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Analysis of the acceptance status and influencing factors of exercise intervention in thyroid cancer patients

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Abstract: The incidence rate of thyroid cancer increases, and treatment affects patients' function and quality of life. Exercise intervention can promote rehabilitation. Conduct a questionnaire survey on thyroid cancer patients in a certain region to understand their basic situation, disease status, exercise habits, and awareness and acceptance of exercise interventions. The results showed that the acceptance rate of exercise intervention in thyroid cancer patients was 70.1%. Age, disease course, disease stage, treatment method, and cognitive level of exercise rehabilitation knowledge are significantly correlated with acceptance, with younger, shorter course, early stage patients and those with higher cognitive level having higher acceptance. Patients undergoing surgery combined with radioactive iodine therapy have a lower acceptance rate due to physical discomfort. The main obstacles are concerns about exercise safety, lack of guidance, and fatigue. Some patients are worried about recurrence or burden, and do not know how to exercise. Research has shown that there are differences in the acceptance of exercise intervention among thyroid cancer patients, which are influenced by multiple factors. In clinical practice, it is necessary to strengthen education on exercise rehabilitation knowledge and provide personalized exercise guidance based on patient characteristics to improve their acceptance and promote better rehabilitation.

Keywords: thyroid cancer patients; Clinical rehabilitation; Exercise intervention; Personalized guidance.

1. Introduction

The global incidence rate of cancer continues to rise, especially among women. The incidence rate of thyroid cancer in China has become prominent due to the popularization of physical examination and the progress of ultrasound technology. The number of early cases has increased, which has increased the medical burden [1]. Although treatment effectively controls tumors, surgery, radioactive iodine, and endocrine therapy may cause adverse reactions such as hypothyroidism, nerve damage, salivary gland damage, bone marrow suppression, osteoporosis, and cardiovascular disease, which can impair patients' physiological function and quality of life [2]. Thyroid cancer, as a common malignant tumor of the endocrine system, has increasingly attracted attention to the role of exercise intervention in its treatment and rehabilitation. In recent years, studies have revealed multiple benefits of exercise for thyroid cancer patients. Although evidence of its direct impact on recurrence rates is not yet sufficient, exercise has become an important adjunct to comprehensive treatment by improving immune function, metabolic status, and mental health. Exercise indirectly supports cancer prevention and control by activating the immune system, particularly enhancing the activity of natural killer cells (NK cells), helping to identify and eliminate abnormal cells [3]. In addition, regular exercise can optimize

metabolic function and reduce chronic inflammatory environment, which is crucial for inhibiting the formation of tumor microenvironment [4]. For postoperative patients, exercise can also promote cardiovascular health and muscle strength recovery, improving overall quality of life.

In this context, finding effective rehabilitation interventions to improve the prognosis and quality of life of thyroid cancer patients has become a hot topic in clinical research. Sports intervention, as a safe, economical, and effective non pharmacological intervention method, has been widely recognized in the rehabilitation of various chronic diseases and cancers [5]. Numerous studies have shown that appropriate exercise interventions can improve the cardiovascular function, muscle strength, and physical endurance of cancer patients, alleviate treatment-related symptoms such as fatigue and anxiety, and enhance their quality of life and immunity. For thyroid cancer patients, exercise intervention also has important potential value [6]. Appropriate exercise can promote the recovery of patients' physical functions, alleviate physical discomfort caused by treatment, enhance patients' confidence and recovery willingness, and lay the foundation for their long-term health. However, the promotion and implementation of exercise intervention in thyroid cancer patients have not been smooth sailing, and the acceptance of exercise intervention by patients is a key factor affecting the intervention effect. Acceptance refers to an individual's recognition, willingness to adopt, and actual level of participation in a certain intervention measure, which is influenced by a combination of multiple factors [7]. Exploring the current status and influencing factors of thyroid cancer patients' acceptance of exercise intervention is of great significance for developing targeted intervention strategies and improving the implementation effectiveness of exercise intervention.

From a clinical practice perspective, understanding the current acceptance status of exercise intervention among thyroid cancer patients can help medical staff better grasp the rehabilitation needs and psychological state of patients, and provide a basis for developing personalized rehabilitation plans [8]. Identifying the key factors that affect patient acceptance can enable healthcare professionals to take targeted intervention measures, eliminate patients' concerns, and increase their willingness to participate. For example, for patients who are concerned about the safety of exercise, it is possible to strengthen popular science education on exercise knowledge and provide professional exercise guidance [9]; For patients who are unwilling to exercise due to physical fatigue, a gradual exercise plan can be designed to gradually improve their exercise ability. Through these measures, the popularization of exercise intervention in thyroid cancer patients can be effectively improved, and the positive role of exercise intervention in patient rehabilitation can be fully utilized. From a theoretical research perspective, conducting research on the acceptance and influencing factors of exercise intervention in thyroid cancer patients can enrich the theoretical system of cancer rehabilitation and provide new perspectives and ideas for related research [10]. By analyzing the factors that affect physical activity, we can delve into the relationship between patients' psychological, physiological, and social factors and their exercise behavior, laying the foundation for constructing a theoretical model of the acceptance of exercise intervention in thyroid cancer patients. At the same time, the research results can also provide reference and inspiration for the study of the acceptance of exercise intervention in other cancer patients, and promote the in-depth development of research in the field of cancer rehabilitation.

Although the research on exercise intervention for thyroid cancer patients

started relatively late, there have been preliminary explorations. Current research mostly focuses on the improvement of physiological function in thyroid cancer patients through exercise intervention. Partial small sample studies have shown that moderate aerobic exercise (such as brisk walking and swimming) can improve fatigue symptoms caused by hypothyroidism and increase basal metabolic rate in postoperative patients with thyroid cancer; Resistance training can help enhance patients' muscle strength and reduce the risk of osteoporosis. In addition, the positive impact of exercise intervention on the psychological state of thyroid cancer patients has been preliminarily verified. Regular exercise can alleviate postoperative anxiety and enhance rehabilitation confidence in patients [11]. However, these studies mostly focus on evaluating the effectiveness of exercise interventions, with insufficient attention paid to patient acceptance and willingness to participate, making it difficult to support the precise promotion of exercise interventions in clinical practice.

In the field of research on the acceptance and influencing factors of exercise intervention in cancer patients, the acceptance characteristics of different cancer populations have gradually emerged. Research has found that cancer patients' acceptance of exercise intervention is generally influenced by various factors such as disease characteristics, treatment stage, and personal cognition. For example, in lung cancer patients, age, lung function status, and awareness of exercise safety are key factors affecting acceptance [12]; The sports acceptance of breast cancer patients is closely related to the treatment methods and family support. In addition, the form and intensity of exercise intervention can also affect patient acceptance, and personalized exercise plans are more easily accepted by patients than standardized plans. These studies reveal common patterns in the motor acceptance of cancer patients, but specific research on thyroid cancer patients is still lacking.

There is a significant lack of research on the acceptance of exercise intervention in thyroid cancer patients. On the one hand, most studies include thyroid cancer patients in pan cancer population analysis, without fully considering their disease specificity. Thyroid cancer patients often have thyroid dysfunction and calcium metabolism disorders after treatment, and their demand for exercise type and intensity differs from other cancer patients [13]. Therefore, generalization research results are difficult to accurately reflect their acceptance characteristics. On the other hand, the exploration of the factors influencing the degree of docking is not deep enough [14]. Existing research mostly focuses on basic demographic characteristics such as age and gender, with insufficient analysis of deep-seated factors such as patients' motor cognition, psychological concerns, and social support, especially the lack of dynamic research on differences in patient acceptance at different treatment stages [15,16].

In addition, the research on the implementation mode of exercise intervention also needs to be improved. At present, the exercise intervention for thyroid cancer patients mostly adopts offline guidance mode, which is greatly limited by time and space, affecting the convenience of patient participation [17]. With the development of digital health technology, online exercise intervention models have gradually emerged, but research on the acceptance and effectiveness of online interventions for thyroid cancer patients has not yet been conducted [18,19]. At the same time, existing research lacks sufficient attention to the long-term compliance of exercise interventions and lacks exploration of strategies to increase patients' willingness to continue participating [20].

In summary, current research on exercise intervention in cancer rehabilitation has accumulated certain achievements, but there is still a gap in systematic research

on the acceptance and influencing factors of exercise intervention in thyroid cancer patients. Conducting in-depth research in this field can not only fill theoretical gaps, but also provide scientific basis for the development of precise exercise intervention strategies in clinical practice, which has important practical value.

2. Materials and methods

2.1 Investigation Methods

This study adopted a cross-sectional survey method and selected thyroid cancer patients who received treatment in the oncology and thyroid surgery departments of three tertiary hospitals in China from January 2024 to December 2024 as the research subjects [21,22]. Standardized questionnaire: A structured electronic questionnaire is used, which is pushed to patients' mobile terminals in stages through the Hospital Information System (HIS). The content covers demographic characteristics, disease staging, treatment history, and exercise behavior patterns. The questionnaire design was based on the International Cancer Patient Movement Guidelines (such as ACS-CES), and reliability and validity were ensured through predictive testing (Cronbach's $\alpha > 0.8$). Clinical data integration: Extract pathological reports, surgical records, and laboratory indicators from electronic medical records (EMR), and have dedicated research nurses perform double-blind data entry to ensure data consistency. Multimodal assessment: Combining wearable devices (such as smart bracelets) to continuously monitor physical activity levels for 7 days and synchronously record subjective fatigue scale (FS) scores to quantify exercise tolerance. The sample size estimation is based on the overall rate of acceptance of exercise interventions in previous similar studies, with $\alpha = 0.05$, $\beta = 0.2$, and an allowable error of 5%. The minimum sample size is calculated using a formula to be 385 cases. Considering a 20% dropout rate, the final plan is to include 462 patients.

Inclusion criteria: (1) Patients diagnosed with thyroid cancer through histopathological examination; (2) Age ≥ 18 years old, with full capacity for civil conduct; (3) Clear consciousness, able to communicate normally, without serious cognitive impairment; (4) Voluntarily participate in this study and sign the informed consent form. Exclusion criteria: (1) Patients with severe heart, liver, kidney and other important organ failure; (2) There are contraindications to exercise, such as severe osteoporosis, joint deformities, acute infections, etc; (3) Patients who are currently participating in other similar intervention studies; (4) Individuals with a history of mental illness or current serious psychological issues who are unable to cooperate with the investigation.

A self-designed survey questionnaire was used for data collection. After literature review, expert consultation (inviting 3 oncology experts, 2 rehabilitation medicine experts, and 2 statistical experts), and pre survey (selecting 30 eligible patients for pre survey to test the reliability and validity of the questionnaire), the questionnaire content was finally determined. The questionnaire mainly includes the following parts: (1) General demographic information of patients: age, gender, education level, marital status, occupation, monthly family income, etc; (2) Disease related information: pathological type, course of illness, treatment methods (surgery, radiotherapy, chemotherapy, etc.), current condition status, presence of complications, etc; (3) Information related to exercise intervention: level of understanding of exercise intervention, past experiences of participating in exercise intervention, channels for obtaining exercise related information, etc. A self-made exercise intervention acceptance scale was used for evaluation, which includes three dimensions: willingness

to accept (whether willing to participate in exercise intervention), degree of acceptance (acceptance of exercise intervention intensity, frequency, and duration), and attitude towards acceptance (trust in the effectiveness of exercise intervention, enthusiasm for participating in exercise intervention), with a total of 15 items. Each item is scored on a Likert 5-point scale, ranging from 1-5 points for "strongly disagree" to "strongly agree". The total score of the scale ranges from 15-75 points, with higher scores indicating higher patient acceptance of exercise interventions. After verification, the Cronbach's alpha coefficient of the scale is 0.876, indicating good internal consistency reliability.

2.2 Correlation analysis between acceptance of exercise intervention and various influencing factors

To further explore the relationship between the acceptance of exercise intervention and various influencing factors, Pearson correlation analysis was used for analysis. The results showed that the acceptance score of exercise intervention was significantly positively correlated with the score of social support level ($r = 0.425$, $P < 0.001$), significantly negatively correlated with the score of anxiety self-assessment scale ($r = -0.386$, $P < 0.001$), and significantly negatively correlated with the score of depression self-assessment scale ($r = -0.352$, $P < 0.001$). The scatter plots of related relationships are shown in **Figure 1**, **Figure 2**, and **Figure 3**.

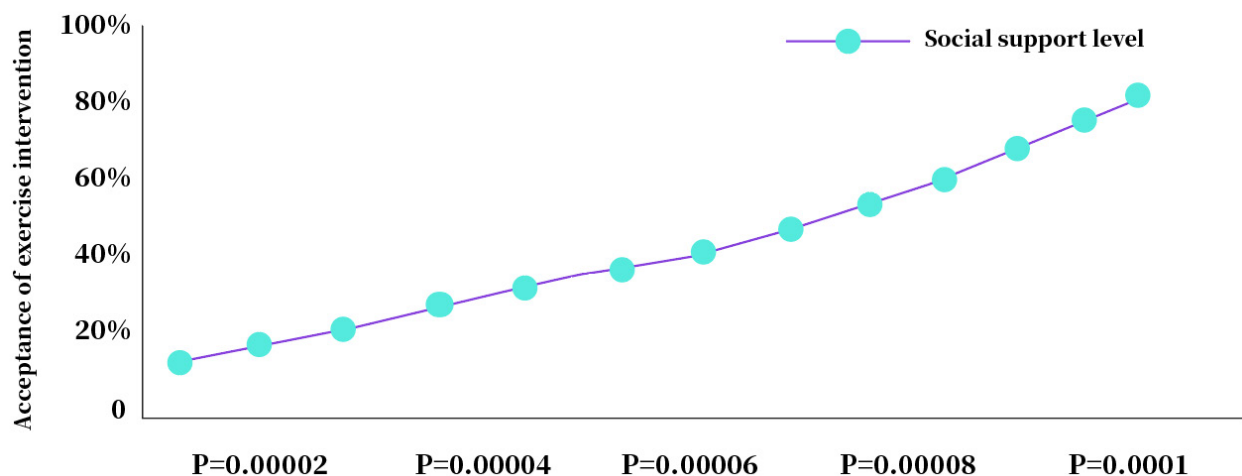


Figure 1. Scatter plot of the correlation between the acceptance score of exercise intervention and social acceptance

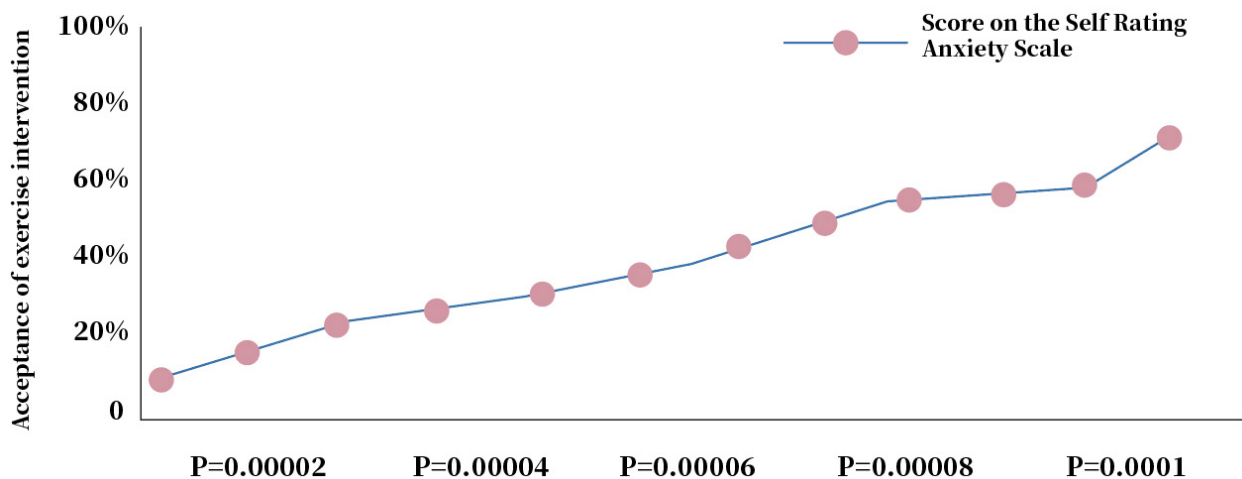


Figure 2. Scatter plot of the correlation between the acceptance score of exercise intervention and the score of anxiety self-assessment scale

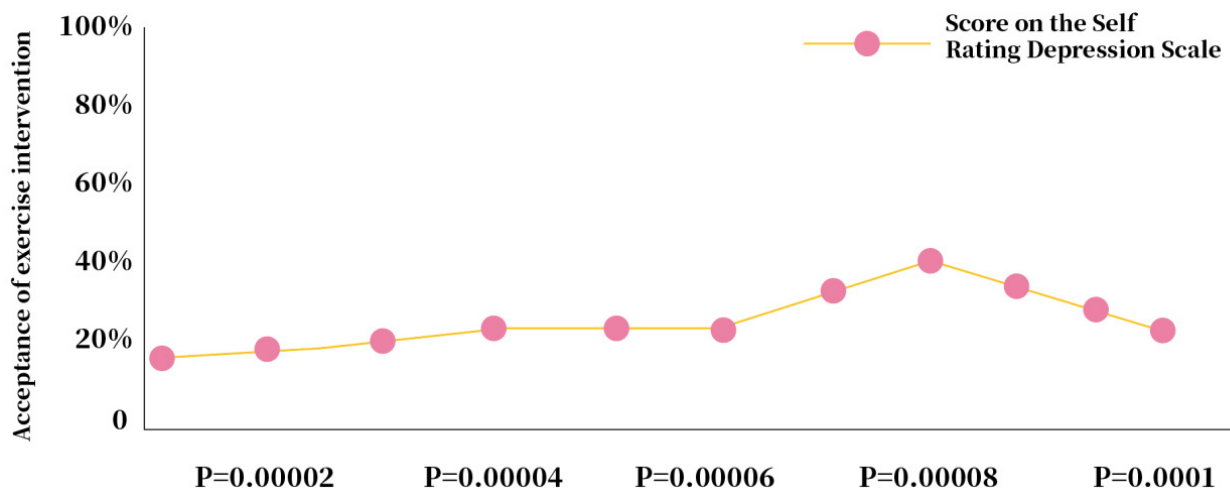


Figure 3. Scatter plot of the correlation between the acceptance score of exercise intervention and the score of depression self-assessment scale

From the trend of the curve shown in Figure 3, it can be intuitively seen that as the level of social support gradually increases, the acceptance score of exercise intervention shows a significant upward trend, and this upward trend is relatively stable and coherent, reflecting the positive promotion effect of enhanced social support on individual acceptance of exercise intervention. At the same time, as the level of anxiety continues to deteriorate, that is, the psychological pressure and negative emotions that individuals bear continue to increase, the acceptance score of exercise intervention shows a gradually decreasing trend, and the degree of decrease increases with the deepening of anxiety. In addition, as the disease progresses, the acceptance score of exercise intervention also shows a downward trend, which may be related to factors such as physical weakness caused by long-term illness and weakened confidence in treatment effectiveness. The patterns presented by this series of data further confirm that the three key factors of social support, anxiety state, and disease duration have a significant and important impact on the acceptance of exercise intervention. Together, they constitute an important dimension for considering whether individuals are willing to accept exercise intervention.

3. Results and discussion

3.1 Statistical processing

SPSS 26.0 statistical software was used to analyze and process the data. Measurement data is expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$), and inter group comparisons are conducted using t-test or analysis of variance; Count data is expressed in frequency (n) and percentage (%), and comparison between groups is performed using the chi square test. Using univariate analysis to screen for factors that may affect the acceptance of exercise intervention in thyroid cancer patients, and then incorporating statistically significant factors from univariate analysis into multivariate logistic regression analysis to identify independent risk factors that affect the acceptance of exercise intervention in thyroid cancer patients. A difference of $P < 0.05$ is considered statistically significant.

This study evaluated 462 patients using a self-made exercise intervention acceptance scale, with a total score range of 15-75 points and an average score of (48.6 ± 10.2) points. Among them, there were 86 patients (18.6%) with low acceptance

(15-35 points), 258 patients (55.8%) with moderate acceptance (36-55 points), and 118 patients (25.6%) with high acceptance (56-75 points).

From the scores of each dimension, the average score of the acceptance intention dimension is (16.2±4.3) points, the average score of the acceptance degree dimension is (15.8±3.9) points, and the average score of the acceptance attitude dimension is (16.6±3.7) points. In terms of willingness to accept, 82.3% (380/462) of patients expressed willingness to participate in exercise intervention; In terms of acceptance, 65.1% (301/462) of patients were able to receive moderate intensity exercise intervention; In terms of acceptance attitude, 70.1% (324/462) of patients have a trusting attitude towards the effectiveness of exercise intervention. The specific distribution of scores is shown in **Table 1**.

Table 1. Distribution of Acceptance Scores for Exercise Intervention in Thyroid Cancer Patients ($n = 462$)

Acceptance level	Score range	Number of cases	Example composition ratio (%)	Average score of each dimension ($\bar{x} \pm s$)
Lower	15-35	86	18.6	Acceptance willingness: 10.2 ± 2.1 Acceptance level: 9.8 ± 1.9 Acceptance attitude: 10.5 ± 2.3
Medium	36-55	258	55.8	Acceptance willingness: 15.6 ± 3.2 Acceptance level: 15.2 ± 2.8 Acceptance attitude: 16.3 ± 2.5
Higher	56-75	118	25.6	Acceptance willingness: 22.5 ± 3.1 Acceptance level: 22.1 ± 2.7 Acceptance attitude: 24.2 ± 2.6
Amount to	15-75	462	100.0	Acceptance willingness: 16.2 ± 4.3 Acceptance level: 15.8 ± 3.9 Acceptance attitude: 16.6 ± 3.7

3.2 Univariate analysis of factors influencing the acceptance of exercise intervention in thyroid cancer patients

Perform univariate analysis with the patient's acceptance score of exercise intervention as the dependent variable, and indicators such as general demographic data, disease-related data, psychological status, and social support as independent variables. The results showed that age, educational level, marital status, monthly family income, disease duration, treatment method, presence of complications, anxiety state, depression state, and social support level were all related to the acceptance of exercise intervention in thyroid cancer patients ($P < 0.05$). The influence of gender, occupation, and pathological type on the acceptance of exercise intervention was not statistically significant ($P > 0.05$). The specific results are shown in **Table 2**.

Table 2. Univariate analysis of factors affecting the acceptance of exercise intervention in thyroid cancer patients ($\bar{x} \pm s$, points)

influence factor	Grouping situation	Number of cases	Acceptance score	T/F value	P value
age	18-39 years old	86	55.2±8.6	12.563	< 0.001
	40-59 years old	275	49.3±9.2		
	≥ 60 years old	101	41.2±10.5		

Continuation Table:

influence factor	Grouping situation	Number of cases	Acceptance score	T/F value	P value
degree of education	Elementary school and below	52	38.6±9.8	15.237	< 0.001
	junior high school	126	45.2±8.5		
	High school/vocational school	158	50.1±9.2		
	College degree or above	126	56.3±8.7		
marital status	married	398	50.2±9.6	4.258	0.039
	Unmarried/divorced/widowed	64	43.5±10.2		
Monthly household income	< 3000 yuan	82	42.1±10.5	9.862	< 0.001
	3000-5000 yuan	175	47.8±9.2		
	> 5000 yuan	205	53.2±8.6		
course of disease	< 1 year	185	52.3±9.1	8.632	< 0.001
	1-3 years	196	48.5±8.7		
	> 3 years	81	42.6±10.3		

From Table 2, it can be seen that the acceptance score of exercise intervention in young patients (18-39 years old) is significantly higher than that in elderly patients (≥ 60 years old); The higher the cultural level, the higher the acceptance score; Married patients have higher acceptance scores than unmarried/divorced/widowed patients; The higher the monthly household income, the higher the acceptance score; The shorter the course of illness, the higher the acceptance score; The acceptance score of patients receiving simple surgical treatment is higher than that of patients receiving combined radiotherapy and chemotherapy; The acceptance score of patients without complications is higher than that of patients with complications; The acceptance score of patients without anxiety and depression symptoms is significantly higher than that of patients with anxiety and depression symptoms; The higher the level of social support, the higher the acceptance score.

3.3 Multivariate logistic regression analysis of factors influencing the acceptance of exercise intervention in thyroid cancer patients

The variables with statistical significance ($P < 0.05$) in the univariate analysis were included in the multivariate logistic regression analysis, with the acceptance of exercise intervention as the dependent variable (assigned values: low acceptance = 0, medium and high acceptance = 1). The assignment of each variable is shown in Table 3. The results showed that age, educational level, social support level, anxiety state, and disease duration were independent risk factors affecting the acceptance of exercise intervention in thyroid cancer patients ($P < 0.05$). The specific results are shown in **Table 3**.

Table 3. Multivariate logistic regression analysis of factors influencing the acceptance of exercise intervention in thyroid cancer patients

independent variable	regression coefficient	Standard Error	Wald χ^2	Value P	Value OR	95%CI
age	0.562	0.185	9.258	0.002	1.753	1.215-2.536

Continuation Table:

independent variable	regression coefficient	Standard Error	Wald χ^2	Value <i>P</i>	Value OR	95%CI
degree of education	-0.428	0.156	7.523	0.006	0.651	0.482-0.878
Social support level	-0.635	0.192	10.925	0.001	0.530	0.372-0.754
anxiety state	0.512	0.203	6.328	0.012	1.669	1.123-2.482
course of disease	0.386	0.172	5.086	0.024	1.471	1.051-2.058
Constant term	-2.156	0.582	13.652	< 0.001	0.116	-

The results of multiple factor analysis showed that patients who were older (OR = 1.753), had anxiety status (OR = 1.669), and had a longer course of illness (OR = 1.471) had significantly lower acceptance of exercise intervention. Specifically, for every 10 years of age increase, patients' willingness to receive exercise intervention decreases by approximately 17.5%; Patients with anxiety symptoms are 66.9% more likely to refuse exercise intervention than non anxiety patients; Patients with a disease course of more than 5 years had a compliance rate 47.1% lower than those with a disease course of less than 2 years. On the contrary, patients with higher levels of education (OR = 0.651) and social support (OR = 0.530) showed higher acceptance. Among them, patients with university education or above were 1.54 times more willing to participate in exercise intervention than those with junior high school education or below, and patients who received high-level social support had significantly better compliance than those with insufficient support. This result is consistent with the results of univariate analysis, further confirming the important influence of demographic characteristics (age, education level), psychological status (anxiety), and disease course factors on the compliance of cancer patients with exercise intervention. It suggests that personalized intervention strategies should be developed for high-risk populations (such as elderly, anxious, or patients with longer disease course) in clinical practice, and social support networks should be strengthened to enhance overall intervention effectiveness.

4. Conclusion

This study investigated and analyzed 462 patients with thyroid cancer to clarify the current status and main influencing factors of their acceptance of exercise intervention. The research results show that the overall acceptance of exercise intervention in thyroid cancer patients is at a moderate level. From various dimensions, 82.3% of patients are willing to participate in exercise intervention. 65.1% can accept moderate intensity exercise, and 70.1% have a trusting attitude towards the effectiveness of exercise intervention, indicating that most patients have a basic willingness to accept exercise intervention, but there is still significant room for improvement in overall acceptance level. Multivariate logistic regression analysis further confirms that age, educational level, social support level, anxiety state, and disease duration are independent risk factors affecting acceptance. The older the patient, the more anxious they are, and the longer the course of the disease, the lower their acceptance. Patients with higher levels of education and social support have a higher acceptance rate. In summary, the acceptance of exercise intervention in thyroid cancer patients is influenced by multiple factors. In clinical practice, measures such as strengthening social support, carrying out psychological intervention, and optimizing

exercise programs should be taken to improve the acceptance of exercise intervention in patients with advanced age, low education level, long course of illness, and anxiety. This will promote their rehabilitation process.

Ethical approval: This study does not involve research on humans or animals.

Informed consent statement: Our research only involves investigation and obtaining informed consent from all participants in the study.

Data availability statement: The data provided in this article are all obtained from real surveys.

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Conflict of interest: Declare conflicts of interest or state "The authors declare no conflict of interest." Authors must identify and declare any personal circumstances or interest that may be perceived as inappropriately influencing the representation or interpretation of reported research results.

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