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GRADUATION THESIS

Title	Application Study of the Exercise Compliance Scale in Pelvic Floor Muscle Exercise for Patients with Urinary Incontinence After Prostate Cancer Surgery
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Abstract

Objective To culturally adapt the 2016 version of the Exercise Adherence Rating Scale (EARS), i.e., to translate and revise the scale into Chinese. Apply the Chinese version of the EARS scale to patients with urinary incontinence after prostate cancer surgery at Changhai Hospital in Shanghai, China, to investigate their adherence to pelvic floor muscle training and to test the reliability and validity of the scale.

Methods Following Guillemin's cross-cultural adaptation guidelines and Brislin's translation-back-translation model, the 2016 EARS scale was initially translated and back-translated. Six experts and professors were invited to evaluate and provide suggestions on the initial scale, which was optimized based on their advice before conducting a pre-survey. A convenience sampling method was used to include 88 patients with urinary incontinence after prostate cancer surgery for the pre-survey, resulting in the initial Chinese version of the EARS. A total of 177 patients with urinary incontinence after prostate cancer surgery who met the inclusion and exclusion criteria and were treated at Shanghai Changhai Hospital from September 2024 to March 2025 were selected to confirm the reliability and validity of the Chinese version of the EARS. Reliability: Cronbach's α coefficient was used to measure internal consistency, the intraclass correlation coefficient (ICC) was used to evaluate test-retest reliability, and the Spearman-Brown corrected split-half reliability coefficient was used as a reference for split-half reliability. Validity: Exploratory factor analysis (EFA) was used to evaluate construct validity, and I-CVI and S-CVI were used to evaluate content validity. SPSS 27.0 software was used for data analysis.

Results The Chinese version of the EARS scale formed through localization contains a total of 16 items. The scale's internal consistency reliability was 0.844, test-retest reliability was 0.879, and split-half reliability was 0.878, all of which were statistically significant ($p < 0.001$), indicating good stability and consistency of the scale. The I-CVI and S-CVI for the scale were both 1.000, indicating good content validity. During exploratory factor analysis for construct validity, four common factors were successfully extracted, with a cumulative total variance explanation rate of 54.590%. The factor loading coefficient for each item was ≥ 0.400 , indicating high

overall construct validity of the scale.

Conclusion The Chinese version of the EARS scale formed in this study consists of 16 items that are simple and easy to understand, and it has good reliability and validity. It provides a scientific, reliable, and targeted assessment tool for evaluating the adherence to pelvic floor muscle exercise in patients with urinary incontinence after prostate cancer surgery.

Key words: Urinary incontinence; Compliance; Pelvic floor muscle exercise; Scale; Cultural adaptation

1 Introduction

1.1 Research Background

Radical prostatectomy (RP) is the standard treatment for localized prostate cancer. Its good clinical efficacy has been recommended as a first-line treatment for prostate cancer by major guidelines in the United States, Europe, China, and other countries ^[1]. Urinary incontinence is a common adverse effect after RP, seriously affecting patients' quality of life and reducing their willingness to undergo subsequent treatment stages ^[2].

Post-prostatectomy incontinence (PPI) is caused by damage to the patient's urethral sphincter, nerves, and blood vessels during surgery, leading to involuntary leakage of urine from the urethral meatus after surgery, which worsens during activities that increase abdominal pressure, such as coughing or exercise ^[3]. Its immediate incidence rate is as high as 85%, and 21.2% of patients still rely on pads one year after surgery. According to data from the International Continence Society (ICS), urinary incontinence (UI) has become one of the five most common diseases globally, often referred to as "social cancer." Patients often lose the ability to control urination and need to rely on pads, which significantly increases the risk of postoperative infection and medical costs, and also negatively affects patients' mental health and social interactions.

Treatment options for PPI include conservative treatment and surgical treatment. It mainly includes the following eight types: lifestyle intervention; pelvic floor muscle training; bladder training; biofeedback therapy; pelvic floor electrical stimulation and extracorporeal magnetic stimulation; medication; surgical treatment, etc. ^[4]. Relevant research indicates that conservative treatment is the first recommendation for patients with urinary incontinence after RP within six months to one year post-surgery.

Pelvic floor muscle training (PFMT) strengthens the pelvic floor muscles through repeated contractions, enhancing pelvic support and intraurethral pressure. It effectively improves the decreased urethral sphincter tone caused by surgery and is currently recommended as a first-line therapy for urinary incontinence ^[5, 6]. Relevant

studies indicate that PFMT can significantly improve stress urinary incontinence after radical prostatectomy, with improvement up to 2.77 times ^[7]. For patients with mild PPI, PFMT should be the first choice [1]; PFMT is the gold standard for preventing and treating urinary incontinence ^[8]. A clinical study found that prostate cancer patients who started PFMT four weeks before surgery had significantly better urinary control than those who started exercising after surgery ^[9]. At the same time, the effectiveness of PFMT depends on the patient's adherence to the rehabilitation exercise, i.e., the degree to which the patient follows the healthcare provider's rehabilitation advice, including the frequency, duration, and motivation for performing the exercises.

The prevalence of pelvic floor dysfunction (PFD) in China is relatively high. As a first-line therapy for PFD, PFMT can effectively improve patients' clinical symptoms, but the adherence of most patients is poor. In a study involving 186 patients undergoing uterine prolapse surgery, only 37% of women continued to perform daily PFMT eight weeks post-surgery, and only 28% of these met the prescribed daily training standards ^[10]. In a retrospective study by Tibaek et al. involving 1544 women with PFD, 48% completed the recommended PFMT program, 30% dropped out midway, and 22% either did not start or did not persist with the training ^[11]. PFMT adherence varies considerably across studies and is influenced by multiple factors.

1.2 Domestic and International Research Progress

The definition of treatment adherence by international medical authorities dates back to the beginning of this century. The concept of adherence was formally established by the World Health Organization (WHO) in 2001, emphasizing that patients are in a passive receiving position regarding medical advice, rather than active, cooperative partners. In 2003, the WHO revised this concept, redefining adherence as a process of adjusting health behaviors based on shared decision-making between doctors and patients, specifically manifested as the degree of congruence between the patient's individual behaviors (medication therapy, dietary management,

lifestyle, etc.) and the medical staff's recommendations and treatment plan during the treatment cycle ^[12]. Based on the above conceptual framework, PFMT adherence can be defined as the dynamic degree of matching between the frequency, correctness of movements, and training completion of PFMT and the clinical treatment plan ^[13].

Current main assessment methods for PFMT adherence include two approaches: subjective experience quantification and objective physiological indicator monitoring. Subjective assessment methods include training diaries actively recorded by users and scale measurements, such as the Visual Analog Scale (VAS), the generic Exercise Adherence Rating Scale (EARS), and specific scales. Objective assessment methods are based on patients' health data; researchers collect extensive objective data through applications, online platforms, wearable devices, etc. ^[13]. Although generic scales, specific scales, and mobile health tools exist for measuring PFMT adherence in patients with PFD, a rigorously developed and validated scale is still lacking. The current methodological dilemma lies in the variability of assessment criteria. The absence of a standardized, universally applicable assessment tool prevents scientific comparison and summarization of adherence levels across studies, fundamentally hindering reliable evidence-based guidance for improving PFMT adherence ^[13]. Therefore, a unified assessment system based on the Delphi method with expert consensus should be constructed to accurately quantify patients' adherence status, assist nurses in identifying patients with poor adherence, promptly implement targeted nursing interventions, and further optimize the allocation of medical resources.

The Exercise Adherence Rating Scale (EARS), used to measure patient adherence to exercise prescriptions, has been translated into multiple languages, such as Brazilian Portuguese, Polish, and Nepali. It has been applied and tested to measure exercise adherence in patients with diabetes and chronic low back pain, as well as PFMT adherence in pregnant women with urinary incontinence, demonstrating good reliability and validity in these contexts. The scale was developed and psychometrically tested by Newman-Beinart et al. in 2016. It can not only determine the quality of exercise adherence but also identify the reasons influencing patient adherence. However, its application effect in Chinese patients with PFD remains to be

further tested ^[14].

In summary, given the current lack of a "gold standard" assessment tool for PFMT adherence in PPI patients, and the increasing number of PPI patients in China, exploring the application effect of the EARS scale is necessary. Therefore, this study aims to translate the EARS scale into Chinese, apply it to PFMT in PPI patients, and test its reliability and validity. This will help standardize the methods and standards for assessing PFMT adherence in clinical practice, laying the foundation for understanding and evaluating the exercise adherence status of PPI patients and adjusting/improving exercise intervention plans.

1.3 Research Hypothesis

The exercise adherence scale based on the culturally adapted EARS can effectively assess the level of PFMT adherence in PPI patients. This scale, integrating aspects such as exercise frequency, movement correctness, training duration, and self-efficacy perception, can systematically quantify patient adherence characteristics. The scale is expected to have good reliability and validity (Cronbach's $\alpha \geq 0.70$, test-retest reliability ICC ≥ 0.80). It is anticipated to provide a more convenient and reliable assessment tool for PFMT adherence in PPI patients and provide a basis for further designing intervention strategies and measures.

2 Scale Translation and Revision

2.1 Research Purpose

To perform cross-cultural adaptation, localization revision, content adjustment, and a pre-survey on the 2016 version of the EARS scale, ultimately forming an initial Chinese version of the EARS scale that conforms to Chinese linguistic context characteristics.

2.2 Research Process

2.2.1 Overview of the Original Scale

The EARS was developed by an interdisciplinary team at King's College London (Newman-Beinart et al.) in 2016 through group discussions, Delphi method-based

expert consultations, systematic literature review, and a pre-survey, followed by reliability and validity testing (Cronbach's α coefficient of 0.81, test-retest reliability of 0.97^[14]). The final scale consists of 16 items designed to assess patients' exercise adherence (6 items: "I do my exercises as often as recommended," "I forget to do my exercises," etc.) and barriers/facilitators (10 items: "I don't have the time to do my exercises," "Other things get in the way of me doing my exercises," etc.). The scale uses a standardized Likert 5-point scoring system (0 = completely agree, 4 = completely disagree). The total score ranges from 0 to 64, with higher scores indicating better patient adherence.

2.2.2 Obtaining Scale Authorization

Authorization for the original scale was obtained by contacting the original scale author, Professor Newman-Beinart, via email. Using a convenience sampling method, patients with urinary incontinence after prostate cancer surgery who visited the Urinary Incontinence Nursing Clinic and Urology Ward of Shanghai Changhai Hospital from September 2024 to November 2024 were selected as subjects for the pre-survey. Inclusion criteria were: ① Underwent radical prostatectomy; ② Age ≥ 18 years; ③ Developed postoperative urinary incontinence; ④ Able to communicate normally in Mandarin; ⑤ Informed and consented to participate in this study. Exclusion criteria were: ① Accompanied by mental illness or other severe physical diseases; ② Presence of cognitive impairment.

2.2.3 Scale Translation and Expert Consultation

2.2.3.1 Scale Translation

Based on Professor Newman-Beinart's experience and advice regarding the 2016 EARS, the research team established a translation expert group. The scale developer was contacted via email. Centered on the cross-cultural adaptation process, the 2016 EARS scale was translated, back-translated, and pre-tested strictly following Guillemin's cross-cultural adaptation guidelines^[16] and Brislin's translation-back-translation model^[17].

2.2.3.2 Initial Translation and Back-translation

Using the 2016 EARS scale as the reference, two bilingual translators with nursing backgrounds were selected to perform independent parallel translations, marking terms with disagreements or semantic ambiguities and noting their reasons. Based on this, a nursing master's student collated the two translations, and a preliminary integrated version was formed through consultation using the Delphi method. To maximize agreement between the two translators, the integration process was documented by a recorder throughout. Additionally, two other bilingual experts unfamiliar with the original scale were selected to perform blinded back-translation, converting the preliminary integrated Chinese version back into English independently. Subsequently, a researcher with a nursing master's background integrated the back-translations. The four participating bilingual experts and the researcher met, reviewed the back-translations, made comparisons, identified differences, adjusted, and determined the most accurate and culturally equivalent Chinese version. Another two bilingual experts were then selected to back-translate this Chinese version, and the final Chinese version was formed through discussion with the researchers ^[17]. Contact was established with the original scale author via email, requesting academic review. Based on this, dictionary consultations were used to clarify language differences ^[18], and in-depth communication and explanatory adjustments were conducted considering the cultural background characteristics of the scale to optimize it into a comprehensive back-translation version with cross-cultural adaptability. All aforementioned participants were organized for a discussion to compare the original scale, the preliminary integrated version, and the comprehensive back-translation version, focusing on translation consistency, conceptual accuracy, and language expression habits. The preliminary integrated version was optimized and revised based on this review, resulting in the initial Chinese version of the scale.

2.2.3.3 Expert Consultation Framework

This study used the Delphi expert consultation method, forming an expert panel comprising 2 urology surgeons/nurses, 2 continence specialist nurses, and 2 English professors. Two rounds of expert consultation were conducted. The 6 experts evaluated the translation consistency, specific semantics, and language habits between

the original scale items and the initial Chinese version using a Likert 4-point scoring method. They provided rationales and corresponding modification suggestions for items requiring further revision. The research team systematically collated the results of the two expert consultation rounds, optimized the scale based on expert opinions, and finally formed the cross-culturally adapted Chinese version of the EARS pre-survey scale.

2.2.3.3.1 Expert Inclusion Criteria

(1) Hold a master's degree or higher academic qualification; (2) Possess bilingual (Chinese-English) application ability; (3) Have 5 years or more of work experience in the medical field or related English field; (4) Clearly understand and agree to participate in this expert review.

2.2.3.3.2 Expert Consultation Form

(1) Part One is the main body, i.e., the expert consultation form for the items of the Chinese version of the EARS pre-survey scale. The Likert 4-point scoring method (not relevant, somewhat relevant, relevant, very relevant) was used to evaluate the content relevance of each scale item to the research topic. (2) Part Two is a record form for basic expert information. (3) Part Three is an expert authority assessment form, specifically consisting of an expert familiarity evaluation scale and a judgment basis evaluation scale.

2.2.3.3.3 Expert Authority and Opinion Coordination

(1) Expert Authority: Quantified by the expert authority coefficient (Cr), which is determined by the expert's familiarity (Cs) with the item content and the judgment basis (Ca). $Cr = (Cs + Ca)/2$. The value size significantly affects the reliability of the research results. When $Cr \geq 0.70$, the research results are considered reliable ^[19]. ① Familiarity (Cs): Assessed using a five-level quantitative scale, with assignment criteria: very familiar 1.0; relatively familiar 0.8; generally familiar 0.6; not very familiar 0.4; unfamiliar 0.2. The arithmetic mean of the data was calculated to determine the experts' familiarity with the research content. ② Judgment Basis (Ca): Specific assignment criteria are shown in Table 2-1. The total arithmetic mean is the expert's judgment basis.

Table 2-1 Self-assessment Assignment Table for Judgment Basis

Judgment Basis	Degree of Influence		
	Large	Medium	Small
Practical Experience	0.4	0.3	0.2
Theoretical Analysis	0.3	0.2	0.1
Domestic/Foreign References	0.2	0.1	0.1
Subjective Judgment	0.1	0.1	0.1
Total	1	0.7	0.5

(2) Expert Opinion Coordination: Analyzed by examining the coefficient of variation (CV) and Kendall's W coefficient. This specifically determines the degree of opinion dispersion and consistency level among experts during the evaluation process. Research by Shi Jingcheng et al. indicates that when $CV \leq 0.25$, expert opinion consistency is high ^[19]. Kendall's W coefficient ranges from 0 to 1. When the test results are statistically significant ($P < 0.05$), a larger value indicates higher convergence of expert opinions.

2.2.4 Pre-survey

The Chinese version of the EARS pre-survey scale contained 16 items. Based on the ratio of sample size to the number of items (ranging from 1:5 to 1:20), the minimum ratio of 1:5 was determined ^[15], calculating a sample size range of 80 to 160 cases. Considering the possibility of 10% invalid questionnaires, the researchers ultimately decided to include 88 patients with PPI who met the inclusion/exclusion criteria as pre-survey subjects.

Using convenience sampling, patients with PPI who visited the Urinary Incontinence Nursing Clinic and Urology Ward of Shanghai Changhai Hospital from September 2024 to November 2024 were selected. Inclusion criteria were: ① Underwent radical prostatectomy; ② Developed postoperative urinary incontinence; ③ Legally adult (age ≥ 18 years); ④ Ability to communicate normally in Mandarin;

⑤ Informed consent to participate in this study. Exclusion criteria were: ① Presence of cognitive impairment; ② Accompanied by mental disorders or other major organic diseases. The pre-survey was conducted on 88 patients meeting the study's inclusion/exclusion criteria.

The following statistical methods were used for pre-survey item selection. Since the scale had a limited number of items, an item was deleted if the number of deletion suggestions for that item was ≥ 2 times; otherwise, it was retained [20].

① Reliability Optimization Method: Changes in the overall scale's Cronbach's α coefficient upon deletion of an item were examined. If deleting an item increased Cronbach's α coefficient, it indicated that the item was a source of interference with internal consistency reliability, and its deletion was considered.

② Item Discrimination Analysis: Sum the scores of each scale item. Use the critical value method to divide the sample into two groups, defined as the low-score group (bottom 27%) and the high-score group (top 73%). Use an independent samples t-test to test for significant differences between groups. Items not reaching statistical significance ($P > 0.05$) were considered for deletion.

2.3 Research Results

2.3.1 Expert Consultation

2.3.1.1 Expert Information

A total of 6 experts were consulted: 2 urology surgeons/nurses, 2 continence specialist nurses, and 2 English professors. All had 5 years or more of relevant work experience and held a master's degree or higher. See Table 2-2 for details.

Table 2-2 Summary of Expert Information

Expert	Age (years)	Gender	Specialization	Education	Years of Work	Professional Title
1	42	Female	Nursing	PhD	21	Associate Chief Nurse
2	52	Male	Clinical Medicine	PhD	30	Chief Physician

Expert	Age (years)	Gender	Specialization	Education	Years of Work	Professional Title
3	38	Female	Nursing	Master's	9	Associate Chief Nurse
4	29	Female	Nursing	Master's	5	Supervisor Nurse
5	46	Female	Medical English	PhD	12	Associate Professor
6	36	Female	Medical English	PhD	5	Lecturer

2.3.1.2 Expert Activeness, Authority, and Coordination

A total of 6 questionnaires were distributed to the experts, with a 100% effective response rate. The research team discussed and summarized the results of the expert evaluations. The data showed that the questionnaire included 6 constructive suggestions regarding the scale, reflecting the experts' high enthusiasm and collaborative spirit. Specific self-assessment results are shown in Tables 2-3 and 2-4. In this study, the expert familiarity coefficient was 0.93, the expert judgment basis coefficient was 0.95, and the final expert authority coefficient reached 0.94, which is at a relatively high level. In the second round of the Delphi survey, the consistency test for scale indicators showed a Kendall's W coefficient of 0.407 ($P < 0.05$), and the coefficients of variation in both rounds were below 0.25. The test results were statistically significant. See Table 2-5.

Table 2-3 Self-assessment of Expert Familiarity (n=6)

Familiarity	Very Familiar	Relatively Familiar	Generally Familiar	Not Very Familiar	Unfamiliar
Number of Experts	4	2	0	0	0

Table 2-4 Self-assessment of Expert Judgment Basis (n=6)

Judgment Basis	Degree of Influence on Expert Judgment		
	Large	Medium	Small
Practical Experience	5	1	0
Theoretical Analysis	6	0	0
Domestic/Foreign References	4	2	0
Subjective Judgment	0	0	6

Table 2-5 Expert Kendall's W Coefficient and Significance Test

Consultation Round	Coefficient of Variation	Kendall's W Coefficient		
		W value	χ^2 value	P
Round 1	0.08~0.13	0.301	27.068	< 0.05
Round 2	0.08~0.12	0.407	36.646	< 0.05

2.3.1.3 Culturally Adapted Items

Based on suggestions from the original scale author and expert consultations, the Exercise Adherence Rating Scale (EARS) was literally translated as "运动依从性量表". However, as daily activities like walking can represent a state of movement, and this study specifically assessed patient adherence to PFMT, "exercise" was translated as "锻炼" (targeted exercise/training). For the exercise adherence behavior part: Item 1 "I do my exercises as often as recommended" was literally translated as "我按照建议进行锻炼", but "recommended" could be ambiguous for patients without a standard. Following expert consensus, it was revised to "我按照推荐的频率进行锻炼" (I do my exercises as often as recommended frequency). For Item 3, "healthcare professional" was literally translated as "医疗专业人员". However, considering domestic cultural differences compared to the author's country and the generally older age of Chinese post-prostatectomy patients, their education level and common

domestic vocabulary, "healthcare professional" in this item was translated as "医护人员" (medical staff). For the reasons for adherence/non-adherence part: Item 14 "I adjust the way I do my exercises to suit myself" was initially translated as "我调整锻炼方式使之以适合自己". During back-translation, attention was paid to sentence fluency and conciseness, leading to revision to "我调整锻炼方式以适合自身情况" (I adjust my exercise method to suit my own situation). The wording order of items 8 and 15 was also adjusted. All experts agreed to these revisions.

2.3.2 Pre-survey Results

A total of 88 questionnaires were distributed in the pre-survey, and 88 valid questionnaires were returned, indicating a 100% effective response rate. Among the 88 patients with PPI, the mean age was 69.16 ± 6.01 years; 77 were married, 11 were divorced or widowed; 56 resided in urban areas, 32 in rural areas; 27 had education level junior high school or below, 30 had high school or technical secondary school, 31 had associate degree or above; 35 had a monthly family per capita income of 2000-4999 RMB, 38 had 5000-9999 RMB, 15 had 10000 RMB or above; 14 were employed, 74 were retired or resigned.

2.3.2.1 Reliability Analysis

The reliability test results showed that the overall internal consistency reliability (Cronbach's α) of the scale was 0.826. Specific item analysis revealed that if item 16 was deleted, the scale's Cronbach's α coefficient increased (> 0.826), so its deletion was considered. See Table 2-6 for details on changes in scale reliability upon deletion of each item.

Table 2-6 Changes in Scale Reliability upon Deletion of an Item

Item	Cronbach's α after deletion	Change compared to 0.826
1	0.807	↓
2	0.804	↓
3	0.801	↓
4	0.807	↓

Item	Cronbach's α after deletion	Change compared to 0.826
5	0.821	↓
6	0.801	↓
7	0.816	↓
8	0.819	↓
9	0.821	↓
10	0.805	↓
11	0.818	↓
12	0.810	↓
13	0.805	↓
14	0.818	↓
15	0.820	↓
16	0.829	↑

2.3.2.2 Item Discrimination Analysis Results

The total scores of the item data were divided into high and low groups. Independent samples t-tests were used to analyze whether there were significant differences between the groups ($P < 0.05$). Items 5 and 14 did not show significant differences between the high and low groups ($P > 0.05$), indicating limited discrimination for these two items, and their deletion was considered. See Table 2-7 for detailed data.

Table 2-7 Difference Analysis between High and Low Groups for Scale Items

Item	High-Score Group	Low-Score Group	t	P
1	3.61 ± 0.722	0.86 ± 0.941	-11.008	< 0.001
2	3.70 ± 0.703	1.95 ± 1.214	-5.853	< 0.001

Item	High-Score Group	Low-Score Group	t	P
3	3.48 ± 1.039	0.41 ± 0.796	-11.086	< 0.001
4	3.17 ± 1.435	0.64 ± 0.727	-7.531	< 0.001
5	3.57 ± 0.896	3.09 ± 1.109	-1.582	0.121
6	3.74 ± 0.864	0.82 ± 1.181	-9.500	< 0.001
7	3.65 ± 0.487	2.77 ± 1.412	-2.768	0.010
8	3.70 ± 0.470	3.18 ± 1.402	-1.633	0.115
9	2.70 ± 1.428	0.95 ± 1.327	-4.232	< 0.001
10	3.87 ± 0.344	1.82 ± 1.332	-7.002	< 0.001
11	3.48 ± 1.163	2.41 ± 1.297	-2.915	0.006
12	3.83 ± 0.491	2.59 ± 1.098	-4.834	< 0.001
13	2.78 ± 1.380	0.27 ± 0.456	-8.262	< 0.001
14	2.91 ± 1.345	0.95 ± 1.327	-4.915	< 0.001
15	3.00 ± 1.348	1.14 ± 1.167	-4.948	< 0.001
16	3.43 ± 1.161	2.36 ± 1.399	-2.800	0.008

Combining the above two item deletion methods, the results for items considered for deletion are detailed in Table 2-8. No items had a deletion count ≥ 2 times, therefore all items were retained ^[21]. This formed the Chinese version of the EARS scale, encompassing a total of 16 items.

Table 2-8 Final Results for Items Considered for Deletion

Item	Cronbach's α Increase	Item Discrimination	Deletion Count	Retain?
16	× (No)		1	Yes
5		× (No)	1	Yes

Item	Cronbach's α Increase	Item Discrimination	Deletion Count	Retain?
14		× (No)	1	Yes

2.4 Research Conclusion

This study culturally adapted and translated the 2016 version of the EARS scale, resulting in a Chinese version of the EARS (Exercise Adherence Rating Scale) comprising 16 items. Analysis of the pre-survey results indicated that the items of the scale had good discrimination and representativeness, as well as strong cross-cultural applicability.

3 Scale Reliability and Validity Testing

3.1 Study Subjects

Patients with PPI who received treatment at the Urinary Incontinence Nursing Clinic and Urology Ward of Shanghai Changhai Hospital from September 2024 to March 2025 were selected. Inclusion and exclusion criteria were the same as those described for the pre-survey. Inclusion criteria were: ① Underwent radical prostatectomy; ② Developed postoperative urinary incontinence; ③ Legally adult (age ≥ 18 years); ④ Ability to communicate normally in Mandarin; ⑤ Informed consent to participate in this study. Exclusion criteria were: ① Presence of cognitive impairment; ② Accompanied by mental disorders or other major organic diseases.

3.2 Research Methods

3.2.1 Sample Size Calculation

The Chinese version of the EARS scale has 16 items. According to the principle that the initial sample size should be 5 to 20 times the number of scale items, a ratio of 1:10 was used. Based on the sample size requirements for confirmatory factor analysis, the sample size was doubled. Allowing for 10% missing or invalid samples, the final calculated actual sample size was 176 cases ^[15, 22].

3.2.2 Research Tools

The survey questionnaire consisted of a general information questionnaire and the Chinese version of the EARS scale.

General Information Questionnaire: Included age, gender, residence area, monthly family per capita income, marital status, and education level.

Chinese version of the EARS scale: Culturally adapted from the 2016 EARS scale, consisting of 16 items. The first 6 items assess the patient's exercise adherence (e.g., "I do my exercises as often as recommended," "I forget to do my exercises," etc.), and the last 10 items assess barriers/facilitators (e.g., "I don't have the time to do my exercises," "Other things get in the way of me doing my exercises," etc.). The scale uses a Likert 5-point scoring method (0 = completely agree, 4 = completely disagree) for scoring, with a total score ranging from 0 to 64. Higher scores indicate better patient adherence. Items 1, 4, 6, 10, 11, 12, and 13 are reverse-scored; higher scores indicate better exercise adherence.

3.2.3 Questionnaire Distribution and Collection

This survey was conducted at the Urinary Incontinence Nursing Clinic and Urology Ward of Shanghai Changhai Hospital. The researchers participating in the survey strictly followed scientific research quality control standards and completed a systematic training process, including an explanation of the research value, questionnaire overview, etc., and promptly answered patient questions during questionnaire completion. The one-on-one interview method could be used to invite patients to complete the questionnaire, or patients could complete it independently before it was collected. The time limit for completing the questionnaire was 3-5 minutes to prevent overly fast or slow completion, which could lead to varied data quality. Questionnaires were collected immediately upon completion, and invalid questionnaires (e.g., incomplete, obvious errors) were excluded to ensure data accuracy and reliability.

3.2.4 Statistical Analysis

SPSS 27.0 software was used for statistical analysis of the data. General information was described using constituent ratios. Continuous data following a normal distribution were expressed as mean $\pm$ standard deviation. Cronbach's α coefficient was used to assess the internal consistency reliability of the Chinese version of the EARS scale. The intraclass correlation coefficient (ICC) obtained from two measurements separated by a time interval was used to evaluate test-retest reliability (stability across time). The Spearman-Brown corrected split-half reliability coefficient was used as a reference for split-half reliability. Exploratory factor analysis (EFA) was used to evaluate construct validity. I-CVI and S-CVI were used to evaluate content validity. A P-value < 0.05 was considered statistically significant.

(1) Reliability Testing

① Internal Consistency Reliability: Cronbach's α coefficient was used to verify the internal consistency of the Chinese version of the EARS scale. Its value is positively correlated with the scale's reliability level. A Cronbach's α coefficient exceeding 0.70 was considered indicative of good internal consistency [23].

② Test-retest Reliability: The same research tool was used to assess the same subjects twice. The intraclass correlation coefficient (ICC) of the two results was analyzed to evaluate the scale's consistency and stability across time.

③ Split-half Reliability: The scale items were divided into two halves (odd and even numbers) and scored separately. Correlation analysis was performed based on the score distribution of the two halves. The corrected Spearman-Brown coefficient was used as a reference. A coefficient > 0.7 indicates acceptable consistency between the two halves [23].

(2) Validity Testing

① Content Validity: Based on the results of the two expert consultations, the content validity at the item level (I-CVI) and scale level (S-CVI) were calculated separately. Generally, $I-CVI \geq 0.78$ and $S-CVI \geq 0.90$ indicate good content validity [19]. I-CVI was calculated for a single item by dividing the number of experts rating

the item as "3" or "4" by the total number of experts. S-CVI is the average of the I-CVIs.

② Construct Validity: Exploratory factor analysis (EFA) was used, employing principal component analysis (PCA) with varimax orthogonal rotation for factor extraction. First, the Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were performed. When Bartlett's test was significant ($P < 0.05$) and the KMO value > 0.5 , the data were considered suitable for factor analysis. Common factors were extracted based on the Kaiser criterion (eigenvalue > 1). Construct validity was considered good when item factor loadings were ≥ 0.4 and the cumulative total variance explained $> 50\%$ [23].

3.3 Research Results

3.3.1 General Information of Study Subjects

A total of 180 questionnaires were distributed. Among them, 177 were valid questionnaires, and 3 were invalid, resulting in an effective response rate of 98.33%, which is relatively high. The mean age was 69.58 ± 6.43 years; 159 were married, 18 were divorced or widowed; 74 resided in urban areas, 103 in rural areas; 53 had education level junior high school or below, 70 had high school or technical secondary school, 54 had associate degree or above; 8 had monthly family per capita income of 2000 RMB or less, 80 had 2000-4999 RMB, 68 had 5000-9999 RMB, 21 had 10000 RMB or above; 27 were currently employed, 150 were retired or resigned. See Table 3-1.

Table 3-1 General Information of Patients (n=177)

Category	Number	Percentage (%)
Marital Status		
Unmarried	0	0.0
Married	159	89.8
Divorced or Widowed	18	10.2

Category	Number	Percentage (%)
Residence Area		
Urban	74	41.8
Rural	103	58.2
Education Level		
≤ Junior High	53	29.9
High School/Tech Secondary	70	39.5
≥ Associate Degree	54	30.5
Monthly Family Per Capita Income		
≤ 2000 RMB	8	4.5
2000-4999 RMB	80	45.2
5000-9999 RMB	68	38.4
≥ 10000 RMB	21	11.9
Employment Status		
Employed	27	15.3
Retired/Resigned	150	84.7

3.3.2 Exercise Adherence Scale Assessment Results

The mean exercise adherence score for patients with PPI was 41.91 ± 11.700 points. Item 7 "I don't have the time to do my exercises" had the highest score (3.42 ± 0.816), while item 13 "I do my exercises because I enjoy it" had the lowest score (1.51 ± 1.516). See Table 3-2 for scores of individual items.

Table 3-2 Scores of Individual Items on the Exercise Adherence Scale ($\bar{x} \pm s$)

Item	Score
1. I do my exercises as often as recommended	2.54 $\pm$ 1.434
2. I forget to do my exercises	3.01 $\pm$ 1.103
3. I do less exercise than the medical staff advise	2.37 $\pm$ 1.612
4. Doing exercises is a habit for me	1.94 $\pm$ 1.617
5. I cannot find the right time to do my exercises	3.32 $\pm$ 0.960
6. I manage to complete my exercises as planned	2.53 $\pm$ 1.634
7. I don't have the time to do my exercises	3.42 $\pm$ 0.816
8. Other things get in the way of me doing my exercises	3.26 $\pm$ 1.153
9. I don't do my exercises when I'm tired	1.72 $\pm$ 1.533
10. I feel confident that I can do my exercises	2.82 $\pm$ 1.360
11. Family and friends encourage me to do my exercises	3.05 $\pm$ 1.154
12. I do my exercises to improve my health	3.31 $\pm$ 0.935
13. I do my exercises because I enjoy it	1.51 $\pm$ 1.516
14. I adjust the way I do my exercises to suit me	1.85 $\pm$ 1.597
15. I stop my exercises when they increase my pain	2.03 $\pm$ 1.588
16. I am not sure how to do my exercises	3.23 $\pm$ 1.136
Total Score	41.91 $\pm$ 11.700

3.3.3 Reliability Testing

3.3.3.1 Internal Consistency Reliability

Internal consistency reliability is represented by Cronbach's α coefficient. A

higher value indicates higher scale reliability; generally, > 0.700 indicates good reliability [24]. The overall Cronbach's α coefficient of the scale was 0.844, indicating good internal consistency of the Chinese version of the EARS scale. See Table 3-3.

Table 3-3 Cronbach's α if Item Deleted and Overall Scale Cronbach's α

Item	Cronbach's α if Item Deleted	Overall Scale Cronbach's α
1	0.829	0.844
2	0.824	
3	0.819	
4	0.826	
5	0.835	
6	0.820	
7	0.833	
8	0.832	
9	0.839	
10	0.820	
11	0.839	
12	0.830	
13	0.826	
14	0.839	
15	0.836	
16	0.840	

3.3.3.2 Test-retest Reliability

Among the initially assessed patients, 30 were randomly selected and invited to complete the questionnaire again two weeks later. The correlation coefficient (ICC) of the two surveys was used to evaluate test-retest reliability. The ICC was 0.879 ($P <$

0.001), indicating good temporal stability of the scale.

3.3.3.3 Split-half Reliability

The 16 items were split into two halves (odd and even numbers) and scored separately. The correlation coefficient between the two halves was calculated. The Spearman-Brown corrected split-half reliability coefficient was used as a reference; a value > 0.700 indicates good consistency between the two halves. The split-half reliability of the Chinese version of the EARS scale was 0.878 ($P < 0.001$), indicating good internal consistency.

3.3.4 Validity Testing

3.3.4.1 Content Validity

When a scale has $I-CVI \geq 0.780$ and $S-CVI \geq 0.90$, its content validity is considered good [19]. In the expert consultation, the relevance of each item to the research was evaluated using a Likert 4-point scale (1 = not relevant; 2 = somewhat relevant; 3 = relevant; 4 = highly relevant). The I-CVI for all items was 1.000. S-CVI/UA and S-CVI/Ave were also both 1.000, indicating good content validity of the scale. See Table 3-4.

Table 3-4 I-CVI from Expert Consultation (n=6)

Item	Number of Experts Scoring 3 or 4	I-CVI
1	6	1.000
2	6	1.000
3	6	1.000
4	6	1.000
5	6	1.000
6	6	1.000
7	6	1.000
8	6	1.000

Item	Number of Experts Scoring 3 or 4	I-CVI
9	6	1.000
10	6	1.000
11	6	1.000
12	6	1.000
13	6	1.000
14	6	1.000
15	6	1.000
16	6	1.000

3.3.4.2 Construct Validity

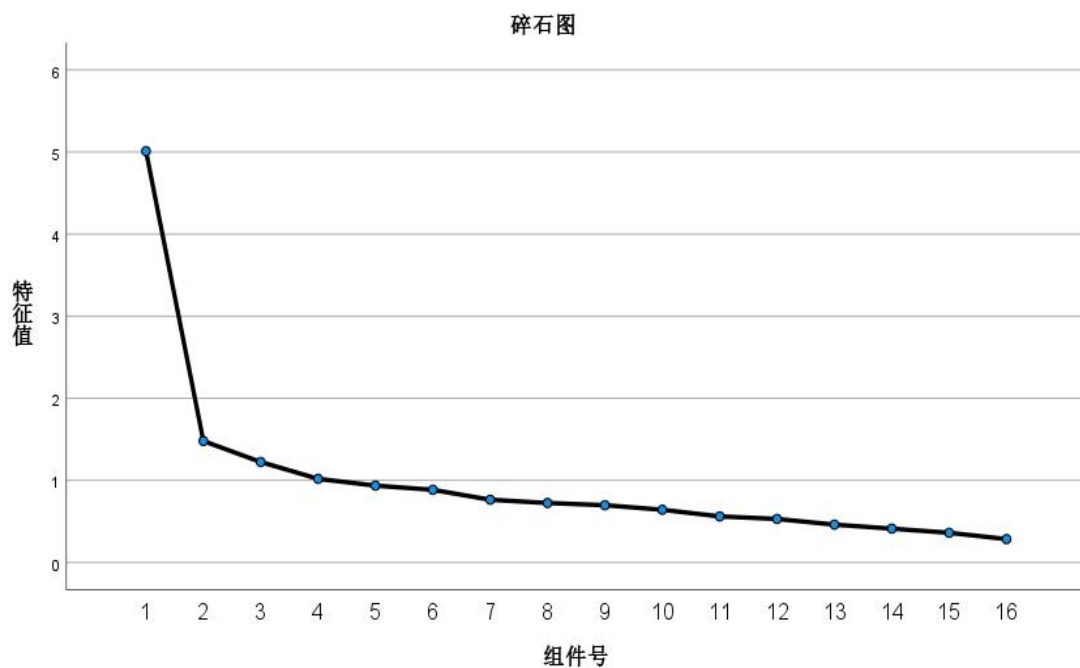
EFA was performed on the data from 177 cases using SPSS 27.0. First, the KMO measure and Bartlett's test of sphericity were used to assess the degree of correlation among the 16 items of the Chinese version of the EARS scale, verifying whether the data met the prerequisites for factor analysis. The KMO value was 0.862 (> 0.800). Bartlett's test of sphericity was significant ($P < 0.05$). These results indicated that the data were suitable for factor analysis [22]. See Table 3-5.

Table 3-5 KMO and Bartlett's Test of Sphericity

KMO Value	0.862
Approx. Chi-Square	763.307
Bartlett's Test of Sphericity	
df	120
P	< 0.001

EFA was conducted on the 16 items of the Chinese version of the EARS scale. Common factors were extracted using principal component analysis (PCA), and the factor loading matrix was constructed using varimax orthogonal rotation. A cumulative total variance explained $\geq 50\%$ and factor loadings ≥ 0.400 indicate good

overall construct validity. Items loading onto two or more common factors should be deleted ^[25]. Observing Figure 3-1, four common factors with eigenvalues > 1 were extracted, explaining 54.590% of the cumulative variance. This indicates good overall construct validity of the Chinese version of the EARS scale. Factor loadings for each item are shown in Table 3-6.



Note: The horizontal axis represents the number of factors, and the vertical axis represents the eigenvalue, i.e., the contribution of each factor to the variability of the original variables.

Figure 3-1 Scree Plot of Exploratory Factor Analysis for the Chinese Version of the EARS Scale

Table 3-6 Factor Loading Matrix from Exploratory Factor Analysis

Item	Factor 1	Factor 2	Factor 3	Factor 4
Item 3: I do less exercise than the medical staff advise	0.791			
Item 1: I do my exercises as often as recommended	0.790			
Item 6: I manage to complete my exercises as planned	0.764			
Item 4: Doing exercises is a	0.425			

Item	Factor 1	Factor 2	Factor 3	Factor 4
habit for me				
Item 9: I don't do my exercises when I'm tired		0.667		
Item 15: I stop my exercises when they increase my pain		0.640		
Item 13: I do my exercises because I enjoy it		0.622		
Item 10: I feel confident that I can do my exercises		0.540		
Item 2: I forget to do my exercises		0.499		
Item 16: I am not sure how to do my exercises		0.485		
Item 8: Other things get in the way of me doing my exercises			0.811	
Item 5: I cannot find the right time to do my exercises			0.795	
Item 11: Family and friends encourage me to do my exercises				0.831
Item 12: I do my exercises to improve my health				0.468
Item 14: I adjust the way I do my exercises to suit me				0.465
Item 7: I don't have the time to do my exercises				0.436
Cumulative Variance Explained (%)	17.488	32.705	44.870	54.590

4 Discussion

4.1 Feasibility of the Chinese Version of the EARS Scale

The scale translation process in this study strictly followed Guillemin's cross-cultural adaptation guidelines and Brislin's translation-back-translation model for the initial translation, back-translation, and pre-testing of the 2016 EARS scale. The translated Chinese version of the EARS scale contains 16 items. During the cultural adaptation process, experts and researchers discussed and adjusted each item regarding readability, ambiguity, and logical errors, resulting in a Chinese version with clear, concise, and understandable item meanings. During the survey, the researcher explained the research purpose and scale content to the patients before they filled out the questionnaire, enabling them to cooperate and complete the questionnaire seriously. The questionnaire completion time was controlled at 3-5 minutes, and the effective recovery rate was 98.33%. This indicates that the Chinese version of the EARS scale is acceptable to most patients, has certain feasibility and comprehensibility, can accurately collect data related to patient exercise adherence, promotes self-management of PFMT in PPI patients, and provides a basis for medical staff to intervene with patients who have poor adherence.

4.2 Reliability and Validity of the Chinese Version of the EARS Scale

The Chinese version of the EARS scale demonstrated a Cronbach's α coefficient of 0.844, test-retest reliability of 0.879 ($P < 0.001$), and split-half reliability of 0.878 ($P < 0.001$), reflecting good reliability. Regarding content validity, the I-CVI, S-CVI/UA, and S-CVI/Ave were all 1.000, indicating that all experts considered each scale item highly relevant to patient exercise adherence. For construct validity, exploratory factor analysis extracted four common factors. The factor loading for each corresponding item was ≥ 0.400 , and the cumulative variance explained rate was 54.590%, indicating that the 16 items can measure the construct of exercise adherence and that the structural stability of the Chinese version of the EARS scale is good.

4.3 Applicability of the Chinese Version of the EARS Scale for Assessing PFMT Adherence in PPI Patients

Urinary incontinence is a common complication after prostate cancer surgery,

significantly affecting patients' quality of life [26]. As a conservative and effective exercise method, PFMT can help patients alleviate or recover from urinary incontinence symptoms. The age distribution of patients after prostate cancer surgery surveyed in this study was 69.58 ± 6.43 years. The patients were at various treatment stages, including postoperative recovery, radiotherapy, and chemotherapy. The average exercise adherence score was 41.91 ± 11.700 , which is a moderate level, indicating that PFMT has some feasibility for post-prostatectomy patients. Research by Sun Na et al. shows that PFMT is effective for any type of urinary incontinence at any stage [27]. However, in many studies, patient adherence to PFMT is often suboptimal, failing to meet exercise standards and thus hindering treatment goals. Therefore, continuously monitoring and intervening in PFMT adherence in PPI patients is meaningful.

The formation of the Chinese adapted version of the EARS scale provides a powerful tool for assessing exercise adherence in PPI patients. Its concise and easy-to-understand characteristics effectively address the generally older age of patients with urinary incontinence after prostate cancer surgery. It helps accurately assess the level of patient adherence to exercise, identify the main reasons affecting their adherence, allow targeted adjustment of exercise plans and implementation of interventions, further improve urinary incontinence symptoms, and enhance patients' quality of life.

5 Conclusion

This study translated and revised the 2016 version of the EARS scale, forming a Chinese version of the EARS scale comprising 16 items. The Chinese version of the EARS scale has good cross-cultural adaptability and good reliability and validity. Currently, there is no rigorously validated scale that can be used to accurately assess adherence to PFMT either domestically or internationally. The Chinese version of the EARS scale has practical value, providing an effective and scientific tool for systematically assessing PFMT adherence in patients with urinary incontinence after radical prostatectomy. However, this study only validated the reliability and validity in patients with PPI from a single hospital, which may limit sample representativeness

and population diversity. Future research should increase the sample size and conduct surveys across multiple regions, hospitals, and other units to obtain richer and more comprehensive sample data, further verifying the feasibility and scientific nature of the Chinese version of the EARS scale across different sample data.

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As I put pen to paper, spring arrives with a gentle breeze, yet my college life is quietly drawing to a close. From a freshman nursing student filled with apprehension and hope to soon donning the white coat and entering clinical practice, this journey has been supported by countless acts of warmth and guidance, all of which will become precious treasures in my career. Here, I want to record with my most sincere words the light that has illuminated my academic and personal growth.

Teachers' kindness moistens things silently.

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The torch of nursing is passed down.

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Closing my computer now seems to mark the end of my college journey, but the nurturing grace of Jiujiang University and the Nightingale spirit of the nursing profession will forever leave a vivid mark on my life's path.

Appendix

Chinese Version of the EARS Scale

Exercise Adherence Rating Scale (EARS)

Regarding the following 6 descriptions about recommended exercise/training, please check the option that best suits your actual situation.

1. I do my exercises as often as recommended.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
2. I forget to do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
3. I do less exercise than the medical staff advise.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
4. Doing exercises is a habit for me.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
5. I cannot find the right time to do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
6. I manage to complete my exercises as planned.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree

Questionnaire on Barriers and Facilitators to Exercise

Regarding the following 10 descriptions of barriers or facilitators to recommended exercise/training, please check the option that best suits your actual situation.

7. I don't have the time to do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
8. Other things get in the way of me doing my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
9. I don't do my exercises when I'm tired.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
10. I feel confident that I can do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
11. Family and friends encourage me to do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
12. I do my exercises to improve my health.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
13. I do my exercises because I enjoy it.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
14. I adjust the way I do my exercises to suit me.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
15. I stop my exercises when they increase my pain.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree
16. I am not sure how to do my exercises.
Completely Agree 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Completely Disagree