LOGISTIC REGRESSION ANALYSIS OF EXERCISE - INDUCED LOW BACK PAIN IN CHINESE COLLEGE STUDENTS

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Abstract

The research objective was to explore the main related factors of exercise-induced low back pain. Methods: 218 college students with exercise low back pain from May 2019 to July 2022 who underwent routine physical examination every year were selected as subjects. Questionnaire survey and exercise low back pain detection methods were used. Univariate analysis were carried out to find out the factors associated with the incidence of exercise low back pain, and multi-factor comprehensive analyses were carried out to find the main risk factors of exercise -included low back pain. The results were as follows: 1) Univariate analysis showed that the factors related to the onset of exercise-induced low back pain were body weight, BMI, WHR, exercise years, exercise conditions, exercise intensity, exercise frequency, exercise style, exercise willingness and exercise injury history. 2) Logistic regression analysis was used to examine, and the final statistically significant factors such us BMI, grade, exercise intensity and sports injury history. 3) Conclusion: The Weight, WHR, exercise years, exercise conditions, exercise frequency, exercise willingness and exercise mode are correlated with the occurrence and presentation of exercise-induced low back pain.

Keywords: College Students, History of Injury, Exercise Low Back Pain, Intensity of Exercise, Logistic Regression Analysis

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Introduction

Low back pain is common and difficult to recover from during exercise, which can seriously affect people's determination to exercise. Patients who have been troubled by waist problems for years believe that the root cause is most likely to be from the first exercise of low back pain, due to the long-term lack of proper treatment of the disease. Exercise is the basis of physical health, and lack of exercise is the basis of many chronic diseases in modern society (Webel, Allison, Jenkins, Trevor, Vest, & Marianne, 2019). Exercise is beneficial to human health. With the increasing number of college students participating in exercise, sports injuries may bring to them by various accidental sports which cannot be ignored. Low back pain is a very common sports injury in the process of exercise. Low Back Pain (LBP) is a painful pain located between the margin of the lower ribs and the crease of the buttocks (Kanematsu, Hanakita, Takahashi, Minami, & Tomita, 2021). It is a group of diseases with low back pain as the main symptom, including lumbar disc herniation, lumbar muscle strain, vertebral arch collapse, lumbar spondylolisthesis, lumbar small joint disorder and lumbar bone joint disease caused by exercise (Liang, & Wang, 2019). Studies have shown that the vast majority of low back pain was non-specific low back pain, which seriously affected the performance of exercise participants (Hartvigsen, Hancock, Kongsted, Louw, Ferreira, Genevay, Hoy, Karppinen,Pransky, Sieper, Smeets, Underwood, & Lancet Low Back Pain Series Working Group, 2018).

Referring to relevant literature, there are a lot of research resulted in sports low back pain in professional athletes (Zou, Guo, Wang, & Tan, 2022), and the conclusions are relatively relevant and close to reality. The lifetime prevalence of training-related chronic low back pain in professional athletes was 88.5%, 81.1% at 12 months, 68.3% at 3 months, and 49.0% at time (Luo, Chang, & Shih, 2021). Factors such as heavy training, repetitive exercise, excessive load, repetitive mechanical strain and extreme body posture may be the main reasons for the high incidence of lower back pain(Shah, Shrivastava, Kumar, & Nagi, 2022). Exercise can strengthen the muscles in certain parts of the body, improve physical performance, and enhance the function of the immune system. However, poor posture and forced movement can strain the lower waist and cause tissue damage(Steele, Bialocerkowski, & Grimmer, 2003). At the same time, muscle fatigue increases the pressure on the bones and structure of the lower waist, excessive exercise or direct impact, in the case of insufficient recovery will appear inflammation or swelling, causing pain.

By 2022, after combing the literature on related factors causing low back pain in exercisers, it was found that the conclusions drawn by predecessors and scholars were inconsistent, especially the inconclusive studies on students, which was not of value for exercise participants. In order to solve this problem, the study adopted the method of multi-factor regression analysis, included the demographic characteristics, body shape characteristics, sports characteristics and sports injury history of Chinese college students, so as to explore the influence of these factors on the incidence of exercise-induced low back pain.

Research Methodology

A total of 218 college students with exercise-induced lumbago who were admitted to XX Hospital in Guangdong Province, China from May 2019 to July 2022 were randomly selected and were willing to be investigated. Among the 218 college students who participated in this study, 126 were male and 92 were female, aged from 18 to 25 years, with an average age of (22.2±3.5) years.

The patients were all from universities in Guangzhou, and they were college students. When the researcher explained the research intention to them, they agreed and cooperated with the survey and measurement data of this study. Study design requirements: The undergraduate volunteers had to undergo regular medical examinations every year. Questionnaire reliability test Retest method was used to check the reliability of the questionnaire, and 80 college students were randomly selected for two rounds of tests, with an interval of 10 days. After analyzing the data of the two surveys, the correlation coefficients were 0.93 and 0.87 respectively, indicating that the reliability of the questionnaire was good.

Investigation contents and detection indicators

The questionnaire included demographic characteristics, physical characteristics, exercise environment, exercise conditions, exercise intensity, exercise frequency, exercise mode, exercise willingness, sports injury and disease history, etc. Demographic characteristics included gender, age, major, grade, years of exercise, etc. Body shape characteristics included height, weight, waist circumference, hip circumference, waist-to-hip ratio WHR (calculated as: waist circumference/hip circumference, measured as waist circumference, hip circumference measured in centimeters, weight measured in kilograms) and Ketole index BMI (calculated as: Weight/height x 1000, the weight was measured in kilograms, height was measured in centimeters), the index was also known as body mass index; Sports environment was divided into indoor environment and outdoor environment; There were three kinds of sports conditions: excellent sports facilities, average sports facilities and lack of sports facilities; Exercise intensity included large exercise load, medium exercise load or small exercise load. Exercise frequency included exercise 3 times/week and 3 times/week; There were four types of sports: physical dominant type, skill dominant type, technical mind could lead type and technical competition could lead type; Movement intention included active movement and passive movement; The history of sports injury included the history of upper limb injury, lower limb injury and body injury. Indicators of low back pain included lumbar muscle sprain or strain, lumbar disc herniation, sacroiliac joint sprain, sprain of the supraspinous ligament or interspinous ligament. The JOA low Back Pain Scale (Alkan, & Yeniehir,2022), created by the Japanese Orthopaedic Association, was divided into four parts: 1) Subjective symptoms: low back pain, leg pain with tingling and tingling, walking ability (9 points); 2) Clinical signs: including straight leg elevation test (including strengthening test), sensory disturbance, muscle strength, a total of 9 points; 3)The limit of daily life: including turning over before going to bed, standing,

washing, forward bending, about 1 hour sitting, lifting weights, walking, a total of 14 minutes; 4) off function: a total of -6-0 points. The JOA low back Pain Scale had a total score of 29, with the highest score being 29 and the lowest score being 0. The lower the score, the more obvious the dysfunction.

Diagnostic Criteria

The current diagnostic criteria for low back pain in sports medicine were adopted :1) Medical history was collected and patients were asked about their general condition (gender, age, body mass index and mood, etc.), trauma history, past history, location nature and duration of pain, etc. 2) The injury should be carried out in the order of visual ⟶ contact ⟶ knock ⟶ joint movement ⟶ measurement ⟶ special examination ⟶ neurological function examination. 3) Radiating pain in the waist and lower limbs caused by positive chest cushion test and curvature to the affected side in scoliosis test could be judged as intra spinal canal damage; If the abdominal pad test was positive and the scoliosis test leads to pain on the healthy side and there were definite tender points, it could be judged as the soft tissue damage outside the spinal canal. If the scoliosis test bended to the affected side causing radiating pain in the lower extremity without deep lumbosacral tenderness, and the chest and abdomen pillow test were negative, the hip soft tissue injury can be determined.

Quality Control

Conduct quality control for questionnaire survey: 1) To train investigators to inquire and operate in a unified and standardized way; 2) To design the questionnaire, unify the definition of the survey items, as well as make it operable and able to be expressed objectively, quantitatively and easily; 3) From the design, questionnaire survey, analysis, summary, specific arrangements and implementation of special supervision.

Results

The research data was divided into two categories: assignment and measurement. The questionnaire data was processed by assignment method, and the survey data was processed and analyzed by SPSS 22.0. The assignment method of classification variables was shown in Table 1.

Table 1 Main research objects and assignment methods

variable	The assignment				
	0	1	2	3	4
Low back pain	no	yes	-	—	—
Gender	—	Men	Women	—	—
Age	—	<20	≥20	—	—
Professional	—	The liberal arts	Science	—	—
Grade	—	The first grade	Second Grade	The third grade	The fourth grade
Years of exercise	—	0	1 to 2	3 - 4	> 5
Sports environment	—	Indoor	Outdoor	-	—
Condition of motion	—	Good	General	The lack of	—
Intensity of exercise	—	Heavy load	Medium load	Small load	—
Frequency of motion	—	<3 times	≥3 times	-	—
Mode of exercise	—	Physical	Skill	Technical heart ability	Technical combat ability
Willingness to exercise	—	Active exercise	Passive motion	-	—
History of sports Injuries	—	Upper limb	Lower limbs	The body	—

Note: Organizing movement is active movement intention; Those who are organized to participate in sports are passive sports intentions; indicates that this item was not available. Height, weight, waist circumference, hip circumference and other body shape characteristics were measured, and the calculated results were expressed by (x ±s).

Univariate analysis of measurement data

All indicators in this part were measured values, corresponding unit measurements were used as described above, and single factor independent sample t - test was used for statistical analysis. The calculated results showed that body weight, BMI and WHR were significantly related to the incidence of low back pain ($p<0.05$), see Table 2.

Table 2 Univariate analysis and comparison of measurement data (x ±s)

Factors gender	Low back pain		P values
	Yes	No	
BMI	72.95±5.86	63.85±6.77	0.030
WHR	26.52±2.54	21.02±2.21	0.001
Factors	0.98±0.03	0.81±0.04	0.000

Univariate analysis of count data

The single factor Chi-square test showed that the factors affecting the incidence of exercise-induced low back pain in college students were: grade, exercise condition, exercise intensity, exercise frequency, exercise mode, exercise willingness and history of sports injury ($p<0.05$), the results are shown in Table 3.

Table 3 Univariate analysis of count data

Factors	Low back pain		P values
	Yes	No	
Gender (1/2)	35/33	91/59	0.203
Major (1/2)	39/29	87/63	0.929
Grade (1/2/3/4)	2/2/30/33	10/21/84/35	0.001
Years of exercise (1/2/3/4)	3/3/34/28	8/19/81/42	0.116
Exercise environment (1/2)	36/37	90/55	0.070
Conditions of Movement (1/2/3)	6/27/35	27/83/40	0.001
Exercise intensity (1/2/3)	9/24/35	22/81/47	0.013
Frequency of motion (1/2)	31/37	95/55	0.014
Mode of movement (1/2/3/4)	2/4/29/33	8/19/85/38	0.007
Willingness to exercise (1/2)	30/38	96/54	0.006
History of sports injuries (1/2/3)	10/22/36	20/85/45	0.002

Note: The figures in the brackets behind each factor are independent variables. See the table for their values.

Multivariate analysis

The results of multivariate analysis showed that the factors related to the incidence of low back pain were weight, BMI, WHR, grade, exercise condition, exercise intensity, exercise frequency, exercise style, exercise willingness and sports injury history. In order to find out the main risk factors of exercise - induced low back pain in college students, the significant factors were introduced into the Logistic regression equation. The final statistically significant factors were BMI, grade, exercise intensity and sports injury history, and the results were shown in Table 4.

Table 4 Logistic regression analysis of factors related to exercise-induced low back pain in college students

Factors	β	SE	Wald values	P values
BMI	1.912	0.725	6.945	0.007
Grade	1.209	0.315	8.331	0.000
Intensity of exercise	1.427	0.069	6.322	0.000
History of sports Injuries	2.937	1.344	1.054	0.000

Note: β is the regression coefficient,SE is the regression coefficient standard error.

Discussion

Pathogenesis of exercise - induced low back pain in college students the pathogenesis theory of exercise-induced low back pain in college students was mainly based on the biomechanical changes in the tissue structure of the lower waist, problems in tissue anatomy, biochemistry, pathology and other aspects, and can lead to recurrent episodes of low back pain and difficult to cure (imhín Ansbro, Homan, Qasem, Bil, & Jobanputra, 2021). Factors

influencing the occurrence of exercise-induced low back pain, such as pathological changes of lumbar para-spinal muscles (Allison, Jenkins, Trevor, Vest, & Marianne, 2019), pathological changes of lumbar interspinous bursa (Marius, 2018), nerve conduction caused by lumbar intervertebral disc lesions (Nagata, Yamamoto, Miyoshi, Sato, Arino, & Mikami, 2016) and inflammatory transmitters (Abdelmalik, Draghic, & Ling, 2019) influence and other factors. Based on college students, this study included demographic characteristics, physical characteristics, sports characteristics and sports injury history into the study to explore the influence of these factors on the incidence of exercise-induced low back pain. Univariate analysis showed that the factors related to the incidence of exercise-induced low back pain in college students were weight, BMI, WHR, grade, exercise condition, exercise intensity, exercise frequency, exercise style, exercise willingness and sports injury history.

Influence of measurement indexes on exercise-induced low back pain. As for the metrological indicators body weight, BMI and WHR, the results of this study were consistent with the domestic and foreign literatures reviewed. High body weight could cause the biomechanical changed of lumbar spine and indirectly leaded to the acceleration of intervertebral disc degeneration. Overweight had been linked to an increased risk of intervertebral disc degeneration. When the body weight increased, the pressure of the intervertebral disc increases correspondingly, and the energy demand and nutrient level of the intervertebral disc also changes accordingly. Long-term overweight will lead to increased apoptosis of intervertebral disc cells, accelerated degeneration, and further leaded to pathological changes such as annulus fibrosis rupture (Horner, & Urban, 2001). Body mass index was a composite index of weight and height, and since weight was associated with low back pain in college students, it could be inferred that body mass index was also associated with low back pain. Studies had shown that the BMI and lumbosacral Angle of female college students with chronic low back pain were higher than those of male college students, and the lumbosacral Angle of college students with chronic low back pain also increased with the increase of BMI (Güldal Funda Nakipoğlu, Aynur Karagöz, & Ozgirgin, 2008). There was a correlation between waist-to-hip ratio and the occurrence of chronic low back pain. The main reason may be that college students with large waist circumference and fat accumulation around the waist were prone to apple-shaped obesity and increased waist load, leading to an increase in the incidence of low back pain, which gradually develops into chronic low back pain (Salas-Fraire, Rivera-Pérez, Guevara-Neri, Urrutia-García, Martínez-Gutiérrez, & Salas-Longoria, 2023).

Influence of counting indexes on exercise-induced low back pain

In the process of exercise, the large stress on the spine of college students would cause them to bend forward and extend back beyond their physiological range of motion. Moreover, the small degree of pelvic rotation and the dissonance of waist-pelvis movement increased the chance of lumbar injury. In addition, the muscles in the waist, abdomen and

thighs of college students exercising were obviously asymmetrical, which might also be an important cause of waist injury. Some studies also showed that exercise-induced low back pain had statistically significant differences with body mass index, working posture, exercise intensity, average daily working time, vibration operation and weekly exercise times ($P < 0.05$) (Wang, Chen, & Zhang, 2022). The results of this study on the movement mode, intensity and frequency of counting indicators were consistent with the domestic and foreign literatures. About the influence of college students' grade, exercise condition, exercise willingness and sports injury history on exercise-induced low back pain, there were few literatures at home and abroad. The results showed that the grade of college students, exercise conditions and sports injury history were related to exercise-induced low back pain in college students, which was the innovation of this study and provided the basis for subsequent research.

Skill, environment and other factors on exercise-induced low back pain

The study found that senior college students experienced fewer injuries and fewer cases of exercise-related low back pain as their proficiency in motor skills increased. Whether the environment of sports facilities was good or not had a great relationship with the occurrence of sports injuries. According to the research results, the poor sports facilities in universities were the important cause of exercise-induced low back pain in college students. During the questionnaire survey, most of the subjects with low back pain believed that the unhealed injury resulted in technical deformation and improper exertion were the key factors for low back pain. The willingness of college students to exercise was related to the state of exercise. Poor state of exercise was prone to uncoordinated movements, and wrong movements were naturally prone to injury.

To sum up, there were few researches on the influencing factors of exercise - induced low back pain among ordinary exercise-related participants, especially Chinese college students, a key exercise-related population. Through single factor analysis, in order to find out the main risk factors of exercise-induced low back pain in college students, meaningful factors were introduced into the Logistic regression equation. The final statistically significant factors were BMI, grade level, exercise intensity, and history of sports injuries. Among the morbidity factors included in this study, the main factors affecting the incidence of exercise-induced low back pain in college students were BMI, grade, exercise intensity and history of sports injury, while the secondary factors are weight, WHR, exercise years, exercise conditions, exercise frequency, exercise willingness and exercise mode.

Research Limitations

The limitations of this study were mainly reflected in the following aspects: (1) The subjects included in this study were mainly from outpatients of college students, rather than the sample survey of college students, so the representativeness of the samples had a certain impact on the research results, and the study sample size was still small, which may affect

the statistical analysis and the comprehensive interpretation of the results. (2) The included subjects come from southern China where the air humidity was high and the climate was hot. The regional particularity of such subjects also affects the universality of the research results. (3) Because the questionnaire used to collect data did not include the pathological diseases of the corresponding parts of the waist and the history of lumbar surgery in the investigation and research items, the objectivity of the research information was affected to some extent.

Conclusion

(1) Factors related to the incidence of exercise-induced low back pain in college students: there were 10 measurement and counting indicators.

(2) The main risk factors of exercise - induced low back pain in college students were BMI, grade, exercise intensity and history of sports injury.

(3) The main risk factors of exercise-induced low back pain in college students were analyzed to provide a reference for reducing low back pain in exercise-related groups.

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Appendix

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