BMC Geriatrics

RESEARCH Open Access

Long-term quality of life and influencing factors in elderly patients after vertebroplasty based on the EQ-5D-3L Chinese utility scoring system: a retrospective study

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Abstract

Background The quality of life of elderly patients after vertebroplasty is influenced by various factors. Although the EuroQol 5-Dimension 3-Level (EQ-5D-3L) scale has been widely used to assess quality of life, the factors affecting the long-term postoperative quality of life of elderly vertebroplasty patients in China have not been thoroughly studied.

Methods This retrospective study included 519 patients aged 65 years and older who underwent elective vertebroplasty. We collected baseline data from these patients and conducted telephone follow-ups 12 months postoperation to evaluate their EQ-5D-3L health utility scores and EuroQol Visual Analogue Scale (EQ-VAS) scores. Univariate and multivariate linear regression models were used to analyse the factors affecting quality of life.

Results Of the 519 patients, the majority were female (78.0%), aged 65 to 95 years, with an average age of 75.2 years. Twelve months postoperation, pain/discomfort was the most commonly reported issue for 68.4% of patients. The median EQ-5D-3L health utility score was 0.783, with a range between 0.450 and 0.887; the median EQ-VAS score was 75, ranging from 60 to 85. Multivariate linear regression analysis indicated that older age, hormone use, higher American Society of Anesthesiologists (ASA) grades, nondrinking habits, and low albumin levels were found to be independent risk factors affecting long-term quality of life in elderly patients after vertebroplasty. Additionally, a history of tumours, the number of vertebral compression fractures, and bone mineral density were also crucial influencing factors.

Conclusions Based on the use of the EQ-5D-3L Chinese utility scoring system, we evaluated the quality of life of patients aged 65 and above 12 months after vertebroplasty. This study identified several factors related to postoperative quality of life in elderly vertebroplasty patients, providing crucial evidence for further clinical decisions and patient education.

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Keywords EQ-5D-3L, Elderly vertebroplasty, Long-term quality of life, Chinese utility scoring system, Influencing factors

Introduction

Osteoporosis is the most common metabolic bone disease in middle-aged and elderly individuals [1]. According to statistics, 10.2% of adults over 50 years old have osteoporosis, a figure that is expected to increase to 13.6% by 2030 [2]. Vertebral fractures are the most common result of osteoporosis, leading to acute and chronic pain, vertebral deformity, decreased mobility, and significantly deteriorated quality of life [3]. An observational study indicated a notable decline in quality of life 12 months postvertebral fracture [4], and even after 18 months, the quality of life did not return to prefracture levels. Percutaneous vertebroplasty (PVP) is a minimally invasive technique that has been widely accepted for its ability to effectively alleviate pain and restore vertebral height and shape, thereby improving patients' functional status and quality of life. However, while the short- and medium-term effects of surgery are widely acknowledged, there is limited research on the long-term post-PVP quality of life [5]. Especially in China, given its large population and evident ageing trend, in-depth analysis of this topic has become particularly important. If fracture treatments result in complications such as nonunion, instability, or increased kyphosis, they can continuously impact the patient's long-term quality of life [6].

Furthermore, the assessment of quality of life is not just about physical health; it encompasses the psychological, social, and functional aspects of health. Thus, selecting an appropriate evaluation tool is crucial. The EuroQol 5 Dimensions (EQ-5D) scale is an internationally recognized quality of life assessment tool [7] that has been widely used worldwide. A systematic review revealed that Chinese scholars have extensively utilized the EQ-5D to assess quality of life among patients with various chronic noncommunicable diseases, including hypertension, diabetes, chronic obstructive pulmonary disease, heart disease, and epilepsy [8]. However, these studies employed utility scoring systems based on different countries or regions, which may lead to variations in outcomes when assessing the same health status [9]. Considering China's unique cultural and social context, using the EuroQol 5-Dimension 3-Level (EQ-5D-3L) Chinese Utility Scoring System, which is specifically designed for the Chinese population [10], becomes especially pertinent. Against this backdrop, our study employs the EQ-5D-3L Chinese utility scoring system for evaluation, aiming to identify factors affecting long-term quality of life in elderly patients postvertebroplasty. The objective of this study was to assign values to these factors and develop a preoperative risk scoring system to guide the selection of anaesthesia methods for future vertebroplasty procedures in elderly patients.

Materials and methods

Patients

This retrospective study analysed data from elderly patients with osteoporotic thoracolumbar vertebral compression fractures who underwent vertebroplasty at Affiliated Hospital 2 of Nantong University between January 2020 and January 2022. The inclusion criteria were as follows: clear diagnosis of OVCF (osteoporotic vertebral compression fracture), need for elective vertebroplasty surgery, age 65 years and older, grade II to IV according to the American Society of Anesthesiologists (ASA) classification criteria [11], and clear verbal communication skills.

The exclusion criteria were as follows: (1) impairment of consciousness, communication or hearing; (2) cognitive impairment, dementia, mental illness, etc.; (3) inability to complete the EQ-5D-3L questionnaire; and (4) bone biopsy due to metastatic tumours or vertebral haemangiomas.

This study was approved by the Ethics Committee of Affiliated Hospital 2 of Nantong University (Approval No. 2022KT181) and registered with the Chinese Clinical Trial Registry under registration number ChiCTR2300069526. Due to the retrospective nature of this study, the requirement for written informed consent was waived by the Ethics Committee of Affiliated Hospital 2 of Nantong University.

Data collection

In this study, we systematically reviewed patients' anaesthesia and medical records to collect data on all patients' demographics, comorbidities, surgical and anaesthesia characteristics, preparation time, length of hospital stay, hospitalization costs, preoperative laboratory results, etc. The data collection information is as follows:

Demographic data: The patient's age, sex, and body mass index (BMI) were obtained from the patient's admission records.

Comorbidities: The conditions of all participants other than osteoporotic vertebral compression fractures, including hypertension, diabetes, heart failure, chronic obstructive pulmonary disease (COPD), and tumour history, were recorded in detail. In addition, information was collected on whether the patients received hormone therapy, whether they had undergone vertebroplasty surgery in the past, and their smoking and drinking habits. The data are primarily based on a systematic review of

patient medical records. Because descriptions of smoking and drinking in medical records may not be sufficiently accurate, the research team further verified this information through follow-up phone calls.

Surgical and anaesthesia characteristics: Data such as the American Society of Anaesthesiologists (ASA) classification, anaesthesia method, surgery duration, number of vertebroplasty segments, total volume of bone cement injected, and use of unilateral or bilateral approaches were recorded. The preparation time refers to the time between the day the patient was admitted and the day of surgery. Preoperative laboratory indicators: The most recent haematological indicators and bone mineral density (BMD) of the patient before surgery were collected. Haematological indicators included key indicators such as white blood cell count, haemoglobin, haematocrit, platelet count, creatinine, blood urea nitrogen, and albumin. Bone mineral density was measured by dual-energy X-ray absorptiometry (DXA). All of these data were obtained through patient medical records.

Main outcome measure: Patient quality of life 12 months after surgery was obtained through telephone follow-up and assessed using the EQ-5D-3L. The EQ-5D-3L comprises five health dimensions and one self-assessment of health known as the EuroQol Visual Analogue Scale (EQ-VAS). The five dimensions include mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has three levels: no problems, some problems, and extreme problems. The EQ-VAS is a scale ranging from 0 to 100, reflecting the respondent's subjective health assessment on that day, with higher scores indicating better health status.

We employed the utility scoring system developed for the Chinese population to calculate health utility scores. The calculations are based on the information presented in Table 1. The health utility scores measured by the EQ-5D-3L range from −0.149 to 1.

The formula for calculating the health utility score is U=1- C- (MO+SC+UA+PD+AD)-N3. If all five dimensions are at the "no problems" level, then U=1. Suppose that all five dimensions are at the "extreme problems" level, U=1-0.039 − (0.246+0.208+0.193+0.236+0.205) -0.022 = -0.149. All survey administrators received professional training before the survey, ensuring that they fully understood the questionnaire content, and were certified.

Table 1 The EQ-5D-3L Chinese utility scoring system

Dimension	No problems	Some problems	Extreme problems
C	0	0.039	0.039
MO	0	0.099	0.246
SC	0	0.105	0.208
UA	0	0.074	0.193
PD	0	0.092	0.236
AD	0	0.086	0.205
N3	0	0.000	0.022

The EQ-5D-3L refers to the European Quality of Life 5-Dimension 3-Level Health Scale. 'MO' stands for mobility, 'SC' represents self-care, 'UA' indicates usual activities, 'PD' denotes pain/discomfort, and 'AD' signifies anxiety/depression. Both 'C' and 'N3' are constants. When at least one of the dimensions is rated as either some or extreme problems, the value of 'C' is set to 0.039. Moreover, when at least one dimension is rated as an extreme problem, the value of 'N3' becomes 0.022

Statistical analysis

The data were entered into Excel software and analysed using SPSS 22.0 statistical software. Normally distributed data are presented as the mean±standard deviation (SD); nonnormally distributed data are presented as the median and interquartile range; categorical data are presented as the frequency and percentage. Utilizing a utility scoring system developed based on preferences within the Chinese population, the 12-month postvertebroplasty health status of elderly patients was converted into health utility scores. The EQ-5D-3L health utility scores and the EQ-VAS were set as dependent variables, and demographic information, comorbidities, surgical and anaesthetic characteristics, preparation time, hospital stay, hospitalization costs, and preoperative laboratory indicators were individually incorporated into univariate linear regression analyses to screen for factors influencing the EQ-5D-3L health utility scores and the EQ-VAS. Variables demonstrating statistical significance ($P<0.05$) in univariate analyses were subsequently included in multivariate linear regression models to identify independent factors affecting patients' EQ-5D-3L health utility scores and EQ-VAS scores 12 months post-PVP surgery. This study further employed independent factors identified from the multivariate linear regression model as criteria for stratification to conduct a detailed analysis of the differences in difficulty rates across EQ-5D-3L dimensions, health utility scores, and EQ-VAS scores under various stratified conditions. The comparison of proportions or rates between groups can be conducted using the chi-squared test or Fisher's exact test; for nonparametric data comparisons between two or multiple groups, the Mann−Whitney U test or Kruskal−Wallis H test is typically employed. The significance level was set at $\alpha=0.05$, with P values less than 0.05 considered to indicate statistical significance.

Results

Patients and depictive data

In this study, 519 patients aged 65 years and older who underwent elective vertebroplasty were included (Fig. 1). Their ages ranged from 65 to 95 years, with an average age of 75.2±6.6 years. The majority of these patients were female (405 patients; 78.0%), while there were 114 male patients (22.0%) (Table 2). Preoperative laboratory data can be found in Table 3.

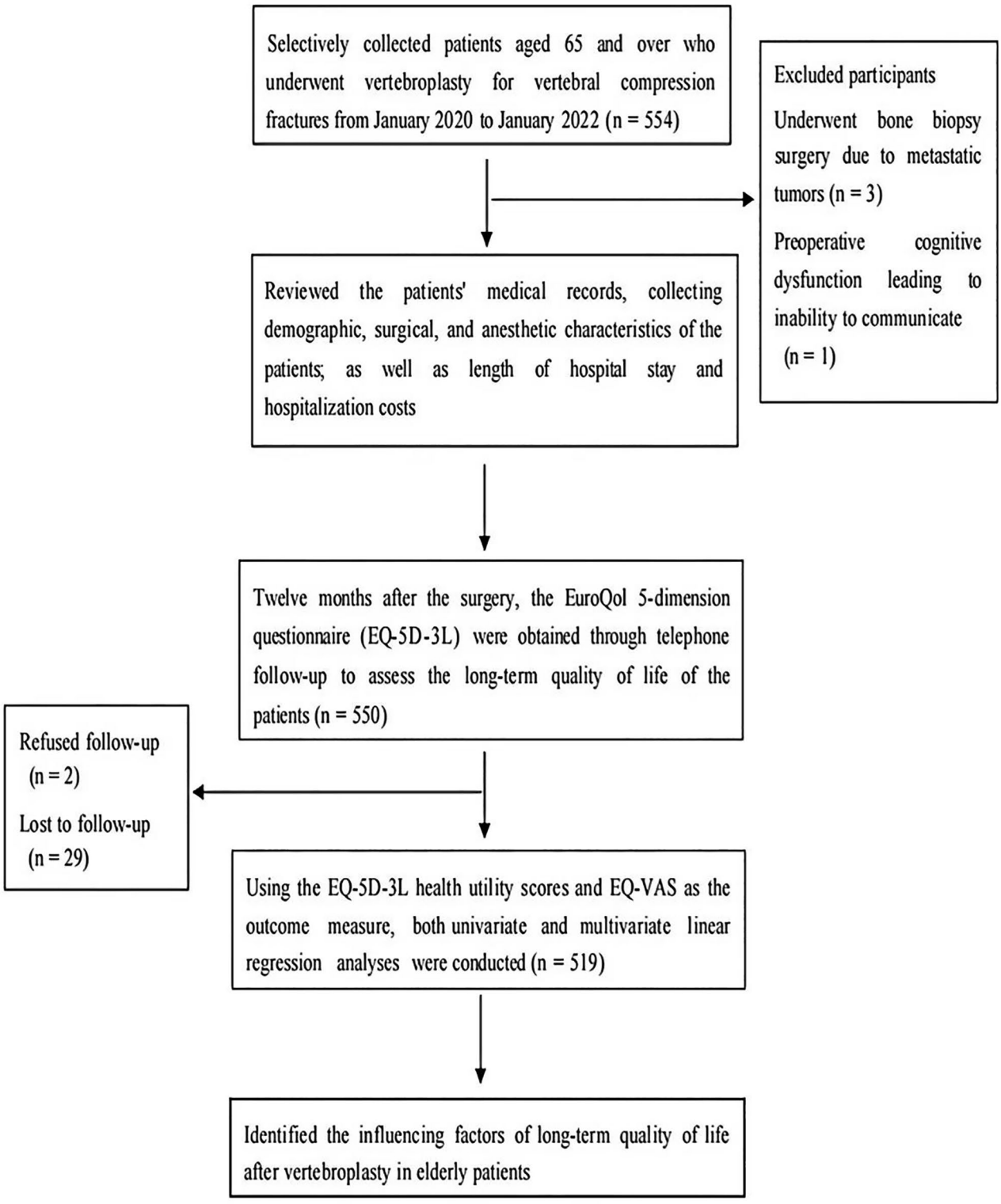

Fig. 1 Flow diagram of the patient selection process

Table 2 Demographic, surgical, and anaesthetic data

	N	
Demographic Data		
Age, years (mean ± SD)	519	75.2 ± 6.6
65 ~ 74, n (%)	-	262(50.5)
75 ~ 84, n (%)	-	205(39.5)
≥ 85, n (%)	-	52(10.0)
Female, n (%)	519	405(78.0)
BMI, kg/m^2 (mean ± SD)	485	23.3 ± 3.3
Comorbidities		
Hypertension, n (%)	519	246(47.4)
Diabetes, n (%)	519	102(19.7)
Heart failure, n (%))	519	20(3.9)
COPD, n (%)	519	73(14.1)
Tumour history, n (%)	519	48(9.2)
Hormone use, n (%)	519	28(5.4)
History of vertebral augmentation surgery, n (%)	519	111(21.4)
Smoking, n (%)	519	41(7.9)
Drinking, n (%)	519	42(8.1)
Surgical and Anaesthetic Characteristics		
ASA	519	
II, n (%)	-	215(41.4)
III, n (%)	-	276(53.2)
IV, n (%)	-	28(5.4)
Anaesthesia Method	519	
MAC or Local Anaesthesia, n (%)	-	75(14.5)
General anaesthesia, n (%)	-	444(85.5)
Surgery duration, minutes (mean ± SD)	519	44.3 ± 15.8
Number of vertebral segments	519	
1, n (%)	-	393(75.7)
≥ 2, n (%)	-	126(24.3)
Total volume of bone cement, ml (mean ± SD)	519	7.7 ± 3.4
Bilateral, n (%)	519	501(96.5)
Preparation time, days (mean ± SD)	519	2.9 ± 1.6
Hospital stay, days (mean ± SD)	519	5.4 ± 2.2
Hospitalization cost, 10,000 RMB (mean ± SD)	510	2.8 ± 0.7

Abbreviations SD, standard deviation; BMI, body mass index; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists; MAC, monitored anaesthesia care

Table 3 Preoperative laboratory data

	N	mean ± SD
White blood cell count (10^9/L)	519	6.4 ± 3.2
Haemoglobin (g/L)	519	122.0 ± 15.9
Haematocrit (%)	519	36.7 ± 4.3
Platelet count (10^9/L)	519	193.3 ± 71.3
Creatinine (umol/L)	519	57.8 ± 17.8
Blood urea nitrogen (mmol/L)	519	6.0 ± 2.1
Albumin (g/L)	519	36.0 ± 3.3
BMD (g/cm^2)	485	0.741 ± 0.169

Abbreviations SD, standard deviation; BMD, bone mineral density

Distribution of the EQ-5D-3L dimensions

Based on the results of the 12-month postoperative telephone follow-up, the frequency of issues reported by patients in each dimension of the EQ-5D-3L scale was tabulated. The categories 'some problems' and 'extreme problems' were considered to indicate difficult circumstances. Pain was reported as the primary issue by 68.4% of patients, followed by usual activities at 47.4%, anxiety/depression at 40.3%, mobility at 39.5%, and self-care at 22.4%. Refer to Table 4; Fig. 2.

Table 4 Health status in each dimension of the EQ-5D-3L scale one year after vertebroplasty in elderly patients (n = 519)

Dimension	No problems (*n*/%)	Some problems (*n*/%)	Extreme problems (*n*/%)
Mobility	314(60.5)	127(24.5)	78(15.0)
Self care	403(77.6)	47(9.1)	69(13.3)
Usual activities	273(52.6)	128(24.7)	118(22.7)
Pain	164(31.6)	252(48.5)	103(19.9)
Anxiety/depression	310(59.7)	115(22.2)	94(18.1)

Analysis of factors influencing the EQ-5D-3L health utility score and the EQ-VAS score

Twelve months after surgery, the median EQ-5D-3L health utility score was approximately 0.783, with an EQ-VAS score of 75. With the EQ-5D-3L health utility score as the dependent variable, univariate linear regression analysis revealed that age, BMI, heart failure within 30 days before surgery, tumour history, history of hormone use, alcohol consumption, ASA grade, anaesthesia method, ≥ 2 vertebral fracture segments, hospitalization costs, haemoglobin, haematocrit, creatinine, albumin, and bone mineral density (BMD) were all factors influencing the EQ-5D-3L health utility score at 12 months postoperation (P<0.05) (refer to Supplementary Table S1). Multivariate linear regression analysis, which included the above variables, revealed that age (regression coefficient β = -0.010, 95% CI -0.016~ -0.005, P<0.001), history of tumours (β = -0.107, 95% CI -0.207~ -0.006, P=0.037), hormone use (β = -0.195, 95% CI -0.326~ -0.065, P=0.003), and ASA grade (β = -0.132, 95% CI -0.195~ -0.069, P<0.001) were negatively associated with the EQ-5D-3L health utility score at 12 months postoperation while alcohol consumption history (β=0.151, 95% CI 0.046 ~ 0.257, P=0.005), albumin levels (β=0.013, 95% CI 0.004 ~ 0.023, P=0.006), and BMD (β=0.196, 95% CI 0.013 ~ 0.379, P=0.036) were positively associated. According to the multivariate linear regression analysis of this study, the R^2 for the EQ-5D-3L health utility score model was 0.301, with an adjusted R^2 of 0.277 (Table 5; Fig. 3).

With the EQ-VAS score as the dependent variable, univariate linear regression analysis revealed that age, BMI, diabetes status, heart failure within 30 days before surgery, chronic obstructive pulmonary disease status, tumour history, history of hormone use, alcohol consumption, ASA grade, anaesthesia method, ≥2 vertebral

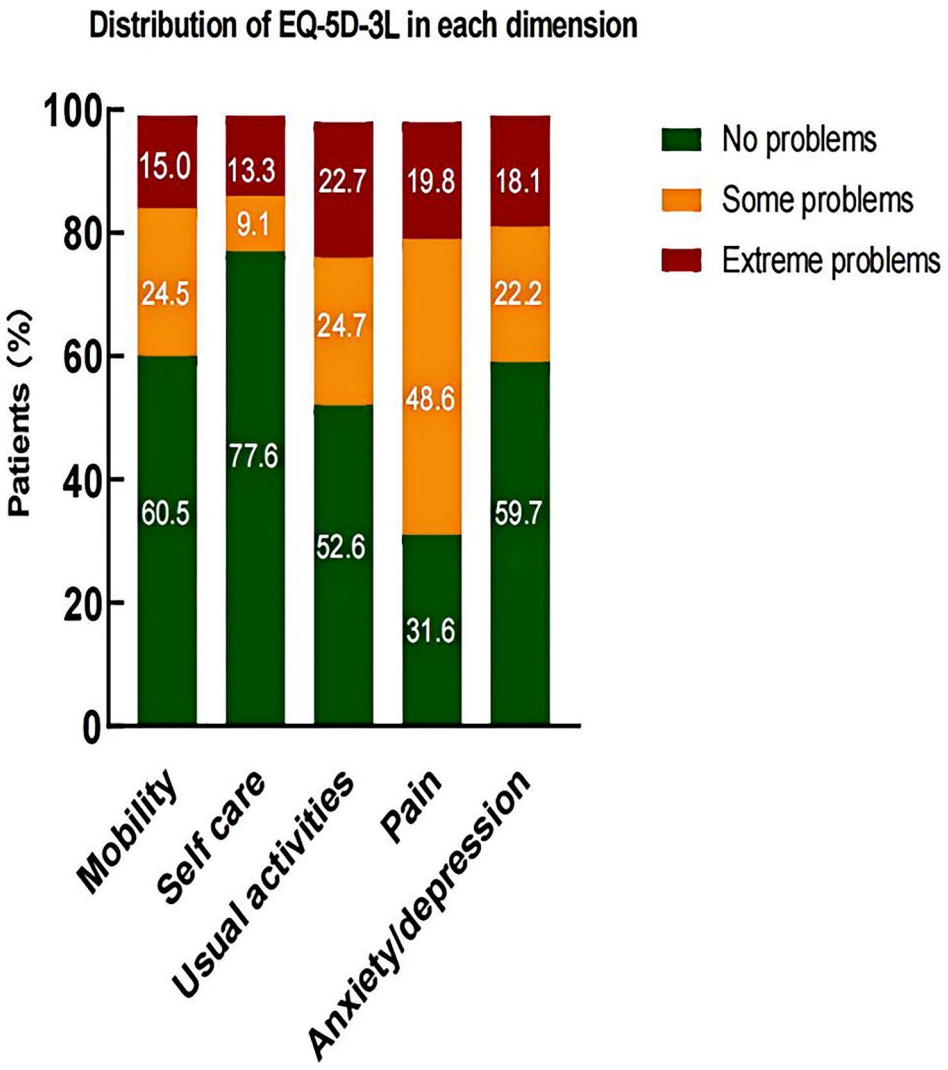

Fig. 2 Distribution of the holistic EQ-5D-3L profile 12 months postvertebroplasty in elderly patients ($n=519$)

fracture segments, bilateral cement injection sites, preparation time, hospitalization costs, haemoglobin, haematocrit, creatinine, and albumin levels were all factors influencing the quality of life according to the EQ-VAS score at 12 months postoperation ($P<0.05$) (Supplementary Table S2).

According to the multivariate linear regression analysis incorporating the above variables, age (regression coefficient β = -0.714, 95% CI -1.111~ -0.317, $P<0.001$), hormone use (β = -14.688, 95% CI -24.045~ -5.331, $P=0.002$), ASA grade (β = -7.683, 95% CI -12.337~ -3.028, $P=0.001$), and ≥2 vertebral fracture segments (β = -5.585, 95% CI -11.127~ -0.043, $P=0.048$) were negatively associated with the EQ-VAS score while alcohol consumption history (β=9.237, 95% CI 1.515 ~ 16.958, $P=0.019$) and albumin levels (β=0.729, 95% CI 0.054 ~ 1.405, $P=0.034$) were positively associated. For the multivariate linear regression analysis of the EQ-VAS model in this study, the R^2 was 0.253, and the adjusted R^2 was 0.224 (Table 6; Fig. 3). The anaesthesia method did not significantly impact the EQ-5D-3L health utility score or the EQ-VAS score at 12 months postvertebroplasty in elderly patients ($P>0.05$).

Comparison of difficulty rates in various EQ-5D-3L dimensions, health utility scores, and EQ-VAS scores among patients with different characteristics

Further stratified analysis was conducted to assess the impact of factors such as age, tumour history, hormone use, alcohol consumption, ASA grade, number of vertebral segments, albumin, and bone mineral density on the difficulty rates of accessing various EQ-5D-3L dimensions, health utility scores, and EQ-VAS scores.

The main factors influencing the difficulty rates across various dimensions of the EQ-5D-3L are age and ASA grade. In patients of different ages and ASA grades, we

Table 5 Multivariate linear regression analysis of the factors influencing the EQ-5D-3L health utility scores

Variables	Beta	SE	T	*P* value	95% CI	
					lower limit	upper limit
Constant	1.068	0.340	3.145	0.002	0.401	1.736
Age (years) ***	-0.010	0.003	-3.608	**<0.001**	-0.016	-0.005
BMI (kg/m^2)	0.006	0.005	1.253	0.211	-0.003	0.015
Heart failure	-0.058	0.078	-0.739	0.460	-0.212	0.096
Tumour history *	-0.107	0.051	-2.088	**0.037**	-0.207	-0.006
Hormone use**	-0.195	0.066	-2.940	**0.003**	-0.326	-0.065
Drinking**	0.151	0.053	2.834	**0.005**	0.046	0.257
ASA***	-0.132	0.032	-4.114	**<0.001**	-0.195	-0.069
General anaesthesia	0.051	0.047	1.085	0.278	-0.041	0.143
Two or more vertebrae	-0.048	0.039	-1.241	0.215	-0.124	0.028
Hospitalization cost (10,000 RMB)	-0.009	0.026	-0.365	0.716	-0.061	0.042
Haemoglobin (g/L)	-0.004	0.002	-1.812	0.071	-0.009	0.000
Haematocrit (%)	0.015	0.009	1.673	0.095	-0.003	0.033
Creatinine (umol/L)	-0.002	0.001	-1.671	0.095	-0.003	0.000
Albumin (g/L) **	0.013	0.005	2.764	**0.006**	0.004	0.023
BMD (g/cm^2)*	0.196	0.093	2.103	**0.036**	0.013	0.379

Notes $R^2=0.301$, adjusted $R^2=0.277$. Significance levels: ***$p<0.001$; **$p<0.01$; *$p<0.05$

Abbreviations BMI, body mass index; ASA, American Society of Anesthesiologists; BMD, bone mineral density

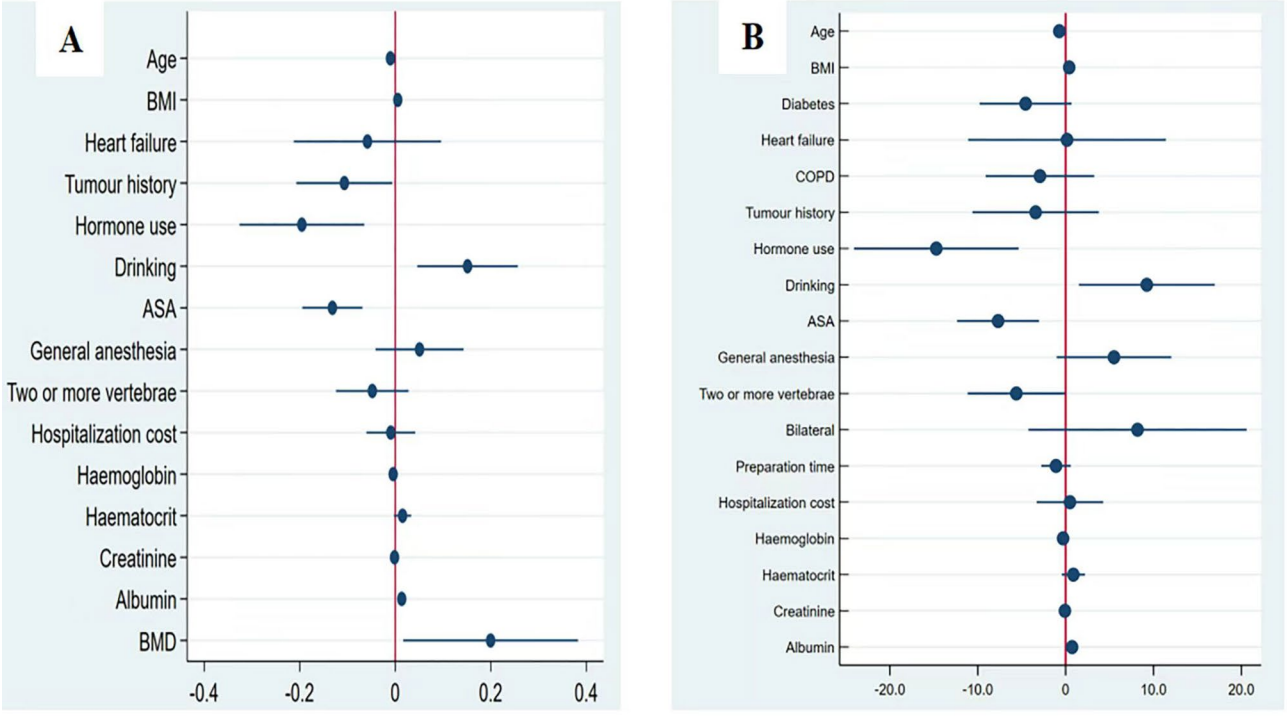

Fig. 3 Panel **A** shows the multivariate linear regression coefficients for the EQ-5D-3L health utility scores; Panel **B** displays the multivariate linear regression coefficients for the EQ-VAS scores

observed statistically significant differences in the difficulty rates for mobility, self-care, usual activities, pain, and anxiety/depression ($P<0.001$). As age and the ASA grade increased, the difficulty rates for each dimension tended to increase. Among them, the pain dimension had the highest reported difficulty rate, followed by usual activities and mobility. Relatively speaking, the self-care dimension had a lower difficulty rate. In elderly patients aged 85 and above, the difficulty rate for pain reached 84.6%, while for self-care, it was 57.7%. For patients with

Table 6 Multivariate linear regression analysis of factors influencing EQ-VAS scores

Variables	Beta	SE	T	*P* value	95% CI	
					lower limit	upper limit
Constant	97.949	27.496	3.562	<0.001	43.915	151.983
Age (years) ***	-0.714	0.202	-3.534	**<0.001**	-1.111	-0.317
BMI (kg/m^2)	0.458	0.326	1.404	0.161	-0.183	1.099
Diabetes	-4.626	2.660	-1.739	0.083	-9.853	0.602
Heart failure	0.170	5.723	0.030	0.976	-11.076	11.416
COPD	-2.946	3.140	-0.938	0.349	-9.116	3.224
Tumour history	-3.423	3.657	-0.936	0.350	-10.609	3.763
Hormone use**	-14.688	4.762	-3.085	**0.002**	-24.045	-5.331
Drinking*	9.237	3.929	2.351	**0.019**	1.515	16.958
ASA**	-7.683	2.369	-3.244	**0.001**	-12.337	-3.028
General anaesthesia	5.483	3.317	1.653	0.099	-1.035	12.001
Two or more vertebrae*	-5.585	2.820	-1.980	**0.048**	-11.127	-0.043
Bilateral	8.251	6.312	1.307	0.192	-4.152	20.655
Preparation time (days)	-1.108	0.854	-1.298	0.195	-2.786	0.570
Hospitalization cost (10,000 RMB)	0.488	1.926	0.254	0.800	-3.296	4.273
Haemoglobin (g/L)	-0.290	0.181	-1.600	0.110	-0.647	0.066
Haematocrit (%)	0.878	0.672	1.306	0.192	-0.443	2.198
Creatinine (umol/L)	-0.081	0.062	-1.294	0.196	-0.204	0.042
Albumin (g/L) *	0.729	0.344	2.121	**0.034**	0.054	1.405

Notes $R^2=0.253$, adjusted $R^2=0.224$. Significance levels: ***$p<0.001$; **$p<0.01$; *$p<0.05$

Abbreviations BMI, body mass index; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists; BMD: bone mineral density

an ASA grade of IV, the difficulty rates for pain/discomfort and self-care were 89.3% and 67.9%, respectively.

Patients with tumours had significantly different difficulty rates in the dimensions of self-care ($P<0.001$), anxiety/depression ($P=0.007$), and pain ($P=0.044$) than patients without tumours. For patients who had been on long-term hormone treatment, there was a more pronounced difference in the anxiety/depression dimension ($P=0.023$) compared to those not using hormones and a difference in self-care ($P=0.027$). However, for patients who consumed alcohol, there was no significant difference in the pain/discomfort dimension compared to nondrinkers, but there was a significant reduction in difficulty rates in the dimensions of mobility, self-care, usual activities, and anxiety/depression ($P<0.05$). Regardless of whether there was one or more vertebral fracture segments, there was no significant difference in difficulty rates across the dimensions ($P>0.05$). Moreover, patients with hypoalbuminaemia (albumin < 35 g/L) had significant differences in difficulty rates in the dimensions of self-care ($P=0.001$), mobility ($P=0.009$), and anxiety/depression ($P=0.038$). There was no significant difference between BMD levels and self-care or anxiety/depression, but there were significant differences in difficulty rates for mobility, usual activities, and pain ($P<0.05$). According to the horizontal comparisons, except for a BMD > 0.8 g/cm^2, the difficulty rate for pain was the highest among all the other characteristics, which is consistent with the overall reported findings (Table 7).

Based on the conversion of the Chinese utility scoring system, we observed that the health utility scores and EQ-VAS scores were generally consistent overall, with median values of 0.783 (IQR: 0.450, 0.887) and 75 (IQR: 60, 85), respectively (detailed in Table 7). In our study, we observed a significant decrease in the quality of life of patients as age increased, as did the ASA grade, presence of tumours, history of long-term hormone use, hypoalbuminaemia, and number of vertebral fracture segments ≥ 2 ($P<0.05$). However, for the EQ-VAS scores, drinking and bone mineral density did not significantly differ ($P>0.05$). Nevertheless, in terms of health utility scores, compared to nondrinking patients, patients who consumed alcohol exhibited a greater quality of life ($P<0.05$). For those diagnosed with osteoporosis (BMD < 0.8 mg/cm^2), we observed a significant reduction in their health utility scores compared to patients with normal bone mineral density ($P<0.05$).

Discussion

In this retrospective study, we utilized the EQ-5D-3L utility score and the EQ-VAS score, which were calculated through the Chinese utility scoring system, to evaluate the long-term quality of life and the associated influencing factors in elderly patients with osteoporotic vertebral compression fractures (OVCF) following vertebroplasty. This study revealed that age, tumour status, hormone usage status, alcohol consumption status, ASA classification, number of vertebral segments, albumin level,

Table 7 Comparison of the difficulty rates of the EQ-5D-3L dimensions, health utility scores, and EQ-VAS scores among patients with different characteristics

	Groups	*N*	Mobility	Self care	Usual activities	Pain	Anxiety/depression	Utility index	EQ-5D-VAS
Total		519	205(39.5)	116(22.4)	246(47.4)	355(68.4)	209(40.3)	0.783(0.450,0.887)	75(60,85)
Age (years)	65 ~ 74	262	64(24.4)	29(11.1)	81(30.9)	156(59.5)	88(33.6)	0.869(0.636,1.000)	80(70,90)
	75 ~ 84	205	100(48.4)	57(27.8)	122(59.5)	155(75.6)	88(42.9)	0.696(0.364,0.869)	70(60,80)
	≥ 85	52	41(78.8)	30(57.7)	43(82.7)	44(84.6)	33(63.5)	0.221(-0.036,0.696)	55(33,79)
	X^2 (H)		65.982	60.153	66.594	20.767	17.093	62.315	56.018
	P		**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****
Tumour history	yes	48	26(54.2)	21(43.8)	28(58.3)	39(81.3)	28(58.3)	00.573(0.217, 0.792)	70(50, 80)
	no	471	179(38.0)	95(20.2)	218(46.3)	316(67.1)	181(38.4)	0.788(0.498, 1.000)	75(60, 85)
	X^2 (Z)		4.762	13.956	2.536	4.040	7.175	-3.423	-2.165
	P		**0.029***	**<0.001*****	0.111	**0.044***	**0.007****	**0.001****	**0.030***
Hormone use	yes	28	15(53.6)	11(39.3)	16(57.1)	22(78.6)	17(60.7)	0.437(0.173, 0.869)	62(46, 75)
	no	491	190(38.7)	105(21.4)	230(46.8)	333(67.8)	192(39.1)	0.788(0.498, 0.896)	75(60, 85)
	X^2 (Z)		2.453	4.891	1.127	1.416	5.143	-2.284	-3.346
	P		0.117	**0.027***	0.288	0.234	**0.023***	**0.022***	**0.001****
Drinking	yes	42	6(14.3)	2(0.3)	13(31.0)	25(59.5)	10(23.8)	0.869(0.725, 1.000)	80(70, 90)
	no	477	199(41.7)	114(23.9)	233(48.8)	330(69.2)	199(41.7)	0.783(0.444, 0.887)	75(60, 85)
	X^2 (Z)		12.157	8.146	4.958	1.666	5.148	2.794	1.949
	P		**<0.001*****	**0.004****	**0.026***	0.197	**0.023***	**0.005****	0.051
ASA	II	215	40(18.6)	14(6.5)	56(26.0)	127(59.1)	63(29.3)	0.869(0.734,1.000)	80(70,90)
	III	276	142(51.4)	83(30.1)	166(60.1)	203(73.6)	126(45.7)	0.696(0.325,0.869)	70(50,80)
	IV	28	23(82.1)	19(67.9)	24(85.7)	25(89.3)	20(71.4)	0.250(-0.149,0.634)	50(0,70)
	X^2 (H)		77.078	73.971	73.781	17.698	25.378	71.251	72.228
	P		**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****
Vertebral count	1	393	146(37.2)	82(28.9)	177(45.0)	262(66.7)	151(38.4)	0.795(0.505, 1.000)	80(65, 85)
	≥ 2	126	59(46.8)	34(27.0)	69(54.8)	93(73.8)	58(46.0)	0.696(0.347, 0.869)	70(59, 80)
	X^2 (Z)		3.737	2.058	3.618	2.252	2.297	-2.580	-2.984
	P		0.053	0.151	0.057	0.133	0.13	**0.010***	**0.003****
Albumin (g/L)	hypoprotein-aemia	193	92(47.7)	59(30.6)	109(56.5)	143(74.1)	90(46.6)	0.696(0.217, 0.869)	70(50, 80)
	normal albumin	326	113(34.7)	57(17.5)	137(42.0)	212(65.0)	119(36.5)	0.792(0.559, 1.000)	80(65, 90)
	X^2 (Z)		6.903	10.42	3.496	0.255	4.295	-3.785	-3.953
	P		**0.009****	**0.001****	0.062	0.614	**0.038***	**<0.001*****	**<0.001*****
BMD (g/cm^2)	<0.8	344	146(42.4)	78(22.7)	173(50.3)	247(71.8)	140(40.7)	0.783(0.445, 0.869)	75(60, 85)
	≥ 0.8	141	44(31.2)	26(18.4)	40(28.4)	41(29.1)	29(20.6)	0.869(0.586, 1.000)	75(65, 85)
	X^2 (Z)		5.299	0.733	4.487	5.430	0.610	2.232	0.641
	P		**0.021***	0.392	**0.034***	**0.020***	0.435	**0.026***	0.521

Notes The comparison of proportions or rates between groups was conducted using the Chi-square test or Fisher's exact test; for non-parametric data comparisons between two or multiple groups, the

Mann–Whitney U test or Kruskal–Wallis H test was employed

Significance levels: ***$p<0.001$; **$p<0.01$; *$p<0.05$

and bone mineral density were found to be independent factors affecting quality of life at 12 months postvertebroplasty in patients older than 65 years. Among these factors, pain/discomfort emerged as the primary issue faced by these patients after 12 months.

Previous studies have frequently reported on the quality of life of elderly patients using the EQ-5D-3L scale. According to the sixth National Health Services Survey (NHSS) conducted in Heilongjiang Province, China, the EQ-5D-3L utility scores for patients older than 60 years with hypertension (0.79) were significantly lower than those of the general population (0.96) [12]. Notably, the median EQ-5D-3L score for hypertensive patients older than 70 years was 0.783, which is consistent with

the quality of life score observed in elderly patients 12 months postvertebroplasty in this study. In a study conducted in Taiwan, elderly patients hospitalized for acute illnesses had a median EQ-5D-3L score of 0.440 upon admission, which increased to 0.648 upon discharge, with the EQ-VAS score increasing from 60 to 70. Compared to those in the current study, those elderly patients with acute-onset conditions had significantly lower quality of life, likely due to the greater median age of the study population (81 years) and the significant impact of physiological function on quality of life in the elderly population [13]. In our study, although the quality of life of elderly patients who underwent PVP surgery did not reach the standards of the general population 12 months postoperation, it was relatively better than that of elderly individuals experiencing acute illnesses. Vertebroplasty may improve the quality of life for elderly patients, yet the literature contains contentious results. A multicentre study in Australia demonstrated that compared with a placebo, percutaneous vertebroplasty (PVP) did not exhibit clinical efficacy in alleviating pain from osteoporotic vertebral compression fractures (OVCFs) for less than six weeks. There was no significant difference in the EQ-5D scores between the two groups preoperatively, but one month postoperatively, the EQ-5D scores for the group treated with PVP (average 0.8) were greater than those for the placebo group (average 0.74) [14]. Another randomized double-blind controlled trial revealed that, during a 12-month follow-up of patients with acute osteoporotic vertebral compression fractures, PVP did not significantly improve pain compared to sham surgery. Both groups of patients showed positive effects of the treatment, with improvements reflected in both the Roland-Morris Disability Questionnaire (RMDQ) and the Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO) scores. However, the positive therapeutic effect observed in the sham surgery group was unexpected, which may be attributed to the efficacy of local anaesthetics used for periosteal infiltration and the natural healing process of the fractures [15]. Notably, since this study was retrospective in design, we were unable to assess patients' quality of life before the fracture and before surgery, so it is impossible to accurately determine the changes in patients' quality of life. Therefore, this study focused mainly on analysing quality of life at a single time point (i.e., 12 months after surgery) and further explored the associated risk factors for quality of life at that time point. We observed that although vertebroplasty effectively alleviated pain and improved vertebral morphology, most patients still reported pain or discomfort within 12 months after surgery. This finding is consistent with previous research [4] showing that quality of life improved in the short term after vertebral fracture. Nevertheless, it remains challenging to return to prefracture status for a long time. This situation may be related not only to the physical damage of vertebral fractures but also to the patient's mental health, social capabilities, and daily life functions. Persistent pain, restricted activity, and physical changes can all lead to anxiety, depression, and low self-worth in patients. Therefore, in this study, in addition to pain/discomfort, patients also commonly reported issues related to usual activities and anxiety/depression.

Our study revealed that age, hormone therapy use, ASA grade, drinking habits, and albumin levels are core factors affecting the long-term quality of life of elderly patients after vertebroplasty. This trend is reflected in both the EQ-5D-3L health utility score and EQ-VAS score. The observed relationships between age, ASA grade, and postsurgical quality of life align with previous research [16]. The American Society of Anesthesiologists [17] did not include age in its grading criteria. However, some studies believe that old age itself is an independent factor for increased perioperative mortality [18], suggesting that even without systemic disease, it is recommended to increase the ASA grade by one level. Therefore, all patients aged 65 years and older in this study were rated as ASA II or higher. Currently, there is no clear conclusion on the best anaesthesia method for vertebroplasty. Some studies have pointed out that patients who undergo minimally invasive spinal surgery with general anaesthesia are more likely to experience fatigue within one month postoperatively [19]. Local anaesthesia may affect the effect of vertebral repositioning due to insufficient analgesia. In this study, univariate regression analysis indicated that the anaesthesia method was an independent factor affecting quality of life. However, when included in multivariate regression analysis, the anaesthesia method was not considered a major influencing factor. This discrepancy may arise from biases in anaesthesia method choices in retrospective studies. For elderly patients with an ASA grade of III or IV, poor cardiopulmonary function and increased anaesthesia risk, anaesthesiologists might prefer to choose local anaesthesia or sedation anaesthesia, which has a relatively minor impact on haemodynamics. This might lead to an imbalance in patient baseline characteristics, thereby affecting the interpretability of the research results.

The long-term use of hormones is closely related to a decrease in bone mineral density and bone fragility, thereby increasing the risk of fractures. This correlation may be due to glucocorticoids upregulating the expression of cytidine monophosphate kinase 2 (Cmpk2) in preosteoblasts [20]. Cmpk2 is a mitochondria-related gene that promotes the production of free mitochondrial DNA, which may then lead to inflammation mediated by the inflammasome, inducing bone cell ageing and mitochondrial dysfunction and ultimately increasing the

risk of osteoporosis. In this study, patients with diseases such as rheumatoid arthritis or ankylosing spondylitis who received hormone therapy had median health utility scores and median EQ-VAS scores of 0.437 (0.173, 0.869) and 62 (46, 75), respectively. In terms of the self-care and anxiety/depression dimensions, there was a statistically significant difference between patients who did not use hormones and those with the same disease type ($P<0.05$).

The influence of alcohol on quality of life is still debatable. One study revealed that drinking is negatively correlated with the quality of life of breast cancer patients and is considered one of the risk factors for breast cancer, leading to recommendations for breast cancer patients to abstain or limit alcohol consumption [21]. Another meta-analysis suggested [22] that regular and excessive drinkers have a greater risk of osteoporosis than nondrinkers; hence, moderate alcohol consumption is recommended for all osteoporosis patients [2]. However, a study in Japan revealed that drinkers generally perceive their health status to be better than nondrinkers [23]. This finding aligns with our findings in the present study, where drinkers reported a greater quality of life on the EQ-5D. This might be related to the subjectivity of the assessment tool, and considering that the majority of the drinkers in the present study were male, it may further imply that light to moderate drinking might be associated with better subjective health perceptions.

Albumin is an important indicator that reflects nutritional status and inflammatory state and can be used to predict adverse outcomes. Previous research has shown that lower serum albumin levels are associated with a decrease in quality of life [24]. In elderly people with low albumin levels, significant muscle mass loss can be observed [25], and albumin is also related to ageing, with serum albumin levels decreasing by 0.08 ~ 0.17 g/L annually. Hypoproteinaemia may be associated with an inflammatory response and poor pathologic recovery, which is considered a risk factor for disability in elderly people [26] and severely affects their health-related quality of life. In this study, we further found that elderly patients with hypoproteinaemia had significant difficulties in self-care ($P=0.001$), mobility ($P=0.009$), and anxiety/depression ($P=0.038$). Additionally, the number of vertebral compressive fractures and bone mineral density are also important factors affecting the quality of life of elderly patients. Multiple vertebral collapses can lead to an overall sagittal imbalance of the spine, resulting in restricted movement, increased pain, and potential neurological dysfunction. When the number of vertebral fractures is ≥2, the risk of residual postoperative pain in these patients significantly increases [27]. Compared to that of patients with single vertebral fractures, the postoperative quality of life of patients with multiple vertebral fractures significantly decreased, but the difficulty rate in each dimension did not significantly differ. Bone mineral density is an indicator that measures the mineral content in bones and is regulated by factors such as age, sex, and hormone levels. As age increases, especially in postmenopausal women, an imbalance in the bone remodelling process leads to a decrease in bone mineral density, thereby increasing the risk of compressive fractures [28]. This not only affects fracture repair and healing but also negatively impacts quality of life. Therefore, timely intervention and targeted treatment for elderly patients with decreased bone mineral density or multiple vertebral fractures are crucial to optimize their postoperative quality of life.

Limitations

There are certain limitations to this study. First, we could not access the quality of life data of patients before the fracture, and we lacked baseline data for comparison. Second, this study used a retrospective design, which might have led to recall or selection bias. Furthermore, our sample size might limit the generalizability of the results since the participants might not fully represent the overall situation of all vertebral fracture patients. Additionally, there are many factors that influence quality of life clinically, and we did not consider all potential factors that might affect the interpretation of the results. Last, since this study mainly relied on patient self-reported data, there might be risks of subjective bias and misreporting, affecting the accuracy of the results. In future studies, researchers should consider using a prospective design and combining objective assessment tools to provide a more accurate and comprehensive assessment of quality of life.

Conclusions

In conclusion, the most frequently self-reported issue 12 months after vertebroplasty in patients over 65 years old was pain/discomfort. According to the EQ-5D-3L Chinese utility scoring system, the key factors affecting the quality of life of these elderly patients included age, presence of tumours, hormone use, drinking habits, ASA grade, vertebral segment number, albumin levels, and bone mineral density. These findings provide important information for clinical decision-making, emphasizing the importance of pain management in elderly patients and prompting doctors to conduct detailed risk assessments on the aforementioned influencing factors, thus offering more precise and personalized treatment recommendations for elderly patients.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-024-05249-x.

Supplementary Material 1

Acknowledgements
We would like to acknowledge the hard work and dedication of all the researchers involved in this study.

Author contributions
Jie Song, Xiuli Jiang, and Jianyun Ge were involved in the conception and design of the study; Min Gao and Zhen Zeng were responsible for data collection; Min Gao, Xiuli Jiang, and Zhen Zeng participated in the data analysis and manuscript writing; Jie Song and Jianyun Ge reviewed and revised the manuscript content. All authors have read and approved the final manuscript.

Funding
This work was funded by the Nantong Municipal Bureau of Science and Technology, with the project grant number JC22022070.

Data availability
The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Affiliated Hospital 2 of Nantong University, with approval number 2022KT181. Due to its retrospective design, the requirement for written informed consent was waived by the Ethics Committee of Affiliated Hospital 2 of Nantong University. For the telephone follow-up conducted 12 months post-surgery, verbal consent was obtained from participants, who were also informed of their right to voluntary participation and withdrawal at any time. Prior to analysis, patient records were de-identified and anonymized.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 29 October 2023 / Accepted: 25 July 2024
Published online: 14 August 2024

References

1. Galibert P, Deramond H, Rosat P, Le Gars D. Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty. Neurochirurgie. 1987;33(2):166–8.
2. Harris K, Zagar CA, Lawrence KV. Osteoporosis: common questions and answers. Am Fam Physician. 2023;107(3):238–46.
3. McCarthy J, Davis A. Diagnosis and management of Vertebral Compression fractures. Am Fam Physician. 2016;94(1):44–50.
4. Svedbom A, Borgström F, Hernlund E, Ström O, Alekna V, Bianchi ML, Clark P, Curiel MD, Dimai HP, Jürisson M, et al. Quality of life for up to 18 months after low-energy hip, vertebral, and distal forearm fractures—results from the ICUROS. Osteoporos Int. 2018;29(3):557–66.
5. Halvachizadeh S, Stalder AL, Bellut D, Hoppe S, Rossbach P, Cianfoni A, Schnake KJ, Mica L, Pfeifer R, Sprengel K et al. Systematic review and Meta-analysis of 3 treatment arms for Vertebral Compression fractures: a comparison of Improvement in Pain, adjacent-level fractures, and Quality of Life between Vertebroplasty, Kyphoplasty, and Nonoperative Management. JBJS Rev 2021, 9(10).
6. Lau D, Funao H, Clark AJ, Nicholls F, Smith J, Bess S, Shaffrey C, Schwab FJ, Lafage V, Deviren V, et al. The clinical correlation of the Hart-ISSG Proximal Junctional Kyphosis Severity Scale with Health-Related Quality-of-life outcomes and need for revision surgery. Spine (Phila Pa 1976). 2016;41(3):213–23.
7. Buchholz I, Janssen MF. EQ-5D-3L norms for the European older Population: country-specific norms for 15 European countires based on the Survey of Health, Ageing, and Retirement in Europe. Value Health. 2023;26(5):721–32.
8. Zhou T, Guan H, Yao J, Xiong X, Ma A. The quality of life in Chinese population with chronic non-communicable diseases according to EQ-5D-3L: a systematic review. Qual Life Res. 2018;27(11):2799–814.
9. Wu C, Gong Y, Wu J, Zhang S, Yin X, Dong X, Li W, Cao S, Mkandawire N, Lu Z. Chinese version of the EQ-5D preference weights: Applicability in a Chinese General Population. PLoS ONE. 2016;11(10):e0164334.
10. Liu GG, Wu H, Li M, Gao C, Luo N. Chinese time trade-off values for EQ-5D health states. Value Health. 2014;17(5):597–604.
11. ASA House of Delegates/Executive Committee. Schaumburg (IL): American Society of Anesthesiologists. 2014. ASA physical status classification system [Internet]. Oct 15 [accessed 11 April 2020]. https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system
12. Zheng E, Xu J, Xu J, Zeng X, Tan WJ, Li J, Zhao M, Liu B, Liu R, Sui M, et al. Health-Related Quality of Life and its influencing factors for Elderly patients with hypertension: evidence from Heilongjiang Province, China. Front Public Health. 2021;9:654822.
13. Lin CF, Huang YH, Ju LY, Weng SC, Lee YS, Chou YY, Lin CS, Lin SY. Health-Related Quality of Life measured by EQ-5D in relation to Hospital Stay and Readmission in Elderly patients hospitalized for Acute Illness. Int J Environ Res Public Health 2020, 17(15).
14. Clark W, Bird P, Gonski P, Diamond TH, Smerdely P, McNeil HP, Schlaphoff G, Bryant C, Barnes E, Gebski V. Safety and efficacy of vertebroplasty for acute painful osteoporotic fractures (VAPOUR): a multicentre, randomised, double-blind, placebo-controlled trial. Lancet. 2016;388(10052):1408–16.
15. Firanescu CE, de Vries J, Lodder P, Venmans A, Schoemaker MC, Smeets AJ, Donga E, Juttmann JR, Klazen CAH, Elgersma OEH, et al. Vertebroplasty versus sham procedure for painful acute osteoporotic vertebral compression fractures (VERTOS IV): randomised sham controlled clinical trial. BMJ. 2018;361:k1551.
16. McGirt MJ, Bydon M, Archer KR, Devin CJ, Chotai S, Parker SL, Nian H, Harrell FE Jr., Speroff T, Dittus RS, et al. An analysis from the Quality outcomes Database, Part 1. Disability, quality of life, and pain outcomes following lumbar spine surgery: predicting likely individual patient outcomes for shared decision-making. J Neurosurg Spine. 2017;27(4):357–69.
17. De Cassai A, Boscolo A, Tonetti T, Ban I, Ori C. Assignment of ASA-physical status relates to anesthesiologists' experience: a survey-based national-study. Korean J Anesthesiol. 2019;72(1):53–9.
18. Kent I, Ghuman A, Sadran L, Rov A, Lifschitz G, Rudnicki Y, White I, Goldberg N, Avital S. Emergency colectomies in the Elderly Population-Perioperative Mortality risk-factors and long-term outcomes. J Clin Med 2023, 12(7).
19. De Biase G, Otamendi-Lopez A, Chen S, Bojaxhi E, Gruenbaum SE, Quinones-Hinojosa A, Abode-Iyamah K. Impact of postoperative fatigue following minimally-invasive lumbar spine surgery. J Clin Neurosci. 2023;112:64–7.
20. Cao N, Wang Z, Huang C, Chen B, Zhao P, Xu Y, Tian Y. Cmpk2 regulates mitochondrial function in glucocorticoid-induced osteoblast senescence and affects glucocorticoid-inhibited osteoblast differentiation. Arch Gerontol Geriatr. 2023;114:105080.
21. Chen S, Liu Y, Fong DYT, Zhou J, Chen H, Wan C. Health-related quality of life and its influencing factors in patients with breast cancer based on the scale QLICP-BR. Sci Rep. 2023;13(1):15176.
22. Cheraghi Z, Doosti-Irani A, Almasi-Hashiani A, Baigi V, Mansournia N, Etminan M, Mansournia MA. The effect of alcohol on osteoporosis: a systematic review and meta-analysis. Drug Alcohol Depend. 2019;197:197–202.
23. Saito I, Okamura T, Fukuhara S, Tanaka T, Suzukamo Y, Okayama A, Ueshima H. A cross-sectional study of alcohol drinking and health-related quality of life among male workers in Japan. J Occup Health. 2005;47(6):496–503.
24. Han K, Wang SS, Jia WP, Yang SS, Cao WZ, Zhao YL, Zhu Q, Ning CX, Liu M, He Y. Association between serum albumin level and health-related quality of life in Hainan centenarians: a cross-sectional study. Zhonghua Liu Xing Bing Xue Za Zhi. 2021;42(1):88–93.
25. Cabrerizo S, Cuadras D, Gomez-Busto F, Artaza-Artabe I, Marín-Ciancas F, Malafarina V. Serum albumin and health in older people: review and meta analysis. Maturitas. 2015;81(1):17–27.
26. Arroyo V, García-Martinez R, Salvatella X. Human serum albumin, systemic inflammation, and cirrhosis. J Hepatol. 2014;61(2):396–407.

27. Wang ZW, Liu DK, Zhang DZ, Hu SB, Zhao C. Risk factors for residual back pain after PVP treatment for osteoporotic thoracolumbar compression fractures: a retrospective cohort study. World Neurosurg; 2023.
28. Singh N, Kumar D, Yadav G, Srivastava MK, Mishra SR, Gupta AK, Jauhari S, Roy MS. Comparison of Quality of Life and Bone Mass Density among Postmenopausal women: a cross-sectional study. J Midlife Health. 2020;11(4):224–30.

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