–292
DOI 10.1007/s00223-008-9117-6

Utility Values Associated with Osteoporotic Fracture: A Systematic Review of the Literature

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Received: 26 September 2007 / Accepted: 28 February 2008 / Published online: 11 April 2008

Abstract We reviewed studies that have estimated the impact of osteoporotic fracture on quality-adjusted life years (QALY) and to determine reference values for countries that would like to carry out cost–utility analyses but that do not have their own values. The computerized medical literature databases Medline and EMBASE were searched from January 1990 to December 2006. The search was carried out in two steps. The first step was to identify studies that related to quality of life in osteoporosis. As part of the second step, only the studies that translated quality of life into a utility value (one single value for health status ranging 0–1) and calculated a utility loss over a period of at least 1 year were selected. From the 152 studies identified in the first analysis, only 16 were retained after the second step. Ten studies investigated utility values for hip fractures, 11 for vertebral fractures, five for distal forearm fractures, and four for other osteoporotic fractures and fracture interactions. Utility values differed substantially between studies, partly due to the valuation technique used, the severity of fractures, and the sample size. This review suggests that there is no meaningful average value across different studies, different samples, different countries, or different instruments. Although we tried to determine the best available values, these values do not preclude the need for country-specific studies. Finally, we also make recommendations regarding the design and methodology for such studies.

Keywords Fracture · Quality of life · Utility value

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Economic evaluation is becoming increasingly important in the field of osteoporosis due to the growing awareness of osteoporosis, the development and introduction of new treatments, and the expanding role of economic evaluations in the health-care decision-making process. Most guidelines recommend comparing interventions in terms of their incremental cost per quality-adjusted life years (QALY) [1–3]. The QALY estimator is an attractive outcome measurement in the field of osteoporosis [4] because it offers the advantage of capturing at the same time the benefits from reduction in mortality and reduction in morbidity [1]. In order to estimate QALY, a utility value for each state in the model is required. Utility value assessment results in one single value for health status, ranging from 0 (corresponding to death) to 1 (corresponding to perfect health) [5].

For the results and conclusions of cost–utility analyses to be reliable and valid, it is important to have good estimates of the reduction in QALY in the year following osteoporotic fracture and in subsequent years. Such estimates are nevertheless difficult to obtain and remain uncertain. This is one of the main challenges in economic modeling in the field of osteoporosis [6].

The objective of the present study was to review the studies that have estimated the impact of osteoporotic fractures on QALY over a period of at least 1 year and to compare them in terms of sample, instrument, and results.

Moreover, we tried to determine reference values for countries that would like to carry out cost–utility analyses but that do not have their own values. Finally, we also make recommendations regarding the design and methodology for future studies. This involves work that is all the more important because the choice of utility values could have a significant impact on the results and conclusions of cost–utility analyses [7].

Materials and Methods

This analysis was based on an exhaustive review of the literature by collecting relevant studies in the field using the Medline and EMBASE databases (from 1990 to December 2006). A keyword search enabled us to cover a group of themes including osteoporosis, fractures, quality of life, utility values, and QALY. All abstracts were reviewed in order to identify any studies of interest. The quotations and the bibliography of selected articles were also a focus of attention in order to identify other worthwhile studies and to supplement the list.

From these studies, we retained for our analysis only those that translated quality of life into a utility value and that calculated a reduction in QALY over a period of at least 1 year. Then, we critically reviewed the eligible studies in order to understand the differences between studies in terms of results, methodology, and sample of respondents. Based on this analysis, we determined reference values that we recommend for countries that do not have their own utility databases.

Results

Of the 152 studies identified by the keyword search, we observed that the majority related to quality of life in general. Many of the studies were therefore not suitable for use in health economic evaluations. Only 16 out of all these studies translated quality of life into a utility value, and these were consequently retained for our analysis. Hip fracture and vertebral fracture (prevalent or incident) were most frequently investigated. In particular, 10 studies provided utility values for hip fractures, 11 for vertebral fractures, five for distal forearm fractures (distal radius, Colles, or wrist), four for other osteoporotic fractures (e.g., humerus, pelvis, or distal femur), and four for fracture interactions. Each study as well as the utility value, the calculation methods, and the sample size are available in a previous report available on the web [8].

Different instruments for valuing QALY were used in the studies. Of the 16 studies retained for our analysis, 11 provided utility values using the Euroqol system (EQ-5D) classification system compared with only two using Health Utilities Index II (HUI-II), one using the Quality of Well-Being Scale (QWB), and one using a psychological scale. Two studies were based on expert judgments and one on a systematic literature review. Few of the studies found had as a direct objective the comparison of the techniques with each other. The EQ-5D classification system had the advantage of being available for more osteoporosis-related conditions than the HUI [9].

Utility was lower in patients following hip fracture and following vertebral fracture. Worse utility was found for patients after a combined hip and vertebral fracture and after multiple vertebral fractures. The reduction in QALY in the year following hip fracture was considerable, estimated at between 0.17 and 0.23 [10–13].

The impact of vertebral fractures on the QALY level differed significantly between the studies. The main reasons for these differences were the nature of the vertebral fractures studied and the time that had elapsed since the fracture. The location of fractures also explained the differences. Thus, the impact of lumbar fractures was slightly higher than that of thoracic fractures [14, 15]. Nevertheless, the location of the fracture had a lower impact on quality of life than the number and severity of vertebral deformities [16].

Distal forearm fractures were associated with the lowest loss of QALY. The decrease in QALY here results from immediate pain and loss of function. Recovery is generally fast. Dolan et al. [17] hypothesized that the fracture had no impact after a period of 48 days. This hypothesis was nevertheless contradicted by Borgstrom et al. [10], who revealed that a wrist fracture had a longer-term effect; the authors assessed in particular a significant loss in QALY at 4 months.

Few data are available for the other osteoporotic fractures and for the medium-term consequences of osteoporotic fractures. The impact of other osteoporotic fractures on QALY resulted from assumptions and expert judgments that attempted to establish similarities [3, 18–20] with the three main fractures (hip, vertebral, and forearm), the effects of which are better known. The medium-term consequences of osteoporotic fractures on QALY were also based on expert opinions.

The number of fractures was also shown to be a significant determinant of quality of life [16]. Thus, QALY decreased as the number of previous vertebral fractures increased [5, 14, 15, 21]. Tosteson et al. [13] estimated the involvement of an interaction between a hip fracture and a vertebral fracture, this proving to be markedly lower with only one of the fractures. The impact of the two fractures was even greater than the product of the impacts related to each of the fractures.

A Set of Reference Values

Utility estimates differed substantially between studies, partly due to the valuation technique, the severity of fractures, and the sample size. Due to the need for utility estimates and the difficulty involved in implementing such studies (requiring time and money), we tried to determine the best available values. These values, summarized in Table 1, are multipliers for the proportionate effect of a fracture on utility values.

Borgstrom et al. [10] recently assessed QALY level at baseline, 4 months, and 12 months after different fractures and allowed estimation of a QALY loss with greater accuracy. Furthermore, their estimates were included in the range of previous studies. This study was therefore preferred for references values.

The first-year impact of a hip fracture on quality of life varied from 0.77 to 0.83, according to the calculation assumption. We therefore recommended an intermediate value of 0.797, corresponding to a previous review [22], and a standard deviation of 0.77–0.82. The impact in subsequent years was considered to be equal to half the reduction in QALY that took place in the first year [22, 23].

The first-year impact of a clinical vertebral fracture was 0.72 (with a standard deviation of 0.66–0.775). For subsequent years, we suggested using a multiplier of 0.931 based on results from Oleksik et al. [14] and Kanis et al. [18]. In order to obtain the multiplier for all vertebral fractures, we presumed, in accordance with the hypothesis of Kanis et al. [18] and the results of Cockerill et al. [21], that the loss of utility from vertebral deformities was equal to one-third of that attributable to clinical fractures. Considering the fact that clinical vertebral fractures represent 25% [18, 24–26] of all vertebral fractures, we thus obtained a multiplier for all vertebral fractures equal to 0.86 for the first year following the fracture and a subsequent year multiplier equal to 0.965.

For distal forearm fracture, we recommended using the conservative assumption that suggested a multiplier of 0.94 (with a standard deviation of 0.91–0.96), so as not to depart too much from the results used previously [17]. For other osteoporotic fractures, we suggested a value of 0.910. This value was obtained applying the proportions of the National Osteoporosis Foundation [3] to our reference values for the three main fractures and was close to another estimate, equal to 0.902 [27]. Distal forearm and other osteoporotic fractures were assumed to have no more effect on the QALY level after 1 year.

Discussion

The objective of the present study was to review the studies that estimated the reduction in QALY following osteoporotic fracture and to compare values. We updated the review of Brazier et al. [22], using the most recent studies. Some stressed that the consequences of vertebral fractures have been underestimated [10]. We also focused on the impact on QALY of osteoporotic fractures other than those of the hips, vertebrae, and forearm and on the consequences of fracture interactions.

From our analysis, it emerged that there were relatively few specific studies and that these were related to a limited number of countries. Moreover, the existing studies were often limited in terms of sample size, time elapsed since fracture, and type of fracture studied. The lack of a control group and the absence of QALY estimates before the fracture also make the calculation of QALY loss uncertain. Therefore, the results differed substantially, suggesting that there is no meaningful average value across different studies, different samples, different countries, or different instruments.

Country-specific studies and international comparisons would be recommended. Improvements in the design and methodology of such studies are also required. Therefore, studies on large populations and with long-term follow-up are necessary. Furthermore, it is important to estimate the QALY level before the fracture, and the presence of a

Table 1 Multipliers for the proportionate effect of a fracture on utility values

Fracture	Years	Value
Hip fracture	First year	0.797 (CI 0.77–0.825)
	Subsequent years	0.899 (CI 0.885–0.91)
Clinical vertebral fracture	First year	0.720 (CI 0.66–0.775)
	Subsequent years	0.931 (CI 0.916–0.946)
All vertebral fractures	First year	0.860 (CI 0.83–0.89)
	Subsequent years	0.965 (CI 0.957–0.972)
Distal forearm fracture	First year	0.940 (CI 0.91–0.96)
	Subsequent years	1
Other osteoporotic fracture	First year	0.910 (CI 0.88–0.94)
	Subsequent years	1

CI, 95% confidence interval

control group could be relevant. Future research should also focus on the impact of age on the relative reduction and on the consequences of each type of fracture and of fracture interactions.

Furthermore, work on the comparison of various instruments and questionnaires could also be relevant. Are the generic questionnaires, which are often used, sufficiently effective to take into account changes in health conditions? The main advantage of these generic instruments is that they allow comparison of several different illnesses. They are nevertheless open to the criticism that they are not able to take account of the specificities of illnesses. Nonetheless, some of them, particularly the EQ-5D, are regularly used to measure quality of life in the field of osteoporosis. The EQ-5D effectively captures the impact of osteoporotic fractures on the quality of life. Specific questionnaires on osteoporosis have been developed over the last few years alongside these generic instruments [28]. They take into greater account the improvements and deterioration involved in the illness [29]; their use has facilitated an understanding of the consequences of osteoporosis on quality of life [30]. Nevertheless, they do not all allow for the calculation of an average value of utility for an individual, and their results cannot therefore be used directly in economic evaluation. An interesting approach would be to develop or to adapt a questionnaire specific to osteoporosis in order to translate quality of life into a utility value.

This report also suggests reference values for countries that would like to carry out cost–utility analyses but that do not have not their own utility databases. These values are multipliers for the proportionate effect of a fracture on utility values. This relative reduction hypothesis is more realistic and more frequently used than the one that presumes an absolute decrease in QALY regardless of the initial level [31]. Consequently, in using the relative reduction approach, a fracture will have a greater absolute effect for younger people than for older people because younger people present a higher initial QALY level. This approach is also supported by Borgstrom et al.'s [10] study, which shows through a multivariate regression analysis that the QALY loss increases with higher initial level before fracture.

Our reference values will have to be adjusted as new data are released, and they do not preclude the need for country-specific studies. We highly recommend the widespread use of generic instruments (such as the EQ-5D) in large populations and with long-term follow-up.

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