

Residents of Mountainous Areas Have a Higher Low Back Pain Prevalence Than Flat Areas of Chongqing, China: A Cross-Sectional Study

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Background and Purpose: Epidemiological studies on low back pain in residents living in mountainous areas are scarce. The study was aimed at investigating the prevalence and associated factors of low back pain in Chongqing, relatively impoverished mountainous areas of China.

Materials and Methods: This was a cross-sectional study conducted at selected community or village health service centers in Chongqing over a 2-month period (May 2021 to June 2021), which included adults of Chongqing aged >18 years with or without low back pain (N=1820) chosen by stratified, cluster-sampling. Associated factors of low back pain including sociodemographic characteristics, lifestyle, and occupational features were collected, along with medical history, Oswestry Disability Questionnaire (ODI), and Numerical Rating Scale (NRS) of patients with low back pain, and carried out for at least 20 minutes per respondent. Univariate and multivariate logistic regression models were utilized for statistical analysis.

Results: Overall, 30.5% of 1704 respondents presented with low back pain, with 26.3% living in flat areas and 35.6% in mountainous areas. The associated factors of low back pain were mountainous area residence (OR 1.4, 95% CI 1.1–1.8), advanced age (OR 1.8, 95% CI 1.3–2.5 for those aged 45–59 years, OR 2.3, 95% CI 1.6–3.4 for those aged 60–74 years, and OR 2.1, 95% CI 1.2–3.6 for those aged ≥75 years), married or remarried (OR 1.9, 95% CI 1.1–3.2), divorced or widowed (OR 2.7, 95% CI 1.4–5.4), moderate labor intensity (OR 1.4, 95% CI 1.1–1.8), frequent stoop (OR 1.6, 95% CI 1.1–2.4), and depressed mood (OR 1.6, 95% CI 1.2–2.1). Residents in the mountainous areas had a higher score on Oswestry Disability Questionnaire (8.3 [SD 6.3] vs 6.2 [SD 4.3]) than those in flat areas.

Conclusion: Mountainous areas in Chongqing had higher prevalence of low back pain as 35.6%, compared with 26.3% in flat areas, with more severe dysfunction in low back pain patients. Multifactorial analysis found that the factors associated with low back pain in Chongqing residents included mountain residence, labor intensity, stoop, psychological factors and frequency of exercise.

Keywords: low back pain, prevalence, associated factors, China

Introduction

The leading cause of disability worldwide is low back pain (LBP).¹ Pain can cause disability, which in turn can worsen pain, potentially leading to absence from work, depression, anxiety, and degressive quality of life.^{2,3} In recent decades, social support systems and healthcare providers have been negatively affected by the rapid increase in LBP disabilities, in low- and middle-income countries, including China.⁴ In 2017, musculoskeletal disorders were one of three main reasons for years lived with disability in China,⁵ and LBP is the second most burdensome musculoskeletal disorder after neck pain.⁶

Epidemiological studies on LBP are fewer in Asian countries than in Western countries.³ The maximum point-prevalence of LBP is 32.9% in high-income, 25.4% in middle-income, and 16.7% in low-income countries.³ China ranked second in the age-standardized one-year prevalence of LBP when compared with 19 member countries of Group

20, excluding the European Union, between 1990 and 2017.⁶ There are many factors related to LBP, including smoking, sex, age, marital status, occupation, and psychological factors.^{6,7}

To our knowledge, there are few epidemiological investigations regarding LBP in people living in mountainous areas. Some studies pointed out that the potential risk of chronic LBP was increased among miners at high altitudes due to the decreased muscle endurance and fatigue caused by hypoxia.⁸ A study also showed that rural mountain residents walked up and down steep slopes on a daily basis, which increased the mechanical load on their bodies and may lead to musculoskeletal disorders such as knee and low back pain.⁹ Therefore, this study hypothesized that the prevalence of LBP and associated factors in mountainous areas would be different from those in flat areas due to their various topographical characteristics, labor characteristics, and residents' lifestyles. In addition, the geographical constraints of mountainous areas lead to limited transportation, relative economic backwardness, and scarce medical resources. It has been reported that low- or middle-income areas are inclined to apply expensive, ineffective, and potentially harmful procedures and interventions to treat LBP, which invariably increased the cost of LBP treatment.¹⁰ LBP has driven people already living in low socioeconomic conditions into more severe poverty and more disability.¹¹ A vicious cycle was created between mountains, low back pain, and poverty.

Public health management faces great challenges in mountainous areas in China because of economic and regional constraints, aggravating poverty. The Chinese government has created the Healthy China 2030 plan, a health policy treating population health as the primary goal of economic development and political reform.⁵ A targeted poverty alleviation policy was implemented in China to eliminate all forms of poverty.¹² We aimed to conduct this cross-sectional survey to respond to the national policy and enhance awareness of LBP in mountainous areas. Chongqing, China, was selected due to its undeveloped economic situation and the richness of special geomorphic features. It comprises three geomorphic features: the west and south have low and medium mountains, 30.24% in total area; the east and north have low hills, 38.81% in total area, and the central basin is a flat dam area, 30.94% in total area.

Therefore, we conducted this survey according to different terrain zones in Chongqing to assess the following questions for motivating clinicians to learn the epidemiological information of LBP in mountainous areas, assisting mountain residents to select healthier lifestyles, and prompting researchers to identify potential risk factors of LBP in mountainous areas, which will guide the direction of the next research:

1. Is there a higher prevalence of LBP in mountainous areas than in flat areas of Chongqing?
2. Are there specific associated factors for LBP in Chongqing?
3. Do people with LBP living in mountainous areas have more severe pain and dysfunction than those living in flat areas in Chongqing?

Materials and Methods

Design

We conducted this stratified, cluster-sampling cross-sectional survey in Chongqing from May 2021 to June 2021. All investigators were medical workers trained for questioning technique and information filling of questionnaires homogeneously. Stratified sampling was divided into two layers considering terrain characteristics. The first layer was low and medium mountainous and low hilly areas (collectively referred to as mountainous areas), and the second layer was flat areas. Two communities were selected from the flat areas, with an average of 400–500 people in each. Five villages were selected from the mountainous areas, with an average of 100–300 people in each.

The investigators filled out paper questionnaires by asking participants questions. The questionnaire comprised four parts. The first part was the associated factors questionnaire ([Appendix 1](#)), including sociodemographic characteristics, lifestyle, and occupational features. Parts two to four were medical history ([Appendix 2](#)), Oswestry Disability Questionnaire (ODI) ([Appendix 3](#)), and Numerical Rating Scale (NRS) ([Appendix 4](#)) of patients with LBP, respectively. ([Appendix 1–4](#) are presented in the [Appendix](#)). All participants needed to answer the questions of the first part, and only those with symptoms of LBP needed to complete the remaining parts of the questionnaire. According to the

symptomatology definition, we diagnosed LBP as a type of pain localized between the lower edge of the costal bone and the subgluteal fold commonly accompanied by radiating pain in one or both limbs.

Participants

The respondents were aged 18 years or older, had no hearing or language impairment, no cognitive impairment, and lived in the surveyed area for ≥ 5 years. Pregnant or lactating women and participants with lumbar tumors and other severe underlying diseases were excluded. The respondents were enrolled by the local public health authorities in Chongqing during the regularly health surveillance.

Data Extraction

The survey data were inputted into EpiData v.3.1 (The EpiData Association, Odense, Denmark) by two researchers. Disputed data and absent items were selected by comparing the results of the two-person input and checked through the original paper questionnaire. And the absent data were corrected through telephone inquiries. If participants could not be contacted or relevant data were not available, the questionnaire would be excluded from the study results.

Data Analysis

A randomized population study by Tsang et al¹³ found that the prevalence of LBP, among adults in Chongqing, was 17.6%. According to the formula for estimating the population rate $N = \frac{2}{\delta^2} \frac{z_{\alpha}^2}{P(1-P)}$ (deff, design effect; P, population rate; and δ , allowable error), the number of participants needed for the study was 1422 in the case where deff was 2.0 and the absolute error was 2.0%.

IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp was used for statistical analysis. First, the prevalence of LBP in Chongqing was calculated. Second, relationships between demographics and LBP status (LBP vs no LBP) were analyzed. Categorical variables, expressed as frequencies and percentages, were analyzed univariately using chi-square tests, Fisher's exact test, and binomial logistic regression analysis. Variables with P values < 0.1 were included in the multifactor binomial logistic regression analysis. The odds ratio (OR) with $\pm 95\%$ confidence interval (CI) was estimated, indicating associated variables with the probability of the LBP. Third, the Mann-Whitney *U*-test was used to evaluate the effect of terrain on LBP and degree of pain; the median (P25, P75) was used to represent measurement data that did not follow the normal distribution. In all the above statistical analyses, statistical significance was set as P values < 0.05 .

Results

Flow of Participants

The study recruited 1820 residents of Chongqing. Overall, 1738 residents completed the questionnaires, excluding 57 who refused to participate and 25 who did not meet the inclusion and exclusion criteria. After excluding 34 failed questionnaires, we included 1704 residents' questionnaires in the statistical analysis. Among them, 935 were from flat areas and 769 from mountainous areas, 520 had LBP, and 1184 had no LBP (Figure 1).

Demographic Characteristics

Most respondents were female ($n=1084$, 63.6%), aged 45–59 years ($n=689$, 40.4%), and of Han nationality ($n=832$, 48.8%). The respondents' characteristics in flat and mountainous areas were similar to all study participants, except for exercising and entertainment. Most respondents in flat areas exercised occasionally ($n=434$, 46.4%), and most respondents in mountainous areas liked walking or fitness ($n=299$, 38.9%). Although most respondents in mountainous areas did not climb mountains often, significantly more respondents in mountainous areas ($n=357$, 46.4%) climbed mountains more often than those living in flat areas ($n=123$, 13.2%). Respondents living in mountainous areas also climbed more times and longer periods per week than those living in flat areas. For example, the number of respondents living in mountainous areas who climbed mountains more than 10 times ($n=100$, 13.0%) and climbed mountains more than 5 hours ($n=184$, 23.9%) per week were far more than those living in flat areas who climbed mountains more than 10 times ($n=9$, 1.0%) and climbed mountains more than 5 hours ($n=32$, 3.4%) per week (Table 1).

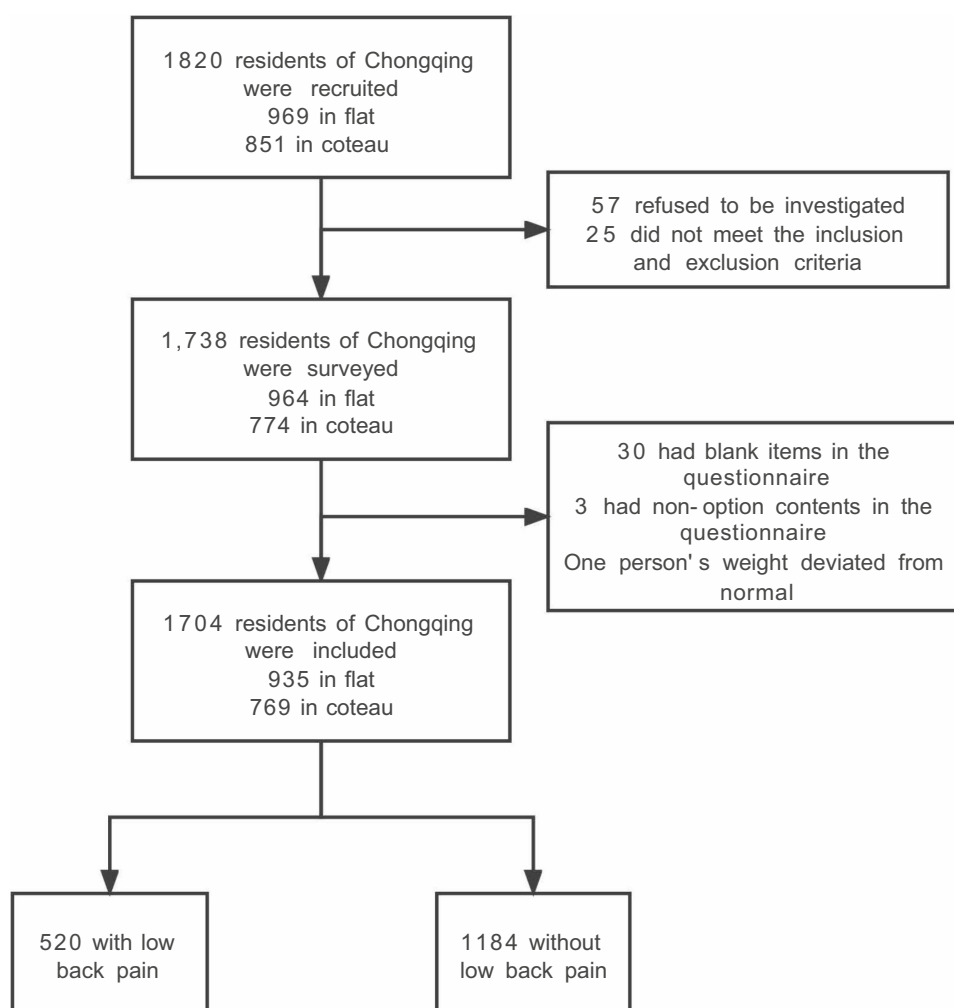


Figure 1 Process of epidemiological investigation of low back pain in Chongqing, China. Flat areas are abbreviated as “flat” and mountainous areas are abbreviated as “coteau.”

Is There a Higher Prevalence of LBP in Mountainous Areas Than in Flat Areas of Chongqing?

Among the participants, 520 (30.5%) experienced LBP (Table 1). In total, 246 interviewees (26.3%) in flat areas and 274 (35.6%) in mountainous areas had LBP. The prevalence of LBP tended to increase with age (21.1% vs 31.5% vs 37.8% vs 36.1%), climbing times (28.0% vs 31.3% vs 37.8% vs 46.8%), climbing frequency (28.0% vs 32.4% vs 35.8% vs 41.2%), the labor intensity (26.2% vs 33.0% vs 37.7%), frequency of sadness (27.8% vs 36.6% vs 43.9%) and tended to decrease with exercise frequency (36.6% vs 29.2% vs 28.0%) (Table 2). In flat areas, prevalence of LBP was lower among people who reported increased exercise frequency (33.9% vs 28.3% vs 19.3%). It was higher among people who reported enhanced labor intensity (23.8% vs 27.1% vs 44.1%), and increased frequency of depressed mood (23.5% vs 31.1% vs 61.1%) (Table 3). People with a higher prevalence of LBP in mountainous areas were mainly concentrated in those aged ≥ 60 years (45.4%, 40.0%), divorced or widowed (45.5%), farmers (38.5%), with moderate labor intensity (41.4%), frequent bending (54.9%) and so on. It is noteworthy that the prevalence of LBP is higher in those who frequently climbed (40.9%), and it increased with increasing frequency of climbing (31.1% vs 35.8% vs 40.7% vs 47.0%) and duration of climbing (31.1% vs 38.8% vs 40.8% vs 41.8%) in mountainous areas. (Table 4).

Are There Specific Associated Factors for LBP in Chongqing?

We obtained modifiable associated factors by multifactorial logistic regression analysis, which were mountainous area residence (OR 1.4, 95% CI 1.1–1.8), advanced age (OR 1.8, 95% CI 1.3–2.5; OR 2.3, 95% CI 1.6–3.4; OR 2.1, 95% CI

Table I Demographic Characteristics of the Respondents in Chongqing, China

	All Study Participants (n=1704)	Flat Areas (n=935)	Mountainous Areas (n=769)
Gender			
Male	620(36.4%)	339(36.3%)	281(36.5%)
Female	1084(63.6%)	596(63.7%)	488(63.5%)
Age, years			
18–44	473(27.8%)	307(32.8%)	166(21.6%)
45–59	689(40.4%)	394(42.1%)	295(38.4%)
60–74	445(26.1%)	207(22.1%)	238(30.9%)
≥75	97(5.7%)	27(2.9%)	70(9.1%)
Nationality			
Han nationality	832(48.8%)	450(48.1%)	382(49.7%)
Tujia nationality	665(39.0%)	354(37.9%)	311(40.4%)
Miao nationality	199(11.7%)	127(13.6%)	72(9.4%)
Others	8(0.5%)	4(0.4%)	4(0.5%)
Education level			
Primary School or below	874(51.3%)	385(41.2%)	489(63.6%)
Junior high school	506(29.7%)	291(31.1%)	215(28.0%)
Senior high school	102(6.0%)	77(8.2%)	25(3.3%)
College or Professional school	143(8.4%)	112(12.0%)	31(4.0%)
University graduate or above	79(4.6%)	70(7.5%)	9(1.2%)
Marital status			
Unmarried	107(6.3%)	67(7.2%)	40(5.2%)
Married or remarried	1501(88.1%)	827(88.4%)	674(87.6%)
Divorced or widowed	96(5.6%)	41(4.4%)	55(7.2%)
Occupation			
Farmer	836(49.1%)	317(33.9%)	519(67.5%)
Blue collar	396(23.2%)	257(27.5%)	139(18.1%)
White collar	197(11.6%)	154(16.5%)	43(5.6%)
Housewife	221(13.0%)	157(16.8%)	64(8.3%)
Retirement	52(3.1%)	48(5.1%)	4(0.5%)
Student	2(0.1%)	2(0.2%)	0(0.0%)
BMI, kg/m ²			
<18.5	110(6.5%)	51(5.5%)	59(7.7%)
18.5–24.9	1043(61.2%)	563(60.2%)	480(62.4%)
25.0–29.9	478(28.1%)	275(29.4%)	203(26.4%)
≥30.0	73(4.3%)	46(4.9%)	27(3.5%)
Smoking			
Yes	404(23.7%)	212(22.7%)	192(25.0%)
No	1300(76.3%)	723(77.3%)	577(75.0%)
Drinking			
Yes	281(16.5%)	133(14.2%)	148(19.2%)
No	1423(83.5%)	802(85.8%)	621(80.8%)
Exercise			
Never	407(23.9%)	180(19.3%)	227(29.5%)
Occasionally	640(37.6%)	434(46.4%)	206(26.8%)
Often	657(38.6%)	321(34.3%)	336(43.7%)
Entertainment			
Not have	119(7.0%)	10(1.1%)	109(14.2%)
Playing cards	215(12.6%)	120(12.8%)	95(12.4%)
Watching TV or phone	750(44.0%)	484(51.8%)	266(34.6%)
Walking or fitness	620(36.4%)	321(34.3%)	299(38.9%)

(Continued)

Table 1 (Continued).

	All Study Participants (n=1704)	Flat Areas (n=935)	Mountainous Areas (n=769)
Do you often climb mountains			
Yes	480(28.2%)	123(13.2%)	357(46.4%)
No	1224(71.8%)	812(86.8%)	412(53.6%)
The average frequency of mountain climbing per week, times			
<2	1223(71.8%)	812(86.8%)	411(53.4%)
2–5	208(12.2%)	85(9.1%)	123(16.0%)
6–9	164(9.6%)	29(3.1%)	135(17.6%)
≥10	109(6.4%)	9(1.0%)	100(13.0%)
Average time spent climbing a mountain per week, hours			
<1	1223(71.8%)	812(86.8%)	411(53.4%)
1–2	170(10.0%)	67(7.2%)	103(13.4%)
3–4	95(5.6%)	24(2.6%)	71(9.2%)
≥5	216(12.7%)	32(3.4%)	184(23.9%)
Main labor intensity			
Mild	724(42.5%)	407(43.5%)	317(41.2%)
Moderate	842(49.4%)	494(52.8%)	348(45.3%)
Heavy	138(8.1%)	34(3.6%)	104(13.5%)
The time of work per day, hours			
0–4	805(47.2%)	432(46.2%)	373(48.5%)
4–8	418(24.5%)	219(23.4%)	199(25.9%)
>8	481(28.2%)	284(30.4%)	197(25.6%)
The longest fixed position held each day			
Sitting position	736(43.2%)	413(44.2%)	323(42.0%)
Standing position	776(45.5%)	437(46.7%)	339(44.1%)
Bending position	184(10.8%)	82(8.8%)	102(13.3%)
Supine position	8(0.5%)	3(0.3%)	5(0.7%)
The time you spend in this position each day, hours			
0–1	541(31.7%)	337(36.0%)	204(26.5%)
1–2	525(30.8%)	306(32.7%)	219(28.5%)
2–3	237(13.9%)	102(10.9%)	135(17.6%)
>3	401(23.5%)	190(20.3%)	211(27.4%)
Whether you feel sad or discouraged about life			
Never	1224(71.8%)	663(70.9%)	561(73.0%)
Occasionally	423(24.8%)	254(27.2%)	169(22.0%)
Often	57(3.3%)	18(1.9%)	39(5.1%)
Low back pain			
Yes	520(30.5%)	246(26.3%)	274(35.6%)
No	1184(69.5%)	689(73.7%)	495(64.4%)

1.2–3.6), married or remarried (OR 1.9, 95% CI 1.1–3.2), divorced or widowed (OR 2.7, 95% CI 1.4–5.4), less exercise ([OR 0.7, 95% CI 0.5–0.9] for often exercise), moderate labor intensity (OR 1.4, 95% CI 1.1–1.8), frequent stoop (OR 1.6, 95% CI 1.1–2.4), depressed mood (OR 1.6, 95% CI 1.2–2.1), and high school education as a potential protective factor for LBP (OR 0.563, 95% CI 0.319–0.996) (Figure 2). For flatland residents, age 45–74 years (OR 2.0, 95% CI 1.3–3.1; OR 2.5, 95% CI 1.5–4.3), university or higher education (OR 2.6, 95% CI 1.2–5.3), and occasional or frequent sadness (OR 1.5, 95% CI 1.1–2.1; OR 5.8, 95% CI 2.1–16.0) were associated factors for LBP, while regular exercise (OR 0.4, 95% CI 0.3–0.7) was an associated factor in the reverse for LBP (Figure 3). For mountainous areas, residents aged 60–74 (OR 2.3, 95% CI 1.3–4.2), 75 years and older (OR 2.3, 95% CI 1.1–4.7), married or remarried (OR 3.4, 95% CI 1.3–9.1), divorced or widowed (OR 4.1, 95% CI 1.3–12.6), fond of playing cards (OR 2.7, 95% CI 1.4–5.3), frequent

Table 2 Univariate Analysis of the Associations Between Demographics and Low Back Pain Status in Chongqing

	Low Back Pain (n=520)	Non-Low Back Pain(n=1184)	P(Chi-Square Test)	Rate of Low Back Pain	P (Linear by Linear Association)	Unadjusted OR (95% CI)
Terrain characteristics			<0.001			
Flat areas	246(47.3%)	689(58.2%)		26.3%		1(ref)
Mountainous areas	274(52.7%)	495(41.8%)		35.6%		1.550(1.260–1.907)
Age, years			<0.001		<0.001	
18–44	100(19.2%)	373(31.5%)		21.1%		1(ref)
45–59	217(41.7%)	472(39.9%)		31.5%		1.715(1.305–2.253)
60–74	168(32.3%)	277(23.4%)		37.8%		2.262(1.689–3.030)
≥75	35(6.7%)	62(5.2%)		36.1%		2.106(1.317–3.367)
Education level			<0.001		0.007	
Primary School or below	308(59.2%)	566(47.8%)		35.2%		1(ref)
Junior high school	130(25.0%)	376(31.8%)		25.7%		0.635(0.498–0.810)
Senior high school	18(3.5%)	84(7.1%)		17.6%		0.394(0.232–0.667)
College or Professional school	37(7.1%)	106(9.0%)		25.9%		0.641(0.430–0.956)
University graduate or above	27(5.2%)	52(4.4%)		34.2%		0.954(0.587–1.550)
Marital status			0.001			
Unmarried	21(4.0%)	86(7.3%)		19.6%		1(ref)
Married or remarried	457(87.9%)	1044(88.2%)		30.4%		1.793(1.099–2.925)
Divorced or widowed	42(8.1%)	54(4.6%)		43.8%		3.185(1.705–5.949)
Occupation			<0.001			
Farmer	296(56.9%)	540(45.6%)		35.4%		1(ref)
Blue collar	107(20.6%)	289(24.4%)		27.0%		0.675(0.519–0.879)
White collar	60(11.5%)	137(11.6%)		30.5%		0.799(0.572–1.117)
Housewife	43(8.3%)	178(15.0%)		19.5%		0.441(0.307–0.633)
Retirement	14(2.7%)	38(3.2%)		26.9%		0.672(0.358–1.261)
Student	0(0.0%)	2(0.2%)		0.0%		0
Smoking			0.090			
Yes	137(26.3%)	267(22.6%)		33.9%		1.229(0.968–1.559)
No	383(73.7%)	917(77.4%)		29.5%		1(ref)
Drinking			0.082			
Yes	98(18.8%)	183(15.5%)		34.9%		1.270(0.969–1.665)
No	422(81.2%)	1001(84.5%)		29.7%		1(ref)
Exercise			0.008		0.005	
Never	149(28.7%)	258(21.8%)		36.6%		1(ref)
Occasionally	187(36.0%)	453(38.3%)		29.2%		0.715(0.549–0.931)
Often	184(35.4%)	473(39.9%)		28.0%		0.674(0.517–0.877)
Do you often climb mountains			<0.001			
Yes	178(34.2%)	302(25.5%)		37.1%		1.520(1.216–1.900)
No	342(65.8%)	882(74.5%)		27.9%		1(ref)
The average frequency of mountain climbing per week, times			<0.001		<0.001	
<2	342(65.8%)	881(74.4%)		28.0%		1(ref)
2–5	65(12.5%)	143(12.1%)		31.3%		1.171(0.851–1.610)
6–9	62(11.9%)	102(8.6%)		37.8%		1.566(1.115–2.199)
≥10	51(9.8%)	58(4.9%)		46.8%		2.265(1.524–3.367)
Average time spent climbing a mountain per week, hours			0.001		<0.001	
<1	342(65.8%)	881(74.4%)		28.0%		1(ref)
1–2	55(10.6%)	115(9.7%)		32.4%		1.232(0.873–1.739)
3–4	34(6.5%)	61(5.2%)		35.8%		1.436(0.927–2.224)
≥5	89(17.1%)	127(10.7%)		41.2%		1.805(1.340–2.433)

(Continued)

Table 2 (Continued).

	Low Back Pain (n=520)	Non-Low Back Pain(n=1184)	P(Chi-Square Test)	Rate of Low Back Pain	P (Linear by Linear Association)	Unadjusted OR (95% CI)
Main labor intensity			0.002		0.001	
Mild	190(36.5%)	534(45.1%)		26.2%		1(ref)
Moderate	278(53.5%)	564(47.6%)		33.0%		1.385(1.113–1.725)
Heavy	52(10.0%)	86(7.3%)		37.7%		1.699(1.160–2.490)
The longest fixed position held each day			<0.001			
Sitting position	211(40.6%)	525(44.3%)		28.7%		1(ref)
Standing position	220(42.3%)	556(47.0%)		28.4%		0.985(0.787–1.231)
Bending position	85(16.3%)	99(8.4%)		46.2%		2.136(1.534–2.974)
Supine position	4(0.8%)	4(0.3%)		50.0%		2.488(0.617–10.040)
Whether you feel sad or discouraged about life			<0.001		<0.001	
Never	340(65.4%)	884(74.7%)		27.8%		1(ref)
Occasionally	155(29.8%)	268(22.6%)		36.6%		1.504(1.190–1.900)
Often	25(4.8%)	32(2.7%)		43.9%		2.031(1.186–3.478)

Table 3 Univariate Analysis of the Associations Between Demographics and Low Back Pain Status in Flat Areas of Chongqing

	Participants of Flat Areas (n=935)	Low Back Pain (n=246)	No Low Back Pain (n=689)	P (Chi-Square Test)	P (Linear by Linear Association)	Unadjusted OR (95% CI)
Age, years				0.095	0.056	
18–44	307(32.8%)	65(21.2%)	242(78.8%)			1(ref)
45–59	394(42.1%)	114(28.9%)	280(71.1%)			1.516(1.068–2.151)
60–74	207(22.1%)	60(29.0%)	147(71.0%)			1.520(1.012–2.281)
≥75	27(2.9%)	7(25.9%)	20(74.1%)			1.303(0.528–3.215)
Education level				0.023	0.416	
Primary School or below	385(41.2%)	113(29.4%)	272(70.6%)			1(ref)
Junior high school	291(31.1%)	73(25.1%)	218(74.9%)			0.806(0.571–1.137)
Senior high school	77(8.2%)	13(16.9%)	64(83.1%)			0.489(0.259–0.923)
College or Professional school	112(12.0%)	22(19.6%)	90(80.4%)			0.588(0.352–0.985)
University graduate or above	70(7.5%)	25(35.7%)	45(64.3%)			1.337(0.783–2.285)
Marital status				0.07		
Unmarried	67(7.2%)	16(23.9%)	51(76.1%)			1(ref)
Married or remarried	827(88.4%)	213(25.8%)	614(74.2%)			1.106(0.617–1.981)
Divorced or widowed	41(4.4%)	17(41.5%)	24(58.5%)			2.258(0.977–5.217)
Exercise				0.001	<0.001	
Never	180(19.3%)	61(33.9%)	119(66.1%)			1(ref)
Occasionally	434(46.4%)	123(28.3%)	311(71.7%)			0.772(0.532–1.120)
Often	321(34.3%)	62(19.3%)	259(80.7%)			0.467(0.308–0.707)
Main labor intensity				0.029	0.034	
Mild	407(43.5%)	97(23.8%)	310(76.2%)			1(ref)
Moderate	494(52.8%)	134(27.1%)	360(72.9%)			1.199(0.847–1.696)
Heavy	34(3.6%)	15(44.1%)	19(55.9%)			2.122(0.978–4.605)
Whether you feel sad or discouraged about life				<0.001	<0.001	
Never	663(70.9%)	156(23.5%)	507(76.5%)			1(ref)
Occasionally	254(27.2%)	79(31.1%)	175(68.9%)			1.467(1.065–2.022)
Often	18(1.9%)	11(61.1%)	7(38.9%)			5.107(1.947–13.398)

Table 4 Univariate Analysis of the Associations Between Demographics and Low Back Pain Status in Mountainous Areas of Chongqing

	Participants of Mountainous Areas (n=769)	Low Back Pain (n=274)	No Low Back Pain (n=495)	P (Chi-Square Test)	P (Linear by Linear Association)	Unadjusted OR (95% CI)
Age, years				<0.001	<0.001	
18–44	166(21.6%)	35(21.1%)	131(78.9%)			1 (ref)
45–59	295(38.4%)	103(34.9%)	192(65.1%)			2.008(1.289–3.128)
60–74	238(30.9%)	108(45.4%)	130(54.6%)			3.109(1.979–4.886)
≥75	70(9.1%)	28(40.0%)	42(60.0%)			2.495(1.361–4.576)
Nationality				0.020(fisher)		
Han nationality	382(49.7%)	155(40.6%)	227(59.4%)			1 (ref)
Tujia nationality	311(40.4%)	96(30.9%)	215(69.1%)			0.654(0.477–0.897)
Miao nationality	72(9.4%)	23(31.9%)	49(68.1%)			0.687(0.402–1.175)
Others	4(0.5%)	0(0%)	4(100%)			0
Education level				0.001	0.071	
Primary School or below	489(63.6%)	195(39.9%)	294(60.1%)			1 (ref)
Junior high school	215(28.0%)	57(26.5%)	158(73.5%)			0.544(0.382–0.774)
Senior high school	25(3.3%)	5(20.0%)	20(80.0%)			0.377(0.139–1.021)
College or Professional school	31(4.0%)	15(48.4%)	16(51.6%)			1.413(0.683–2.925)
University graduate or above	9(1.2%)	2(22.2%)	7(77.8%)			0.431(0.089–2.095)
Marital status				0.003		
Unmarried	40(5.2%)	5(12.5%)	35(87.5%)			1 (ref)
Married or remarried	674(87.6%)	244(36.2%)	430(63.8%)			3.972(1.536–10.272)
Divorced or widowed	55(7.2%)	25(45.5%)	30(54.5%)			5.833(1.987–17.124)
Occupation				0.001		
Farmer	519(67.5%)	200(38.5%)	319(61.5%)			1 (ref)
Blue collar	139(18.1%)	45(32.4%)	94(67.6%)			0.764(0.513–1.136)
White collar	43(5.6%)	17(39.5%)	26(60.5%)			1.043(0.552–1.971)
Housewife	64(8.3%)	9(14.1%)	55(85.9%)			0.261(0.126–0.540)
Retirement	4(0.5%)	3(75.0%)	1(25.0%)			4.785(0.494–46.319)
Entertainment				0.033		
Not have	109(14.2%)	38(34.9%)	71(65.1%)			1 (ref)
Playing cards	95(12.4%)	43(45.3%)	52(54.7%)			1.545(0.879–2.716)
Watching TV or phone	266(34.6%)	79(29.7%)	187(70.3%)			0.789(0.492–1.268)
Walking or fitness	299(38.9%)	114(38.1%)	185(61.9%)			1.151(0.728–1.820)
Do you often climb mountains				0.005		
Yes	357(46.4%)	146(40.9%)	211(59.1%)			1.535(1.141–2.066)
No	412(53.6%)	128(31.1%)	284(68.9%)			1 (ref)
The average frequency of mountain climbing per week, times				0.013	0.001	
<2	411(53.4%)	128(31.1%)	283(68.9%)			1 (ref)
2–5	123(16.0%)	44(35.8%)	79(64.2%)			1.231(0.806–1.881)
6–9	135(17.6%)	55(40.7%)	80(59.3%)			1.520(1.017–2.272)
≥10	100(13.0%)	47(47.0%)	53(53.0%)			1.961(1.257–3.059)
Average time spent climbing a mountain per week, hours				0.045	0.007	
<1	411(53.4%)	128(31.1%)	283(68.9%)			1 (ref)
1–2	103(13.4%)	40(38.8%)	63(61.2%)			0.629(0.439–0.901)
3–4	71(9.2%)	29(40.8%)	42(59.2%)			0.882(0.539–1.444)
≥5	184(23.9%)	77(41.8%)	107(58.2%)			0.959(0.550–1.674)
Main labor intensity				0.005	0.032	
Mild	317(41.2%)	93(29.3%)	224(70.7%)			1 (ref)
Moderate	348(45.3%)	144(41.4%)	204(58.6%)			1.700(1.232–2.347)
Heavy	104(13.5%)	37(35.6%)	67(64.4%)			1.330(0.832–2.125)

(Continued)

Table 4 (Continued).

	Participants of Mountainous Areas (n=769)	Low Back Pain (n=274)	No Low Back Pain (n=495)	P (Chi-Square Test)	P (Linear by Linear Association)	Unadjusted OR (95% CI)
The longest fixed position held each day				<0.001 (fisher)	<0.001	
Sitting position	323(42.0%)	102(31.6%)	221(68.4%)			1 (ref)
Standing position	339(44.1%)	113(33.3%)	226(66.7%)			1.083(0.782–1.500)
Bending position	102(13.3%)	56(54.9%)	46(45.1%)			2.638(1.673–4.158)
Supine position	5(0.7%)	3(60.0%)	2(40.0%)			3.250(0.535–19.750)
Whether you feel sad or discouraged about life				0.014	0.039	
Never	561(73.0%)	184(32.8%)	377(67.2%)			1 (ref)
Occasionally	169(22.0%)	76(45.0%)	93(55.0%)			1.674(1.179–2.377)
Often	39(5.1%)	14(35.9%)	25(64.1%)			1.147(0.583–2.259)

bending (OR 2.0, 95% CI 1.1–3.6), and occasionally feeling sad (OR 1.7, 95% CI 1.1–2.4) were associated factors for LBP, while Tujia nationality (OR 0.6, 95% CI 0.5–0.9) and being a housewife (OR 0.4, 95% CI 0.2–0.97) were associated factors in the reverse for LBP (Figure 4).

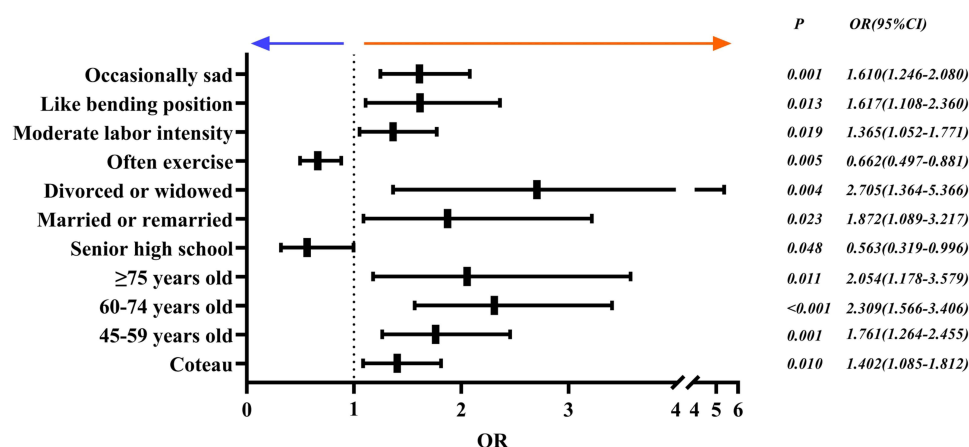


Figure 2 Multivariate analysis of the associations between demographics and low back pain status in Chongqing, China. P values <0.05 were statistically significant. Bounded by OR=1 (indicated as a vertical dashed line in the figure), the potential protective factors for LBP are on the left and the potential risk factors for LBP are on the right. Flat areas are abbreviated as “flat” and mountainous areas are abbreviated as “coteau.” Confounders included occupation, smoking or not, drinking or not, climb mountains or not, the frequency of mountain climbing, and the time to be spent climbing mountains.

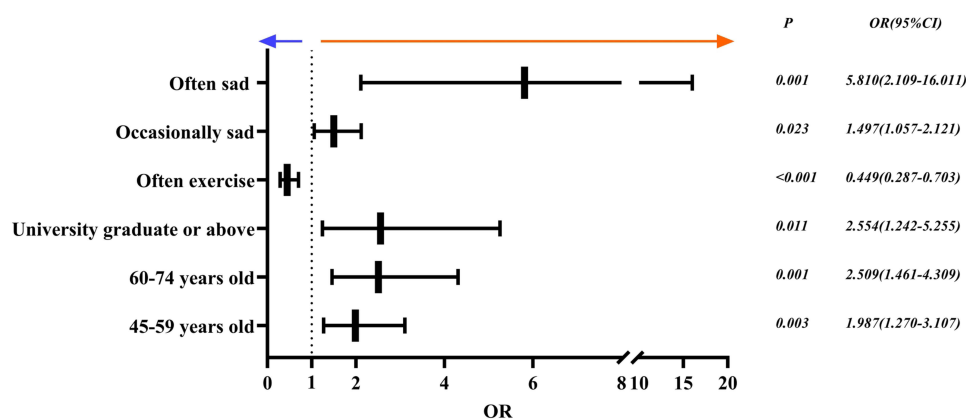


Figure 3 Multivariate analysis of the associations between demographics and low back pain status in flat areas of Chongqing, China. Confounders included marital status, and main labor intensity.

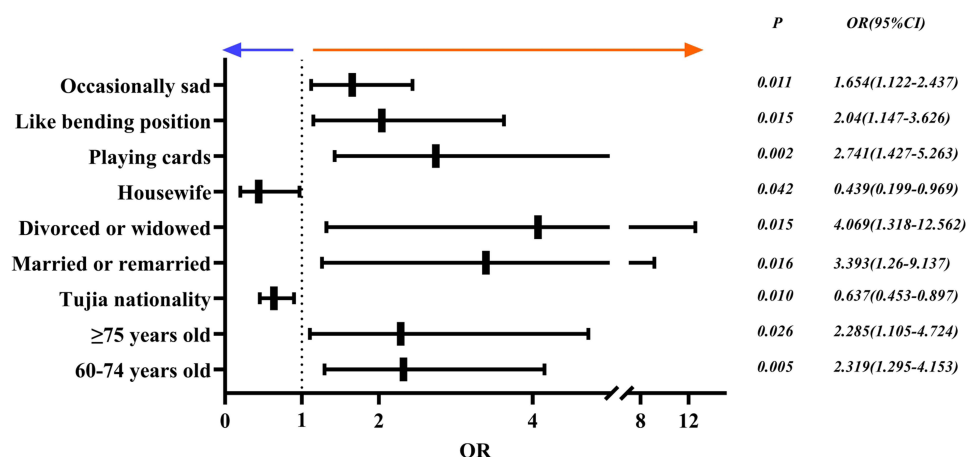


Figure 4 Multivariate analysis of the associations between demographics and low back pain status in mountainous areas of Chongqing, China. Confounders included education level, climb mountains or not, the frequency of mountain climbing, the time to be spent climbing mountains, and main labor intensity.

Do Patients with LBP Residing in Mountainous Areas Manifest More Severe Pain and Dysfunction Than Those in Flat Areas in Chongqing?

Finally, among interviewees with LBP, the ODI score of mountain areas was higher than that of flat areas (3.0–8.0 vs 3.8–11.0). Residents of mountainous areas showed greater dysfunction and degree of pain compared with residents in flat areas ($P=0.012$; $P<0.001$) (Table 5).

Discussion

This stratified, cluster-sampling survey of over 1700 residents in Chongqing showed that the LBP prevalence is higher in Chongqing than in middle-income countries and low-income countries,³ especially in the mountainous areas where LBP prevalence was 35.6%. Residing in mountainous areas, older age, being married and remarried, divorced and widowed, less exercise, moderate labor intensity, frequent stoop, and depressed mood were associated factors for LBP. In addition, the associations between different residential areas and LBP may be caused by the different characteristics of the populations. The population of flat areas highly associated with LBP was primarily middle-aged and elderly, and highly educated people, while LBP in mountainous areas was concentrated in older people, and frequently bending due to occupational characteristics (for example, farmers). Finally, we also found that although there is no difference in the degree of pain between LBP patients in mountainous and those in flat areas, LBP patients in mountainous areas suffer more serious dysfunction.

To our knowledge, this is the first epidemiological survey conducted in China on a large population comparing LBP in flat areas and mountainous areas. Liu C et al¹⁴ found that the prevalence of LBP in mountainous areas in Taiwan was 56.4%, but it was specific to the elderly. Wu et al¹⁵ reported the age-adjusted point prevalence of LBP in China while lacking provincially specific studies. Thus, Chongqing was selected to conduct this survey with unique topographical characteristics while controlling for other confounding factors (eg, climate). In the next sections, we will discuss in detail the factors associated with LBP as well as the pain level and dysfunction of LBP patients in Chongqing.

Table 5 Effect of Terrain on Low Back Pain Dysfunction and Degree of Pain

	All Low Back Pain Respondents (n=520)	Flat Areas (n=246)	Mountainous Areas (n=274)	P (Mann-Whitney U-tests)
NRS score	3.0±1.3	2.8±1.1	3.1±1.3	0.012
ODI score	6.0(3.0–10.0)	5.0(3.0–8.0)	7.0(3.8–11.0)	<0.001

Abbreviations: ODI, Oswestry Disability Questionnaire; NRS, Numerical Rating Scale.

The large confidence intervals found for some variables indicated that those associations may not be so accurate. In the present study, the variables age and marital status had larger confidence intervals in the results of the multifactorial analysis, thus the relationship between these two variables and LBP needs to be further clarified. It has been reported that the prevalence of LBP was higher during work years, and then decreased after retirement.¹⁶ A study of middle-aged and elderly Japanese women noted a significant increase in the prevalence of LBP after the age of 70, which may be related to the lifelong agricultural work characteristics of the female population in the region.¹⁷ The average retirement age of the Chinese is 60 years.¹⁸ The present study found a definite correlation between residents aged 40–59 years and LBP, and the association between residents 60 or older and LBP was relevant, but the accuracy of the correlation was diminished. This may be explained by the fact that a large proportion of the population in Chongqing were farmers (Table 1) who would have been devoted to agricultural work throughout their lives, leading to a relatively increased prevalence of LBP in people over 60 years old and then strengthening the correlation between people over 60 years old and LBP. Moreover, this present study showed an association between marital status and LBP with wide ranges of confidence intervals. Contrary to the studies of Lee et al¹⁹ and Takahashi et al¹⁷ they did not reveal an association between LBP and marital status. The association between LBP and marital status needs to be specified more clearly.

The four variables “moderate labor intensity, frequent stoop, depressed mood, and frequent exercise” in the multivariate analysis of the present study had relatively narrow confidence intervals for their correlation with LBP, which indicated that the relationship between them and LBP was more accurate.

First of all, moderate labor intensity was an associated factor for LBP in Chongqing residents. Yolande et al²⁰ reported that current exposure to a weight-bearing environment would increase the risk of chronic LBP after 5 years. Takahashi et al¹⁷ found that the prevalence of LBP was significantly greater in the manual labor group than in the unmanual labor group. A meta-analysis concluded that lifting heavy weights may have profound effects on the musculoskeletal health of workers, with the intensity and frequency of lifting significantly predicting the onset of LBP.²¹ In the present study, the prevalence of LBP was higher among residents engaged in moderate-intensity labor such as the intermittent lifting of moderately heavy loads, weeding and hoeing of fields (Table 2), which was consistent with the above studies.

As a second point, the present study found that frequent stoop was significantly associated with an increased prevalence of LBP. Similarly, a Korean study of factors associated with LBP in farmers revealed that occupation-related biomechanical factors were strongly associated with LBP, and repetitive forward bending, twisting, and backwards tilting of the low back were potential risk factors for LBP among the population.¹⁹ And Żywień et al²² found that LBP in adults was associated with spinal curvatures. Some studies also indicated that anterior lumbar flexion and twisting were correlated with increased pressure on the intervertebral discs, and repetitive motions caused degeneration and herniation of the discs.^{23,24} Thus, frequent bending was a potential risk factor that cannot be ignored by Chongqing residents.

Depressed mood was another significant independent predictor of LBP in the present study. Chronic pain and mental disorders are independent of each other and often coexist in individuals as comorbidities.²⁵ A study has demonstrated that depression is a strong, independent risk factor for LBP.²⁶ Furthermore, depressed Chinese people tend toward somatization.²⁷ Significant effects of LBP on sleep, depression/psychological problems and social life have also been observed.²⁸ Patients with chronic LBP had a relatively high prevalence of anxiety symptoms.²⁹ Consequently, the causal relationship between LBP and psychological factors needs to be confirmed by additional research.

Finally, the prevalence of LBP among residents who exercise regularly was found to be significantly below the reference for the present study (adjusted OR of 0.662), which was in accordance with the findings of Masiero S, Yiengprugsawan V, and Hashimoto et al^{30–32} However, the effectiveness of physical activity on LBP was controversial. Some studies have highlighted that the relationship between physical activity and LBP was a U-shaped curve,^{33,34} which indicated that inadequate or excessive exercise can predispose to the development of LBP. Sundell CG et al³⁵ reported that increased physical activity was associated with the risk of developing LBP, the duration of LBP, and disability due to LBP.

There was no difference in the degree of pain between patients with LBP in mountainous areas and flat areas in Chongqing, but the degree of dysfunction was significantly worse in patients with LBP in mountainous areas than in flat

areas. The present study revealed a statistically significant difference in the pain level of patients with LBP in the two regions (mean difference, 0.3; $P = 0.012$). However, according to the minimum clinically important difference (MCID) of the NRS recommended by the international consensus that MCID of NRS was 2,³⁶ there was no clinically meaningful difference in pain levels between patients with LBP in the two regions. Hartvigsen et al⁴ demonstrated that absence of management of pain can exacerbate functional impairment in patients with LBP. The degree of dysfunction of LBP patients in mountainous areas was more severe with no difference in pain level, which may be caused by the inadequate medical resources and popularization of LBP rehabilitation treatment in mountainous areas due to geographical limitations, resulting in the insufficient treatment of LBP, and the inferior degree of completion of ODI-related functions such as self-care ability, lifting, walking and sitting of LBP patients. These indicate that we may reduce the impact of LBP on the function in mountainous areas by enhancing “pain management” guidance for LBP patients.

Study Limitations

Owing to the increase in migrant workers, the female population included in this study was greater than the male population, which weakened the representativeness of the sample to some extent. Besides, there was a lack of scale assessment of the mood factor variable, which may have increased the influence of participants' subjective factors on this variable. In future studies, scales assessing mood factors should be included. And in addition to assessing the effect of physical factors such as weight and height on LBP, other physical factors such as spinal curvatures and the pressure pain threshold on LBP can still be assessed.²² Also, Constraints imposed by the time point of the survey have possibly classified a proportion of patients in remission from chronic LBP as LBP-free populations, resulting in a relatively lower prevalence of LBP. Lastly, the present study design failed to clarify the causal relationship between LBP and demographic characteristics of Chongqing residents, and additional cohort studies would be needed to identify risk factors for LBP.

Conclusion

The prevalence of LBP in Chongqing residents has reached 30.5%, in which, the prevalence of LBP in mountainous areas was much higher than that in flat areas. The associations between LBP and labor intensity, frequent stoop, depressed mood, and frequent exercise were well defined in Chongqing residents, however, the associations between LBP and age and marital status remain to be determined more clearly. Lastly, an individual analysis of LBP patients revealed that although there was no difference in pain levels between the mountainous and flat LBP patients, the degree of dysfunction was more severe in the mountainous LBP patients.

Abbreviations

LBP, Low back pain; ODI, Oswestry Disability Questionnaire; NRS, Numerical Rating Scale; MCID, Minimum Clinically Important Difference.

Ethics Approval

The Qilu Hospital of Shandong University Scientific Research Ethics Committee (KYLL-202111-060) approved this study. And the study complied with the Declaration of Helsinki. All participants gave written informed consent before data collection began.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work. All authors meet the authorship criteria and have read and agreed to the manuscript.

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Disclosure

The authors report no conflicts of interest in this work.

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